MARITIME ARCHAEOLOGY AT KEITH'S WARF AND BATTERY COVE (44AX119) FORD'S LANDING ALEXANDRIA, VIRGINIA

Prepared for

Cook Inlet Region of Virginia

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VII. ARCHAEOLOGICAL FINDINGS

As is often the case in historical archaeology, deposition at the Ford's Landing site was relatively complex, the excavations covering a wide area within which lay a number of interbedded fill layers and structural features. In choosing a format for description of the data from the site, an exhaustive trench by trench, stratum by stratum accounting was considered inappropriate: there would be little useful logic to a top-to-bottom description, and thus it would be difficult to emphasize relevant data. Separation of deposits by excavation phase was also regarded as of little analytical or descriptive value: recording during Phase II operations was determined to constitute sufficient documentation for many of the features on the property, while for the remainder, Phase II excavations exposed only portions of the materials, making separate Phase II and Phase III descriptions repetitive.

Features and deposits from both phases of the project are thus described together in chronological order; that is, in the order in which the materials were originally introduced to the site. For the purposes of stratigraphic analysis, composite profiles were drawn of various transects across the wharf to provide a somewhat more coherent view of site-wide depositional sequences (*Figure 28*). As a result, the major stratigraphic deposits occurring on-site have been given generalized or Universal Stratum designations (*Table 2*). These and the profile reconstructions from which they were drawn will be referenced throughout the description of each phase of site development. Pertinent depth measurements are presented as relative values, *i.e.*, depth below grade, as well as in absolute figures, above or below current mean sea level (msl). Summary column profiles of selected trench excavations are presented as needed within the text to illustrate particular aspects of deposition. Complete stratum descriptions, by trench in order of excavation, are included in tabular form in Appendix D.

Eighteenth-Century Materials -- Keith's Wharf

A major focus of the archaeological excavations at the Ford's Landing site was the investigation of the materials remaining on-site from Keith's Wharf. Additional emphasis was placed on examining data related to nineteenth-century shipyard industries and subsequent phases of activity on the property. Several of the trenches used in the survey portion of the investigation were designed to section the wharf area diagonally, relative to property lines, cross-cutting the presumed locations of most of the relevant features predicted

to exist below modern grade. Evidence of the eighteenth-century wharf was sought in the form of surface features such as the extensions of Franklin and Madison Streets; structures on the wharf at the intersection of the streets or along the several street fronts; possible interior portions of the wharf substructure, such as crib framing; samples of wharf fill; and the exterior framework of the wharf. The lengths of the diagonal trenches were left indefinite in the proposed work plan to allow the trenches to be extended sufficiently to locate the edge of the wharf and sample deposition in the docks alongside.

Stratum A:	Various late nineteenth to mid-twentieth-century fill layers, generally mixed and undifferentiated as to period, characterized by clay and clay loams, gravels, coal and coal residues, brick and other rubble
Stratum B:	Various late nineteenth-century deposits related to marine railway and shipyard use of the property, listed with subscripts for differentiation where appropriate
Stratum C:	Eighteenth-century wharf fill, fairly uniform brown, reddish brown or gray clayey sand, with few inclusions
Stratum D:	Corps fill, dredging spoil introduced into the south portion of the site by the Corps of Engineers in 1911 to infill Battery Cove, gray to dark greenish gray sandy silt, dense, largely impermeable, occasional small gravels and small mussel shell fragments, micro-strata of sand or coal dust appear infrequently suggesting the infilling operation was carried out in stages, with the area left open for extended periods
Stratum E:	Twentieth-century cove bottom, natural deposit, most recent accumulation of gray silt, sand and debris on bottom of Battery Cove prior to twentieth-century filling, observed over the south edge of the eighteenth-century wharf and south of the wharf bulkhead
Stratum F:	Early cove deposits, darker gray sandy silt representing cove surface prior to wharf construction in the eighteenth century, recognized across site below wharf fill (Stratum C) and twentieth-century cove bottom (Stratum E)

Table 2. Universal Stratigraphy

In summary, the only material encountered in the survey trenches from the surface of the wharf were nineteenth- and early twentieth-century shipyard, workshop and light industrial remains near the center of the wharf -- there was no direct evidence of an eighteenth-century wharf surface. No complex wharf stabilization structures, such as cribbing, were apparent in any portion of the site -- the wharf retaining structure was formed by a simple bulkhead of stacked timbers. The fill deposited within the bulkhead line consisted of relatively clean clayey sand, mostly in the form of redeposited subsoil, although there was evidence of historic and prehistoric artifactual material mixed into the fill in some areas.

Based on these findings, more extensive data recovery excavations were conducted, mainly concentrated on the exposure of several lengths of the bulkhead to allow examination of construction techniques -- corners, stabilization and support systems, joinery, and if possible, tie-ins with fast land.

The following exposition describes the eighteenth-century wharf related materials as they were encountered during the current excavations. Historical depictions of the wharf will be considered, after which the character of the wharf fill as sampled in various locations will be described with reference to composite profile sections. The bulkhead and its stabilization system will then be described, along with remnants of the wharf surface and deposits outside the wharf.

Documentary Evidence

Few contemporary descriptions of Keith's Wharf are known. The earliest reference to the structure appears in a petition to the Virginia Legislature in 1785. In that document, the wharf was characterized as 400 feet in length from the high water mark, extending 124 feet east of Madison Street, a cross street lying one block east of Union Street (Virginia Legislative Petitions 1785). The width, or perpendicular dimension of the wharf was not mentioned.

Certain ambiguities exist with regard to this description which make plotting the outline of the wharf on modern maps problematical. When transposing the locations of structures from historic to modern maps, one difficulty often lies in the relatively large scales

at which early maps were typically drawn, making measurements over small distances imprecise. Small errors in plotting, either on the original map or in the calculation of distances from the given scale, are magnified, producing error margins which may be too large to reconcile systematically in the field.

Another difficulty lies in the determination of reference points. Keith's wharf was specified as 400 feet in length, yet it is not clear from what point the measurement was actually taken. Documents indicated the extent of the wharf eastward from the shoreline into the river, i.e., "from the high water mark." Yet, the location of the eighteenth-century high water line is uncertain. Comparisons of period maps indicated that before the middle of the nineteenth century, by which time sedimentation had altered the original outline of the wharf somewhat, the structure did not extend more than 325 feet east of the center of Union Street -- the measurement ranging from 225 feet, on the earliest maps with the wharf represented (Gilpin 1798, Anonymous 1803), to a maximum of 325 feet in the mid-nineteenth century (Ewing 1845). Maps drawn before the erection of the wharf were not adequately detailed to allow precise delineation of the shoreline with reference to later landmarks, but it appears that the bank lay well to the west of what is now Union Street. This contention is supported by the 1785 petition which referred to the two lots purchased by Harper and his associates east of Water Street:

> part of the two lotts of ground...which lay below high water mark within...which they have extended four hundred feet forward into the river and are now engaged in filling it with earth at a very heavy expense (Harper *et al.* 1785).

With regard to the second measurement, 124 feet east of Madison Street, it was not until the beginning of the mid-nineteenth century that land was depicted more than 10 to 40 feet beyond the location of Madison (Ewing 1845; Hopkins 1877).

The north/south dimension of the property was depicted as being considerably less variable throughout the same period, with the leading, or eastern edge of the wharf measuring approximately 300 feet in length, and to the west, along Union Street, about 400 feet. In addition, the earliest maps show a small block, measuring either 75 by 100 feet

(Gilpin 1798) or 100 by 125 (Anonymous 1803), at the southwest corner of the wharf. This block appeared to have either eroded or become enveloped by sediment, since it was no longer recorded as a separate structure by the mid-1830s (U.S. Army Topographical Engineering Department 1836; Ewing 1845).

Portions of the bulkhead forming the outer retaining structure of the wharf were identified archaeologically in Trenches 12, 14, 22, 23 and 23X. The southeast corner of the wharf, representing the furthest eastward extent of the structure, lay at a point approximately 400 feet east of Union Street, suggesting that the high water mark along this section of the cove in the late eighteenth century was in fact situated near the present location of the street. The southern edge of the feature lay in a position approximately 220 feet south of the centerline of Franklin Street. This portion of the bulkhead formed a somewhat uneven line from the southeast corner of the wharf to within less than 100 feet of the presumed location of the shoreline. No evidence of the small, southern block appearing on the earliest maps was observed.

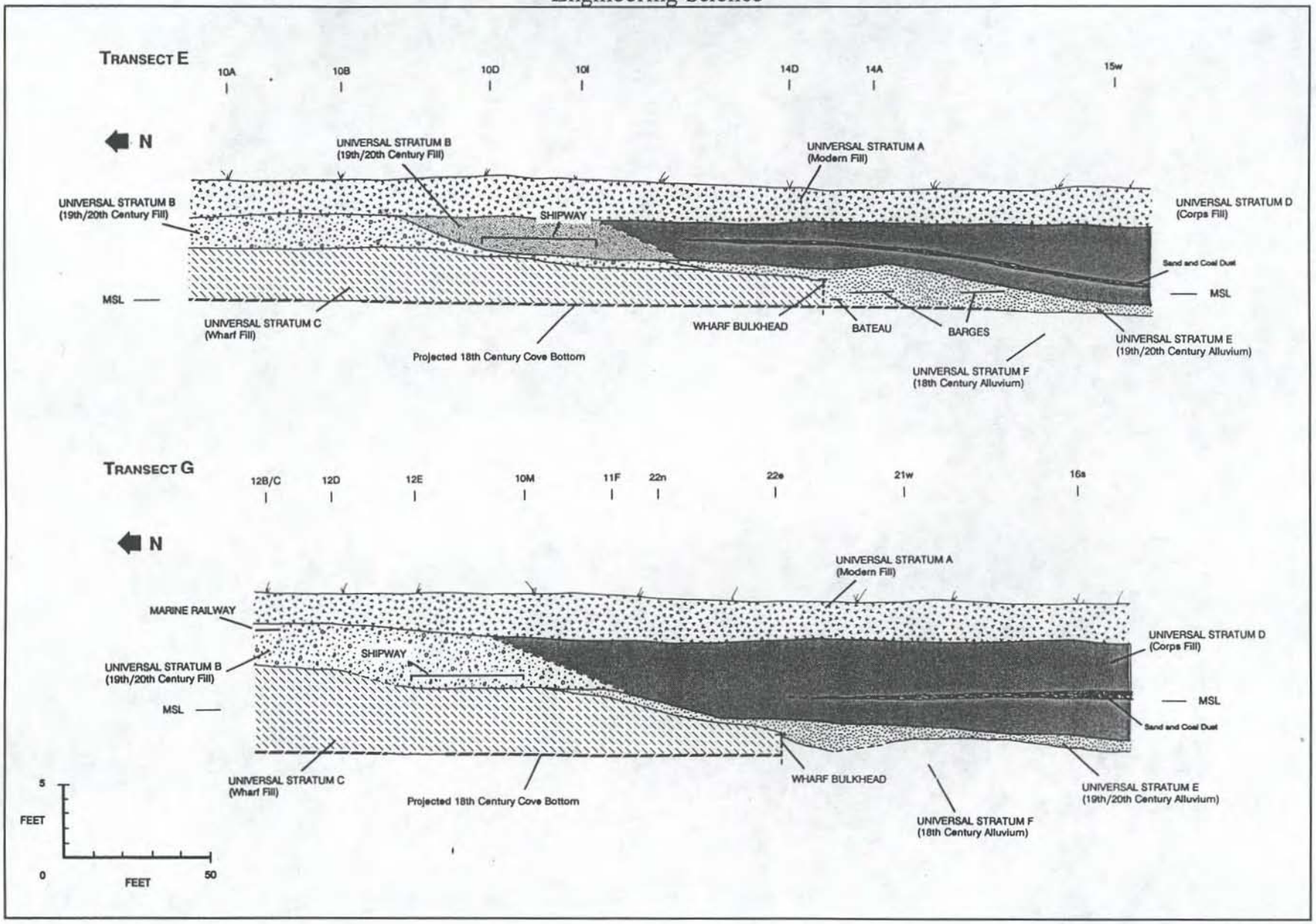
Wharf Fill

Wharf fill deposits were encountered in four of the original five survey trenches (Phase IIb) -- Trenches 10, 11, 12 and 13 -- along with two of the cove survey trenches (Phase IIc) -- Trenches 22 and 23 -- and in Phase III extensions of Trenches 12 and 14.

Transect E

The extent of wharf fill deposition along the western edge of the site can be seen in the profile reconstructed along *Transect E* (*Figure 29*), running north/south parallel to Union Street. Six sections of Trench 10 were excavated roughly 60 feet east of the center of Union, while portions of Trench 14 and the west end of Trench 15 lay approximately 85 to 100 feet east of the street.

Briefly summarized, the ground surface along Transect E lay between +8.10' and +7.31' msl, sloping gently to the south. Below lay various layers of nineteenth- and twentieth-century fill, Universal Stratum A and B, and a late nineteenth century shipway,



Source: Engineering-Science
Ford's Landing

Figure 29
Composite Profile
Transects E and G

Feature 1, the latter described separately below. Wharf fill, Universal Stratum C, began just over 4 feet 6 inches below grade to the north in Trench 10A and sloped gradually downward to the south, meeting the top remaining run of the wharf bulkhead (Feature 33), 6 feet below grade at a point approximately 230 feet to the south in Trench 14D. The base of the eighteenth-century fill was positively identified in only one trench section, 10B, at a depth of just over 8 feet below grade. This level matched the base of the eighteenth-century riverine deposits in Battery Cove to the south in Trench 15, and thus a line was extrapolated across the length of the transect as the approximate base of the wharf fill in this area.

In Sections A and B at the north end of Trench 10, wharf fill was identified 23 to 24 inches below grade (6.10 feet above msl) under concrete and layers of black sandy loam, coal and gravel, representing remnants of late nineteenth-century industrial site use. Wharf fill was encountered approximately 4 feet 7 inches below grade. The deposit was wet, increasingly so with depth, eventually becoming highly unconsolidated and incapable of supporting trench excavation below a level of 6 to 7 feet. Through a combination of sump excavation and pumping to relieve hydraulic pressure, portions of Trench 10B were excavated to a depth of approximately 12 feet below grade (-3.90' msl), with the final 4 feet consisting of gray alluvial silt and sand.

Fifty feet to the south, in Sections D and G of Trench 10, wharf fill was encountered at similar a level below various nineteenth-century fill layers and Feature 1, the late nineteenth-century shipway. The base of the shipway lay between 4 feet 6 inches and 5 feet below grade (+3.25' msl) at this point, resting on a 4- to 6-inch layer of hard packed clay fill. Wharf fill consisted of very pale brown (10YR 7/4), reddish yellow (7.5YR 7/6) and light gray (10YR 7/2) loose clayey sand. A sump was excavated between the long timbers of Feature 1 to the north, in Section G of the trench, primarily to control inundation from water trapped in the fill layers above Feature 1, the shipway, to allow detailed examination of that structure. Additionally, the sump allowed the sampling of wharf fill, though the fill itself became too unconsolidated to allow extensive examination *in situ* below an average of 7 feet. The sump was cleaned several times throughout the course of excavations with the maximum depth reached by the backhoe being between 9 and 10 feet (-1.75' msl). Examination of the backdirt from these excavations showed no clear indication that the base of the fill had been contacted, suggesting the possibility of slight variations in the surface of the underlying cove deposits.

A sump was also excavated in Section I of Trench 10, at the south end of one of the long shipway timbers, 30 to 35 feet south of Trench 10D, beyond a twentieth-century rail spur which lay near modern grade. Wharf fill was located slightly lower than to the north, at a depth of 6 feet (+2.02' msl). The sump was excavated to approximately 8 feet (0.0' msl), at a level above the base of the wharf deposit. As in Trench 10D, the soils were too unstable to allow deeper excavation.

Section D of Trench 14 was a Phase III extension of survey Trench 14, excavated to complete the exposure of the bow of Feature 31, a barge grounded at the edge of Battery Cove in the early twentieth century. The trench extended to the southern edge of the eighteenth-century wharf, exposing wharf fill and remnants of the bulkhead, Feature 33, erected to retain the fill. The excavation lay some 70 feet south of Trench 10I and 25 feet east of the profile transect thus far described (100 feet east of the present center of Union Street). The wharf fill deposit, Universal Stratum C, was encountered 6 feet below grade (+1.32' msl), lying beneath successive layers of modern debris, Corps dredging spoil, and alluvial sand and silt, the latter accumulated on the bottom of Battery Cove in the late nineteenth and early twentieth centuries as the cove waters overran the deteriorating edge of the wharf. Due to the relatively long-term inundation of this portion of the wharf, the fill contained more leached organic material than to the north, and thus was light gray to gray (10YR 6/1) in color. The sloping line of the fill, apparently eroded by tidal action as the level of the cove rose in the nineteenth century, met the remnant of the bulkhead approximately 6 feet below grade (+1.32' msl).

Transect F

Transect F was reconstructed from profiles an average 35 feet east of Transect E, in the central portion of the wharf area, and intersecting Transect E at Trench 14. Ground surface along the transect ranged from +8.18' msl at the north end of Trench 11 to +7.32' msl at Trench 14 and 15. Similar soil profiles were recorded below modern fill in Sections A and B of Trench 11, excavated diagonally across the wharf from northwest to southeast, and in Trench 10, Sections E, F and N. The transition from nineteenth- to eighteenth-century fill was less clear-cut. While no precise delineation within the fill was made in the field, numerous thin strata were noted throughout the profiles. Comparisons with profiles to

the east (Trench 10B) and west (Trench 12B/C) indicated that a significant break in fill sequencing was in fact represented at a depth of approximately 10 feet 6 inches (-2.28' msl).

Approximately 55 feet to the south, in Section E of Trench 10, the fill was sampled in a hand excavation, Unit 4, used to investigate the base and possible underpinnings of the nineteenth-century shipway, Feature 1. The base of the timbers lay at a depth of 5 feet 5 inches below grade (+2.85' msl), resting directly on the wharf fill deposit. Due to the known extent of the fill, the unit was excavated only a short way into the deposit, 14 inches, to provide a controlled sample of the material. The soil was described as pale brown (10YR 6/3) to gray (10YR 6/1) clayey sand.

In Section F, wharf fill was excavated in a sump area placed between shipway timbers north of the centerline of the feature to control water build up in the trench. As in Sections D and G to the west, the material was too unconsolidated to support deep excavation. The fill began between 5 feet 3 inches and 5 feet 6 inches below grade (+2.75' msl); the base of the deposit was not determined. Excavation in Trench 10, Section N, 30 feet to the south, at the southern edge of Feature 1, located wharf fill at a similar level to that in Trench 11B, 5 feet 3 inches below grade (+2.77' msl).

From this point, the transect followed Transect E to Trenches 14 and 15, as described above.

Transect G

Transect G (*Figure 29*) sectioned the wharf area near the center of the structure, approximately 180 feet east of the centerline of Union Street. The trench profiles used in the reconstruction included the northern sections of Trench 12, excavated parallel with Trench 11 on a northwest/southeast line, Section M of Trench 10M west of the Quonset huts, the southern end of Trench 11 (Section F), and portions of Trench 22, within which Feature 33, the wharf bulkhead, was located. The transect continued into Battery Cove in Trenches 21 and 16. Ground surface ranged from +7.97' msl at the north end of Trench 12 to +7.00' msl at Trench 22 and +6.72' msl at the south end of Trench 16. As in Transects E and F, wharf fill was encountered near the center of the wharf, in Trench 12B/C, below nineteenth-

century fill deposits and the remains of the engine room and railbed of a marine railway (Features 18 and 19), and associated workshops (Features 16-17 and 21-22). A deep test was excavated between and south of the fieldstone alignments for the marine railway track, Feature 19, which lay between 12 inches and 2 feet 6 inches below grade. Below the track bed was a heavy, coal stained silty clay fill deposit containing sand and gravels. Wharf fill was recorded at a depth of 5 feet (+2.97' msl), as reddish brown (7.5YR 6/6) to yellow (10YR 7/6) clayey sand, saturated and unconsolidated as in the other trench sections. The deposit was excavated to a depth of 6 feet 6 inches (+1.50' msl), where it graded to reddish brown (5YR 6/4) clayey sand running to at least 9 feet (-1.03' msl). The excavation was halted at this point due to excessive wall slump leading to potential disturbance of the overlying marine railway features.

In Section D of Trench 12, 45 feet to the south, the upper layers of later nineteenth-century fill -- largely consisting of coal and wood pulp -- were partially disturbed by the footing of a demolished water tower. The initial levels of the wharf fill deposit were likewise disturbed, but appeared to begin at a depth of around 5 feet 3 inches (+2.62' msl) as a light grayish brown (10YR 6/2) sandy clay, probably discolored by percolation from the overlying coal layers. Below lay reddish brown (7.5YR 6/6) sand and clayey sand, recognized as undisturbed wharf fill, beginning at a depth of 6 feet 6 inches (+1.38' msl) and extending as deep as 11 feet 6 inches (-3.60' msl). The base of the wharf fill deposit was not positively identified.

A complex area of turn of the century fill -- coal, wood pulp, clays, gravels and chalky marl -- overlay wharf fill in Section E of Trench 12, located 50 feet to the southeast. The wharf fill deposit began from 6 feet to 6 feet 3 inches below grade (+1.62' msl). At a depth of 11 feet (-3.15' msl) a dense clayey silt layer was encountered, identified as alluvium deposited prior to eighteenth-century wharf construction. The final depth excavated in this location was 13 feet (-5.15' msl).

Approximately 80 feet to the south, a sump was excavated for water control in Section M of Trench 10, to allow further examination of the nineteenth-century shipway, Feature 1 exposed within the excavation. In the sump area, wharf fill was identified at a depth of 6 feet 4 inches below grade (+1.37' msl), lying beneath nineteenth-century fill and

the shipway timbers. Wharf fill appeared in this location as light grayish brown (10YR 6/2) sand and sandy clay.

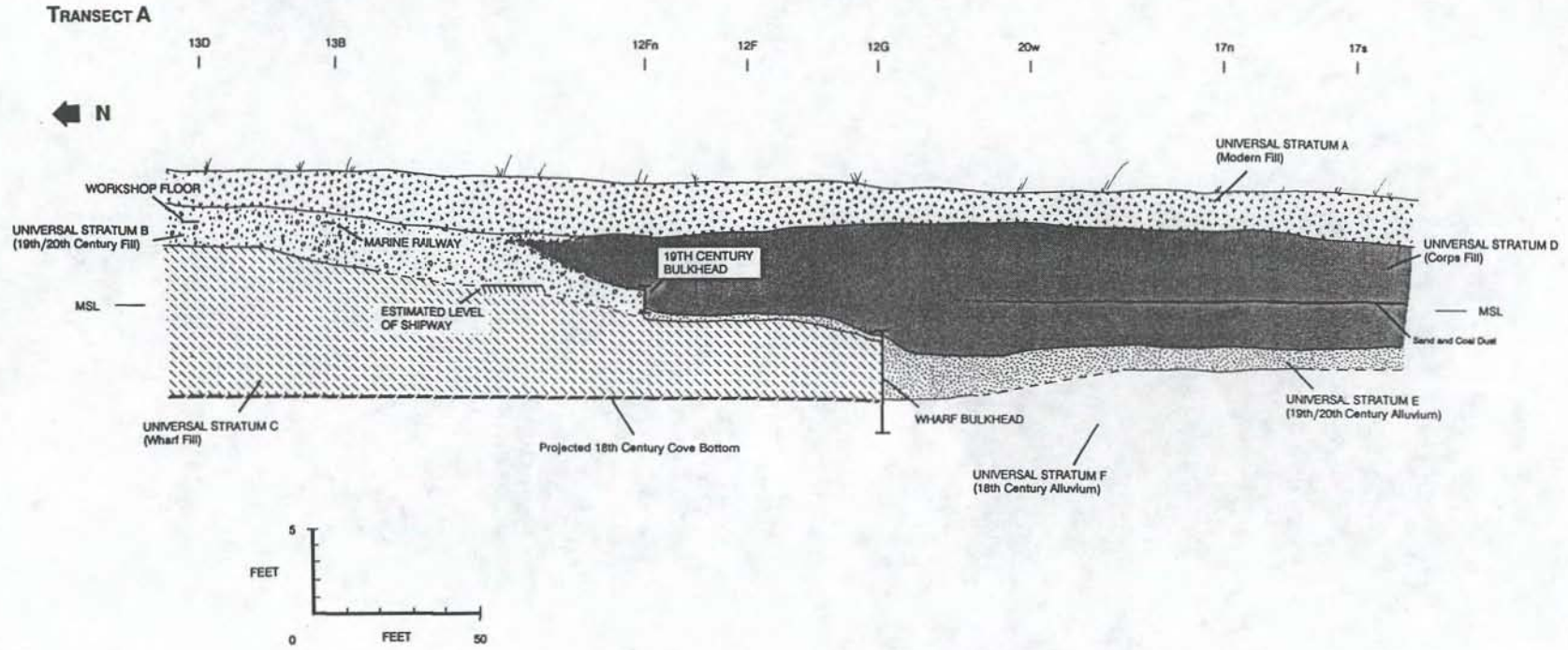
Sixty feet to the south, at the southern end of Trench 11, the stratigraphic profile of Section F indicated the presence of wharf fill beginning at a depth of 7 feet 6 inches (+0.53' msl), sloping downward to the south beneath modern surface fill, Universal Stratum A, Corps dredging spoil, Universal Stratum D, and a thin layer of riverine sand and silt deposited on the bottom of Battery Cove as it overran the edge of the wharf in the later nineteenth century, Universal Stratum E. Wharf fill was a darker gray than in the excavations to the north, apparently intermixed with organic materials from the overlying alluvium. The excavation was continued to a depth of over 13 feet (-5.00' msl) with no clear indication of a transition to the eighteenth-century alluvial deposit. Based on transitions recorded in other trench excavations in and outside of the bulkhead line -- *e.g.*, Trench 12E, Trench 10B, Trench 11B and Trenches 15 and 16 -- the base of the wharf fill was extrapolated at a depth of -3.25' msl.

Column profiles from two sections of Trench 22, excavated over the edge of the wharf during the cove survey, completed the profile reconstruction of Transect G within the wharf. At the north end of Trench 22, 30 feet south of Trench 11F, wharf fill was encountered at a lower level than to the north, at a depth of 7 feet 9 inches below grade (-0.66' msl), beneath Corps fill and nineteenth-century cove bottom deposits. Eighty feet further south, in the southeast corner of Trench 22, the surface of the wharf fill dropped off rapidly to meet the top remaining run of timbers making up Feature 33, the wharf bulkhead, this at 9 feet 2 inches below grade (-2.10' msl). The deposit was characterized as a mottled, silty and clayey sand, pale brown (10YR 6/3), light gray (10YR 7/2) and grayish brown (10YR 5/2) in color, with pale brown clay lumps and occasional gravels throughout. The base of the wharf fill was not positively identified in either excavation within Trench 22, though a line can be extrapolated from depositional breaks within Battery Cove south of the bulkhead, in Trench 21 and further to the south in Trench 16, and to the north within the wharf, in Trench 12E.

Transect A

Profile Transect A (*Figure 30*) lay 70 feet east of Transect G, and 260 feet from the center of Union Street, approximately two-thirds of the distance from the west property line to the leading edge of the wharf. The trench profiles used to construct the transect included Trench 13, Sections D, C and B, lying south of the Ford Plant building; two column profiles along Section F of Trench 12; and Section G of Trench 12, excavated over the wharf bulkhead. The transect was extended to the south to show the relationship of the wharf deposits with those within Battery Cove, using column profiles from the west end of Trench 20, and the north and south ends of Trench 17 -- these last will be examined in detail in a later section describing deposition in the cove portion of the site. Ground surface varied from +7.89' msl at Trench 13C to +6.52' msl at the south end of Trench 17.

Trench 13, was excavated northwest/southeast, parallel with Trenches 11 and 12. Due to disturbances known to lie directly east of Trench 13 -- a deeply buried storage tank, reported at the time to contain fuel or fuel oil, and a two-story concrete blockhouse -- the trench constituted the easternmost excavation feasible within the central area of the wharf. Section D of Trench 13 was excavated closest to the Ford Plant structure over the remains of a nineteenth-century workshop floor (Feature 29), which lay below a 7-inch concrete slab and an average of 2 feet 4 inches of nineteenth- and twentieth-century fill (at +4.97' msl). A shovel test was excavated through the 3-inch wood plank floor during Phase II operations. The test was not excavated to a sufficient depth to contact wharf fill. To the south, in Sections B and C, wharf fill was mechanically excavated beneath other nineteenth-century features -- the fieldstone bedding for the marine railway track, Feature 19, in Section B, and a wooden gutter, Feature 28, in Section C. Wharf fill was identified in Trench 13B at a depth of 5 feet 6 inches (+2.40' msl) and 4 feet 5 inches (+3.49' msl) in Trench 13C, though disturbances in the latter section made the demarcation only tentative. In both cases, in Sections B and C, access to deeper deposits was limited by utility lines near modern grade, and by nineteenth-century features. Deep excavation in Section B, for example, was conducted in the 6 foot space between the marine railway alignments. A large utility line and seepage from an oil plume generated by the leaking storage tanks to the east prevented excavation to the south, between the marine railway and the standing Quonset huts. Due to the unstable nature of the wharf fill, undermining of the nineteenth-century features and



Source: Engineering-Science
Ford's Landing

Figure 30
Composite Profile
Transect A

surrounding deposits became critical at the depths reached. The base of the wharf fill was thus not identified in this area.

Trench 12, Section F, intersected the profile transect approximately 100 feet to the south, beyond the Quonset huts. Extrapolating from elevations recorded to the north, in Trench 13B/C, and west, in Trench 10M and 12E, the slope of the surface of the wharf fill was reconstructed, tending downward to intersect the base of Feature 23, a small bulkhead associated with the nineteenth-century shipyard, at the north end of Trench 12F. At this location, the deposit lay at a depth of approximately 7 feet 10 inches below grade (-0.67' msl), beneath modern fill, a layer of Corps dredging spoil and nineteenth-century fill. The base of the fill was extrapolated from depths farther to the south, in Section G of the trench, at approximately 12 feet 7 inches below grade (-5.45' msl).

Halfway along Section F, 45 feet from the north end of the excavation, the silty Corps fill ran to a depth of 6 feet 5 inches (+0.83' msl), followed by two organic rich silt deposits laid down in the bottom of Battery Cove when, in the later nineteenth century, it extended over the margins of the eighteenth-century wharf. Wharf fill was recognized as a compact sandy clay deposit, mottled light yellowish brown (10YR 6/4) and light brownish gray (10YR 6/2), followed by light brownish gray clayey sand, beginning 7 feet 7 inches below grade (-0.33' msl). The deposit was excavated to 12 feet 3 inches (-5.06' msl) with no evidence of the underlying river bottom silts. The profile reconstruction is ambiguous at this point, but extrapolation suggests that the eighteenth-century river silts may have been situated just below the reach of excavation in this locale.

Wharf fill was not sampled at the south end of Section F of the trench, to avoid disturbing Feature 27, one of the scow hull fragments located along the edge of the wharf at the base of the twentieth-century Corps fill, approximately 9 feet below grade (-1.78' msl). Section G was excavated roughly perpendicular to Section F to follow the eighteenth-century bulkhead, Feature 33, to the east. Corps fill extended 8 feet 6 inches below grade (-1.63; msl), at a similar elevation to that at the south end of Section F. Controlled excavation of the wharf fill in Section G and identification of the base of the fill was impractical due to an array of logistical problems, including the presence of the scow, a complex arrangement of long tie-back supports for the bulkhead, and the unconsolidated nature of the sandy fill deposit itself, the latter intensified by persistent rains in October and November. The level

can be deduced from known levels in the interior of the wharf and the level of the cove bottom identified outside the bulkhead: as deep as 12 feet 1 inch below grade (-5.30' msl).

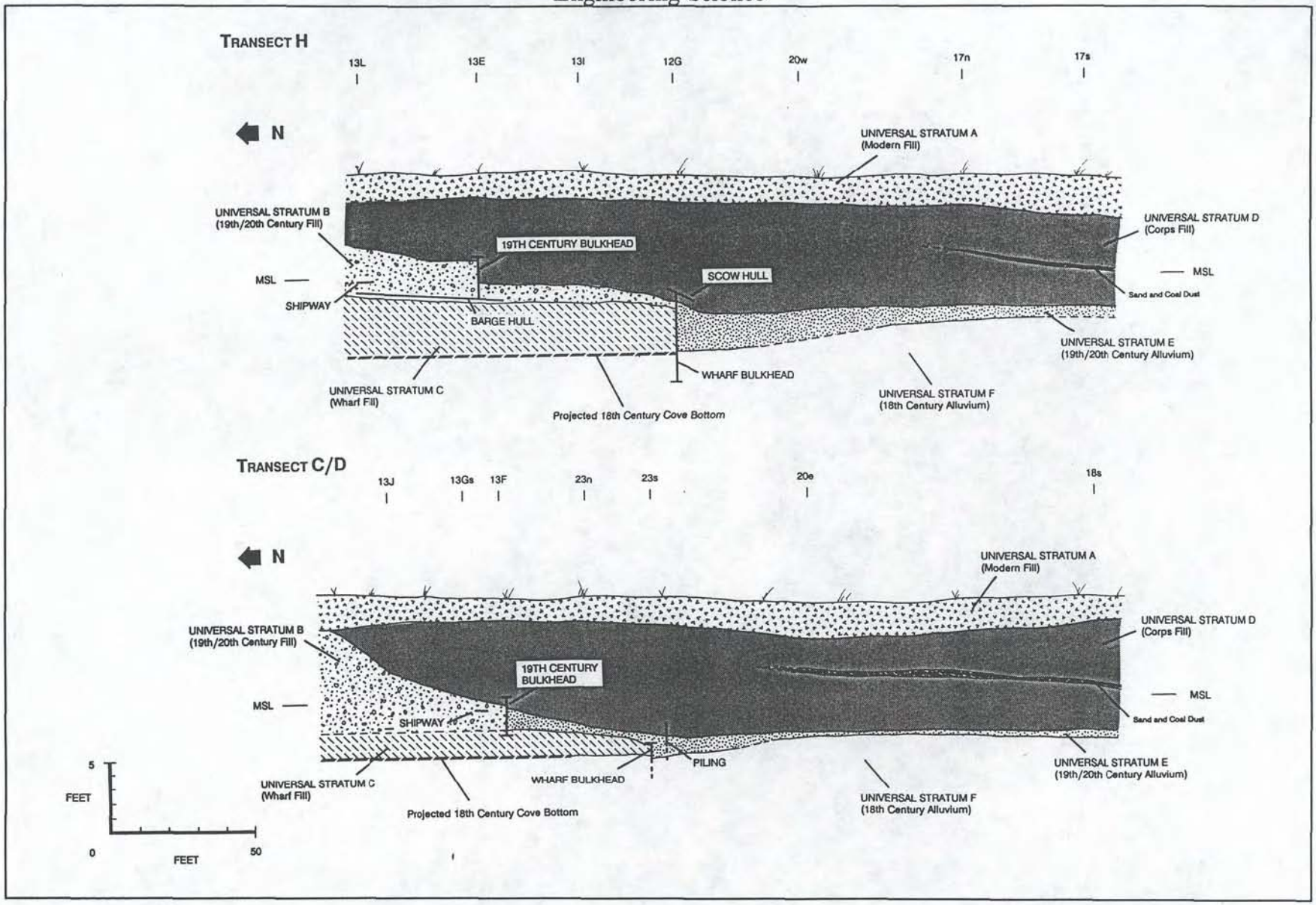
Transect H

Transect H (*Figure 31*) was shorter than the transects to the west, beginning at Trench 13, Section L, south of the underground storage tank disturbance and intersecting transect Transect A at Trench 12G. Surface elevations ranged from +7.25' msl at Trench 13L to +6.83' msl at 12G.

Section L of Trench 13 exhibited a profile consisting of modern or mixed fill to a depth of 3 feet 10 inches (+3.43' msl), Corps dredging spoil to 6 feet 2 inches (+1.11' msl) and dark, coal and gravel rich late nineteenth-century fill to 7 feet 6 inches (-0.22' msl). At this level, Feature 1, the nineteenth-century shipway, was encountered resting atop Feature 30, a long barge hull which had lodged beneath the nineteenth-century bulkhead, Feature 23, to the south. The barge lay on a thin bed of sand deposited by cove waters in the late nineteenth century, followed by wharf fill, identified as an organic stained, brown (10YR 7/3) sandy clay, beginning 8 feet 8 inches below grade (-1.38' msl). The base of the fill was not recorded in this location.

Thirty feet to the south, at the nineteenth-century bulkhead in Section E of the trench, a similar sequence was revealed. Corps fill began 1 foot 8 inches below grade (+5.61' msl) under modern rubble fill and, north of the bulkhead, extended to 6 feet (+1.27' msl), and was followed by nineteenth-century fill to the level of Feature 30, at Fig 31 a depth of 8 feet 6 inches (-1.25' msl). South of the bulkhead Corps fill extended to 7 feet 4 inches (-0.03' msl), followed by several inches of cove bottom sand accumulated over Feature 30 in the late nineteenth and early twentieth centuries.

An additional 30 feet to the southeast, in Section I of the trench, the turn of the century cove bottom deposit lay at approximately the same elevation, 7 feet 5 inches below grade (-0.14' msl), sloping downward to the south at an increasingly steep angle to meet the eighteenth-century bulkhead in Trench 12G. Wharf fill was identified below at 8 feet 4



Source: Engineering-Science
Ford's Landing

Figure 31
Composite Profile
Transects H and C/D

inches, consisting of pale brown (10YR 6/3) sandy clay quickly grading to reddish yellow (7.5YR 6/6) and strong brown (7.5YR 5/8) clayey sand.

The eighteenth-century bulkhead lay approximately 30 feet to the south. At this point, as described above, the later cove bottom deposit intersected the bulkhead line from the north at a depth of 8 feet 6 inches (-1.63' msl). The deposit averaged 4 to 6 inches in thickness, and gave way to wharf fill at approximately 9 feet 2 inches (-2.30' msl).

Transect C/D

Transect C/D (*Figure 31*) was reconstructed from trenches located 50 to 60 feet to the east of Transect H, near the east end of Trench 13F. Beginning in Section J of Trench 13, 40 feet south of the concrete blockhouse structure, and continuing in Section G, 10 to 20 feet to the south, wharf fill lay below the level of the nineteenth-century shipway, Feature 1, at a depth estimated at approximately 9 feet below grade (-1.85' msl), an elevation determined from the depth of the deposit south of the bulkhead and from the various levels of the shipway. South of the bulkhead in Section F of Trench 13, the wharf fill deposit lay 9 feet 3 inches below ground surface (-1.99' msl) occurring as silty, clayey sand, pale brown (10YR 6/3) in color becoming progressively reddish yellow (7.5YR 7/6) within the first 4 to 5 inches. The base of the deposit was not encountered in this location, but was recorded at a depth of 10 feet 10 inches (-3.57' msl) to the south in Trench 23.

At the north end of Trench 23, 25 feet south of the nineteenth-century bulkhead, the late cove bottom deposit occurred below Corps fill at 9 feet (-1.66' msl). The sandy bottom accumulation was approximately 5 inches thick, with a distinct transition to wharf fill, appearing as a pale brown (10YR 6/3) to reddish yellow (7.5YR 6/6) mottled clay and sandy clay, at a depth of 9 feet 5 inches (-2.08' msl). As indicated above, the base of the fill lay at 10 feet 10 inches (-3.57' msl). Approximately 25 feet to the south, at the eighteenth-century bulkhead, the wharf fill deposit dipped sharply to meet the bulkhead at a depth of 10 feet 6 inches (-3.28' msl), 4 inches below the top run of timbers, with the late cove bottom sands overrunning the edge of the wharf. The base of the fill was determined at this point from measurements at the north end of the trench and from the level of the earlier, eighteenth-century cove bottom immediately south of the bulkhead.

Summary

In review, wharf fill consisted of a loose, clayey sand deposit ranging in color from light gray to reddish yellow. The deposit was recorded at increasingly lower depths across the area, sloping downward towards the edges of the wharf. The fill lay beneath a variety of later features and fill deposits: various early-to-mid twentieth-century or turn of the century fill deposits in the northwest section of the study area, closest to the Ford Plant building and the intersection of Franklin and Union Streets; late nineteenth-century shipyard features -- a marine railway, a shipway and an associated bulkhead -- in the central portion of the area; and an increasingly deep deposit of dredging spoil in the form of silt introduced by the Corps of Engineers in the early twentieth century, further to the south near the edge of the cove as it existed in the latter portions of the nineteenth century. The fill consisted of relatively uniform clayey sand, with some mottled clay inclusions and occasional gravels. Color depended on the amount of leached coal or organic materials present, the latter increasingly apparent in the areas to the south which had been inundated for some time by the waters at the edge of Battery Cove as its level rose during the nineteenth century.

Wharf Bulkhead

The wharf retaining system associated with Keith's Wharf consisted of a simple bulkhead structure, comprised of a series of large timbers stacked lengthwise to form a wall or revetment around the perimeter of the wharf. The wall was stabilized with struts or back-braces, anchored in the fill behind the bulkhead line. Portions of bulkhead were recorded in Trenches 14D, 22, 12F, 12G and 23, these segments comprising the southern edge of the wharf, and in Trench 23X, the southeast corner of the structure. The combined lengths of the portions of the bulkhead excavated amounted to approximately 88 feet over a total length of 290 feet, stretching from Trench 14D to Trench 23X. Description of the feature begins with the segment encountered in Trench 12G, the excavation which provided the greatest exposure of the structure, both vertically and horizontally.

Trench 12, Section G

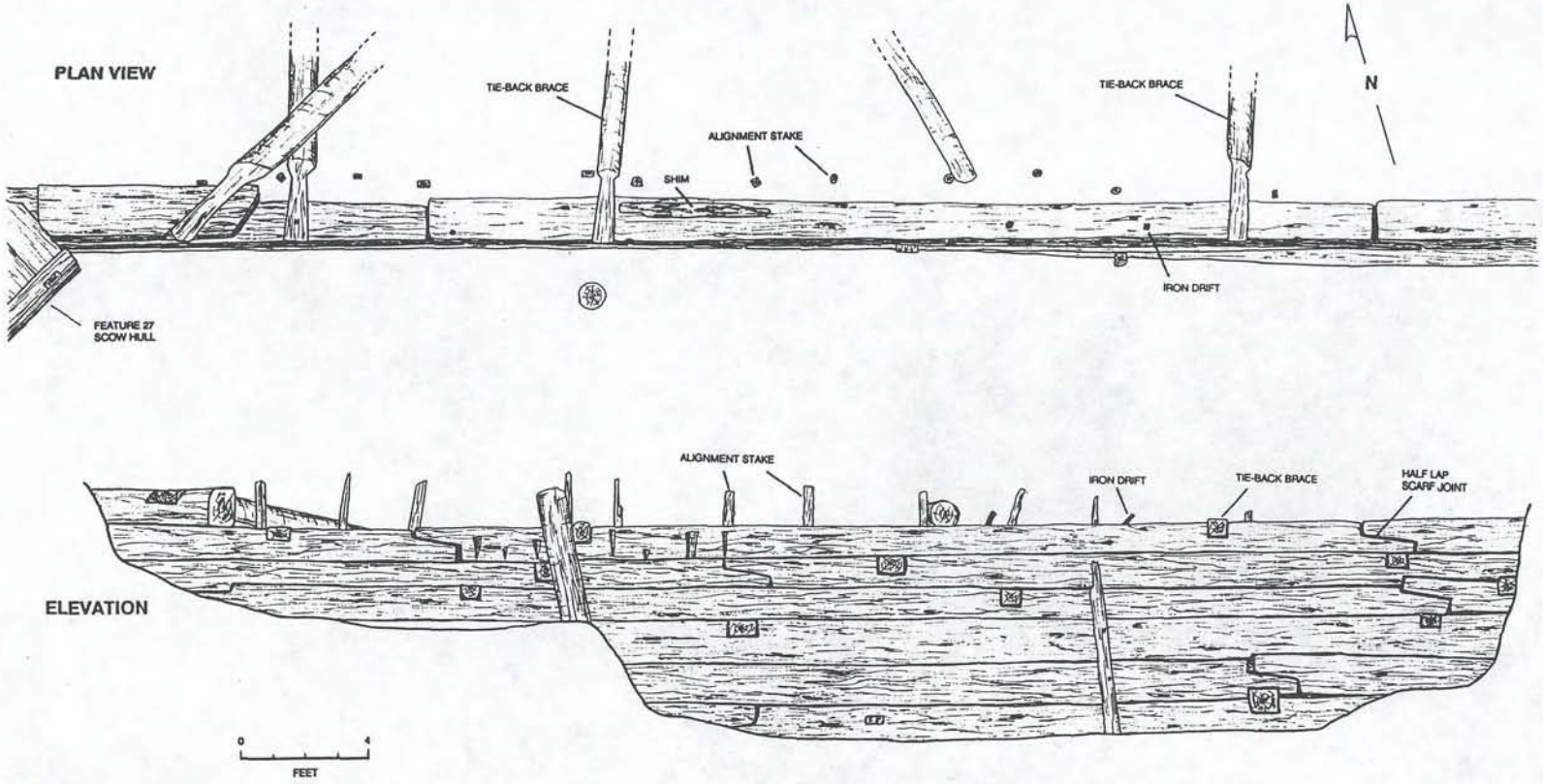
Approximately 65 feet of bulkhead was examined in Trench 12, 44 feet in Section G (*Plate 24; Figure 32*) and an additional 21 feet beneath Feature 27 in Section F. Only the

Plate 24. Feature 33--Eighteenth-Century Wharf Bulkhead, Trench 12G

Plate 25. (Below) Detail of Adze-Work, Trench 12G

Source: Engineering-Science
Ford's Landing

Plates 24 & 25



Source: Engineering-Science

Figure 32. Feature 33: Wharf Bulkhead

portion in Section G was systematically exposed. The line of the bulkhead was slightly skewed in relation to the east/west property line. At the east end of the excavation the feature lay 220 feet south of a line extended from the present center of Franklin Street (1 foot south of the southern edge of the Ford Plant building), and at the west end, beyond Feature 27, 225 feet south of the line.

Main Bulkhead Timbers. In Section G of the trench, the bulkhead consisted of six to seven courses of hand hewn timbers, each measuring from 10 to 17 inches in diameter. The timbers had been roughly shaped on one or more sides, depending on their size and position in the stack. For example, the top two courses were planed on three surfaces, with the interior left uncut and the bark remaining in place, while several of the lower timbers appeared to be planed on only the outer or southern face, the bark remaining on the upper and lower surfaces. One timber, the smallest in diameter, was left naturally round, with bark and a branch stub remaining where the wood did not extend beyond the outer or southern face of the bulkhead.

Shaping and planing of all surfaces had been accomplished through the use of broadaxe and adze, the latter work referred to as dubbing -- the marks of the work, some quite deep and fresh in appearance, were still readily visible throughout the lengths of the timbers (*Plate 25*). Two of the beams were completely exposed horizontally in the archaeological excavations, exhibiting lengths of 30 feet 3 inches and 36 feet 9 inches. Field assessment of the bulkhead timbers determined that the wood used was yellow pine -- lab analysis confirmed the species as southern yellow pine (*Pinus spp.*). None of the timbers appeared reused. The only markings other than those obviously related to surface finishing were seen on the uppermost timber, where eight "V"-shaped notches were noted along a portion of the exposed outer face. The notches were shallow, at less than 1 inch in depth, were evenly spaced approximately 1 foot apart, and varied from 3 to 12 inches in length. A single notch was observed on the fifth course. None appeared to be functional, and all were too sharply cut and regular in shape to have been caused by the prow of a vessel ramming or scraping the side of the wharf -- they may represent nothing more than the work of a bored adzeman.

The wharf timbers were all connected by means of half-lap splices or scarf joints, with iron dowels or drift bolts driven vertically through the joint (*Plate 26*). In several cases

Plate 26. (Above) Detail of Scarf Joint, Trench 12G

Plate 27. Tie-Back Bracing Trench 12G

Source: Engineering-Science
Ford's Landing

Plates 26 & 27

the scarf was uneven, with the upper lap rising above the level of the lower timber. In such cases the overlying beam was cut out underneath, or fayed, to produce a close fit. Drifts were also observed at non-systematic intervals along the upper timber between splices, indicating that the timbers were pinned throughout their length to assist in horizontal stabilization. The pins which could be observed were hand wrought, square or rectangular in cross-section, and varied in diameter from $^1/_2$ by $^7/_8$ inch to $^3/_4$ by $^7/_8$ inch. Several were seen protruding 5 to 6 inches above the uppermost remaining timber course and were bent well out of vertical. A 4-foot 8-inch section of $^1/_2$- by 4-inch lath was noted along the north or interior edge of the uppermost timber course, apparently serving as a shim to level the next beam in the stack. In spite of the adze work, shimming and pinning, some of the joints did not appear to be solid, perhaps as a consequence of shifting and settling over the past two hundred years.

Bracing. Vertical stabilization was achieved by means of back-braces or tie-backs, long timbers, less massive than the main bulkhead members, anchored within the fill to the north (*Plate 27*). The ends visible along the face of the bulkhead measured variously 6 by 6 inches, 6 by 10 inches and 5 by 8 inches. Most had been cut flush with the bulkhead face, though the end of one brace had been roughly cut to form a dihedral angle extending 1 to 2 inches beyond the bulkhead line, and another a large brace on the lowest run of timbers, was rounded and extended 4 to 5 inches beyond the bulkhead line. Generally, one back brace was observed on either side of a lap joint, 4 to 5 feet from the center of the joint. The pattern was more regular in the upper 2 courses, less so below. Only one brace was noted on the lowest run, fitted into the upper surface of the bottom timber, beneath a scarf between the two timbers of the run above, taking advantage of a single drift pin. The brace was large -- 9 by 12 inches at the visible end of the tenon, and dovetailed, with the base of the overlying timber notched $2^1/_2$ to 3 inches to fit. Those braces exposed along the top course of the bulkhead consisted of untrimmed timbers with one end dubbed to form a tenon, often dovetailed, and inserted into a mortise cut into the upper surface of the bulkhead timber. Most of the brace tenons were pinned in a manner similar to the lap joints, though some were not fastened.

Of the five braces visible at the present, eroded surface of the wharf, two had originally been connected to a now missing course above the uppermost run seen along most of the trench. A portion of this higher run was visible beneath the east end of Feature 27, a

fragment of a nineteenth-century scow hull resting across the bulkhead west of the exposed profile. The timber was larger than those seen below and to the east, measuring 14 by 18 inches, and was mortised to receive a dovetailed tenon at a 45 degree angle. The brace set into the mortise was also larger than the other braces exposed in the trench, consisting of a bole approximately 11 inches in diameter, with a tenon 31 inches in length, flaring from $6^1/_2$ to $8^1/_2$ inches. No pin was observed, the dovetailed tenon serving as sufficient fastening. A second brace was uncovered halfway along the exposed profile which had also been attached to a timber on the same, now missing course. The bole extended perpendicularly from the bulkhead, measuring $7^1/_2$ inches in diameter; the tenon of the brace was missing. Three other braces were mortised into the topmost complete run of bulkhead timbers. Each was set perpendicularly to the line of the bulkhead and the tenon dovetailed. The measurements were recorded as follows:

Position in Trench	Bole Diameter	Length of Tenon	Dovetail Flare	Type of Fastening
west	$9^1/_2$"	23"	$5^1/_2$" - 9"	pinned
center	$8^1/_2$"	24"	5" - $7^1/_2$"	pinned
east	10"	29"	$6^1/_2$" - $6^3/_4$"	no pin observed

Table 3. Feature 33: Dimensions of Selected Bulkhead Braces

Most of the braces appeared to be quite long. Though the ends were not visible due to the sloppy digging conditions, several of the ties were followed beneath the wet fill with the backhoe arm. Those examined in this way appeared to measure between 20 and 30 feet in length and to be attached to posts driven into the fill or to deadmen, large pieces of wood buried horizontally in the fill acting much as a sheet anchor functions for a sailing vessel -- the drag of the deadman against the surrounding earth would serve as a stop, counteracting the tendency of the fill to push the bulkhead outward.

As noted above, the tie-backs were set at several angles to the line of the bulkhead. They were also angled downward somewhat to increase the drag; thus, for the wall to lean outward the brace and anchor must be pulled both upward and outward. The angles of the braces as measured in the field varied from 6.5 to 19 degrees below horizontal (equal to

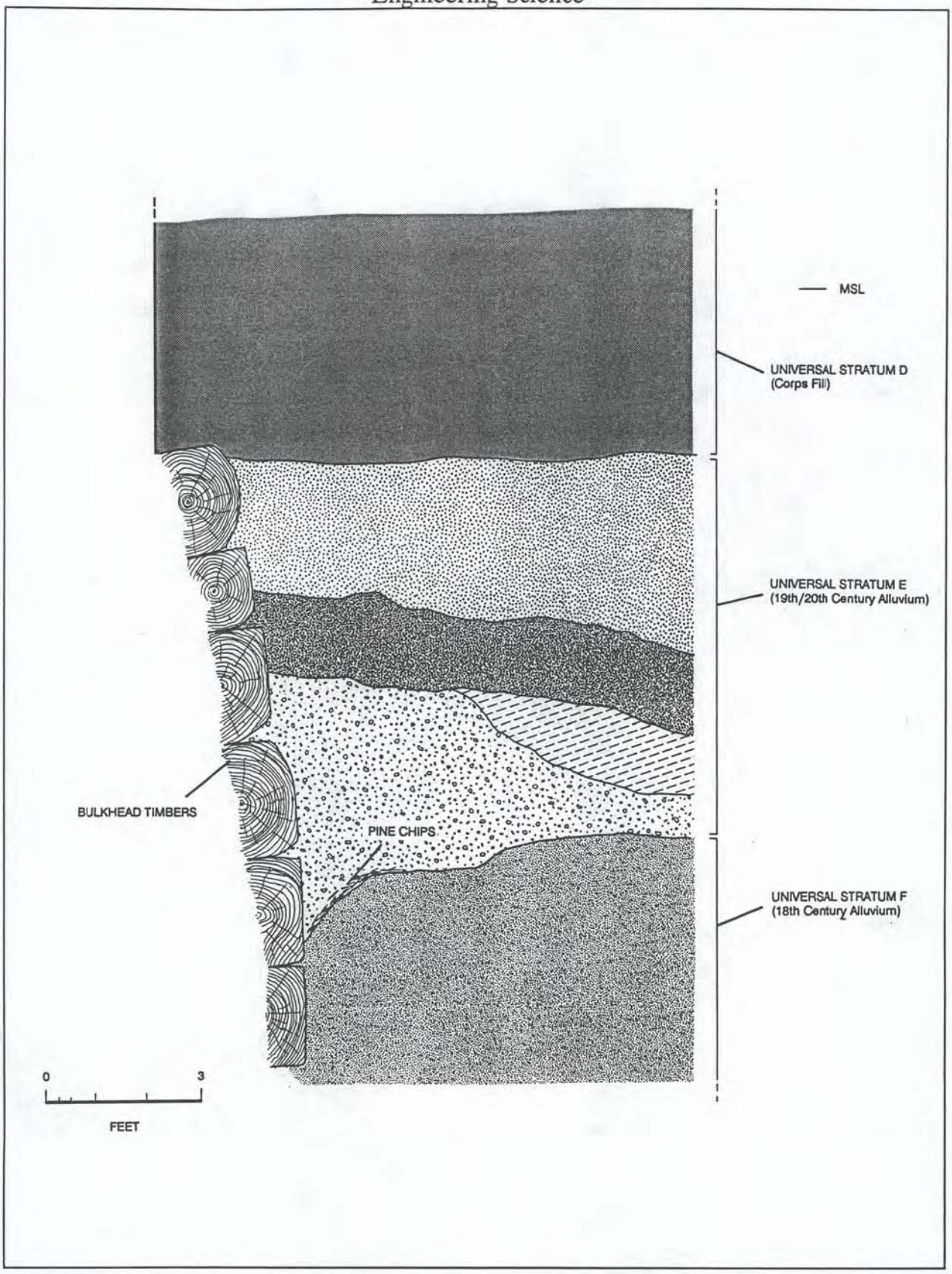
slopes of 1.5:12, or 12.5%, to 4:12, or 33.9%). The angles may have been varied to add support capability by increasing the number of vectors or directions of force within the fill. It should be noted that the angles recorded in the field were not the same as those at which the braces had originally been set. The top three remaining courses of the bulkhead were canted inward at an angle varying from 3 to 10 degrees from vertical. It was at first thought that this banking was intentional, a construction feature in which the line of the revetment tilted inward, making the wharf look somewhat like a large, flat hipped roof. Yet with even a few added courses above those currently visible, the top edge of the wharf would have been situated well inward from the bottom, making docking and load transferring impractical. A more likely explanation for the tilt appears to be that the wharf fill, being relatively unconsolidated, was compressed by the weight of the dense, silty dredging spoil pumped in above it by the Corps of Engineers in the early twentieth century. The heavy overburden appeared to have pushed the upper layers of sandy fill downward, along with the braces contained within it, pulling the bulkhead timbers to which they were tied backward, away from the vertical. Thus only the upper courses appeared to have been affected. The use of deadmen to anchor the braces is also implied by this evidence, since if anchored to posts driven deeply into the fill, the braces would be expected to have settled less. The average correction to the slopes, calculated by projecting the banked portion of the bulkhead to vertical, was 6.8 degrees, resulting in ties sloping at rates ranging from nearly level to 21.7 degrees below horizontal. The lack of steeply sloped braces, *i.e.*, approaching 45 degrees, may indicate that heavy support was not considered necessary or desirable. The lengths of the braces may have been assumed to have supplied sufficient buttressing, relying on the mass of the fill as a stabilizer between the anchor and the bulkhead line. Level or horizontal braces, requiring simpler mortising, would have been easier to install, which suggests the almost *ad hoc* nature of certain aspects of construction. Greater structural support for more permanence may not have been considered as high a priority as fast and less expensive work.

Other Features. A series of small stakes or posts measuring from 2 to $3^1/_2$ inches in diameter were set along the inside edge of the bulkhead. The stakes, often consisting of untrimmed wood with bark and branch stubs still attached, were located 2 to 5 feet apart. Too small to have been structural, the posts probably served as alignment devices during construction.

Two uprights were found outside the bulkhead. One was an 11-inch-diameter bollard or piling, abutting the wharf at the base of the bulkhead, but canted outward, either from the weight of the overlying silt fill, or from the base of the bulkhead creeping outward. The piling may have been used as a mooring, though it lay well below the estimated top of the wharf. Alternatively the piling may have been related to construction of the wharf, used, for example, as a tie up or bracing for construction equipment. The second upright was a smaller post, approximately 5 inches in diameter, of untrimmed wood. The post was nailed to the exterior of the bulkhead in two places. Its function is uncertain.

The bulkhead timbers were not level, but appeared to have settled considerably, again possibly due to the weight of the overlying fill deposits. The feature was lower to the west, away from the river. The uppermost course lay 1 foot 3 inches higher at the east end of the trench excavation than at the west end -- 8 feet 3 inches below grade (-1.47' msl) at the east end and 9 feet 6 inches (-2.67' msl) at the west. The underlying runs of timber were parallel with the top course. The base of the bulkhead, as measured near the center of the trench, lay 13 feet 9 inches below grade (-6.92' msl). A number of timber courses were missing from the feature, as evidenced by the presence of the truncated run below Feature 27, by several broken tie-back braces which would have attached to courses higher than those remaining at present, by several iron drifts extending from the topmost timber run, and by the higher elevation of eighteenth-century fill as measured to the north, near the center of the wharf.

The profile of the deposits outside the bulkhead (*Figure 33*) revealed Corps fill to near the top of the uppermost remaining course of timbers, the top of the bulkhead being recorded at 8 feet 3 inches (-1.47' msl) and the base of the Corps fill at 8 feet 5 inches (-1.63' msl). Below the dredging spoil, there followed a series of sandy deposits representing a combination of natural cove bottom accumulation and sandy wharf fill seeping from between the timbers of the bulkhead and eroded from the surface of the wharf as the upper timber courses deteriorated. Earlier, eighteenth-century cove bottom silts and sands occurred further below at a level 12 feet 1 inch below grade (-5.30' msl), the surface appearing fairly level to the south. The deposit dipped sharply to meet the bulkhead at the top of the fifth run at 13 feet 1 inch (-6.25' msl). A large number of pine chips were encountered in the trench formed along the line of the bulkhead and extending outward to the south some 8 to 10 inches, indicating that much if not all of the notching and trimming of the bulkhead timbers was done in place.



Source: Engineering-Science
Ford's Landing

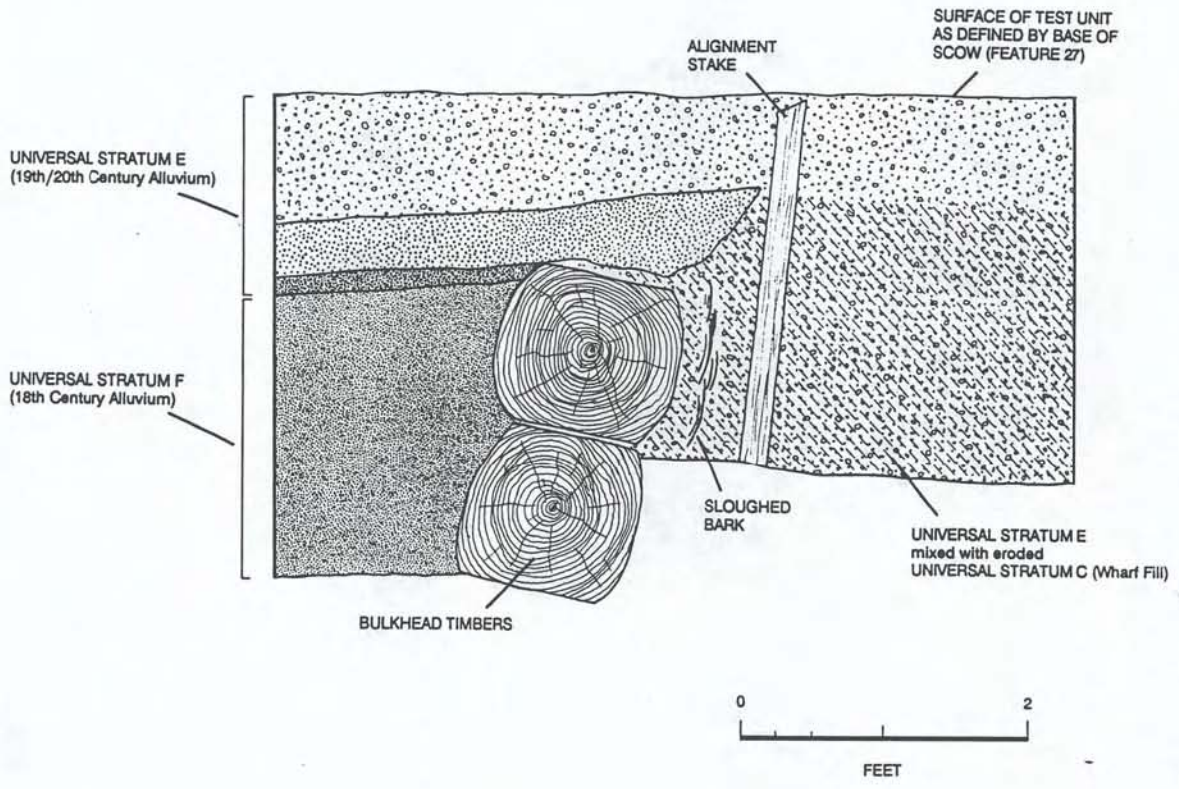
Figure 33
East Profile Section
Trench 12G at Bulkhead Line

Trench 12 Section F

The surface of the uppermost course of bulkhead timbers was exposed in Section F in the excavation surrounding Feature 27. The 14- by 18-inch timber with the large, diagonally mortised back-brace attached, seen in the west end of the Trench 12G profile, extended beneath the southeast corner of the scow. Near the northwest corner, the top run of the bulkhead was revealed as a 12-inch timber -- further exposure of the bulkhead at this end of Feature 27 was not attempted, due to the length of time the excavation around the vessel was left open, contributing to already difficult problems with maintenance of trench walls in unconsolidated fill. Feature 27 was removed temporarily from atop the bulkhead to allow examination of its underside and of the deposits below. A 3- by 5-foot hand excavation, Test Unit 5, was placed over the line of the bulkhead (*Figure 34*). From 8 to 13 inches of accumulated cove bottom sediments were observed between the base of the hull and the bulkhead timbers. Two courses of bulkhead timber were exposed, each measuring 12 by 13 to 14 inches, trimmed on three sides. To the north, facing the interior of the wharf, bark was observed peeled away from the timbers. A 2 by 2-inch alignment stake was set 5 inches back from the bulkhead line, also within the wharf fill. Both the bulkhead timbers and the alignment stake were canted inward at a 12 degree angle, a slightly greater amount of lean than was observed in the bulkhead timbers to the east, in Section G. Fragments of wine bottle glass, white salt glazed stoneware, creamware, pearlware, construction materials, shoe leather, animal bone and a quartz flake were recovered from two thin layers of silty sand which had collected over the bulkhead: the artifacts were typical of those found in other excavations at the edge of the bulkhead, and probably represented a combination of material swept over the edge of the wharf and material originally contained in wharf fill which had eroded into the cove as the bulkhead deteriorated.

Trench 23

Trench 23 was one of ten survey trenches excavated within the fill deposits at the edge of Battery Cove. Its purpose was to examine the fill at the edge of the wharf and to locate the corner of the bulkhead structure. A 5 foot length of Feature 33, the wharf bulkhead, was exposed near the south end of the trench. The bulkhead lay 217 feet south of the present centerline of Franklin Street at this point, at a depth of 10 feet below grade



Source: Engineering-Science
Ford's Landing

Figure 34
Test Unit 5
West Profile Section

(—3.10' msl). A single run of timber was exposed at this level, measuring 15 inches in diameter and trimmed on three surfaces, with bark remaining on the interior or northern face.

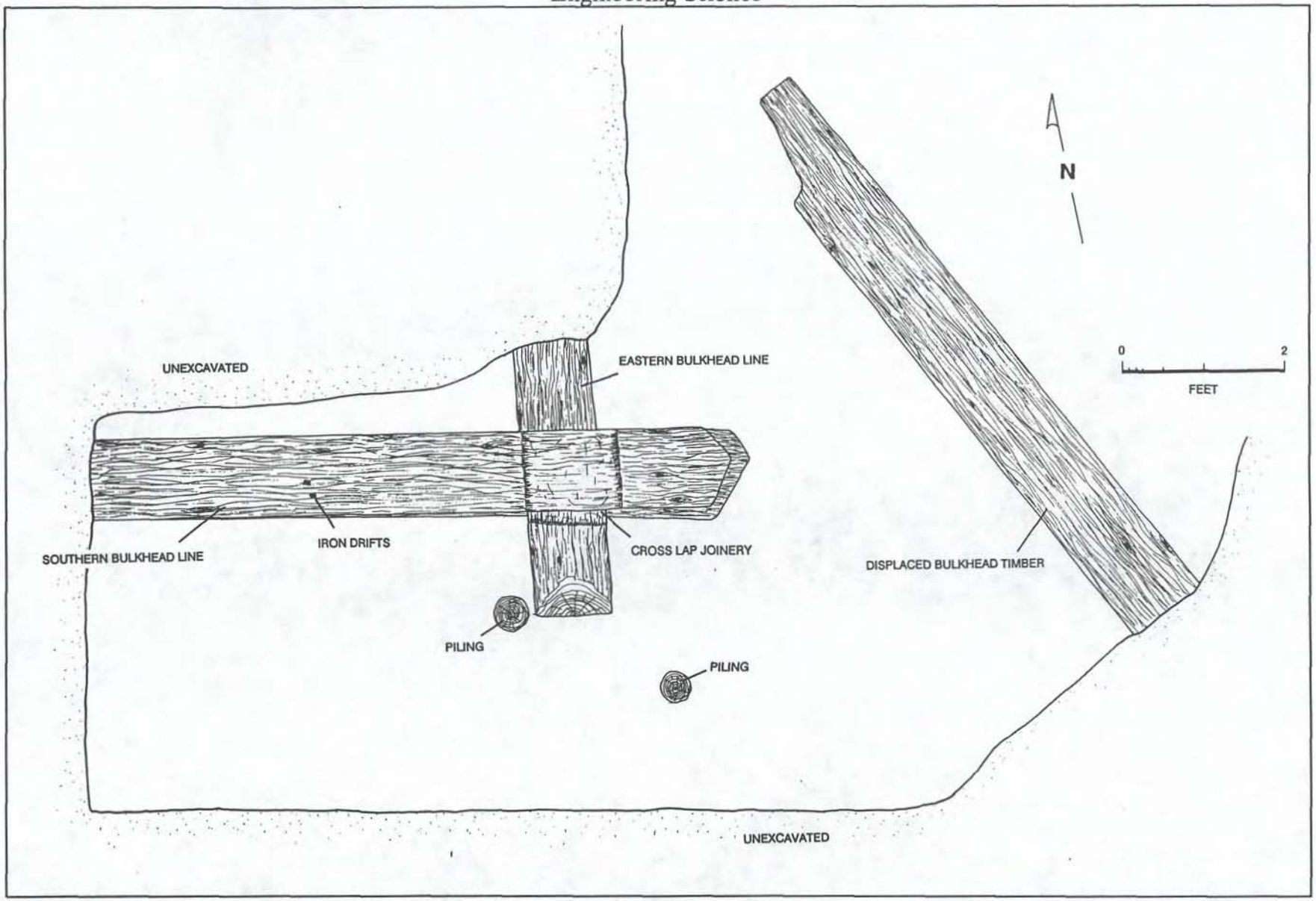
A diagonal back brace extended into the fill to the northeast at an angle of approximately 35 degrees to the line of the bulkhead. Like those in Trench 12G, the brace consisted of an untrimmed bole 13 inches in diameter with an adze-cut tenon 6 inches wide, mortised into the second run down -- the connection was not exposed. The brace sloped downward into the fill at a rate of 12.5% (1.5:12). Though only the uppermost run of the bulkhead was exposed, there appeared to be no appreciable inward tilt as had been recorded in Trench 12. The timber was $3^1/_2$ to 4 inches lower at the west edge of the excavation, which suggested settling to the west. Inconsistencies in the thickness of the timber which could not be seen in the limited excavation could account for at least some of the difference in elevation.

A second planed timber, 12 inches in diameter, lay at an oblique angle across the back brace 2 to 3 feet north of the line of the bulkhead, and appeared to be displaced. A 14-inch-diameter piling lay 1 foot south of the bulkhead at a depth of 8 feet 9 inches (-1.76' msl), 1 foot 3 inches above the remaining bulkhead courses. An apparent waterline or sediment mark was observed on the piling at a depth of 9 feet 6 inches (-2.47' msl).

Trench 23X

This excavation was an eastward extension of Trench 23, used to locate the corner of the wharf. As seen at the base of the trench, the bulkhead timbers forming the south edge of the wharf lay 217 feet south of the present center of Franklin Street, while those forming the east edge lay 395 feet east of the present center of Union Street.

Two courses of timber were exposed along the south edge of the bulkhead, and one along the east bulkhead line (*Figure 35*). The corner was formed by means of deep cross-lap notching, with the ends of the timbers extending beyond the bulkhead lines in each direction (*Plate 28*). In neither bulkhead line was an inward tilt detected.



Source: Engineering-Science
Ford's Landing

Figure 35
Feature 33: Southeast Corner, Plan View

Plate 28. Southeast Corner of Bulkhead, Trench 23X

Both of the southern bulkhead timbers exposed in the excavation had been cleaned of bark and roughly planed on at least three surfaces -- the north or interior faces were not exposed in the excavation. The upper timber measured 12 inches in width and 11 inches in thickness, though the end of the beam was splintered and tapered to 8 inches in thickness. Two cross-lap or saddle cut notches had been adzed or dubbed into the timber. The upper notch measured 4 inches in depth and 14 inches across, while the lower, which fitted over the crossing timber from the east bulkhead, measured 2 by 12 inches. The timber extended 19 inches beyond the east bulkhead line. No pinning was observed within the corner connection. Two rectangular dowels or drift pins were observed $6^1/_2$ feet to the west, reinforcing the horizontal position of the timber. The pins measured $^1/_2$ by $^3/_4$ inches and $^1/_2$ by $^7/_8$ inches. A large cut nail was also noted along the exposed surface of the timber -- its function is unclear, but it may have served as a temporary attachment during the erection of the bulkhead. The lower timber measured 12 by 12 inches, though it was somewhat wider, up to 14 inches, beyond the cross-lap notch. The notch, measuring $4^1/_2$ to $4^3/_4$ inches deep and 15 to 16 inches across, had been dubbed into the upper surface to receive the lower notch of the crossing timber of the east bulkhead. The end of the timber extended $22^1/_2$ inches beyond the east bulkhead line. The ends of both the upper and lower timbers had been saw-cut to rough, vertical dihedral angles.

Like the south bulkhead timbers, the single timber exposed along the east bulkhead had also been roughly planed on at least three sides. It measured 11 inches in width and 12 inches in thickness. Cross-lap notches had been dubbed into both surfaces -- the upper measured 2 by 16 inches and the lower 6 by 16 inches. The timber extended 15 inches beyond the south bulkhead line and had been saw-cut to a horizontal dihedral angle.

Two small posts were encountered at the corner of the wharf. One measured 5 inches in diameter and lay at the end of the east bulkhead timber. The second measured 4 inches in diameter and lay approximately 2 feet southeast of the bulkhead corner. Both were deteriorated, rising only to the level of the remaining south bulkhead timbers. Judging from their sizes and positions, the posts were probably related to alignment during wharf construction.

A displaced bulkhead timber was exposed lying on its side near the base of the bulkhead, 3 to 4 feet southeast of the corner of the wharf. It was planed on all surfaces and

measured 12 by 12 inches in cross-section. Nine and one-half feet of the timber were uncovered, one end disappearing into the south wall of the trench excavation, the other ending in a half-lap cut-out.

Approximately 11 feet of the southern bulkhead was exposed in the excavation, and elevation measurements indicated that, as was the case in Trench 12G, the timbers appeared to have settled to the west. The upper surfaces of the remaining course were measured at 9 feet 10 inches below grade (-4.74' msl) to the east and 10 feet 2 inches (-5.24' msl) to the west. The base lay 20 to 24 inches below, at 11 feet 4 inches (-6.40' msl) to 12 feet 2 inches (-7.23' msl).

The two bulkhead lines met at an angle of 86 degrees, noticeably out of true. The cross-lap notches were also ill-fitted, with fill material, including a large brick fragment, wedged into the gaps. While these may be indications of less than exacting standards employed during construction due to the use of informal surveying techniques, they are more likely the result of movement of the unreinforced corner of the bulkhead, as it settled into the silty cove bottom, with the process quickened by the overfilling carried out in the early twentieth century.

The west profile of the trench excavation showed a thick layer of Corps dredging spoil lying over the early twentieth-century cove bottom deposit. The latter consisted of a thin layer of coal dust and sand over gray silty sand and small organic debris, followed by a darker silty deposit with pine bark chips near the bulkhead line. These late cove deposits extended to within approximately 1 inch of the top of the bulkhead. At this point, dark gray, organic stained sandy wharf fill was observed overrunning the bulkhead, stretching in a thin wedges 3 feet 6 inches to the south before dissipating.

Trench 22

Small segments of the wharf bulkhead were exposed in Trench 22 at either end of Feature 34, a second scow fragment resting over the edge of the wharf. East of the scow, the bulkhead line lay 226.5 feet south of the present center of Franklin Street; west of the

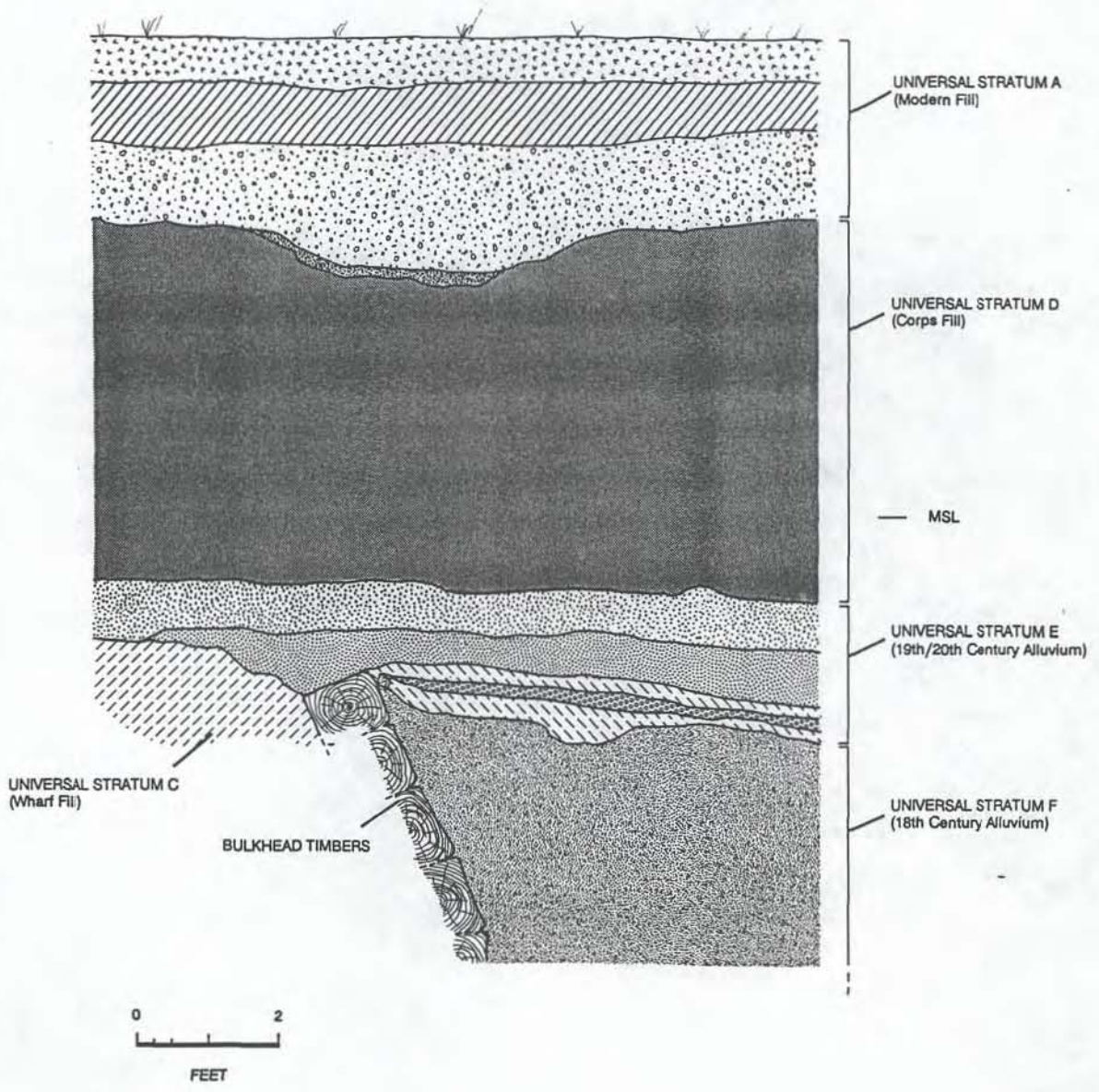
scow it lay between 223 and 224 feet south of Franklin Street. In both cases, poor excavation conditions restricted access to a wide view of the bulkhead timbers.

A section of bulkhead 5 feet 3 inches in length was uncovered east of Feature 34, beginning at a depth of 9 feet 2 inches (-2.15' msl). Portions of four timbers were exposed, each planed on 3 surfaces, as seen in the trenches to the east -- Trench 12G, 23 and 23X. The uppermost timber measured 12 by 12 inches. Below, the only measurable dimension of the timbers was thickness, running between 10 and 12 inches. One half lap scarf was exposed in the excavation, joining timbers in the second run. The base of the timber lying over the joint was fayed to the shape of the top lap, which rose above the level of the joint.

Three back brace tenons were visible along the open face of the bulkhead. One, with the exposed end measuring $6^1/_2$ by $7^1/_2$ inches, was mortised into the top of the second run of logs. The second, $6^1/_2$ by 9 inches, was fitted into the top of the third run, while the third, $5^1/_2$ by $6^1/_2$ inches, lay approximately 3 feet to the west. None of the braces themselves were visible, and no pins could be seen at any connection. A partial mortise had been cut into the southern, or exterior, edge of the uppermost timber, measuring 6 to 7 inches wide and 5 inches deep and angled 60 degrees from the bulkhead line. The mortise had not been cut completely across the log, suggesting that it was unfinished. The channel may indicate that the timber was reused, though the cut appeared fresh, with no sign of wear. More likely, the mortise was begun before the log was laid on the bulkhead stack, and the timber was eventually laid in the direction opposite to that originally planned.

There was a marked northern tilt, approximately 23 degrees from vertical, to the top three bulkhead members (*Figure 36*). While comparatively little of the lowest, or fourth timber was exposed, it appeared to lie close to vertical.

The profile in the east wall of the excavation showed twentieth-century Corps fill extending to within 15 inches of the bulkhead, followed by two 6- to 8-inch layers of silt or silty sand, representing nineteenth and early twentieth-century cove bottom deposits. The lowest of these overran the bulkhead and disappeared 3 feet to the north -- at the base lay wood chips, brick bits, and small organic debris, and in the portion behind the bulkhead, pine bark from the bulkhead timbers.



Source: Engineering-Science
Ford's Landing

Figure 36
East Profile Section
Trench 22 at Bulkhead Line

The area within which excavation could proceed was confined to the west by Feature 34 and to the east by a narrow corridor between Trench 22 and Trench 12G, which had Fig 36 by this time become a construction road, providing access for heavy equipment to the south end of the property . Due to the limited space, the base of the bulkhead could not be reached in this location. Depths along the surface of the top run of timbers ranged from 9 feet 2 inches (-2.15' msl) at the east wall of the trench to 9 feet (-1.98' msl), at a point 5 feet to the west, where the bulkhead ran beneath the fill under Feature 34. Though only a short portion of the feature was visible, it appeared that, in contrast to the segments seen in Trenches 12G and 23, the bulkhead had settled somewhat to the east.

Approximately 10 feet of the bulkhead was exposed west of the scow fragment, in an area in which the wharf edge appeared disturbed. The bulkhead here consisted of at least two courses of timber. The uppermost was a single log running continuously across the excavation. It measured 12 by 12 inches and was planed on three surfaces, though the log tapered slightly to the east, where the bark had not been completely removed from the southern, or exterior, face. Below lay two timbers comprising the second run, again measuring approximately 12 by 12 inches and planed on three surfaces. The timbers were joined in a butt lap, which was unpinned and without supporting tie-back braces. The joint had separated, and the two timbers were laterally displaced, extending 11 inches beyond the line of the upper timber with the maximum displacement occurring at the separated joint. All of the timbers were canted noticeably inward, at an angle of at least 20 degrees from vertical.

Portions of three back brace struts were visible within the excavation. Two were seen at a level above the uppermost surviving run of timber. As was the case with the braces seen to the east, these ties consisted of untrimmed boles, $9^1/_2$ and 11 inches in diameter, with adze-cut tenons. One tenon measured 12 inches in length and 6 inches in width with no dovetailing apparent; the second tenon had been truncated. If in place, these two tie-backs would have attached to timbers several courses higher than those remaining. Yet they appeared to lay too far back from the inner edge of the bulkhead to be in place, and so may have been attached to the next course up and settled down and back when the Corps fill was introduced over the top of the wharf. The third brace consisted of a 9-inch diameter bole with a dovetailed tenon 30 inches in length, expanding from 4 to $7^1/_2$ inches at the outer end. An iron dowel was driven through the tenon and protruded several inches above the surface

of the timber. The end of the tenon was split, suggesting a wrenching force applied from behind. The brace ran into the fill at a steep angle.

An untrimmed alignment post approximately 5 inches in diameter was situated south of the bulkhead at the displaced butt lap. It was canted severely in toward the bulkhead suggesting an even greater lateral displacement of bulkhead timbers below those currently visible.

The uppermost course of timbers lay 10 feet below grade (-2.89' msl). A slight amount of settling was observed to the west, though the upper timber was not planed absolutely flat, making measurement uncertain. Due to the unconsolidated nature of the soils in the excavation, trench walls could not be maintained well enough to allow assessment of the stratigraphic profile over the bulkhead.

Trench 14, Section D

A small section of bulkhead was located in Trench 14D, lying 218 feet south of the present center of Franklin Street. Due again to poor digging conditions -- unconsolidated deposits and nearby features which could not be disturbed -- only the uppermost remaining course of bulkhead timber was exposed. Like the section seen west of Feature 34 in Trench 22, the bulkhead appeared to have been partially dislocated. Two timbers, measuring 12 by 12 inches and planed relatively flat with an adze on all four surfaces were exposed. Originally scarfed with a half-lap joint, the logs were now separated, the upper lap (to the east) pushed upward and inward, raised approximately 18 inches and lying 7$^1/_2$ inches out of line. While the joint had been pinned with an iron dowel or drift bolt, the upper timber had pulled off the pin, leaving it projecting 7 inches above the lower lap. Debris in the form of large and small cobbles was lodged beneath the raised timber, possibly as a result of natural forces, though some of the cobbles appeared too large to have been brought in even on a storm tide.

A single tie-back was centered 3 feet 8$^1/_2$ inches from the end of the raised timber. The brace consisted of a 13-inch bole, with a tenon measuring 19 inches in length and dovetailed from 11 to a final width of 12$^1/_2$ inches, ending unevenly 6 to 8 inches beyond the

exterior edge of the bulkhead timber. The center of the tenon was pinned with an iron drift. The tenon had been cut away from the bole of the brace with an axe, with the irregular cut marks still visible. The cut end of the brace lay 14 inches to the north, presumably pulled back by the weight of the overlying fill. A small stake, $4^1/_2$ to 5 inches in diameter, was encountered near the cut end of the tie-back tenon, and appeared to have been an alignment device use during wharf construction.

A number of large posts or pilings were encountered to the south of the bulkhead, within the cove area. Planking attached to several of the pilings and crossed over the bulkhead line, presumably fastened to a piling unexcavated to the north. These materials may have represented part of a small, temporary pier or landing. Judging from the depths at which they occurred and the hardware associated with them (*e.g.* wire nails and wire rope), all appeared to have been related to later nineteenth-century use of the cove edge. Below the bases of the pilings lay the remains of an eighteenth-century bateau, Feature 35, which, based on its stratigraphic position, may have been associated with the wharf.

While the bulkhead was disturbed in this location, the timbers did lay fairly level, with no northward tilt apparent, suggesting that few courses remained below. Analytical reconstruction of the cove bottom in the eighteenth and nineteenth centuries and of the bulkhead as it would have stood in the late eighteenth century tended to confirm that few timber courses remained below the course visible in the archaeological excavation (the reconstruction appears in a later section of the report). On the visible course, the upper lap member had been pulled out of line, and the position of the back-brace suggested that heavy pressure had been exerted on the structure, enough to have pulled the pinned lap joint apart. This was the only location along the bulkhead in which a separation between lapped timbers was observed, possibly indicating that in this case the hole drilled for the drift pin was too large, producing a less sure connection. The bulkhead lay at a shallower depth in Trench 14, than in the trenches to the east, though still under 6 feet of fill, almost 4 feet of which consisted of dense Corps dredging silt, apparently enough to have wrenched the uppermost remaining timbers apart.

The area around Trench 14 appeared to have been at the shoreline of the cove prior to the turn of this century, as indicated by a humus layer at the level of the bulkhead timber. The protruding portion of the lap joint may have been propped up with cobbles for use as a

temporary mooring post at that time, though later it was covered with water and silt from the rising cove.

Nineteenth- and Early Twentieth-Century Materials

In most instances, it was difficult if not impossible to distinguish either in the field or during analysis between mid-to-late nineteenth century and turn of the twentieth century deposits at the site. Most of the deposits were mixed or related to features used almost continuously from the 1870s through the 1920s. Thus, the description of nineteenth-century deposition will be feature oriented; *i.e.*, features, such as the shipway, bulkhead and marine railway, will be described, with stratigraphy and artifactual evidence incorporated into the presentation only as pertinent. Also described will be the deposits investigated in the portion of Battery Cove which lies within the Ford's Landing property bounds and the vessels or vessel fragments encountered at the edge of the cove. Detailed analysis of the relative stratigraphic positions of the features and a consideration of the implications for the understanding of the overall development of the site will be reserved for a later evaluation section.

General Stratigraphy

As noted, few of the deposits studied in the current excavations could be recognized as related solely to nineteenth-century use of the property based on stratigraphic context or artifactual evidence alone. In comparison with the relative lack of use of the wharf in the late eighteenth and early nineteenth centuries, the property was used continuously from the mid-nineteenth century, and heavily by the end of the century. Little evidence was seen in the portions of the site investigated of sequential depositional layering. In fact, several late nineteenth-century features, Feature 1, the shipway for example, appeared to have disturbed earlier deposits. Early- to mid-twentieth-century activity also served to mix most of the later nineteenth-century deposits.

As was noted in the descriptions of the reconstructed profile transects, most of the deposits above the eighteenth-century wharf were designated Universal Stratum A during analysis, a catch-all label used to denote later fill or demolition and industrial remains which could not be differentiated as to time period. Demonstrably nineteenth-century deposits,

labeled Universal Stratum B, occurred mainly in the form of workshop debris dating to the very latest years of the nineteenth century.

Shipway

One of the major shipyard features located within the southern portion of the wharf was a shipway or building slip, a wooden ramp on which ships would have been constructed and launched. The slip, designated Feature 1, was initially identified near the western edge of the property in Section D of Trench 10 and was followed eastward in successive sections of Trench 10 and eventually in Trench 13. Except for isolated disturbances from the erection of two water towers at the west end of the lot in the early twentieth century, the slip remained apparently complete to the edge of the wharf as it existed in the late nineteenth century. In the presentation which follows, the general characteristics of the feature will be described, followed by short descriptions of the materials occurring in each trench section.

General Configuration

The shipway or building slip consisted of a series of long timbers laid parallel on 8 foot centers and oriented roughly north/south (*Plate 29*). These timbers formed the main supports for the slip, their length serving to spread the weight of the ship over a wide area. The slip was thus oriented east/west, toward the river, perpendicular to the spreaders. Each timber consisted of a single section of wood, the bole of a tall Southern Yellow Pine (*Pinus spp.*). The timbers measured roughly 40 feet in length and 12 to 15 inches in diameter, and had been milled on opposing planes, with circular saw marks clearly visible on most segments -- the remaining surfaces were unmodified and for the most part retained their platy bark.

Filling the gap between these long spreaders were three shorter planks, also of yellow pine, measuring 8 to 10 feet in length and an average 7 to 8 inches in thickness -- widths varied considerably. These intermediate planks straddled the centerline of the slip, lying on $1^1/_2$ to 2 foot centers. Temporary blocks, which would have supported the keel blocks upon which the keel was laid, were positioned over the centerline on each long and short timber, or every $1^1/_2$ to 2 feet down the length of the slip (*Plate 30*). The blocks, also of yellow pine, measured 3 to 4 feet in length, 12 to 15 feet in width and 3 to $3^1/_2$ inches in thickness.

Plate 29. (Above) Feature 1, Nineteenth-Century Shipway, Trench 10E/F

Plate 30. Shipway--Detail of Keel Blocks, Trench 10E/F

Source: Engineering-Science
Ford's Landing

Plates 29 & 30

Overall more regular in dimension than the underlying intermediate planks, the blocks were attached to the planks below with a large cut nail at either end. A wide, shallow notch had been hewn into each block, measuring approximately 18 inches in length, centered over the centerline of the slip. The notches extended the entire width of the block and ran approximately one-half inch deep, with the edges beveled. On several examples, faint trails of dull reddish brown lead paint were visible in two parallel lines approximately 6 inches either side of the centerline. A small ($^1/_8$-inch) peghole was noted at either end of the long stretchers, and may have been related to the milling process. Along with the temporary blocks, these were the only markings or attachments observed along the timbers.

The slip timbers had been placed on a thin layer of compact clay fill lying over the eighteenth-century clayey sand wharf fill, or lay directly atop the wharf fill. No pilings or other subsurface supports were observed. The portion of the slip exposed extended over a distance of 368 feet, on an average incline calculated at slightly less than 2%, with the slope increasing slightly approaching the river, and a final, more rapid drop-off at the river's edge.

Running parallel with the slip on a line approximately 35 feet to the south lay a low wooden bulkhead, Feature 23, which was apparently situated at or near the edge of the wharf in the late nineteenth century, as the general rise in sea level and increased silt build up in the cove to the south forced water higher above the margins of the deteriorated eighteenth-century wharf. The physical characteristics of Feature 23 will be presented in more detail below; the feature is mentioned here to clarify certain aspects of the building slip.

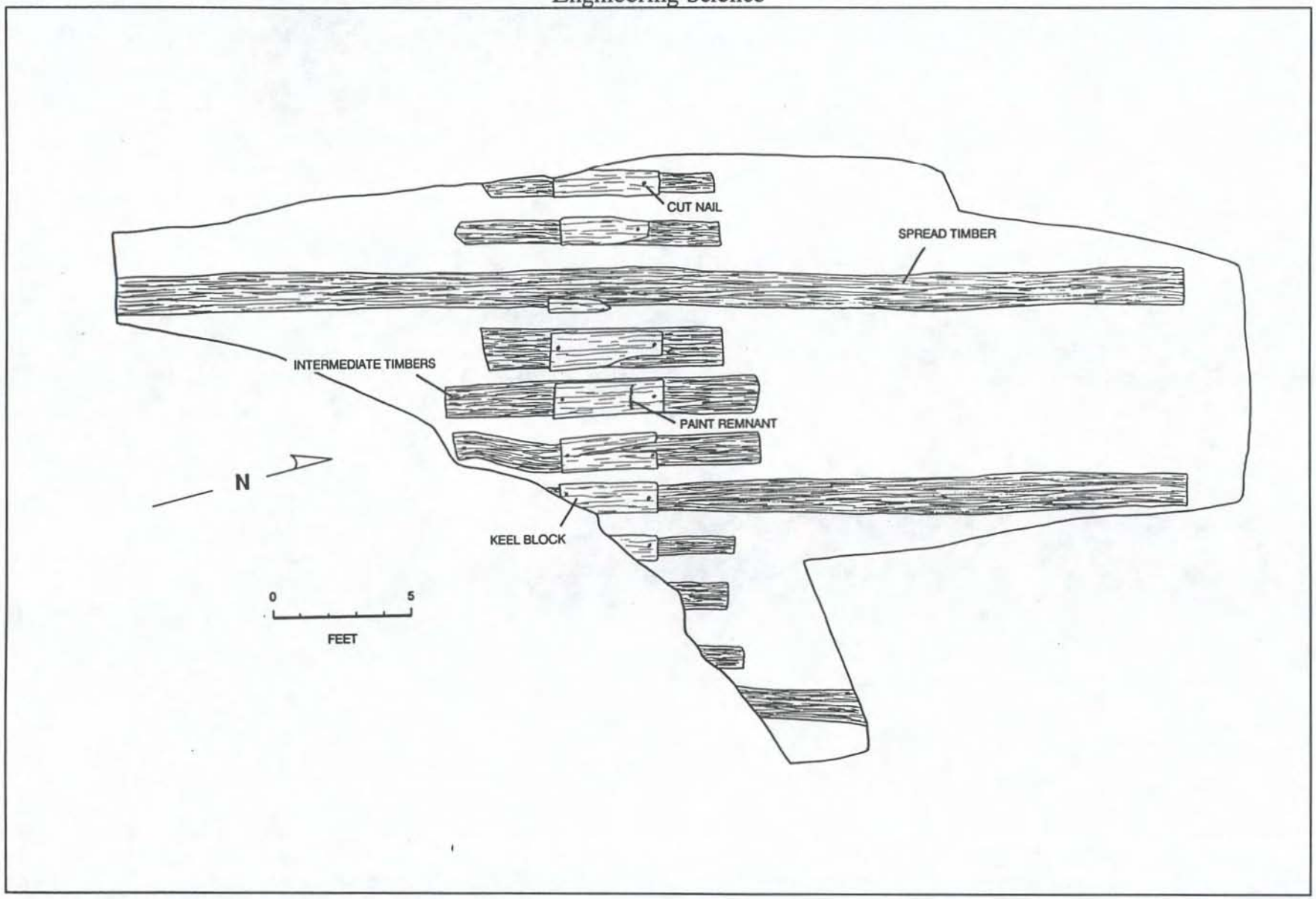
Two anomalous areas along the slip were noted. Near the east end of the feature, the shipway timbers were laid atop a portion of a barge hull, Feature 30, which was lodged beneath the nineteenth-century bulkhead. A number of the framing timbers had been cut from the barge to allow the shipway timbers to lie at their proper levels. At the east end of the slip, near the shoreline of the river, the timbers were laid over two other barge hull fragments, Features 32 and 38. In this case, the hulls appeared to have been placed below the slip intentionally, for added support.

Detailed Description

The following paragraphs will describe the shipway in more detail by excavation trench section, beginning at the west edge of the site and proceeding eastward toward the river.

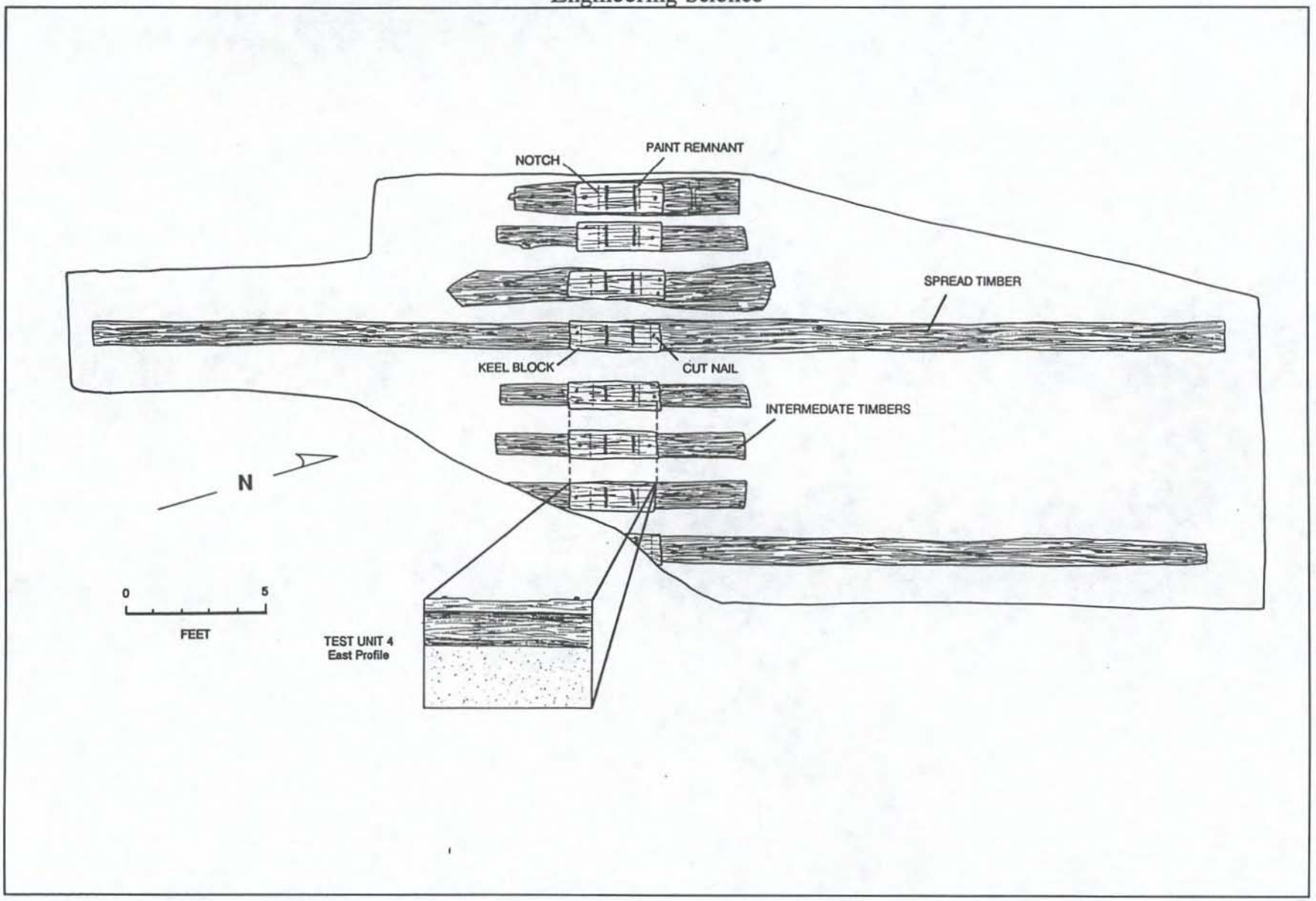
Trench 10, Section D was a Phase II excavation over Feature 1 along the west property line, later widened in Phase III to include Sections G, H and I. Two long spreaders were exposed within the trench excavation (*Figure 37*) at depths of between 4 feet and 4 feet 2 inches below present grade (+4.27 and +4.07' msl), beneath a variety of modern and late nineteenth-century fill deposits. Neither timber was completely exposed due to the presence of a modern rail spur at grade which truncated the trench to the south, cross-cutting the spreaders. Trench Section I was excavated immediately south of the spur to expose the south end of one of the timbers, which measured 40 feet 7 inches in length. The widths of the timbers ranged from $10^1/_2$ to 14 inches. The intermediate timbers were somewhat irregular in shape, varying from 7 to 12 inches in width and 8 to 11 feet in length. In several cases the temporary blocks were wider than the underlying timber to which they were attached. Perhaps due to the relatively low depths, the temporary blocks were more deteriorated in this trench section than in most sections to the east. A sump was excavated between the spreaders north of the centerline of the slip as a means of water control within the trench. Both long and short timbers were seen to lie on a 6-inch stratum of compact sandy clay fill, followed by gray to reddish brown eighteenth-century wharf fill. Excavation was halted to the west by the fenceline and bicycle path lying along the current property line, with no obvious or formal end to the feature observed.

Sections E and F of Trench 10, widened by Sections J and N, lay 20 feet to the east and contained a similar portion of the building slip (*Figure 38*). Two spreaders lay at depths of 4 feet 5 inches to 4 feet 7 inches below grade (+3.86' to +3.66' msl), covered, as in Trench 10D, by a variety of nineteenth- and twentieth-century fill layers. Only one of the timbers was completely exposed, measuring 40 feet 4 inches in length. The second lay partially beneath the standing water tower. All of the fully excavated components of the slip were centered over the keel line, and thus the length of the second spreader may be calculated from the exposed portion at 41 feet. The widths of the spreaders ranged from 11 to 15 inches. The exposed end of the second timber appeared to have been thinner than the



Source: Engineering-Science
Ford's Landing

Figure 37
Shipway
Plan View, Trench 10D



Source: Engineering-Science
Ford's Landing

Figure 38
Shipway
Plan View, Trench 10E/F

preset width of the planing saw, as the flat cut surface of the wood ended approximately 8 feet from the north end of the bole. Several of the intermediate plank timbers in this portion of the slip were irregular in shape. Most measured from 8 feet 6 to 8 feet 9 inches in length and 10 to 11 inches in width. Two irregular pieces were not planks, but rather small tree trunks which had been planed flat on two sides. One of the more regular planks exhibited cut-outs at both ends from earlier use, one end notched to a short tenon and the other with a bearing surface cut for a spindle 15 inches long and 2 inches in diameter and bracketed at either end. Lead paint was better preserved on the temporary blocks in this portion of the slip than in other locations.

A sump was excavated north of the centerline of the feature between the spread timbers. The slip timbers had been laid directly on eighteenth-century wharf fill. Several intermediate plank timbers were removed to investigate the possibility of support structures such as pilings. No underpinnings were encountered, nor were there any signs of connections on the under surfaces of the planks. The same was true for the spreaders. Due to continual water influx from surface drainage collecting in the overlying gravelly fill layers, the feature remained submerged unless the accumulated water was pumped out of the excavation. At one point the spreader which had been completely exposed floated free. The log was pushed askew from its original position and the trench pumped dry to allow the trough below to be examined. No indication of pilings or other underlying supports was observed. The timber was eventually refloated, sunk back into place and held there by several large cobbles.

As in Trench 10D, few artifacts were recovered from the deposit which would have represented ground level during the use of the slip. A 3 by 3 foot hand excavation, Test Unit 4, was placed in the area beneath one of the intermediate plank timbers. No sign of an open surface associated with the building slip was noted. The artifacts recovered from the unit -- a small amount of prehistoric lithic debris and a few fragments of non-diagnostic historic construction material -- were consistent with the types of artifactual material found in the wharf fill deposit in other areas of the site.

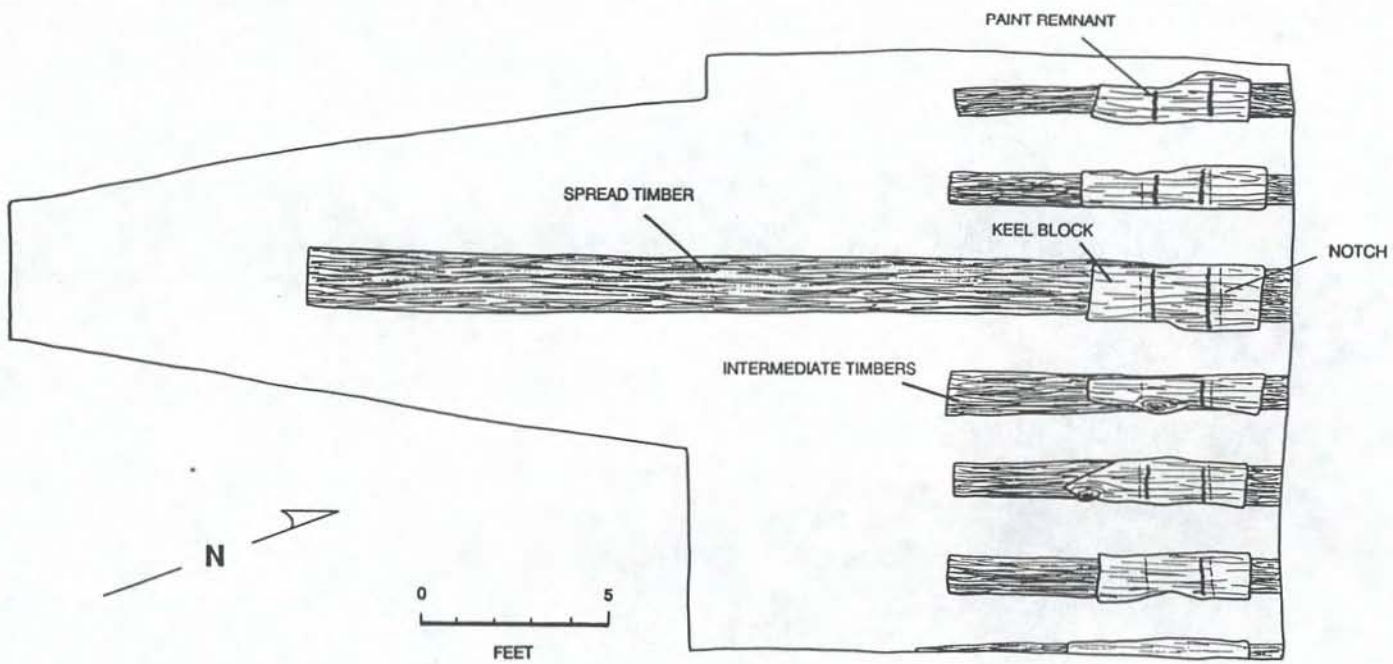
Sections J and K of Trench 10 were small excavations within which slip timbers were present, but had been truncated by a concrete junction box housing waterlines from the standing tower to the south and the concrete spread footing of the earlier tower foundation to

the northeast. Section J was excavated at the northeast corner of 10E, while Section K lay an additional 10 feet to the east. The slip measured 5 feet 1 inch below grade (+3.19' msl) in Section K. Elevations were not taken in Section J due to the amount of utility disturbance.

Ten feet east of Section K, in Section L of Trench 10, the slip timbers were also truncated by the base of the earlier tower to the north of the excavation. Intermediate planks measured from 7 to 14 inches in width in this location, and several exhibited irregular shapes and overlapping temporary blocks. All had small stakes at the south end (the north ends could not be exposed beneath the concrete water tower ledge). The stakes were too light to have been structural in nature, measuring 1 inch in thickness and 3 to 6 inches in width, and thus were assumed to have been used as alignment markers. The slip materials lay at depths of between 5 feet 1 inch and 5 feet 2 inches below grade (+3.01' to +2.95' msl), resting on wharf fill. Overlying deposits consisted mainly of fill related to the construction of the water towers.

Section M of Trench 10 was excavated 25 feet east of Section L, in an area just west of the Quonset huts. One spread timber was exposed within this excavation from the centerline of the ways to the south end of the spreader (*Figure 39*) -- the length of the timber was calculated at 34 feet 9 inches; the width measured a consistent 15 inches. The timber lay 5 feet 6 inches below grade (+2.20' msl) under a complex assortment of nineteenth- and twentieth-century fills, mostly consisting of coal, ash or woody debris. The intermediate planks were more uniform in this location than in the excavations to the west, measuring an average 9 feet in length and 8 to 10 inches in width. In contrast, the temporary blocks were more irregular in shape, some with knots remaining in one or more places. Lead paint was visible on several blocks, though not all were notched. A number of small stakes were scattered around the area: 1- by 3-inch and 1- by 5-inch stakes at the ends of some of the intermediate planks; two irregular stakes between planks; and a 1- by 5-inch piece along the east edge of the spreader near the south end.

The shipway was exposed in four sections of Trench 13. In Section K, immediately east of the Quonset huts, portions of two spreaders were exposed. The area in which the trench was excavated was confined on three sides by concrete slabs at grade, and thus little of the slip was exposed. The spreaders were seen north of the centerline of the slip, at depths of 6 feet 9 inches (+0.68' msl). None of the intermediate planks was exposed.



Source: Engineering-Science
Ford's Landing

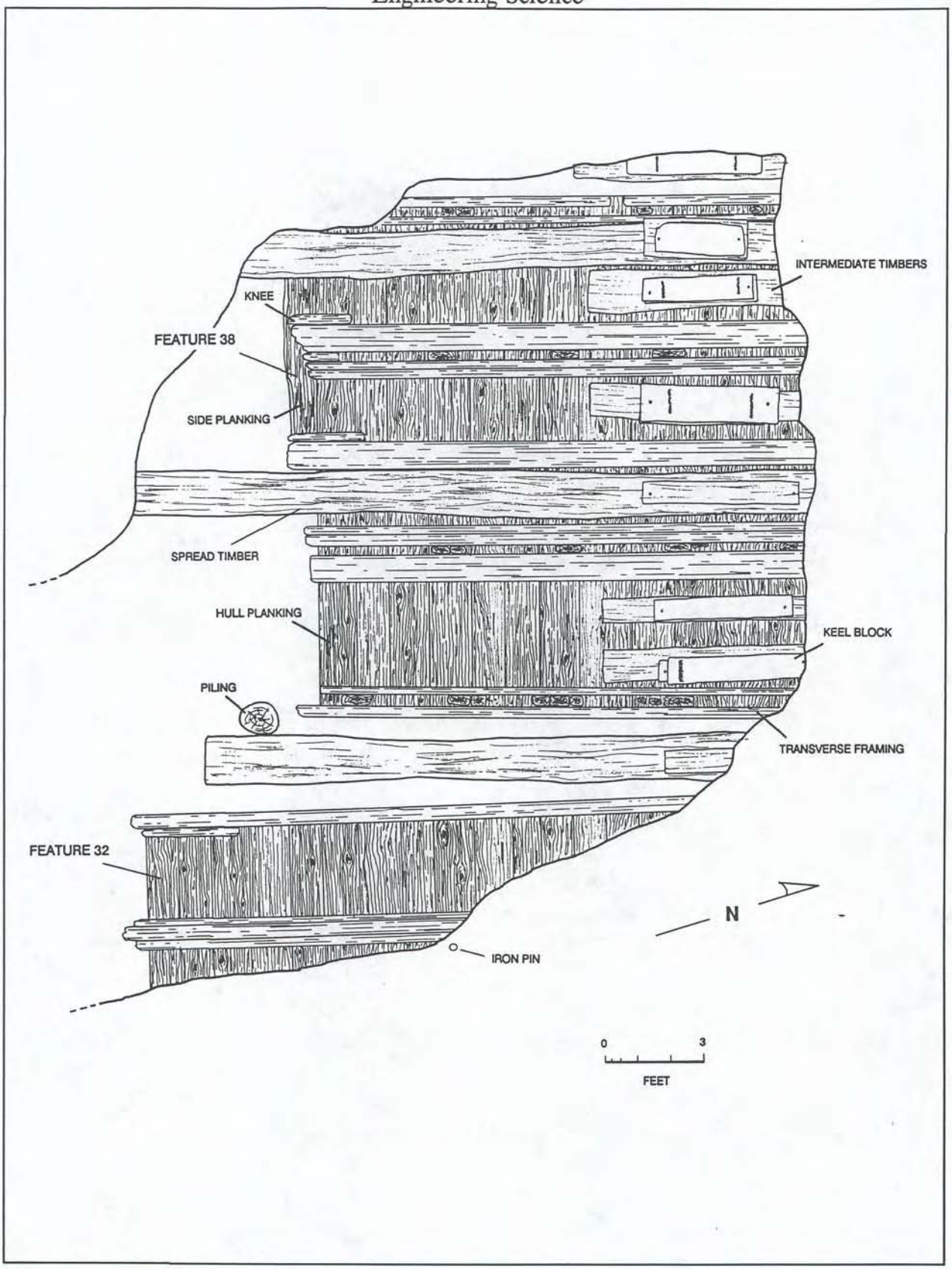
Figure 39
Shipway
Plan View, Trench 10M

Immediately to the southeast, in Section L of Trench 13, the timbers lay atop Feature 30, the barge hull mentioned earlier. Portions of two spreaders and three intermediate planks were exposed as far as the centerline of the slip at a depth of approximately 7 feet 1 inch below grade (-0.45' msl). The overlying fill consisted of several layers of modern debris -- sand, gravel and rubble -- 2 feet of Corps dredging spoil along with a thin layer of coal and sand, followed by sandy silt accumulated at the bottom of the cove in the early twentieth century. The spreaders measured from 14 to as much as 17 inches in width, and the segment exposed for the greatest length (33 feet, of which 13 feet was incompletely excavated) exhibited a marked bowing. The intermediate planks were irregular in size and placement. They ranged from 7 to 18 inches in width and 8 to 9 feet in length. The temporary blocks were also somewhat irregular and poorly preserved. The framing of the barge hull had been cut out -- axed rather than sawn -- to accommodate the shipway materials, which were oriented at a slight angle to the vessel. In several cases, the fit was snug, while in others large gaps were apparent, with the angles at which the frames were cut occasionally opposite to the direction of the slip timber, as at the south end of the exposed spreader. One of the intermediate plank timbers was unevenly spaced. It appeared, then, that the hull had been prepared before the timbers were laid on it, and that the angles at which the slip crossed the vessel may have been misjudged somewhat. A modern disturbance was seen in a 6-inch bore hole through the edge of the slip spreader and the barge hull, a remnant of geotechnical drilling during a 1987 survey.

Approximately 50 feet east of Section L, the southern ends of two spreaders were exposed in Section G of Trench 13, which was originally excavated to examine a portion of the back-bracing of the nineteenth-century bulkhead, Feature 23. The materials lay between 7 feet 7 inches and eight feet 3 inches below grade (-0.50' and -0.98' msl), beneath 2 feet of modern fill, as much as 6 feet of Corps spoil and 1 foot of mixed nineteenth-century fill and sandy cove bottom accumulation from the turn of the century. The timbers were exposed for a length of approximately 12 feet from their south ends and, like the others excavated, were sawn flat on opposite sides to create an upper and lower surface, with bark left on the rounded sides of the bole. The widths of the timbers ranged from 15 to 17 inches. Due to surface obstructions south of the concrete blockhouse structure, excavation within the trench section was not continued sufficiently to the north to expose the intermediate plank timbers.

The final segment of the slip occurred in Section J of Trench 13, which lay as close as 55 feet to the modern high tide line. In this portion of the slip, the timbers were also laid on barge hulls, Features 32 and 38, though rather than as an expedient measure, as in Section L, the hulls had been intentionally positioned below the slip (*Figure 40*). The depth at which the feature lay was considerably below that of previously excavated portions, 9 feet 1 inch (-1.59' msl) at the west end of the trench, and 10 feet 6 inches (-3.01' msl) 18 feet to the east, at the east end of the excavation. The overlying strata included early twentieth-century cove bottom sand and silt directly over the slip, Corps fill material, and a variety of twentieth=century gravel and rubble deposits. The trench excavation exposed the slip from approximately 3 feet north of the centerline to as much as 18 feet south of the line (*Plate 31*). Within that area, only one stretcher, the easternmost, was exposed to one end. Assuming that it was centered, the timber measured 31 feet 9 inches in total length. The portion exposed was sinuous in outline, and varied in width from 12 to 16 inches along its length. The remaining spreaders were incompletely exposed, measuring at least 28 and 36 feet in length, with widths ranging from 18½ to 23 inches. Only 2 intermediate timbers lay between each spreader, as opposed to the three seen elsewhere along the slip. The remaining spaces were taken up by the framing of the barge hulls. Temporary blocks were placed on each spreader and intermediate plank, but rather than consisting of a single plank of wood, they were often composed of two or more thin, laminated planks. Both the intermediate planks and temporary blocks were irregular in shape and size. As would be expected, the thickness of both elements was fairly regular, the planks averaging 6 inches and the temporary blocks 4½ to 5 inches (the latter in total, if layered). Three of the eight temporary blocks exhibited the wide, shallow notches seen in the slip to the west, and one bore faint traces of red lead paint.

Portions of the slip rested on the disconnected, flat-bottomed hull sections of two barges, Features 32 and 38. More detailed descriptions of the barge hulls are included in the later section dealing with the vessels documented at the site. For the moment, the following general characteristics are provided to supplement the description of the building slip. The western hull, Feature 38, appeared to be a portion of a rectangular, flat-bottomed deck scow or barge, oriented east/west, in Plate 31 line with the slip, judging from the hull planking and framing. Assuming that the hull was centered beneath the slip, the width of the hull section was calculated between 23 feet 5 inches and 24 feet, the discrepancy appearing because one of the shipway plank timbers was centered approximately 6 inches north of the



Source: Engineering-Science
Ford's Landing

Figure 40
Shipway
Plan View, Trench 13J

Plate 31. Shipway Laid on Barge Hull (Feature 38), Trench 13H

remaining two making it difficult to determine which represented the actual centerline of the slip. Along the line of the slip, the hull measured 15 feet 10 inches in length, divided into 3 bays which varied from 4 feet 6 inches to 5 feet in width. The framing was relatively complex, with thin double frames running the length of the hull and several sets of uprights attached to them. A second set of frames, these considerably larger, measuring 9 by 9 inches, had been added to each bay in an apparent refurbishing project. A large amount of coal was observed lodged within the narrow spaces between frames, suggesting that the vessel had served as a collier during one of its last runs.

Feature 32 also appeared to have been oriented east/west, in line with the slip, with single timbered and laminated frames. A slight upturn or sheer in the hull planks at the south end of the hull suggested that end represented the initial rise of the partially curved stern or bow of the vessel. Again assuming that the fragment was centered beneath the slip, the width of the hull section was calculated to be at least 36 feet 6 inches. A single bay, 4 feet in length, was exposed along with a portion of a second to the east.

Within the hull sections, the slip timbers were supported by 4 to 5 inches of silty clay, raising the temporary blocks 1 to 5 inches above the hull framing. Two elements of the slip did not lie on either hull: the easternmost of the three spreaders exposed lay in the 14- to 16-inch gap between Feature 32 and 38, and an intermediate plank timber lay west of Feature 38, partially exposed in the west wall of the archaeological trench. A 12-inch diameter piling was located at the southeast corner of Feature 38, near the end of the last, or easternmost, spreader. The top of the piling presently lay almost 7 inches below the level of the spreader, but its original vertical extent was uncertain due to the degree of deterioration evidenced. A large iron pin, $1^1/_2$ inches in diameter, had been driven into the fill east of Feature 32, possibly as a stabilization measure. The extent of the shipway to the east, toward the river, was not determined, due to logistical problems associated with deep excavation near the modern shoreline and due the unconsolidated nature of the trench walls in this portion of the site.

Nineteenth-Century Bulkhead

Associated with the nineteenth-century shipyard features was a low bulkhead, designated Feature 23, constructed of smaller timbers than had been used in Feature 33, the

wharf bulkhead. Feature 23 was apparently used to retain the upper remnants of wharf fill and later nineteenth-century fill at the edge of Feature 1, the building slip. As will be seen, establishing the contemporaneity of Features 1 and 23 was somewhat difficult, but while there was little direct evidence to support a contention that the bulkhead was constructed specifically for the building slip, circumstantial evidence appeared to point to a functional association between the two features.

The bulkhead was examined in several locations along a length of approximately 203 feet, beginning with the westernmost portion excavated, Trench 12F (14 feet), and continuing east in Trench 13 Sections E, F and G (95 feet) and Section J (21 feet). Neither end of the feature was encountered in the excavations.

General Configuration

In these excavations, the bulkhead was found to consist of from 2 to as many as 5 courses of selected Southern Yellow Pine (*Pinus spp.*) timbers, straight boles of relatively consistent diameter -- ranging from 8 to 10 inches (*Plate 32; Figure 41*). Each bole had been sawn flat on two opposing sides to provide for stability and close fit, producing a timber 6 to 8 inches in thickness. One timber was somewhat smaller than average, and a $1^1/_2$- to 2-inch-thick plank served as a spacer between it and the lower course. In Trench 13F, the bulkhead stood a total of 3 feet 11 inches in height near the west end of the trench, where most of 5 courses remained intact, and 1 foot 11 inches near the east end of the excavation where only 3 courses remained. Only two courses remained in Trench 12F, totaling 1 foot 7 inches. In Trench 13J, the bulkhead totaled up to 4 feet 3 inches, though in this area the normal pattern of long round timbers was interrupted by repair work, as will be described below.

The length of the complete timbers was comparatively standard, measuring approximately 21 feet, with a range of 20 feet to 21 feet 4 inches. While there was evidence of bark remaining on several of the lowest timbers, bark had been removed from most of the boles. Except for one extreme case discussed below, there were no signs of damage from vessels brushing against the bulkhead line. Small, 1- by 2-inch to 1- by 4-inch, alignment stakes were located along the exterior edge of the bulkhead, but no evidence was recorded of fender pilings or other buffers. This portion of the cove was probably not navigable by the

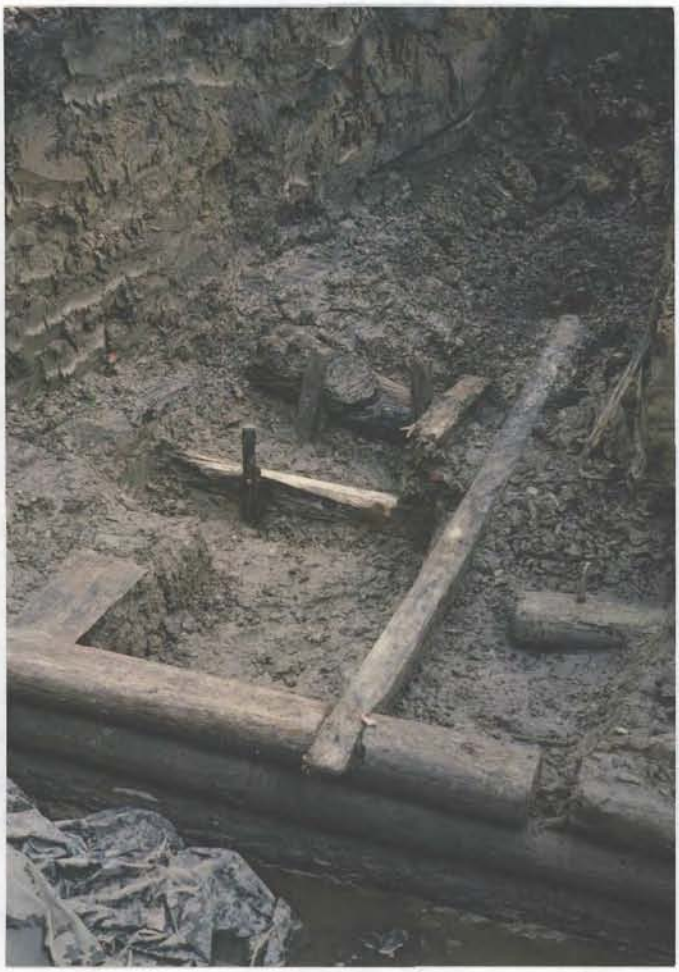
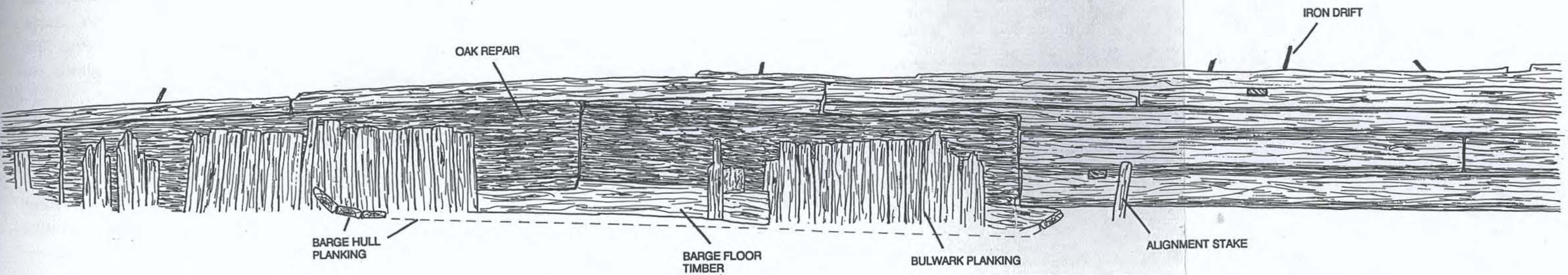


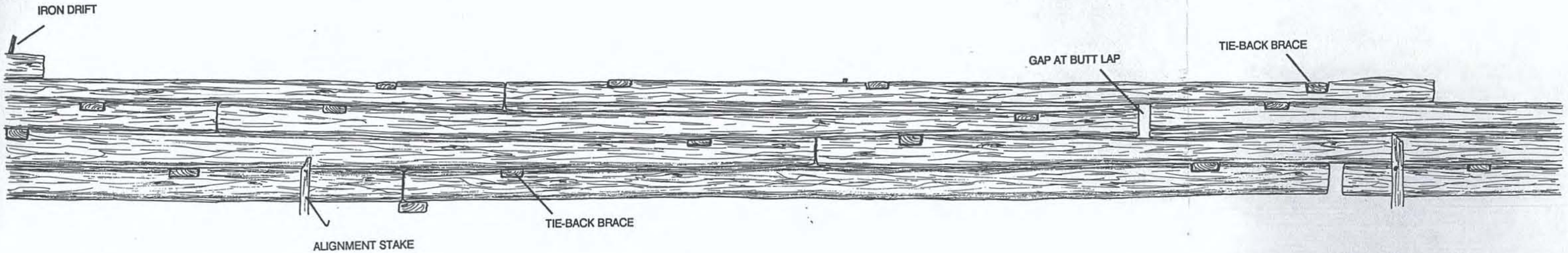
Plate 32. (Above) Feature 23--Nineteenth-Century Bulkhead, Trench 13F

Plate 33. Detail of Tie-Back Braces, Trench 13G

Source: Engineering-Science
Ford's Landing

Plates 32 & 33





Source: Engineering-Science

Figure 41. Feature 23: Nineteenth Century Bulkhead

late nineteenth century, and thus vessels would not have ventured along the south side of the wharf. Yet, except for the uppermost, or fifth, timber course remaining in the west end of 13F, there was little evidence of rotting associated with drying, suggesting that the bulkhead was, for the most part, submerged.

The timbers of the bulkhead were primarily butted together, end to end. Several of the butt joints had separated by from 3 to as much as 5 1/2 inches, suggesting that a degree of settling had occurred, though of a different sort from that seen associated with the original bulkhead, Feature 33. Feature 23 had been Fig 41 constructed on a gradual but marked slope downward to the east, roughly equivalent to that of the shipway, and it appeared that several of the timbers had migrated downslope somewhat.

Round iron dowels or drift pins were observed in the top remaining timber courses, the fourth and fifth from the base, in the west portion of Trench 13F. The dowels, or drifts, ranged from 3/4 to 1 inch in diameter. Several of the pins extended 5 to 8 inches above the top remaining course of the bulkhead -- though bent at odd angles, some almost perpendicular -- implying at least one additional run of timbers. To the east, where only the lower 3 timber runs remained, no dowels were observed, suggesting that only the uppermost courses of the feature were thus secured.

Bracing

Further stabilization was accomplished with back braces (*Plate 33*). Similar to the tie-back system in Feature 33, the braces consisted of an assortment of different size lumber and beams -- spliced two-by-fours; wide, saw-cut planks (some with circular saw marks visible); small tree boles; and even a puncheon-like first trimming plank from a sawmill, with one side sawed and the other round and still retaining most of its bark. Many of the pieces appeared to have been reused. One example in Section J exhibited seven 1 1/4-inch-diameter holes drilled in line at one end and five 1-inch holes at the other. The braces ranged in length from 7 to 15 feet and were tenoned at one end to fit into mortises cut into the top surfaces of the bulkhead timbers. The tenons were straight, as opposed to dovetailed as was seen on the eighteenth-century bulkhead, and ranged in width from 5 to 8 inches and in thickness from 1 1/2 to 2 inches. The braces were set 1 1/2 to 2 1/2 feet inward from the end

of each timber to stabilize the butt joint. Only two exceptions to this general pattern were seen: one timber in the second run from the bottom exhibited only a single brace; and a third brace had been added near the center of one timber on the fourth course. In all but one case, the tenons exposed along the top courses of the bulkhead were secured with two large nails, set either in line or staggered -- one tenon did not appear to have been nailed, whether by design or oversight was unclear (possibly the latter, since as was noted, no dovetailing was in evidence to provide purchase on the bulkhead timber). The end of a single, wider tenon was seen at the base of the bulkhead near a butt joint. There was no mortise associated with the tenon, and its function was not determined.

As with the earlier bulkhead, the braces of Feature 23 were not horizontal, but had been angled downward into the wharf fill at slopes ranging from 5% to over 23% -- there was no sign of settling or warping from the pressure of the overlying fill. The ends of the ties were attached to either posts or small piers driven into the fill, or to deadmen. A least one of the missing bulkhead timbers, with a 3/4-inch dowel still attached, lay in the fill behind the bulkhead.

Repairs or Unusual Segments

Two anomalous areas were recorded along the length of the bulkhead. At the west end of Trench 13F, the long timbers of the feature were interrupted by a patchwork of large oak blocks and shorter, squared timbers or beams, representing repairs to the original bulkhead (*Plate 34*). Two large, rectangular blocks of White Oak (*Quercus spp.*) formed the bulk of the patch. The blocks measured 11 feet 6 inches and 5 feet in length, respectively, stood approximately 1 foot 9 inches in height and varied in width from 13 to 26 inches. One of the original bulkhead timbers extended from the east was tied to the blocks with a long half-lap splice. Several thinner, square beams lay over the blocks, secured to them by iron dowels and large spikes. The beams were further stabilized with back braces 8 to 9 feet in length attached to stakes or deadmen in the fill to the north. A portion of the area had been covered with a protecting bulwark of 1- by 5-inch planks set vertically to an average height of 21 inches along the south or cove face of the bulkhead.

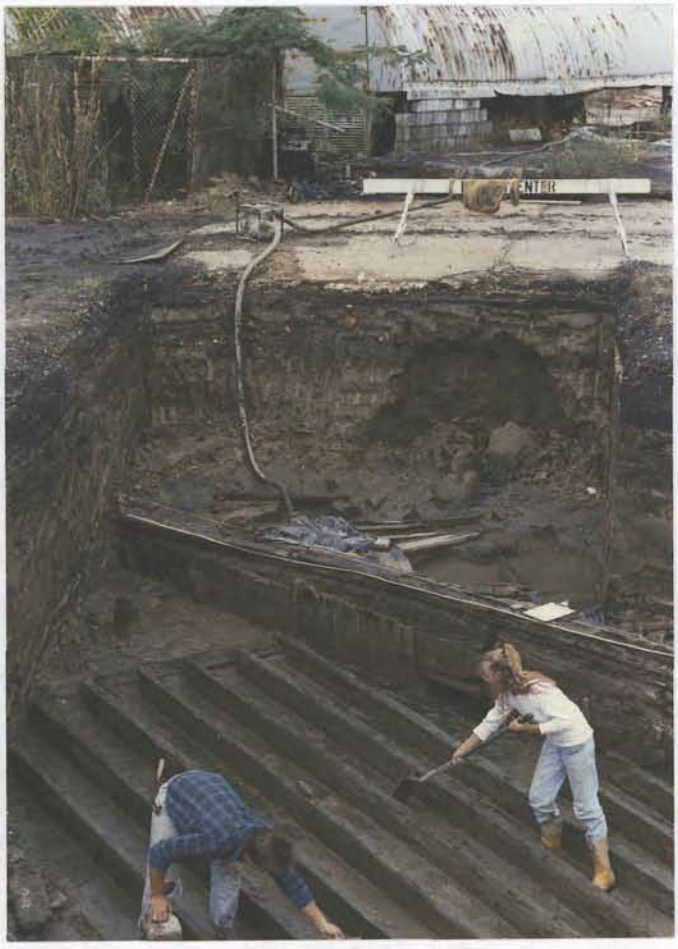


Plate 34. (Above) Detail of Bulkhead Repair, Trench 13F

Plate 35. Nineteenth-Century Bulkhead Repair Over Barge Hull (Feature 30), Trench 13F

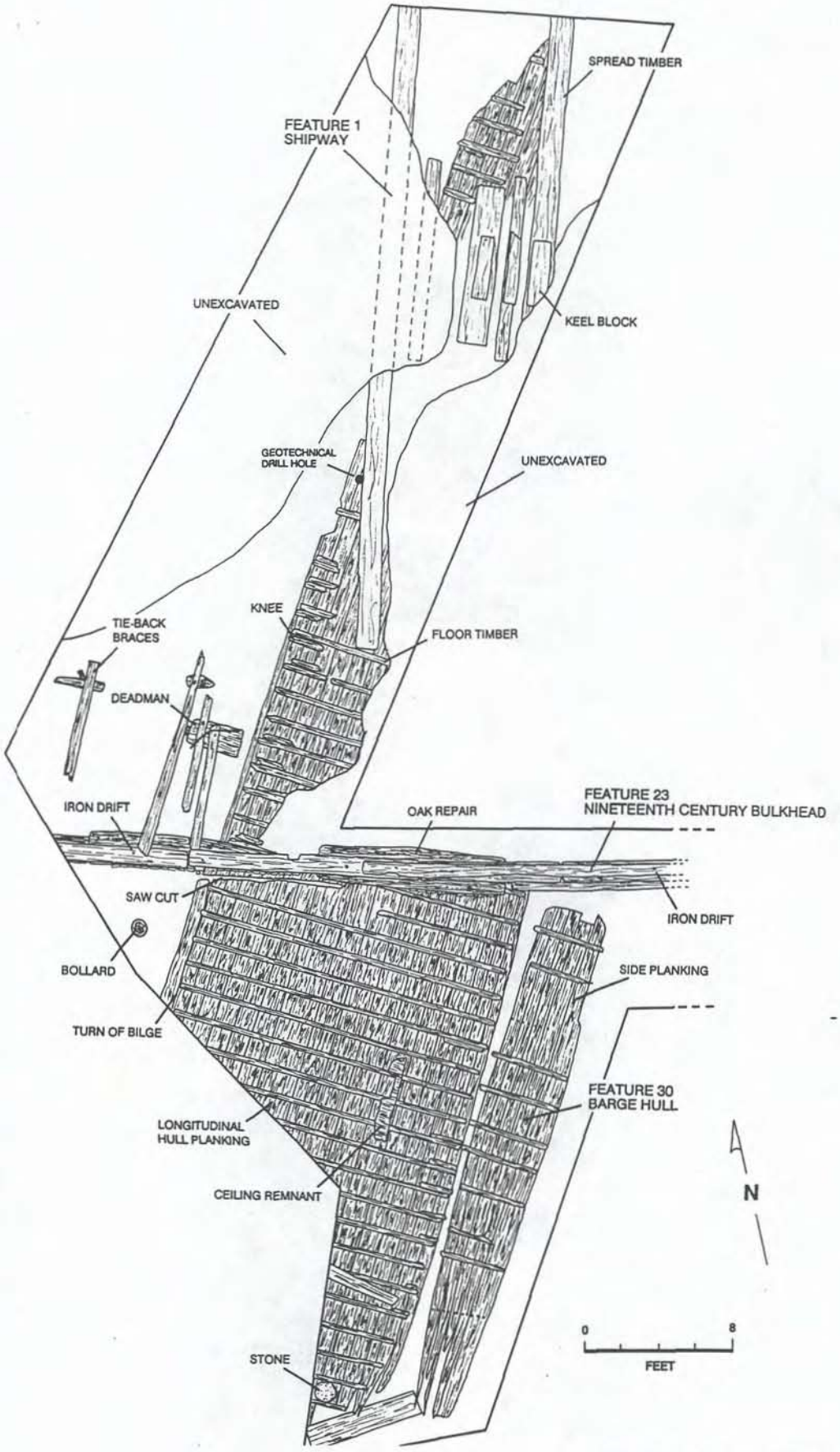
Source: Engineering-Science
Ford's Landing

Plates 34 & 35

Below the patched area and stretching to the south, into the cove, and north, beyond the bulkhead, lay Feature 30, the wide, flat base of a barge hull (*Plate 35; Figure 42*). Feature 30 will be described in detail later, with the rest of the vessels documented at the site. At present it is noted that the hull was oriented almost perpendicularly to the bulkhead, *i.e.*, the bulkhead lay almost directly athwartships, with the large oak blocks resting across several of the 3- by 8-inch framing timbers. The beam of the vessel was approximately 16 feet, with the sides rising in a gradual curve -- only 6 to 9 inches of the first side planks remained intact.

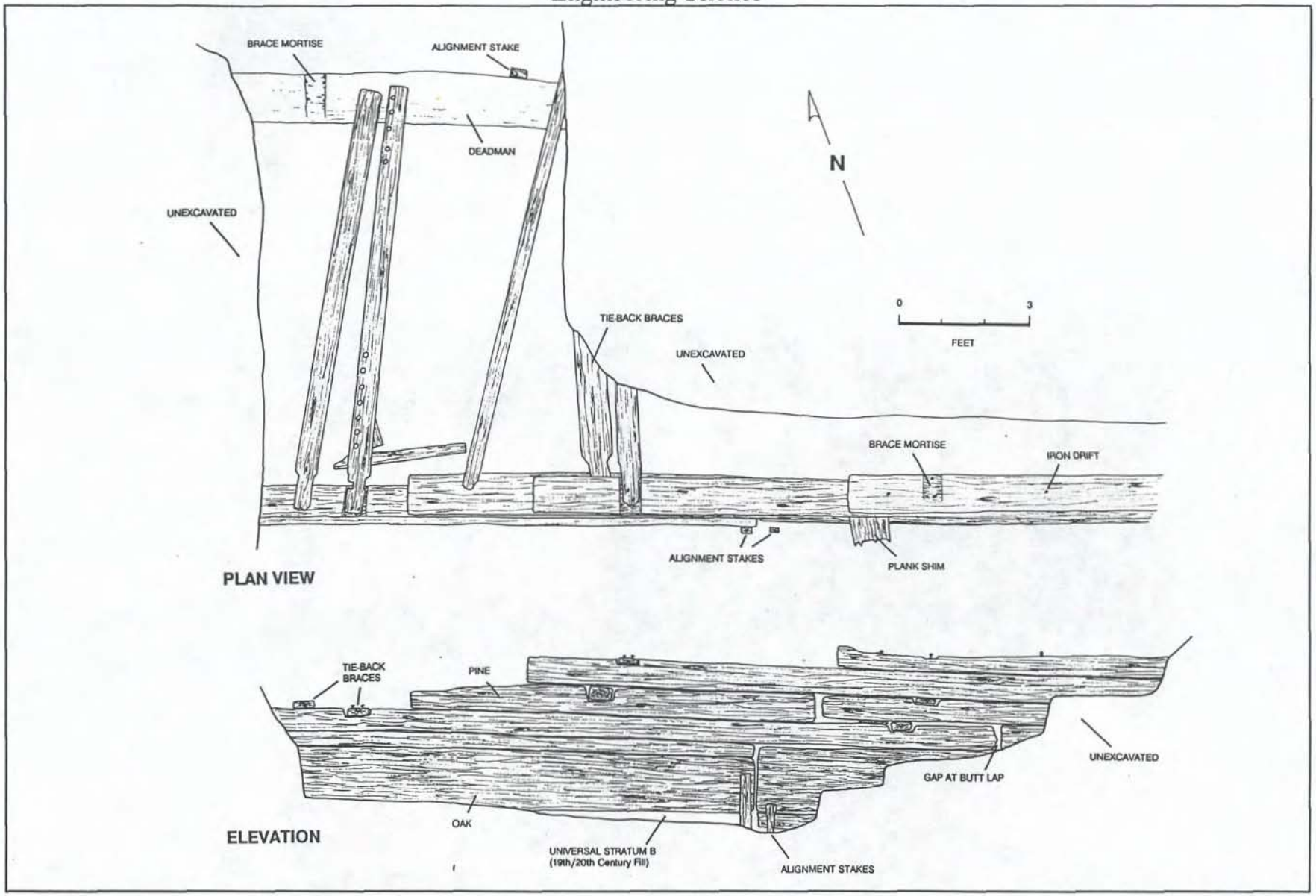
The hull appeared to have been partially cut, as evidenced by a $1^1/_2$- to $2^1/_2$-inch kerf extending 7 feet 6 inches from the west edge of the vessel, seemingly in an attempt at removing the hull prior to repairing the bulkhead. The effort was abandoned and the bulkhead laid atop the hull floors. It was not possible to directly date either the hull, the irregular, refurbished portion of the bulkhead, or the rest of the revetment, and thus it is only possible to infer the sequence of events responsible for the present state of the bulkhead. The bulkhead appeared to have been damaged in a heavy flood or storm. This section of the line was undercut and eventually washed out. The derelict hull rode in on the flood and became lodged in the gap in the bulkhead along Fig 42 with a large amount of sand and other debris. A vain attempt was made to remove the hull, and eventually the bulkhead was repaired with material at hand, the original timbers spliced onto the irregular wood used to fill in the breech.

A second anomalous section was observed at the east end of the bulkhead, in Trench 13J (*Figure 43*). The same long, round timbers seen throughout much of the length of the feature in 13F were used along the upper courses in this section, but the base of the revetment consisted again of large blocks of oak. The blocks were incompletely exposed in the archaeological excavation, but were of similar dimensions as those recorded in the repair at the west end of 13F. Both blocks had been shimmed with 4-inch-thick beams. There was no evidence from the view of the south elevation of the bulkhead of tie-backs or other stabilization procedures connected with these large bulkhead elements. Above the blocks lay at least 4 courses of the same uniform, rounded timbers seen in Trench 13F, similar in shape and dimension but for one section which measured only 9 feet 3 inches in length. Chinking was needed in one portion near the east end of the excavation where the timber in the third run from the top was thinner than average ($6^1/_2$ as opposed to 8 inches). A 1- by 4-inch plank



Source: Engineering-Science

Figure 42. Bulkhead Repair:
Feature 23/30, Plan View



Source: Engineering-Science
Ford's Landing

Figure 43
Feature 23:
Southern End, Trench 13J

had been inserted below one end of the timber oriented almost perpendicularly to the line of the bulkhead, and had been left extending 4 to 5 inches to the south, into the cove, implying that this portion of the bulkhead was well below the waterline and that there was no need for concern with a smooth face to the revetment. The upper portion of the bulkhead displayed back braces similar to those observed along the line to the west. Two mortises along the uppermost remaining courses, one with a rotted brace tenon, the other with no tenon remaining, were more deeply cut along the north edge of the bulkhead timber than the edge facing south, indicating well sloped tie-back braces.

Stratigraphy

The deposits within which the bulkhead was contained can be summarized as Corps dredging spoil over the feature, followed by late nineteenth-century cove bottom deposition south of the bulkhead, and nineteenth-century fill to the north. Below these nineteenth-century deposits lay eighteenth-century wharf fill and eventually the natural base of the cove.

More specifically, ground surface lay at +7.13' msl at the west end of the excavated portion of Feature 23 (Trench 12F), and rose slightly to +7.29' near the middle of Trench 13F before beginning a slow drop-off toward the Potomac, reaching +6.68'msl at the east end of Trench 13J. Modern gravel and rubble fill, in places well mixed with coal, extended from approximately 20 inches at the west end of 13F to a maximum thickness of 3 feet 4 inches in 13J, as the underlying deposits fell more rapidly toward the river. Below lay a thick deposit of dredging spoil, the material pumped into the cove by the Corps of Engineers in 1911. The fine sand and silt layer ranged in thickness from 4 feet to almost 8 feet, as measured south of the bulkhead.

The surface of the fill was relatively level, while the base reflected the eastward slope of the cove in the early twentieth century.

North of the bulkhead, the base of the Corps fill deposit was either level with the remaining bulkhead course or extended somewhat below the uppermost remaining run of timber:

Trench & Section	Level of Bulkhead	Base of Corps Fill	Difference in Elevation
13E	+1.27' msl	+1.27'msl	0.00'
12F	+1.63' msl	+1.13'msl	0.50'
13G	+1.15'msl	-0.25'msl	1.40'
13J(west end)	-0.34'msl	-1.30' msl	0.96'

Table 4. Base of Corps Fill Relative to Nineteenth-Century Bulkhead

Below these levels lay late nineteenth-century fill, areas in which the early wharf fill had been disturbed during construction of the later bulkhead. No obvious ground surface had been detected in association with the shipyard features nor was any observed behind the bulkhead. Nor were artifact assemblages from the various proveniences informative. For example, from the general excavation of Section E of Trench 13, north of the bulkhead, only two fragments of ceramic were recovered from the mixed fill deposit, labeled trench Stratum E. Both were refined earthenwares, but both were badly burned and thus could not be confidently typed. The eighteenth-century fill directly below (trench Stratum F) contained similar fragments of burned earthenware along with fragments of creamware and pearlware and a prehistoric artifact -- a fragment of heated rock. In controlled excavations in Unit 3, adjacent to the north elevation of the bulkhead at the intersection of Sections G and F of Trench 13, the mixed fill layer, Stratum A, identified as a light grayish brown sand and gravel mixed with lighter, yellowish brown silt and sand, contained hand wrought and cut nails, a fragment of window glass, wine bottle glass, creamware and pearlware sherds, 2 fragments of gray salt glazed stoneware, oyster shell and 3 prehistoric lithic artifacts (1 quartz and 2 quartzite flakes). While no artifacts were recovered from the lower strata, which represented early wharf fill, recorded as brown to reddish yellow clayey sand, the deposit was not deeply sampled. Although small, the artifact sample from Unit 3 does not differ markedly from the general run of artifacts observed in the eighteenth-century wharf fill, suggesting that the stratum identified near the bulkhead as nineteenth-century fill was in fact only slightly disturbed eighteenth-century fill, churned up during the installation of the bulkhead and bracing system, but otherwise not significantly altered. The deposits were not sampled in sufficient detail in other locations to provide additional artifactual data. Nevertheless, soil texture and color, along with general context indicated that the break between the nineteenth-century disturbance and the undisturbed eighteenth-century wharf fill

lay on a slope similar to that of the bulkhead: -0.03' msl in 13E; -1.00' msl in 13I; -2.40' msl in Unit 3; -2.10' msl at the east end of 13F. The transition was not identified in 12F, the westernmost portion of the feature exposed, but can be extrapolated at approximately +0.30' msl. At the opposite end of the bulkhead line, at the east end of Trench 13J, the deposits were not examined behind the bulkhead due to logistical factors including the depth below grade and water control problems, and due to the fact that the area lay well beyond the eastern edge of the wharf.

South of the bulkhead, the Corps fill material extended approximately 1 foot below the top remaining bulkhead timbers, where the silts had been pumped in over the existing cove bottom deposit. The cove bottom consisted of a gray, occasionally coarse grained sand, with silt and gravels intermixed, and containing a relatively large amount of artifactual material, mainly in the form of small bits of nineteenth-century ceramic and glass along with wood and metal objects discarded or lost over the bulkhead or washed in on tidal currents. A large mooring pile lay on its side within the cove bottom sands parallel with the bulkhead. The piling measured 19 feet in length, 15 inches in diameter at one end and $9^1/_2$ inches at the other. The wider end appeared to have been saw-cut, and a $3^1/_2$-inch iron ring attached with a heavy staple 15 inches from the end. There was no indication, in the form of splitting or crushing at the top end, for example, that the piling had been driven into the river bottom.

The cove bottom deposit measured 9 to 21 inches in depth, the deeper portions possibly representing areas eroded by tidal eddies and eventually filled in with silt and sand in later flood. The soils over which the cove bottom had collected consisted of eighteenth-century wharf fill, identified as such by their texture and color, the latter grading from gray to reddish yellow in relation to the depth of organic leaching from the cove deposits above. As noted in the earlier, detailed description of the wharf fill, the base of the deposit was not observed in all locations, but was extrapolated from levels recorded in the several excavations in which the transition to intact, pre-wharf cove deposition was identified -- the elevation averaged between -2.50 and -3.50' msl (*e.g.* -2.82' msl in 13F).

Marine Railway

Archival records indicate that marine railway activity in the south central portion of the wharf began in the last quarter of the nineteenth century. At least one earlier ship repair

slip had operated farther north on the property as early as the mid-nineteenth century. Any extant remains of that feature lay beneath the Ford Plant structure and was thus inaccessible for current investigation. Remains of the later and larger marine railway were encountered in Sections A, B and C of Trench 12 and in Section B of Trench 13.

Trench 12 -- Engine Room

Machinery foundations associated with the engine room of the railway and the foundations for the iron rails or track of the ways were uncovered in Section B of Trench 12. The remains of related structures were encountered to the north, in Section A, and to the south, in Section C of the trench. All of the features lay within 1 to 2 feet of modern grade, covered by mixed fill, a concrete slab and a thin surface layer of asphalt.

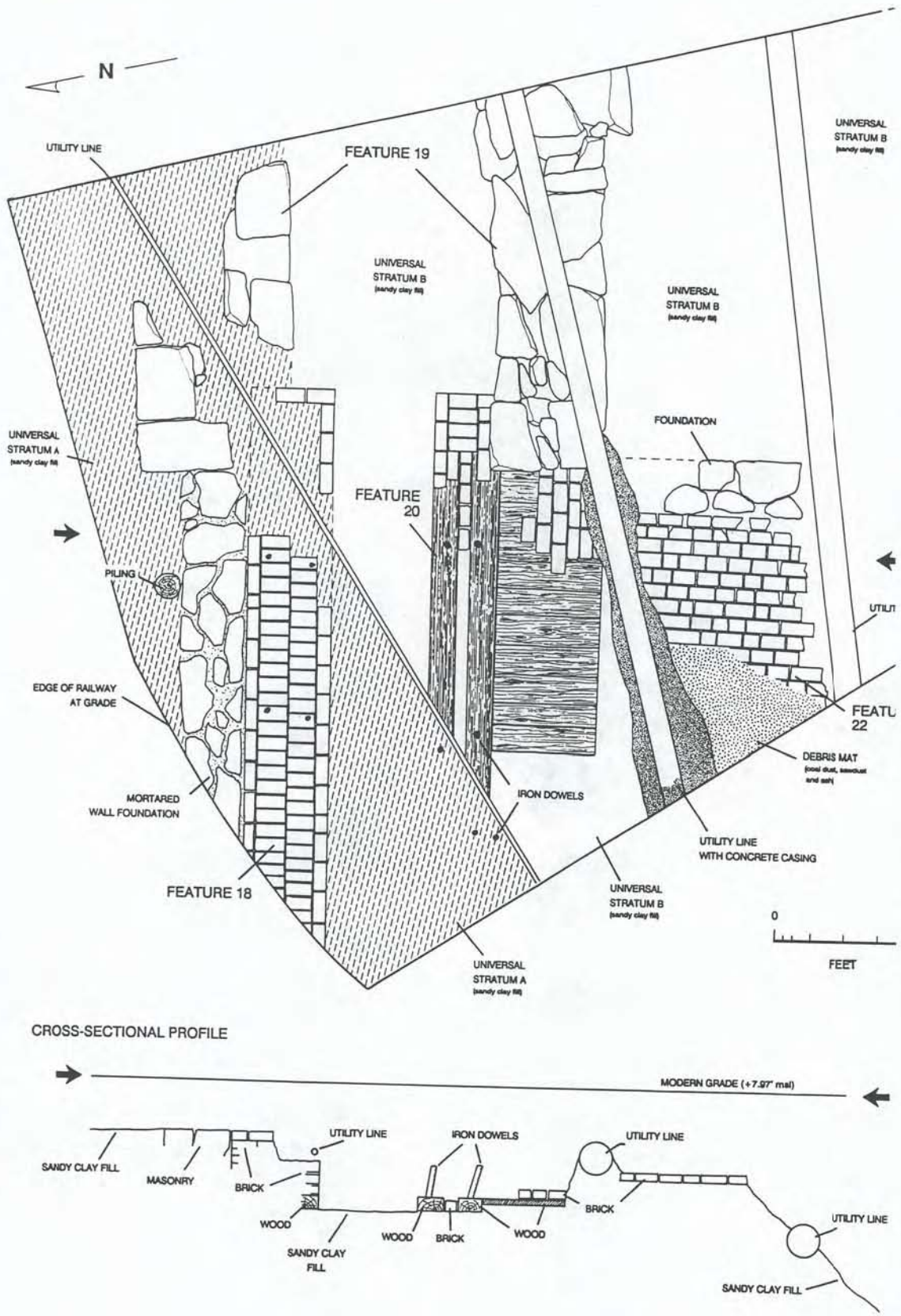
The central portion of the marine railway, referred to variously on insurance maps as the Engine Head House, Capstan and Engine Room, or Capstan Room, was located in Section B of the trench, and consisted of the brick and wood base or mounting of the engine which ran the capstan, the large, vertical winch used to haul vessels up the rails and out of the water (*Plate 36; Figure 44*). The features exposed in the archaeological trench, Features 18 and 20, consisted of two brick walls or elongated piers straddling the centerline of the railway, lying as little as 18 inches below present grade (+6.60' msl). The brickwork rested on pairs of $4^1/_2$- by $8^1/_2$-inch timbers which acted as mats or floating footers. The beams were laid parallel, along the line of the way, with a $6^1/_2$-inch gap between each pair, which had been filled with brick rubble and packed clay. The walls themselves were constructed of orange brick bonded with friable sand and lime mortar. The brick was standard size, averaging $2^1/_4$ by 4 by $8^1/_4$ inches, though many were irregular and there was evidence of reuse, mainly in the form of numerous brickbats. The north pier measured 26 to 27 inches in width, with 7 to 10 vertical courses of brick surviving to a maximum height of 25 inches. The east end of the wall was partially disturbed by a $1^1/_2$-inch utility line within a 1-foot 6-inch to 2-foot trench cutting diagonally through several of the uppermost remaining courses. In the south pier, little brick remained beyond the extreme east end of the feature. At the east end of both piers the wood footer ended, the final two feet being replaced by a course of brick headers.

Plate 36. (Above) Feature 18, Marine Railway Engine Room Foundations, Trench 12B
(Feature 19, track bed foundation in foreground)

Plate 37. Feature 19, Marine Railway Track Bed Foundation Trench 13B

Source: Engineering-Science
Ford's Landing

Plates 36 & 37



Source: Engineering-Science

Figure 44. Marine Railway Engine Room: Trench 12B, Plan View

Five pairs of iron dowels, which appeared to have served as anchoring for the machinery above, extended vertically through the brick and wood of the piers. Although none was removed from the feature, all were loose and could be easily turned in place, and thus it was assumed that they were either clinched or secured with wide washers on the underside of the wood. Two pairs of dowels were recorded along the north wall and Three along the south, suggesting that there were originally at least six sets of rods anchoring the machinery.

Beyond the north pier lay a fieldstone and mortar wall footing and, in Section A of the trench, the interior of a workshop containing machinery foundations and a portion of a deteriorated coal bin, Features 16, 17 and 21, described separately below. Beyond the south pier, a series of planks had been laid perpendicular to the wall. The planks measured 30 inches in length, were 2 inches thick and ranged from 8 to 10 inches in width. The wood lay on clay fill (Universal Stratum B), and apparently served as a spread foundation for overlying brickwork, only a portion of which remained at the east end of the feature. The brick had been irregularly laid in common bond, and may have served as a floor surface, although part of a second vertical course was noted in one section, suggesting instead a rather massive wall. Fig 44 Further to the south lay another stone and mortar wall footing and a brick floor, designated Feature 22. The area separating the engine room and Feature 22 had been disturbed by a 9-inch utility line, encased in a sand and lime tempered concrete and lying within a 2 foot wide trench running nearly parallel with the wall of the workshop, displacing evidence of the north wall of the shop and the abutment with the engine room wall.

To the east of the engine room, toward the river, lay two parallel, clay bonded fieldstone alignments which served as foundations for the rails of the ways. Both alignments averaged 30 inches in width, and were inset approximately 20 inches from the interior edge of the brick engine foundations, producing a space between the track beds which averaged 5 feet 9 inches. The centerline of the ways measured 64 feet south of the Ford Plant building. The stones used in the foundation generally consisted of schist, and were large, measuring 2 feet or more at widest and up to 8 inches in thickness. Vertically the stone was rough coursed, with two to three courses remaining. At its base, the masonry lay on a fairly compact sandy clay fill (Universal Stratum B). The alignments were exposed for a length of approximately 14 feet, at which point they disappeared into the east wall of the archaeological trench.

The marine railway features lay beneath 8 inches of concrete, a thin bed of gravelly sand and an additional 6 to 12 inches of mixed sandy clay and gravel fill. A thin layer of dark sand, loam, coal and cinder lay in some areas, particularly between the machinery foundations and over the southern pier. This deposit was deeper between the stone foundations of the railway track, extending to almost 3 feet, and contained late nineteenth and early twentieth-century artifacts including cut and wire nails, window glass, bits of rubber and paper, early twentieth-century bottle glass, small amounts of gray salt glazed stoneware and whiteware, 2 small buckle fragments, two scissors fragments, a tapered wooden insulator peg, and a large, cast-iron, chain hawser guide related to the operation of the railway. This deposit and the various brick, stone and wood portions of the marine railway features lay atop nineteenth-century fill, a coal stained gray sandy clay assigned by context to Universal Stratum B. The deposit was not fully excavated, so as to avoid disturbance to the surrounding features. Relevant elevations within Section B of the trench are summarized in *Table 5*.

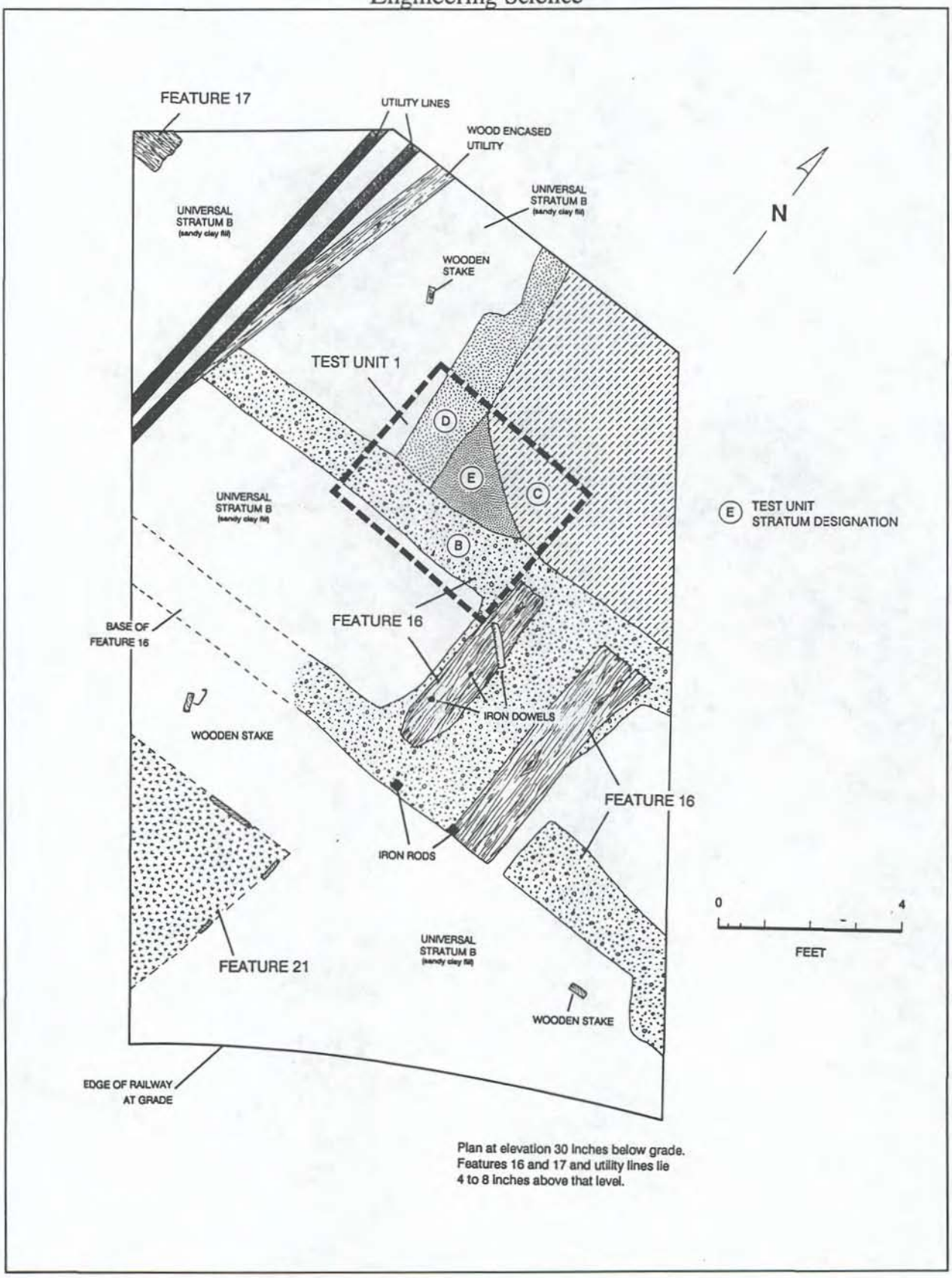
Trench 12 -- Adjacent Structures

To the north of the engine room, in Section A of Trench 12, lay the remains of a workshop area which at various times was associated with the operation of the railway. The stone and mortar wall footing or foundation seen in Section B was apparently related to the engine room and not the workshop to the north -- study of insurance maps from the late nineteenth and early twentieth centuries suggested that the workshop did not abut directly against the engine room, but was separated from it by a gap of 4 to 5 feet. The workshop was demolished sometime between 1907 and 1912, and any foundation which may have survived was eventually disturbed by a mid-twentieth-century rail spur bending through the site from the south from Union Street to parallel the south edge of the Ford Plant building. All of the features in Section A were covered by layers of mixed fill (Universal Stratum A) and modern surfacing -- a concrete slab poured on a gravel bed and later covered with asphalt. Modern railroad tracks cross-cut the area, lying as little as 2 inches below grade, dividing Sections A and B of the trench.

-- surface to west of trench	+7.97' msl
-- modern tracks 2" below grade (directly under modern asphalt surface)	+7.78'msl
-- highest remaining point on brick/north wall	+6.60' msl
-- wood footer/south wall	+4.77' msl
-- base of stone track beds as measured at Feature 18	
north =	+4.42' msl
south =	+4.25' msl

Table 5. Summary of Elevations: Trench 12 Section B

No actual floor surface remained in the workshop area, though the bases of several features were observed in the underlying fill (*Figure 45*). Feature 16 consisted of two parallel stacks of short timbers. The timbers were in a poor state of preservation, with dimensions, as measured on the most complete specimen, estimated at 10 by 10 by 48 inches. The wood was stacked on $^{3}/_{4}$-inch iron dowels, though the dowels remained only on the west stack. One of the pins, bent horizontal during demolition, extended 16 inches above the uppermost timber, implying at least one more course on the stack. The stacks lay an average 1 foot 4 inches apart, beginning at a depth 11 inches below grade (+7.06' msl) and extending at the deepest point observed to $38^{1}/_{2}$ inches (+4.77' msl). Shallow linear trenches measuring 13 to $13^{1}/_{2}$ inches in width led from each corner of the timbers on an approximate east/west line. A 3 by 3 foot hand excavation, Test Unit 1, was placed over the trenches west of the timber stacks for closer investigation. The trenches consisted of roughly square bottomed cuts, extending $4^{1}/_{2}$ to 5 inches into the underlying fill and running in parallel lines which extended beyond both the east and west walls of the archaeological excavation. The cuts and the space between the timbers of Feature 16 contained an oily, black sandy loam full of coal and small gravels, sawdust and wood chips, concentrations of corroded ferrous metal, a few cut nails and a fragment of gray salt glazed stoneware. A similar cut intersected the east/west lines from the north, producing a right angled corner, with the area to the northeast covered with a thin, deteriorated sand and mortar surface. This deposit contained cut nails, window glass, mold blown bottle glass, and one fragment each of whiteware and Rockingham/Bennington. Several $^{3}/_{4}$- by 2-inch stakes were scattered around the area, though in no readily apparent pattern. Three utility lines lay near the northwest corner of the trench excavation, between 1 foot 9 inches and 2 feet 3 inches below grade: a 2-inch metal



Source: Engineering-Science
Ford's Landing

Figure 45
Workshop Remains
Trench 12A, Plan View

line encased in wood (total diameter 6 inches); and two 3-inch metal lines within overlapping trenches varying in total width from 14 to 23 inches.

Feature 17 consisted of a large timber, 12 to 13 inches in diameter west of the utility line disturbances and extending into the west wall of the trench at a depth of 24 inches. Further examination, after the feature number had been assigned, indicated that the timber probably derived from Feature 16 and had been displaced during demolition of the overlying structure.

Feature 21 was a rectilinear patch of coal stained fill which was partially exposed in the west wall of the trench excavation, beginning at a level 14 inches below grade. The two sides of the feature exposed in the trench met at an angle of 70 degrees, with the arms of the angles running for a length of 3 feet 6 inches and 4 feet 6 inches before passing into the wall of the excavation. Scraps of deteriorated wood planking were noted at the edges of the stain, suggesting that the feature was originally a wood-lined storage box, possibly a coal bin, with one side collapsed by the pressure of the surrounding fill.

The area south of the engine room features in Trench 12 was designated Section C. A 9-inch utility line and associated trench disturbance, which extended from 18 inches to approximately 3 feet below grade, formed the division. Near the west margin of the archaeological trench excavation lay a brick floor, designated Feature 22. The floor was situated 27 inches below grade (+5.67' msl), in a location shown on insurance maps as containing a structure housing boilers and a saw room. The brick was common orange brick, stained black from overlying coal dust. It was dry laid in an irregular variation of common bond. The frequent use of bats in the flooring indicated that the brick was reused. On the surface of the floor was a layer of coal dust, sawdust, ash and wood chips, apparently debris collected on the floor of the structure over time, which had formed a tough, cohesive mat up to 2 inches thick. East of the brickwork lay a wall footing or foundation comprising the east wall of the structure. The wall was constructed of fieldstone and sandy mortar. A great deal of disturbance was noted in the area, and no evidence of a builder's trench could be discerned. The area between Feature 22 and the engine room to the north was disturbed by the 9-inch utility line described above, lying in a trench measuring from 2 feet 6 inches to 3 feet 6 inches in width. To the south was a second 9-inch line, parallel with the first, though lying well below the level of the floor, 45 inches below grade (+4.22' msl). Six feet further

to the south lay a 17-inch line, parallel with the others at a depth of approximately 8 feet. In combination, these utilities had effectively destroyed most of the remaining evidence of the structure represented by Feature 22.

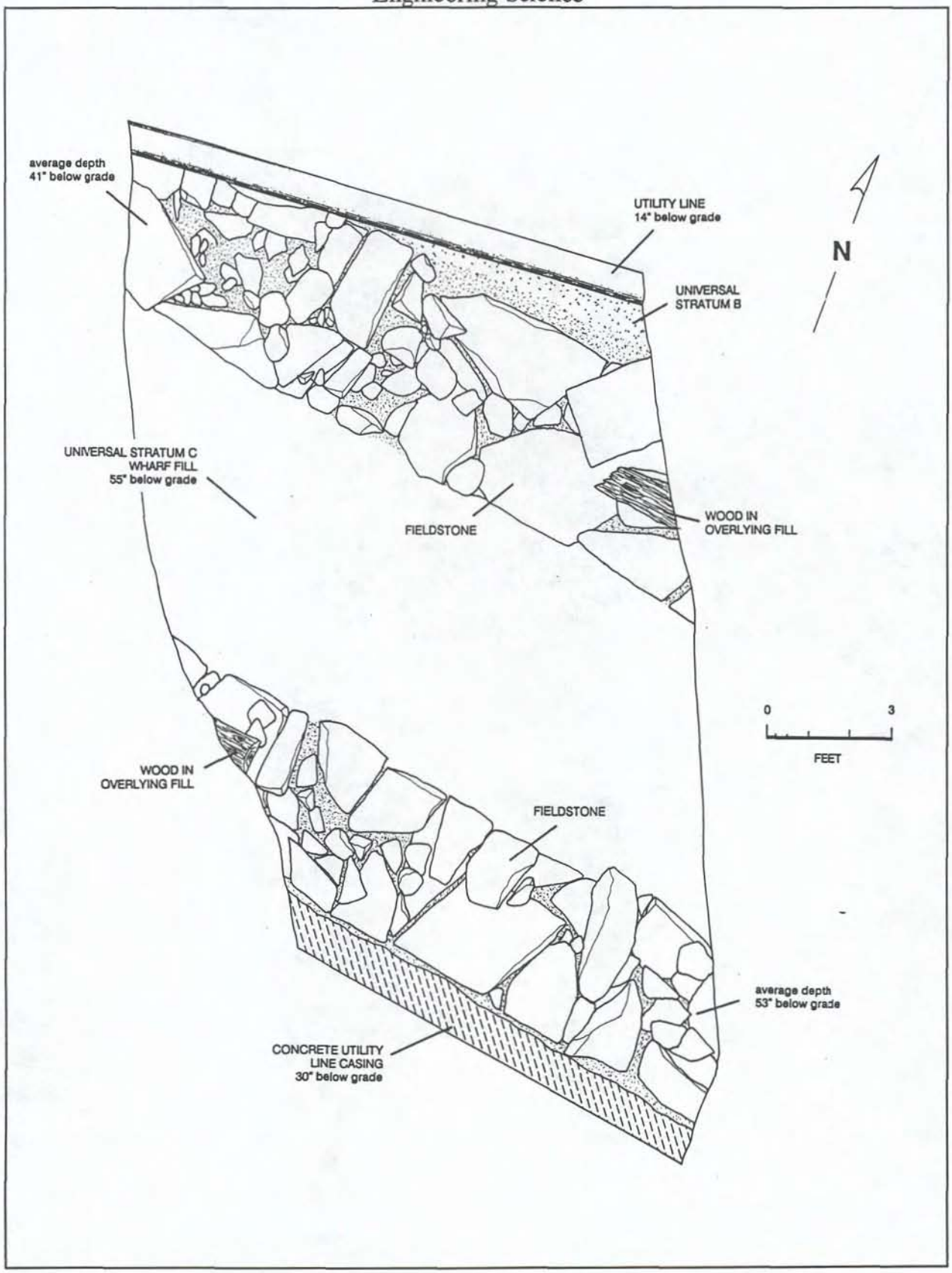
Relevant elevations within Sections A and C are recapped below:

-- Feature 16 (machinery foundation)		
	highest point	+7.06' msl
	lowest point	+4.77' msl
-- top of Feature 21 (coal bin)		+6.81' msl
-- Feature 22 (brick floor)		+5.67' msl
-- utility lines:	Section A	+6.27'msl
	Section B/C	+6.45' msl
	Section C	+4.22' msl & -0.03' msl
-- transition from nineteenth-century industrial fill to eighteenth-century wharf fill		+2.97' msl

Table 6. Summary of Elevations: Trench 12 Sections A & C

Trench 13 -- Track Bed. Remains of the track bed of the marine railway and features possibly associated with the operation of the ways were located in three sections of Trench 13: Section B contained portions of Feature 19, the masonry track bed for the iron rails; Section C contained Feature 28, a wooden gutter running parallel with the rail line in Section B; and Section A contained Feature 20, the wooden floor of a workshop or storage facility. As in Trench 12, the features lay beneath asphalt, concrete and modern fill, though they were generally found at greater depths relative to modern grade, in several instances lying below deposits of late nineteenth and early twentieth-century domestic and industrial debris.

Feature 19, the rail bed masonry (*Plate 37; Figure 46*), lay in Section B of the trench, with the centerline of the ways approximately 65 feet 6 inches from the south edge of the Ford Plant building. The stonework beds were not proportionate in width: the north bed measured 4 feet 3 inches to 4 feet 6 inches, while the south measured 3 feet 9 inches to 4 feet 2 inches, in both cases wider than near the engine room, in Trench 12. The gap between the beds averaged 6 feet 3 inches, also somewhat wider than in Trench 12. The masonry was roughly coursed, with the highest remaining stones lying along the north bed at a depth of 3



Source: Engineering-Science
Ford's Landing

Figure 46
Marine Railway Trackbed
Trench 13B, Plan View

feet 2 inches below grade -- the north foundation was in general higher than the south, lying between 3 feet 5 inches and 4 feet 1 inch below grade as opposed to 4 feet to 4 feet 5 inches to the south. Both alignments appeared to slope somewhat to the south, following the prevailing slope of the immediately overlying fill, suggesting the possibility of settling -- precise measurement was not attempted due to the rough coursing of the stonework. As in Trench 12, most of the stones were schist, and many were large, measuring up to 4 feet in maximum horizontal dimension and 8 to 9 inches in thickness. Several sections of the foundation were filled in with cobbles and large gravels. Three main vertical courses remained throughout the length of the excavation, measuring 14 to 20 inches in total thickness. The stone was bonded with sandy clay soil and lay on the same sandy fill as in Trench 12, though portions of the north bed lay on a 2-inch layer of coarse sand and gravel mixed with coal.

Overlying deposits consisted of 8 inches of asphalt, concrete and a bed of sandy gravel measuring up to 6 inches thick, this followed by 2 to 3 feet of mixed fill (Universal Stratum A). Within the fill were a number of large schist flagstones, remnants of the track bed, a twisted segment of iron rail and two wooden rail ties. Each tie measured approximately 8 feet 6 inches in length (the ends being somewhat deteriorated) and 8 to 9 inches in diameter. Standard rail plates, each secured by three rail spikes, were centered 23 inches from each end, producing a track spacing of 4 feet 9 inches. Also recovered from the fill were two cast-iron wheels, one a large, heavy hawser guide similar to that found between the rail beds in Trench 12B, and the second, a smaller, follower wheel. A variety of nails and spikes were also contained within the fill. Below this mixed fill lay $4^1/_2$ to 9 inches of dark loam and sand mixed with woody fibers and sawdust, and containing early twentieth-century beverage container glass, fragments of milk glass, whiteware and porcelain, and an oyster shell. The deposit corresponded with nineteenth-century workshop debris, identified in Section C of the trench, which had been spread over the area, probably in the late 1920s during a demolition phase.

Deep excavation was carried out between the alignments within a wet, gray sandy silt deposit, with brown to orange sandy mottling. The deposit was identified as eighteenth-century wharf fill, Universal Stratum C. In contrast to the stonework in Trench 12, the masonry in Trench 13 held a large amount of ground water which constantly flooded the excavation between the alignments. This, added to the already saturated condition of the fill,

threatened to undermine the track beds, and thus excavation was stopped at 9 feet, still within the eighteenth-century fill deposit. Investigation of the exterior edges of the feature was limited by the presence of several modern utility lines: an 8-inch metal line in a 1-foot 6-inch trench at the north edge of the feature, lying 14 to 16 inches below grade; a 5 inch terra cotta line in a 2-foot-wide trench 30 inches below grade, lying 1 foot south of and roughly paralleling the 8-inch line; and a line of undetermined diameter encased in concrete measuring 12 by 21 inches and lying 30 inches below grade at the south edge of the feature. Relevant elevations in Section C are summarized as follows:

-- surface elevation +7.88' msl
-- highest remaining point of Feature 19
north alignment +4.81' msl (measured at west trench wall)
south alignment +3.90' msl (measured 2 1/2 feet from west trench wall)
-- base of Feature 19
north +2.53' msl (measured at east trench wall)
south +2.00' msl (measured at east trench wall)
-- utility lines
north +6.68' msl & +5.38' msl
south +5.38' msl
-- eighteenth-century wharf fill +1.63' msl

Table 7. Summary of Elevations: Trench 13 Sections C

Trench 13 -- Gutter. In Section C of Trench 13, a wide, flat wooden gutter was encountered lying 44 to 45 inches below grade (+4.11' msl, approximately the level of the remaining courses of the railway foundation). The feature extended from the west wall of the trench for a distance of approximately 8 feet, at which point it was truncated by a disturbance of unknown date. The gutter roughly paralleled Feature 19, lying just over 6 feet 6 inches to the north of the edge of the railway foundation.

A long plank, measuring 14 inches in width and 1 inch in thickness, formed the base of the gutter. Laths measuring 1 1/2 inches by 3 inches lay along the edges of the plank, to form the sides of a shallow trough. Originally the feature had been covered by thin planks, 2 to 4 1/2 inches in width and 1/4 inch thick, laid across the side laths. Several planks remained complete at the west end of the excavation, though they had collapsed under the weight of the

overlying fill -- others were seen as fragments. No fasteners were observed along the length of the gutter, suggesting that the feature was either unfinished or, as is more likely the case, was designed only for temporary use, possibly with a thin layer of dirt used to secure the covering planks. Little evidence of a slope adequate for proper drainage was noted, probably as a consequence of settling due to the weight of later fill above compressing the looser fill on which the feature lay. A shallow builder's trench was located along either edge of the feature, varying in width from $1^{3}/_{4}$ to $4^{1}/_{2}$ inches. The trench contained a slightly darker brown sandy clay than the surrounding brown and orange fill matrix, within which a cut nail (copper) and a single fragment of ironstone were recovered. Due to the presence of utility lines framing the archaeological trench near present grade making lateral expansion of the excavation impractical, the gutter was removed to allow deep testing of the underlying fill to determine the depth and composition of the eighteenth-century deposits in this portion of the site. On removal, the bottom plank of the trough was seen to rest directly on light brown clayey sand identified as wharf fill.

The deposits which overlay the gutter consisted of the same modern asphalt, concrete and gravel surfacing material seen across most of the central wharf area, followed by mixed nineteenth and twentieth-century fill and a fairly distinct deposit of dark, coal rich sandy loam, labeled trench Stratum C. In addition to coal, the deposit contained a large amount of woody debris, laths (some with white paint still adhering), iron stove parts, sheet metal with wire nails attached in places, heavier metal plating used for machinery shrouding, wire and cut nails, various other ferrous metal hardware, such as nuts, washers, springs, strapping and a cutlery knife blade, early twentieth-century bottle glass, a portion of a glass beer mug, a fragment of lamp chimney glass, bird bone and oyster shell. The deposit appeared as a relatively thin layer across the entire trench, but formed a pocket or pit extending 5 feet from the west wall of the trench excavation, and measuring as much as 14 inches in depth. Below Stratum C lay another mixed gravelly clay fill deposit containing more early twentieth-century container glass fragments, and finally, a black, sandy loam deposit, trench Stratum E, which extended to the level of Feature 28 and the eighteenth-century wharf fill. Stratum E contained a large amount of coal and woody debris along with more iron plating, fragments of wine bottle glass, mold blown bottle glass, small amounts of whiteware and ironstone and a gray salt glazed stoneware jug handle, a leather shoe sole and clam and oyster shell.

Trench 13 -- Workshop or Storeroom Floor

Section D of Trench 13 lay northwest of Section C, separated from it by a 2-inch utility line lying 2 feet 6 inches below grade in a gravel filled trench. Approximately 3 feet 6 inches below grade across the entire area exposed in Section D lay Feature 29, a deteriorated wooden floor. The floor was composed of planks, 9 to 14 inches in width and running approximately north/south. Two planks in the east portion of the excavation were raised above the level of the others as if to form sills, though they lay too far apart for a single sill and too close together to form a pair. A single cross-member was observed, lying above all but one of the other planks. Nails secured most of the planks, suggesting the possibility that joists lay below as a foundation. Most of the wood in the western half of the excavation was too poorly preserved to allow the identification of individual planks, so that the pattern of the remainder of the floor was unclear. The configuration of the structure represented by the floor could not be determined. All of the wood was blackened, though it did not appear charred, leading to the assumption that the color was due to staining from coal, the main fuel source for industry on the property for much of the nineteenth century.

A shovel test was excavated through the deteriorated wood in the northwest quarter of the trench section. In this portion of the floor, the planks were 2 inches thick, lying atop black, coal-rich silty loam which extended an additional 6 to 8 inches in depth. Below lay more brownish clay fill. Above the floor lay various mixed fills (Universal Stratum A), with a combination of concrete and asphalt at the surface.

Elevations within Sections C and D of Trench 13 are summarized as follows:

-- surface:
  Section C +7.89' msl
  Section D +7.88' msl
-- Section C/Stratum C (industrial debris) +6.23' to +5.57' msl
-- Feature 28 (gutter) +4.11' msl
-- Feature 29 (wooden floor) +4.88' msl
-- utility lines:
  separating Sections B & C +6.56' msl
  separating Sections C & D +5.38' msl

Table 8. Summary of Elevations: Trench 13 Sections C & D

Battery Cove Deposits

Excavation within the section of the Ford's Landing property representing the northern end of Battery Cove took three main forms: Phase IIb survey trenches which extended from the eighteenth-century wharf into the area of the cove; Phase IIc trenches, in an additional phase of survey specifically designed to test the remaining cove deposits on the property, this prompted by the discovery of portions of derelict vessels in Trenches 12 and 14 from Phase IIb; and Phase III data recovery excavations, which were concentrated on maritime features identified in the Phase II trenching programs. In combination, these excavations resulted in the documentation of a number of vessels and vessel fragments abandoned at or near the edges of the cove. In addition, the depths and characteristics of the Corps dredging spoil and underlying alluvial deposits observed in the trenches gave indications as to the development of the shoreline through the early twentieth century.

Cove Trenching

Portions of two Phase IIb trenches lay partially or completely within the northern bounds of the cove. Section F of Trench 12 extended approximately 15 feet beyond the edge of the eighteenth-century wharf, while Trench 14 lay 25 feet south of the bulkhead line. Ten trenches, numbered 15 through 24, were excavated within the cove in Phase IIc. These excavations measured between 7 and 8 feet in width and averaged 50 feet in length. In total, the excavations represented a sample of slightly more than 5.6% of the approximately 1.8 acre extent of the cove within the project area. In general, stratigraphy consisted of 3 feet of modern fill -- gravel, sand and silt, and modern structural rubble -- followed by Corps dredging spoil ranging from 2 to 7.5 feet in thickness, generally deeper to the south and east. Below the dredging spoil lay natural cove bottom silts. Detailed stratigraphic profiles of each trench are provided in Appendix D.

Stratigraphy

To the north, closest to the nineteenth-century shipyard deposits on the wharf, layers of fine coal dust were recorded near the top of the Corps fill, suggesting that the filling process may have slowed or been intermittent as the projected fill elevation was reached, allowing wind-blown debris from the coal yard residues on the wharf to collect. In addition, a thin stratum of coal dust and sand was observed midway through the Corps fill deposit in

most trenches. The material consisted of wind borne debris from the surface of the wharf spread across the northern portion of the cove, either during a long break in the filling process or as a result of a single event, such as a violent wind storm.

The most recent natural cove bottom deposits, *i.e.*, those from the turn of the twentieth century, were readily identified, since they had been filled over quickly by dredging spoil. The deposits were differentiated from earlier deposition by consistency and the presence of inclusions. Being almost continually submerged, the sediments at the bottom of the cove were somewhat fluid. Thus, with time they were subject to filtering, settling and eventually compaction, such that the most recent layers contained significantly higher percentages of coarser grained sands along with other, non-clastic materials, mainly in the form of organics such as small mollusk shells and woody debris. While the rate of settling and compaction could not be quantified, due to the variety of factors operating on the sediments, including frequent high energy flooding related to storms and the lack of a well-defined seasonal sedimentation cycle, the various depths at which coarser sands, artifacts and organic debris were observed gave an indication of the amount of sedimentary build up during historic times (cf. Guilcher 1957).

Profile sections of the various cove survey trenches were combined to form a generalized transect, providing an indication of the configuration of the cove at various times from the late eighteenth century, when Keith's Wharf was constructed, through the early twentieth century, when the cove was infilled. A typical profile section within the cove area consisted of from 2 feet 6 inches to 4 feet of modern fill -- sand, silt, gravels, cobbles and areas of brick and concrete rubble. This fill layer directly overlay Corps dredging spoil, a fine sandy silt, highly compact, impermeable and varying in color from pale brown (10YR 6/3) to light brownish gray (10YR 6/2) and grayish brown (10YR 5/2). Occasional patches of crushed shell (freshwater mussel) were noted: gravels were few and isolated. The surface of the dredging spoil layer was level, at roughly +4.00' msl (plus or minus 0.5'), a reflection of the once saturated nature of the material. Near the west edge of the property, in the area of Trench 14A/D, the spoil deposit was somewhat higher, extending to +5.30' msl, possibly a indicating that a final episode of dumping was conducted in this area. The addition of dredging spoil into Battery Cove by private concerns associated with the shipyard continued sporadically into the 1920s. No direct evidence of this later filling was observed on the property, suggesting that the material was disposed of further south within the cove.

The base of the Corps fill represented the surface of the natural cove bottom sediments in the early twentieth century at the time the embayment was infilled. Elevations suggest a gentle declination to the east toward the river. The base of the dredging spoil deposit measured -0.69' msl to the west, in Trench 15, and sloped gradually to -2.84' msl at the west end of Trench 19, a drop of 2.15 feet over a distance of 350 feet equalling an average slope of 0.6%. The incline became more pronounced at this point; the base of the deposit was measured at -4.33' msl at a point 50 feet to the east, at the east end of Trench 19, as the bottom began to drop off toward the channel of the river.

The western edge of the cove as it existed in the late nineteenth and early twentieth centuries was detected in Trench 14, in an area in which the shoreline turned northeastward to meet the eroded remnants of the wharf. The base of the Corps fill in these locations lay between +1.32' and +2.17' msl, considerably higher than in the trench excavations to the south and east, indicating a rise near the edge of the cove basin. In Trench 14D, a layer of dark gray sand, designated trench Stratum F, lay directly below the Corps fill deposit, and contained grassy organic debris and small fragments of turn of the century artifactual material. The deposit, recorded at an elevation of +1.34' to +1.76' msl, was identified as a shoreline build-up of humus. Two complete gravel barge hulls which had been beached at the edge of the cove were located in sections of Trench 14, lying within layers of mussel shell and silt which had been pumped in with the Corps spoil at elevations ranging from +0.93' to -0.71' msl. No indication of fast land was recorded in Trench 15, to the south, though the level of the early cove bottom was significantly higher in Trench 15 than in the cove trenches to the east, indicating that the bottom was sloping upward to the shoreline. In addition, a relatively large amount of artifactual material was recovered from the cove bottom in Trench 15 directly below the dredging spoil layer -- small fragments of Chinese porcelain, pearlware, whiteware, ironstone, lead glazed redware, bottle and lamp chimney glass, cut nail, bird and animal bone and a quartzite flake -- further suggesting that the shoreline lay only a short distance to the west.

There was no evidence encountered of the World War I shipyard, the Groton Iron Works' Virginia Shipbuilding Corporation, which operated south of the wharf from 1917 through 1921. Some of the heavy brick and concrete construction rubble observed in the cove trenches above the Corps spoil deposits, as well as the large amount of brick in the shallows off the present shoreline, may have been related to demolition of the numerous

structures from the yard. No foundations or other features were recorded. Photographs of the yard, such as *Plate 14*, indicated that the ways, office buildings and other structures lay well south of the present study area. The modern, three-rail marine railway at the southern end of the site was not part of the yard, and did not appear on maps of the area prior to a survey by Holland Engineering in 1988, conducted in advance of the present development project. Trench 19 was excavated across the landward end of the rails: no evidence of an engine head or other structure was encountered.

Faunal Evidence

A variety of mollusc shells were observed in the alluvial deposits below the Corps spoil in several of the trench excavations in the cove area. Samples were taken as possible indicators of environmental conditions within the cove in the nineteenth century. The results of the analysis are listed in *Table 9*.

All of the recovered species live in either fresh or brackish water. The habitat peculiarities of the species represented and the variations in distribution of each species within the sampled portions of the cove were studied. Based on the analysis, it appeared that the portion of Trench 12 sampled, that is, Section F just north of the eighteenth-century bulkhead, was an area of tidal flat with a thick marsh weed or grass population. The finding is generally consistent with the location of the excavation at the edge of the deteriorating wharf, in the shallows along the shoreline as it migrated slowly northward. In contrast, the areas sampled in Trenches 13E and Trench 19 appeared to have contained fewer grasses, based on the mollusc species observed, probably being subject to more continual or complete submergence.

TRENCH SECTION	MOLLUSC VARIETY
12F	Seaweed Snail (*Hydrobia spp.*) Vitrinella (Family *Vitrinellidae*) Freshwater Mussel (Family *Unionidae*)
13E	Hornshell snail Marsh Periwinkle (*Littorina irrorata*) Freshwater Mussel
19	Marsh Periwinkle Seaweed Snail Short siphoned Fingernail Clam (*Sphaerium spp.*)

Table 9. Mollusc Species from Battery Cove Sediments

Cove Vessels

Seven derelict vessels were recorded within the deposits in the area of Battery Cove, either lying over the remains of the eighteenth-century bulkhead, beached on the late nineteenth-century shoreline or sunk just off the edge of the wharf. Two additional vessel fragments were found incorporated into the late nineteenth-century shipway. Several of these vessels were observed and documented by John Broadwater and Billy Ray Morris, of the Virginia Department of Historic Resources, and by Bruce Terrell, then of the Norfolk Maritime Museum. Terrell was subcontracted to complete an analysis of the vessels, and his report may be found in Appendix C. To avoid duplication of effort, the vessels which have been described in the appendix will only be dealt with cursorily here, incorporating data which were unavailable to the researcher during his site visit. Nautical terminology used in the descriptions is contained in the Glossary in Appendix A. The vessels were documented with large format and 35mm photographs (*Plates 41-66*) may be found at the end of this section of the report.[1]

[1]Note: due to site conditions, large format photography of Feature 37 was not feasible.

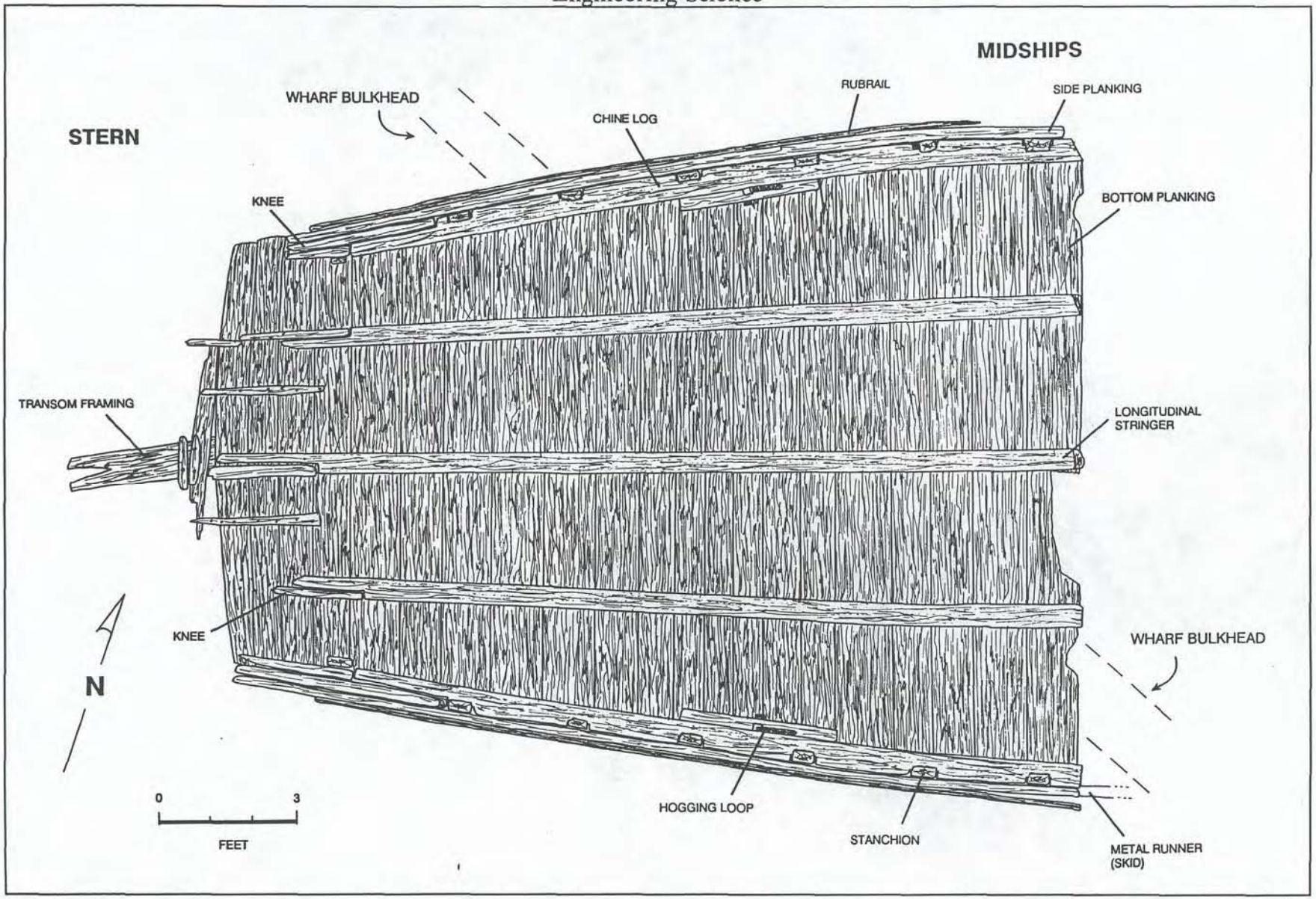
The vessels are arranged by hull design: Features 27 and 34, round-ended scows; Features 31 and 2, squared-ended barges; Feature 30, a longitudinally planked barge lying beneath the nineteenth-century bulkhead; Features 32 and 38, barge sections used in construction of the nineteenth-century shipway; Feature 35, a bateau hull; and Feature 37, the bow and midships portion of a keeled vessel.

Feature 27

Feature 27 (*Figure 47*) was a fragment of a scow, or flat bottomed transport vessel, which had lodged atop the uppermost surviving run of bulkhead timbers in Trench 12 Section G, at a depth of between -1.10' and -2.14' msl, under 6 to 7 feet of Corps dredging spoil. The hull had been sawn apart across its width and rested diagonally across the bulkhead line. The hull section had been distorted somewhat by the weight of the overlying dredging material, with the southwest corner, assumed to be the starboard stern, lying just over 1 foot lower than the forwardmost remaining portion of the vessel to port amidships (*Figure 48*). The existing portion of the hull measured 18 feet 6 inches in length, 14 feet in width at the cut end (from the configuration of the hull, this measurement appeared to be equivalent to the beam, or widest measurement athwartships), and 8 feet 6 inches in width at the stern.

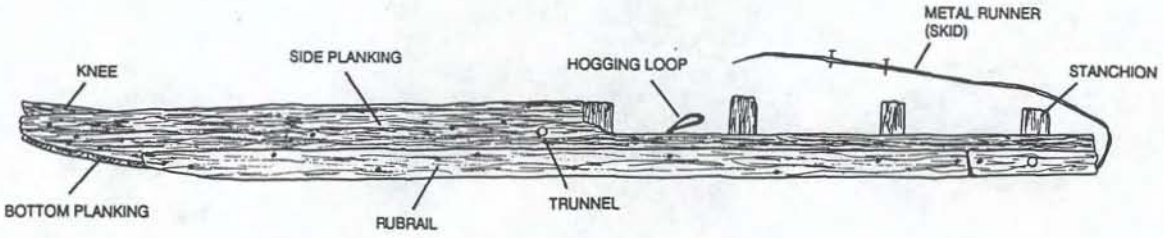
As indicated in Appendix C, the hull exhibited a hard turn of bilge, defined as the angle at which the upright portion of the hull diverged from the hull bottom. A chine log, a large 6- by 6-inch square timber running the length of the vessel, reinforced this angle and supported the stanchions which served as upright frames to which the hull planks were attached. The stanchions, $2^1/_2$ by 5 inches in section, were spaced regularly on 31-inch centers, and had been notched into the chine logs, with a form of vertical half-lap. While little of the uprights remained above the chine logs, they appeared to have stood perpendicular to the hull bottom. Two $^5/_8$-inch wire hogging loops were bolted to each chine log through $3^1/_2$- foot sections of 2- by 6-inch reinforcing block, at points 7 feet aft of the truncated midships section of the vessel. Hogging loops would have been used in association with cables to stabilize the ends of the vessel from sagging or "hogging."

The starboard side of the hull gave the appearance of having undergone major repairs. The chine log on that side of the hull was not as well shaped as on the port side, and did not evidence the same amount of curvature as the hull faired inward, curving toward the stern.

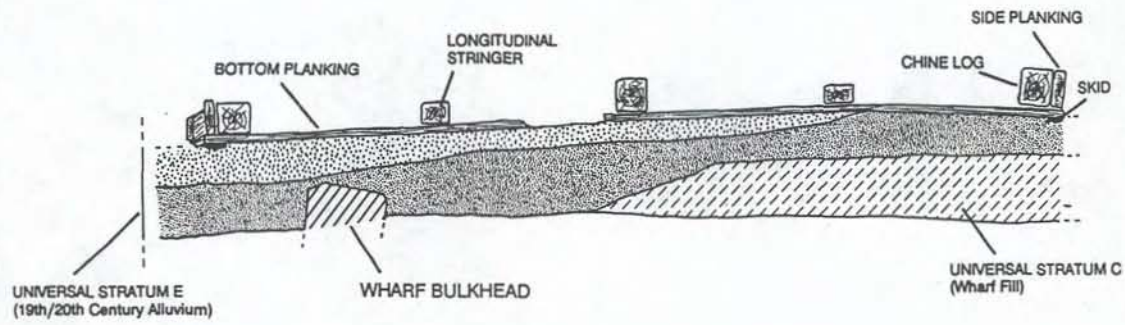


Source: Engineering-Science
Ford's Landing

Figure 47
Feature 27:
Scow Hull, Plan View



STARBOARD ELEVATION



MIDSHIPS CROSS-SECTION

Source: Engineering-Science
Ford's Landing

Figure 48
Feature 27: Starboard Elevation
and Midships Cross-Section

The last four or five hull bottom planks extended from 1/2 to 3/8 inches beyond the turn of bilge, suggesting that the log had not been adequately fitted to existing hull lines. In addition, the rubrail on the starboard side appeared somewhat less worn, and was thicker than on the port side. Both rubrails were secured with iron nails and trunnels. During the course of investigation, the hull section was lifted using one of the iron wire hogging loops, revealing that the iron strapping or skids protecting the edges of the hull bottom were of different dimensions: 1 1/4 by 1/8 inches on the port side and 2 1/2 by 3/8 inches on the starboard side. The strapping on the starboard side extended an additional 8 feet beyond the remaining wooden portion of the hull. Also on the bottom of the hull were two metal straps approximately 20 inches in length reinforcing the upturn of the stern along the centerline of the hull. The straps were attached with cut nails to the central stringer. After the hull bottom had been documented, the vessel was returned to its original position.

An additional longitudinal plank, measuring 8 by 36 inches, reinforced now missing stern or transom planking. All of the longitudinal framing timbers, including the chine logs and stringers, were single, unspliced pieces. With the exception of the trunnels along the rubrails, all of the fasteners observed on the scow hull were iron nails, most of them cut, though many large wrought nails were in evidence. A sample is depicted in (*Plate 38*). There was no discernable nailing pattern. The hull bottom planks varied in width, from 8 to 14 inches, and there was evidence of replanking in the form of varied wear patterns. Wood samples were taken from the hull bottom planking, the central stringer and one of the stanchions: all were identified as White Oak (*Quercus spp.*). A compact sand and shell concretion was found within the hull, particularly in the after portion against the stringers and chine logs. Though the materials may have been the remnants of a late cargo of sand and gravel, it is more likely that the material was a natural concretion formed of bottom sediments carried into the hull with the ebb and flow of the tide as the vessel lay derelict at the edge of the cove.

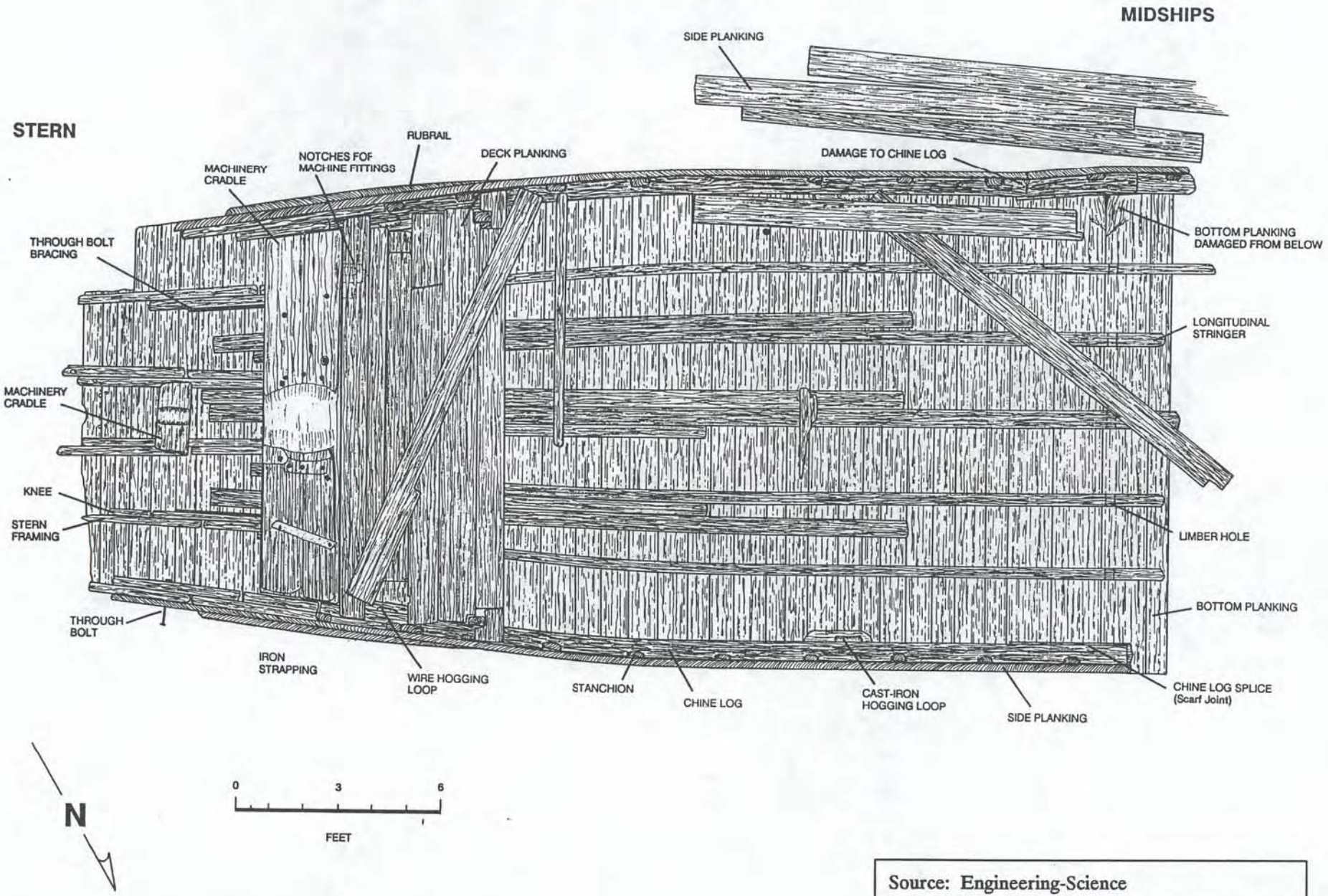
The hull planks in Feature 27 had been split in several places by the pressure of the dredging material on bulkhead features below, including broken tieback braces which had been attached to a higher, now missing bulkhead run, and a piling outside the bulkhead. The after portion of the vessel was in an advanced state of deterioration, indicating long-term exposure of the wood to air. Thus, it is assumed that the vessel originally lay with its aft end above the waterline, probably at some other point within the cove or at another location

altogether. Since the opposite end of the hull had been cleanly cut, it appeared that the vessel had been broken up for removal or for some specific use, as a staging platform for repair work, for example.

Feature 34

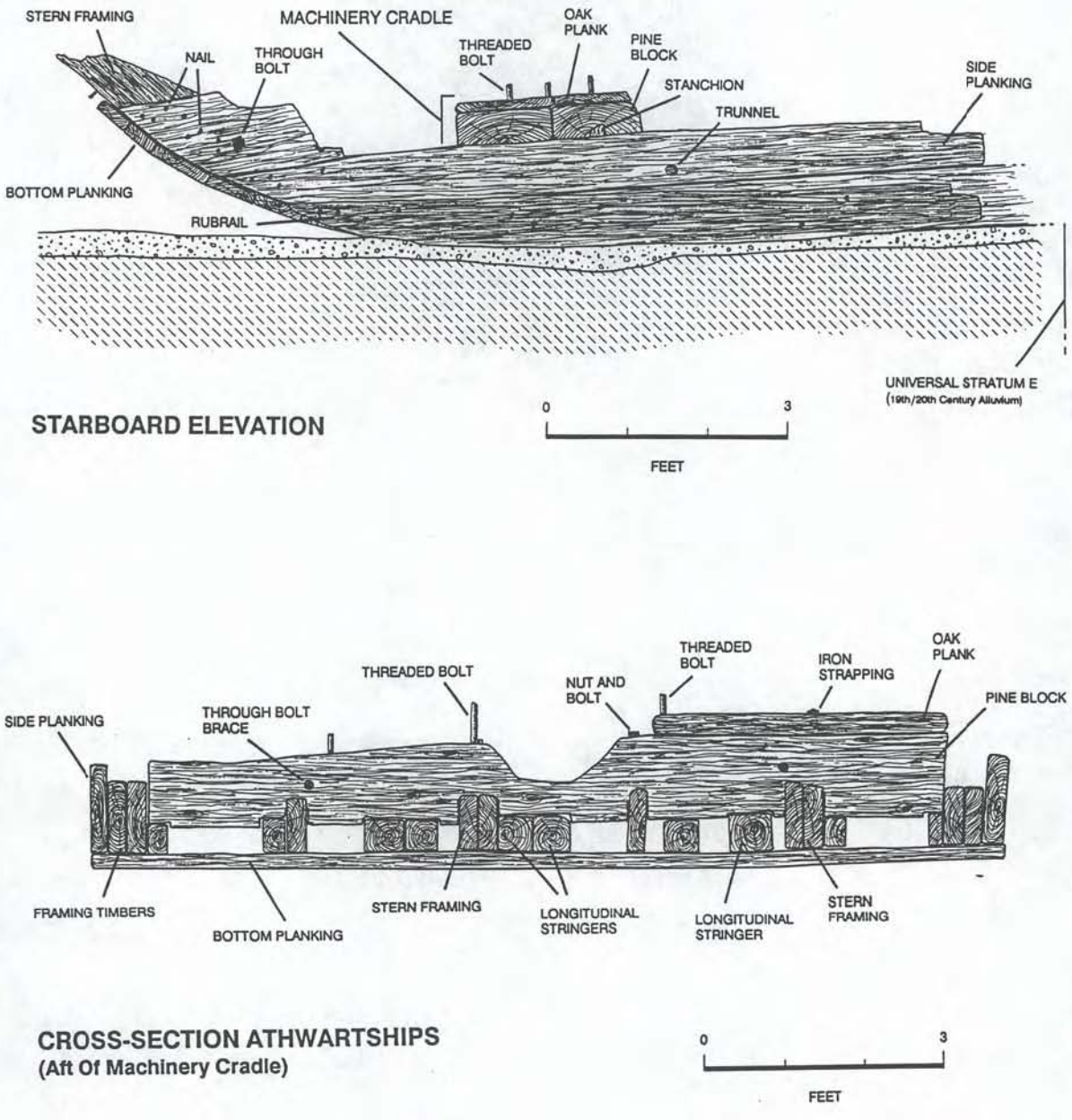
A second, larger scow fragment was found also lodged over the remaining run of the eighteenth-century bulkhead, this to the west, in Trench 22. The surviving portion of the vessel measured 32 feet 6 inches in length, 14 feet in the beam, and 10 feet 6 inches at the stern end (*Figure 49*). Like Feature 27, the stern was incomplete, and the hull had been sawn apart amidships. The heavy chine logs supporting the hard turn of bilge measured 6 inches square, and each was spliced at the same location along the length of the hull with a simple or plain scarf joint secured with a single iron nail. Five stringers, each measuring 5 inches square, formed the longitudinal framing. A single set of limber holes, approximately $3^1/_2$ inches in width, was visible in the stringers near the truncated end of the hull. The frames were double and triple laminated with 5- and 6-inch square timbers in the after portion of the vessel. All of the longitudinal framing of the vessel was identified as White Oak (*Quercus spp.*). A large timber cradle or yoke lay athwartships over the reinforced stringers at the aft end of the hull (*Figure 50, 51*). The cradle was constructed of four pieces of wood, two large blocks of Southern White Pine (*Pinus spp.*), measuring 12 by 15 inches in section and 10 feet in length, and topped by planks of White Oak (*Quercus spp.*), each 3 by 14 by approximately 3 feet 7 inches. The oak planks were secured (or possibly repaired) with an iron strap ($^1/_4$ by $2^1/_2$ by 24 inches) nailed diagonally across the upper surface. A basin-like cut out area, measuring between 18 and 24 inches in width and 9 inches in depth, formed the center of the cradle. Heavier knee construction was apparent at the stern of the vessel as compared with Feature 27, the knee timbers measuring 3 by 12 inches. The large cradle was supported by $^1/_2$-inch through bolts attached to the stern knees. A smaller saddle, of Eastern White Pine (*Pinus strobus*), lay farther aft, across the two central knee and frame assemblies.

Deck planking remained at the aft end of the hull just forward of the large timber cradle. The planks, identified as White Oak (*Quercus spp.*), were each 2 inches thick and varied in width from 6 to 13 inches. The decking was attached to the chine logs with wire nails, and was not well fitted to the side of the hull. In the gaps, cut nails from earlier



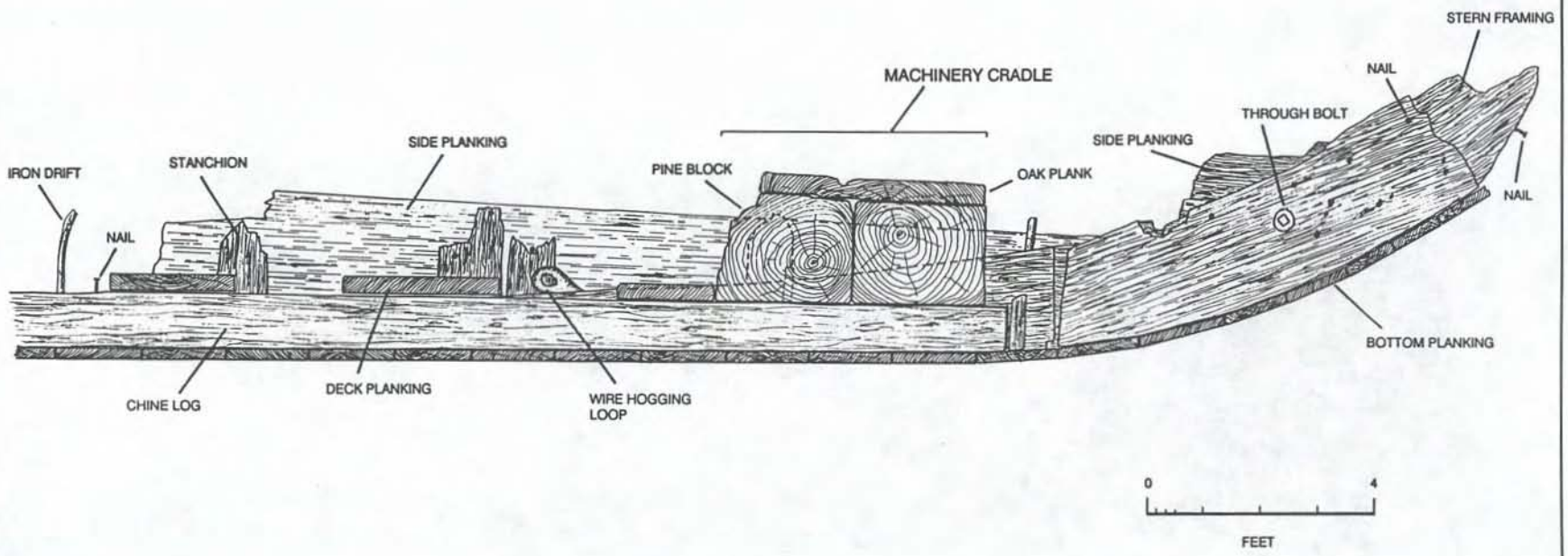
Source: Engineering-Science

Figure 49. Feature 34:
Scow Hull, Plan View



Source: Engineering-Science
Ford's Landing

Figure 50
Feature 34: Starboard Elevation and Cross-Section Athwartships at Timber Cradle



Source: Engineering-Science
Ford's Landing

Figure 51
Feature 34: Inboard Profile, Starboard Quarter

planking remained, suggesting planks 1 1/2 inches thick. One plank, lying against the cradle, had been notched to receive machine fittings, though it could not be determined if the fittings were related to the cradle or whether the plank had been reused.

The hull lines were straight amidships, beginning to fair inward at a point approximately 19 feet from the remaining end of the stern. A short rubrail was attached to the aft end of both the port and starboard quarters, measuring 9 feet in length, 8 1/2 inches in width and 2 inches in thickness. The rails were well-tapered forward, and sharply beveled aft. Due to site conditions, it was not possible to turn the vessel on its side to allow examination of the bottom of the hull. Nevertheless, a section of iron skid, similar to that observed on Feature 27, was recorded at the forward end of the starboard side of the hull. An additional length of the material was recovered from the fill west of the vessel, suggesting that the total length of the hull was at least 60 feet 6 inches.

At the upturn of the stern on the starboard side of the vessel, a 1-inch through bolt (machine bolt, square headed) 17 inches in length protruded approximately 7 inches beyond the line of the hull. The inboard surface of the knee holding the bolt was countersunk, indicating that the bolt was intended to reach beyond the line of the hull to secure a now missing component to the exterior. Leeboards, used for stabilization under sail, are a possibility, though the position of the bolt is farther aft than is customary for leeboards (John Broadwater, personal communication 1989).

Slightly forward of the bolt, the first strake, frame and knee assembly was notched. Though the wood was deteriorated and the pieces misaligned at the current observation, it was apparent that the assembly had been pierced by a hole fit to receive a 1-inch bolt similar to the one currently visible. The corresponding portion of the port stern was missing.

The stanchions (upright frames) were, like most of the timbers in the hull, identified as White Oak (*Quercus spp.*). They were notched into the chine log as were the stanchions on Feature 27, and appeared to stand perpendicular to the hull bottom. Side planking had been attached to the uprights with cut nails. Several 3/4-inch drift pins were also observed at irregular intervals along the side of the hull. An extra pair of stanchions appeared forward of the large timber cradle and set inboard of the chine logs, possibly serving to support a shed

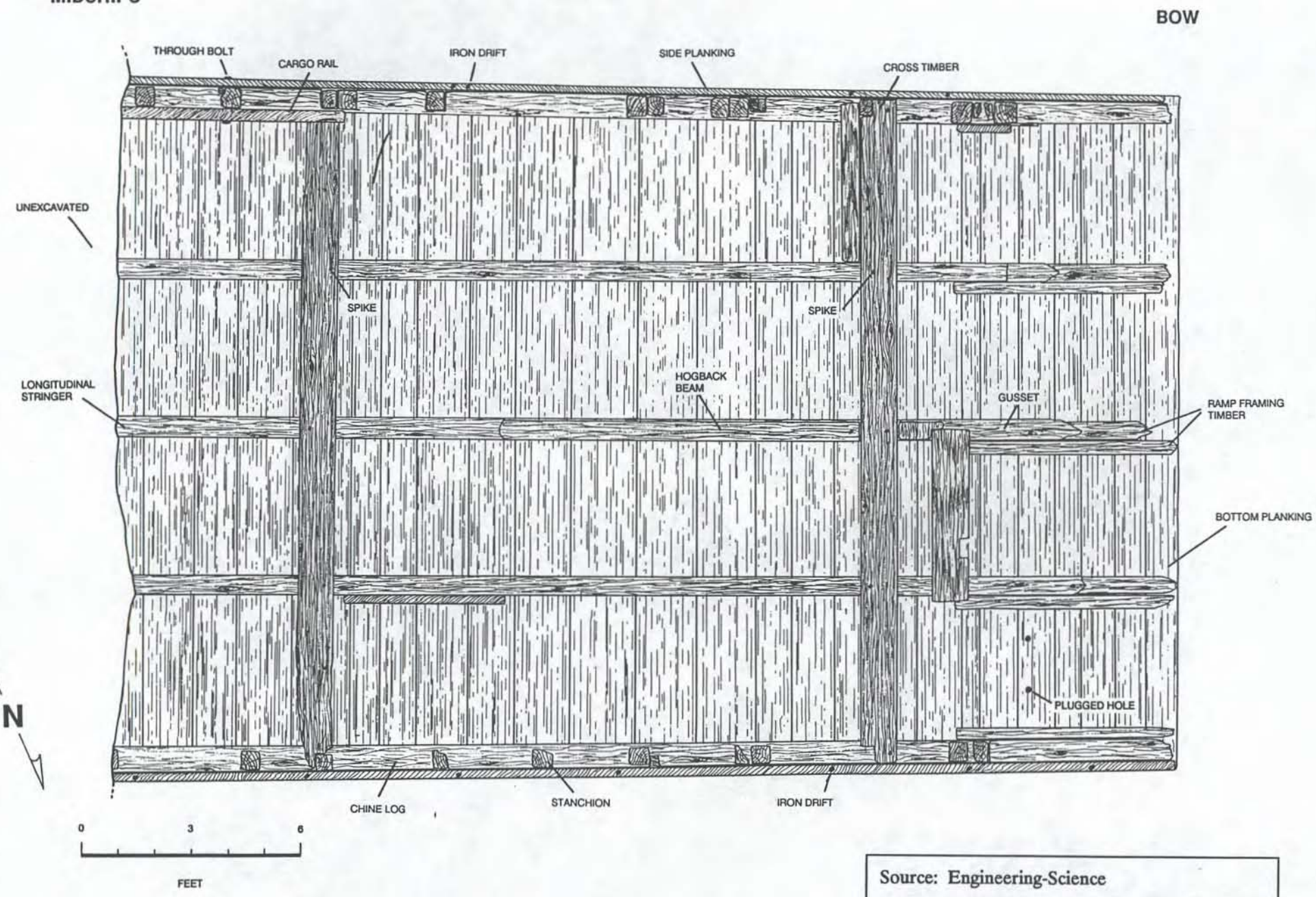
or other covering above the cradle. Two sets of hogging loops were noted. Just forward of the cradle were two heavy gauge iron wire loops bolted to the chine logs and supported with reinforcing blocks. The deck planking had been cut short in this area to allow access to the loops. Farther forward were two cast-iron loops, similarly secured to the chine logs.

The hull planking, of White Oak (*Quercus spp.*), was 1 inch thick and varied in width from 5 to 17½ inches. Several round, plugged holes were observed in the stern hull planks. Black, coal-rich sediment was found between the stringers in the midships portion of the hull, possibly indicating one of the last cargos hauled. Part of the port side planking remained, having collapsed outward into the cove bottom sediments. Portions of at least three planks were noted, measuring a regular 2 by 10 inches, with lengths of approximately 13 feet 6 inches.

Feature 34 lay with its centerline roughly parallel with the bulkhead, and thus may have been somewhat better supported under the weight of Corps fill than was Feature 27. This, along with the heavier construction noted and at least two feet of cove bottom sediments which had accumulated over the bulkhead prior to the arrival of the vessel, resulted in less distortion of the hull. The vessel lay at elevations ranging from +0.07' to -0.87' msl, under approximately 6 feet of Corps dredging spoil. Two large bollards (11 to 12 inches in diameter) lay along the starboard side of the hull (to the north, inside the bulkhead line). A strand of barbed wire ran between the pilings and into both the east and west walls of the archaeological trench. There was no direct evidence that the vessel had been intentionally moored at this point, but the contextual data suggested that this may have been the case.

Feature 31

Two large, nearly complete barge hulls were documented in portions of Trench 14, which was excavated near the shoreline of the Battery Cove in the late nineteenth century. Feature 31 (*Figure 52*) was the larger, more heavily timbered of the two vessels. It was partially excavated, with approximately 30 feet exposed at the west end, 12 feet at the east end. The hull was roughly rectangular, measuring 67 feet 8 inches in length and 19 feet 6 inches in the beam. The ends of the vessel appeared to taper somewhat -- to 18 feet 10 inches feet at the west end, 19 feet 2 inches at the east end -- yet the small difference from



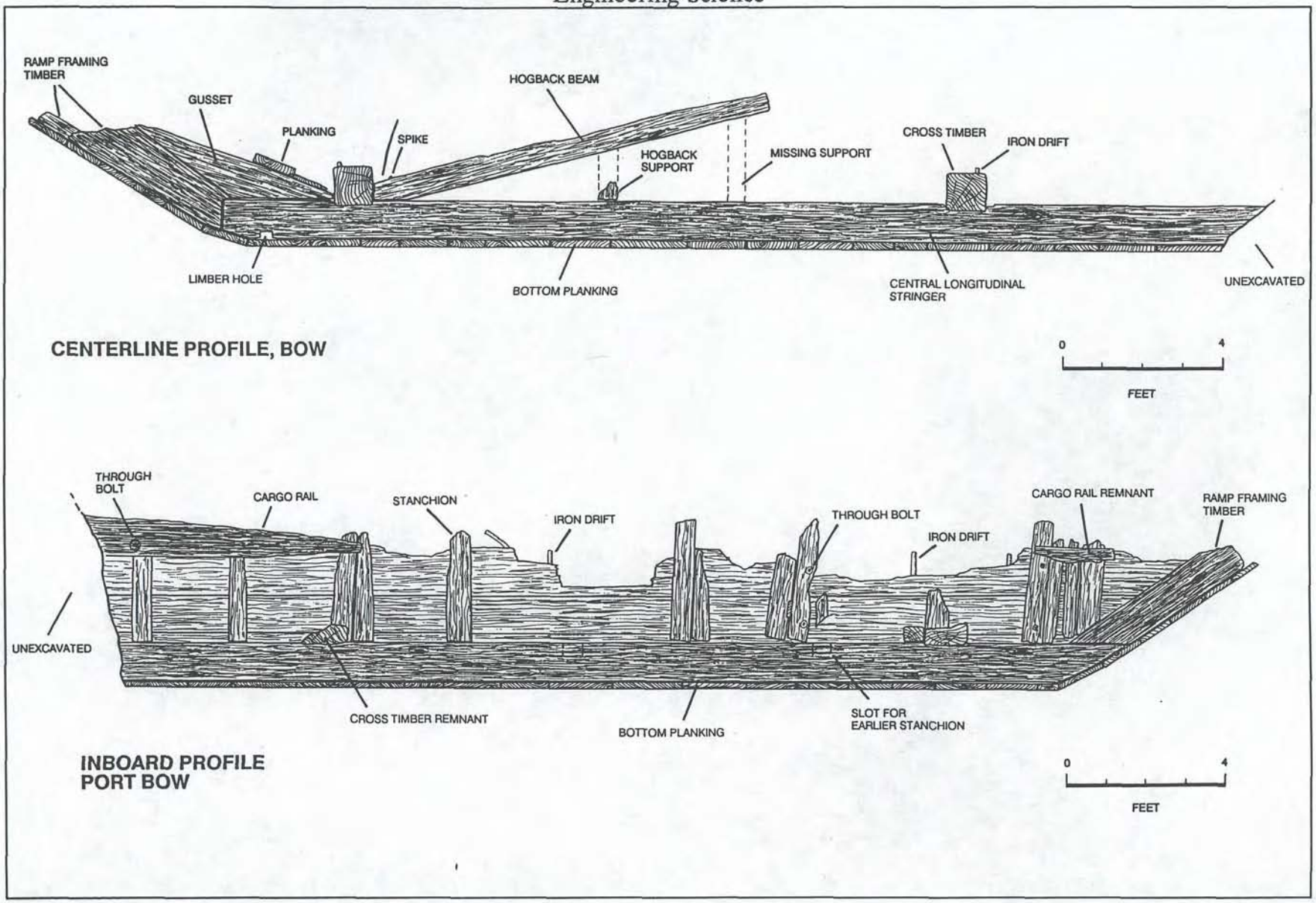
Source: Engineering-Science

Figure 52. Feature 31:
Barge Hull, Plan View

the beam and the variance between the two measurements themselves may indicate that the narrowing was in fact variation resulting from wracking due to a combination of heavy use, age and the weight of the Corps dredging spoil. Both ends consisted of timber reinforced ramps lying at angles of approximately 30 degrees to the flat bottom of the vessel. There were no obvious identifying marks to differentiate the bow of the vessel from the stern, but for clarity in the following description, the western end will be considered the forward or bow section.

All framing and plank timbers were of Southern Yellow Pine (*Pinus spp.*). Internal framing consisted of the following: three longitudinal stringers, chine logs at each turn of bilge and heavy cross timbers spaced regularly along the length of the hull. The central stringer measured 7 inches wide by 11 inches deep, the intermediate stringers 6 inches by 10 inches, the chine logs $8^1/_2$ by 12 inches, and the cross timbers $11^1/_2$ by 11 inches. The forwardmost cross timber, which lay at the upturn of the bow ramp, was notched approximately 1 inch to fit over the central stringer, while a second cross timber, lying 14 feet 9 inches aft, was notched at all three stringers. None of the remaining cross timbers was completely excavated. The cross timbers were secured at each joint by $^3/_4$- or $^5/$- inch drifts. At the aft end of the hull, a heavy knee reinforced the joint between cross timber and upright framing. The knee was $5^1/_2$ inches thick, was secured to the cross timber by $^3/_4$-inch spikes, and was notched to fit beneath the cargo rail and against the upright. There was no direct evidence of similar knees at the forward end of the vessel, but the portions of the cross timbers connecting with the chine logs were not well preserved, and thus such bracing may have existed.

A 6- by 7^1/2-inch hogback beam rose from the central stringer at an angle of approximately 15 degrees (*Figure 53*). The beam butted against the forwardmost cross timber and was secured to the stringer by a $^3/_4$-inch iron dowel. As it rose aft, the beam was supported by at least two 5- by 5-inch uprights held in place by wrought nails toed in to the stringer. The aft end of the timber was deteriorated, and thus the original length of the hogback could not be determined. A limber hole measuring 2 by 3 inches was noted at the forward end of the central stringer.



Source: Engineering-Science
Ford's Landing

Figure 53
Feature 31: Centerline Profile and Inboard Profile, Port Bow

The vessel was cross-planked, with bottom planks measuring 2 inches thick and ranging in width from 9 to 19 inches. The bow ramp was formed by inclined extensions of the longitudinal frames, either butted or shallowly scarfed to the frames and reinforced with large knee-like gussets held in place by 5/8-inch iron drifts. In addition, lighter framing was attached to one side of each frame. A plank measuring 12 inches by 4 feet 9 inches by 3 1/4 inches, with a 3- by 7-inch beveled notch off-center along the forward edge, was attached to the gussets on the central stringer and the starboard intermediate stringer. A similar plank was observed at the stern end of the vessel. Nail patterns and rotted plank remnants on the portside stringer suggested that the planking at one time spanned both sides of the centerline. Those attachments securing the planking to the framing which were visible at the bow ramp consisted of 1/2-inch wire spikes. This was the only piece of timber on which saw marks were observed; they indicated the use of a circular saw, suggesting a late nineteenth-century date for the addition of this feature.

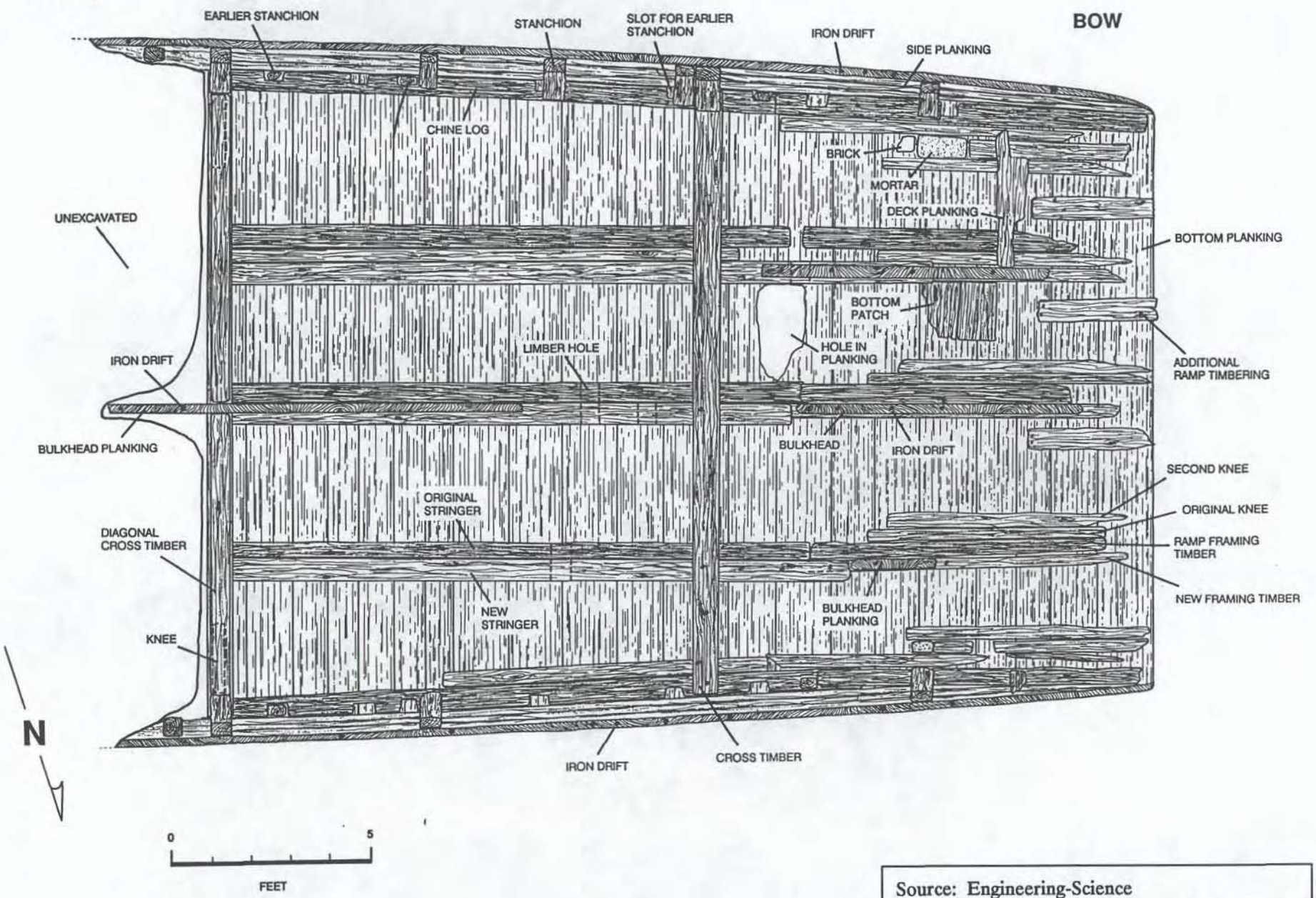
Uprights measuring 5 by 6 inches and 6 by 6 inches were located at irregular intervals along the chine logs. These stanchions were occasionally paired, and most rested atop the chine log, secured with toed-in nails. Several older, deteriorated uprights were also noted, notched into the outboard edge of the chine log. All of the uprights were perpendicular to the hull bottom. The side walls of the hull consisted of planking 4 inches thick and 9 to 12 inches wide, secured to the uprights with 3/8-inch wire nails and, occasionally, 5/8-inch threaded bolts. Three-quarter-inch through bolts attached the side planking to the chine logs and bow and stern framing, and 7/8-inch drifts had been driven through the planking vertically at 2 to 3 foot intervals along each side of the hull as reinforcement. The uppermost strake, or run of planking, of the hull was badly deteriorated, suggesting that the vessel been waterlogged and later exposed to air for a relatively long period. Based on the extent of the drift pins observed in the side planking, the depth of the hold was slightly over 4 feet. Portions of an inner, cargo rail were observed along both sides of the hull beginning approximately 3 feet from the hull bottom. The remaining planking measured 3 1/2 by 10 inches, and was attached to various uprights with 3/4-inch threaded bolts. Like the side planking, the bow and stern ramps were badly deteriorated, yet there was evidence of a bumper or bump rail at each end, formed by a slight, rounded extension of the topmost side plank.

Extensive repair work was in evidence throughout the vessel. Different types of uprights, different nailing patterns and the variety of types of attachments, from wrought nails to wire nails and threaded bolts, indicated that the sides of the hull had been refurbished and the planking probably replaced. Numerous plugged holes, several with the wooden plug wedged with an iron nail, were observed in the hull bottom and sides.

Feature 2

Feature 2 (*Figure 54*) was the smaller, more lightly timbered of the two nearly complete barge hulls beached on the late nineteenth-century shoreline of Battery Cove. Like the larger hull, Feature 31, Feature 2 was not completely excavated. The perimeter of the vessel was exposed to allow measurement of overall dimensions and identification of major structural features. The western third of the vessel was completely excavated to permit detailed documentation. The bow and stern ends of the barge could not be differentiated, and thus as with Feature 31, the west end of the hull was designated forward for descriptive purposes.

Feature 2 measured 58 feet 10 inches end to end with a 17-foot, 6-inch beam occurring approximately amidships. The sides of the hull faired gently inward to measurements of 14 feet 4 inches forward and 14 feet 10 inches aft (note that as with most of the vessels documented at the site, all measurements are approximate and may possibly be somewhat short, due to the relatively poor state of preservation of the wooden structural members). The vessel displayed the same major architectural features as Feature 31: the hull was flat bottomed, cross-planked, with a central longitudinal framing timber or stringer, intermediate stringers on either side of the centerline, chine logs at the hard turn of bilge and cross timbers at intervals down the length of the hull. The ends of the hull were upturned in the form of ramps, inclined at an angle of approximately 30 degrees, though the ramps showed more curvature than did those on Feature 31. Frames extended up the ramps from the stringers, showing evidence of multiple repair in the form of laminated framing and knees.



Source: Engineering-Science

Figure 54. Feature 2:
Barge Hull, Plan View

The centerline stringer measured roughly 5 1/2 inches square. The wood was badly deteriorated. A 6- by 6-inch companion stringer had been added on the starboard side. Both were secured from below with nails through the 3-inch-thick bottom planking -- the planks were of Southern Yellow Pine (*Pinus spp.*) and ranged in width from 8 1/2 to 16 inches. A 6-inch limber hole had been cut through both timbers near the forward end of the vessel. A second 6-inch hole, plugged with wood, was observed in the larger, later stringer 12 inches forward of the through hole, suggesting either that the timber had been reused or that the hole had been pre-cut but did not align with the limber hole in the existing timber. Longitudinal bulkhead planking lay atop the newer stringer, secured with 3/4-inch drift pins. The planking was 3 inches thick, 12 inches deep, and badly deteriorated. Portions of two planks survived to a height of 18 to 20 inches (the remaining drift pins indicated an original height of 3 feet above the framing timbers).

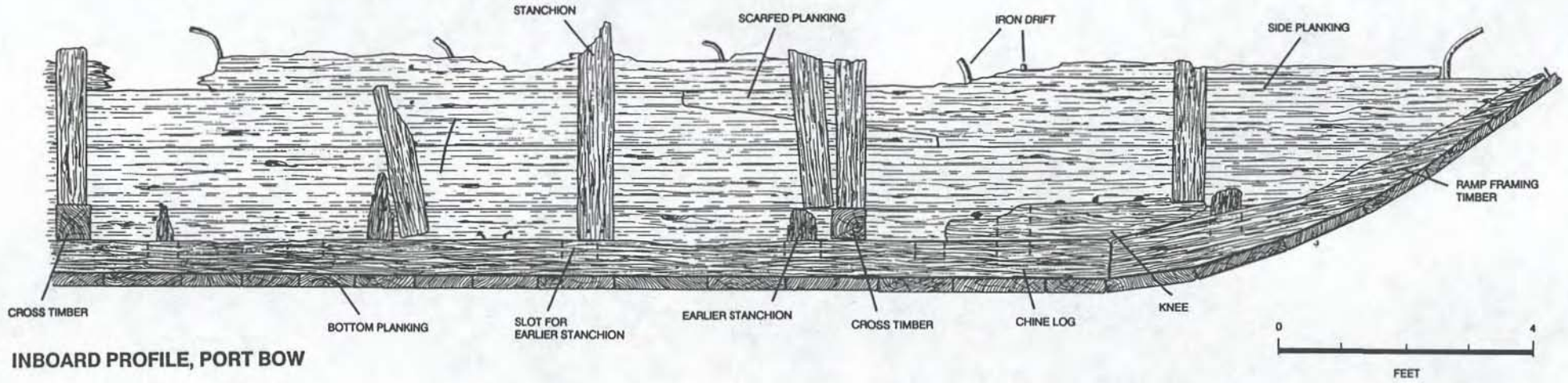
To port lay a deteriorated stringer, probably the original intermediate stringer to port, fashioned of Southern Yellow Pine (*Pinus spp.*) and measuring roughly 5 1/2 inches square. Newer frames had been added, including a 6-by 6-inch run of Eastern White Pine (*Pinus strobus*), appearing in relatively pristine condition and elaborately scarfed from several pieces. Fitted snugly between these two frames lay a third, of yellow pine, 4 1/2 inches square and not attached to the hull bottom planking. To starboard lay a deteriorated 5 1/2 square stringer laminated with a newer 6- by 6-inch timber. There was no evidence of bulkhead planks on either intermediate stringer aft of the forward cross timber, which lay at the upturn of the forward ramp. Wire nails were observed on all the upper surfaces of the stringers suggesting the presence of ceiling planks.

The forward ramp consisted of a complex assemblage of frames, knees longitudinal bulkhead planking and patching material. To simplify the exposition, only one set of framing will be described in detail as an example. Forward of the starboard side intermediate stringer, the original ramp framing timber, 4 3/4 inches square, was butted against the end of the main stringer at the upturn of the ramp and attached with nails through the bottom planking. A 3-inch thick, knee-like plank was attached with cut nails to the port side of the frame. A second, newer knee, 3 1/2 inches thick, was attached to the port side of the first knee with wire nails. A second framing timber, 3 inches thick, lay to starboard of the original frame, scarfed to the end of the newer starboard stringer. Longitudinal bulkhead planking was secured to the newer framing timber with 3/4-inch drifts.

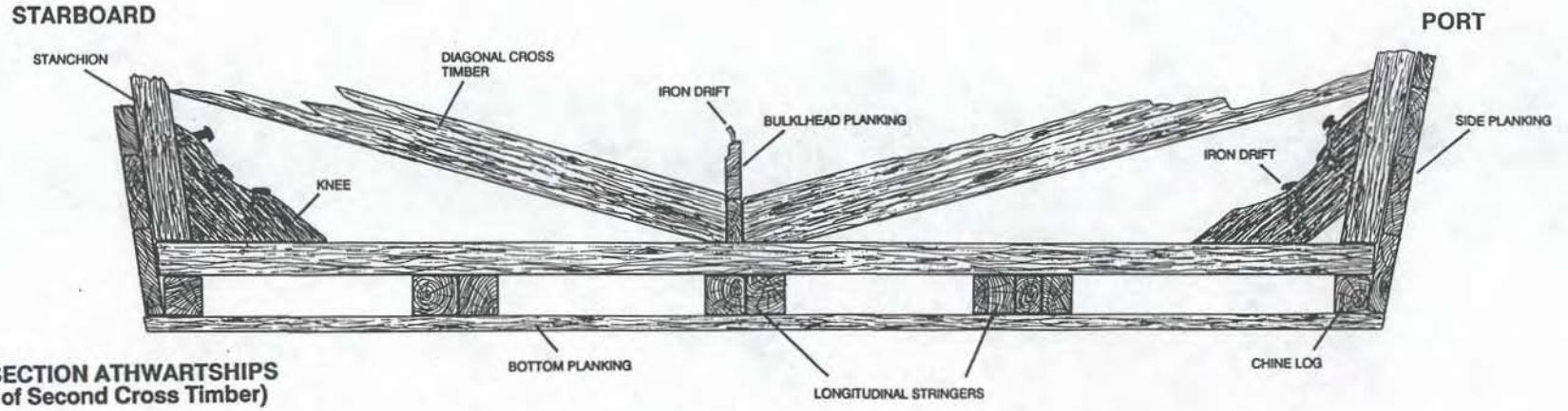
Several 2- by 6-inch planks had been nailed to the bottom planking of the ramp near the forward edge as reinforcement. Many small and large holes in the forward hull planking were repaired with wooden plugs, concrete, and 1-inch-thick planking. One large hole to port of the central stringer at the upturn of the ramp was not repaired. Finally, a portion of 1-inch thick ceiling planking remained attached to the stringer and chine log on the port side of the ramp.

The chine logs consisted 6- by 6-inch sections of oak (*Figure 55*). Uprights or stanchions, varying in dimension from 5 by 5 to 6 by 6 inches, extended from the chine logs to support the hull strakes. The stanchions frequently occurred in pairs, though there was little pattern apparent in the placement. Older, deteriorated uprights of White Oak (*Quercus spp.*) were notched into the outboard edge of the chine logs, though there was often little remaining of these timbers except the notch in the longitudinal member. Newer uprights, fashioned of pine, rested atop the chine logs, in one case partially covering an earlier, notched upright. Side planking was poorly preserved in many places. The planks measured 3 inches in thickness, 10 to 12 inches in width, and were reinforced vertically with $^{3}/_{4}$-inch drift pins. At least one strake, or run of planking, near the forward end of the hull consisted of two planks connected by a large, pinned scarf joint. The planking above the first strake on both sides of the vessel appeared to have been part of a later repair effort. Wrought nails were noted attaching the lowest run of planks to the remains of the older oak posts. These planks were noticeably more deteriorated than those above, which showed no sign of attachments in line with the oak posts. The upper planks were attached to the newer, pine stanchions with cut or wire nails. The sides of the vessel sloped outward slightly, the stanchions set at an angle of about 6 degrees from vertical. That this was the actual configuration of the hull and not the result of pressure exerted by the heavy Corps spoil was evidenced by the angle of the transverse framing described below.

Two cross timbers were exposed in the excavation (*Figure 55*). They varied in dimension from 5 by 6 inches to $8^{1}/_{2}$ by 6 inches (sided by molded), with the largest occurring forward in the hull. Knees, fashioned of White Oak (*Quercus spp.*) and measuring $3^{1}/_{2}$ thick, were attached to the cross timbers and to 6- by 6-inch stanchions with $^{7}/_{8}$-inch iron drift pins. Diagonal beams, measuring 5 by 6 inches in section, further supported the cross members, attached to the stanchions above the knees and extending downward to the centerline to abut the opposite diagonal at the longitudinal bulkhead planking.



INBOARD PROFILE, PORT BOW



CROSS-SECTION ATHWARTSHIPS
(Forward of Second Cross Timber)

Source: Engineering-Science

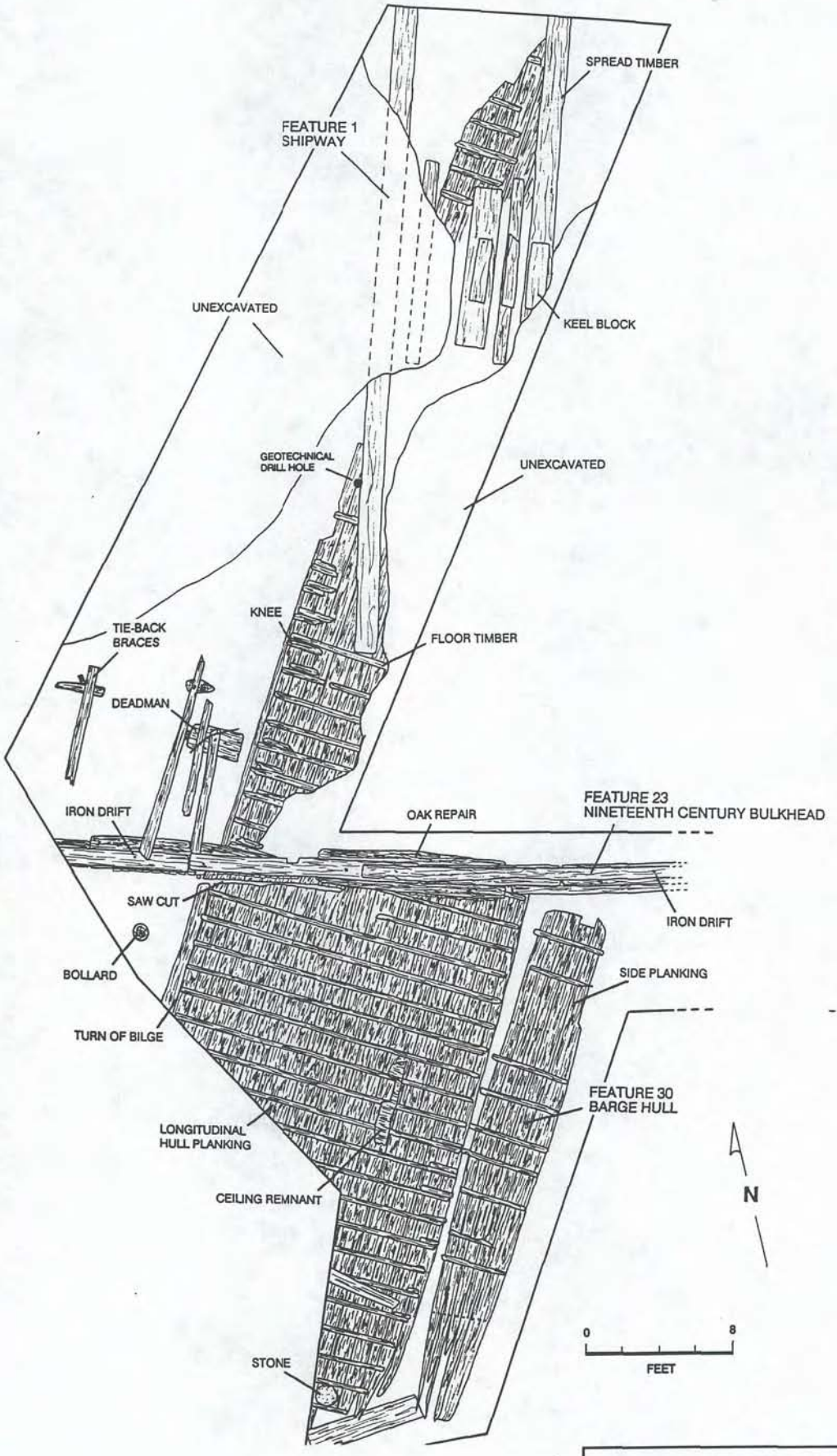
Figure 55. Feature 2: Inboard Profile, Port Bow and Cross-Section Athwartships

As indicated, the vessel was exposed around its perimeter to allow measurement and identification of the major framing members. A total of four cross timbers were observed. Double hull planking was noted aft, beginning 30 feet from the forward end on the port side of the vessel and continuing to the stern. On this side, the planking consisted of two 2-inch-thick planks. On the starboard side, doubled planking began 42 feet 6 inches from the forward end and consisted of two 3-inch-thick planks. On both sides of the hull, the planking was secured by wire nails through from the inboard plank and clinched against the outboard plank. Though the aft ramp was only partially excavated, laminated framing similar to that documented at the forward end of the hull was observed. More ceiling planking appeared to remain in place aft than at the forward ramp, and the port corner of the stern had been reinforced with a $^1/_2$-inch by 4-inch iron band, attached to the hull with wire nails.

Feature 30

Feature 30 (*Figure 56*) consisted of a long, narrow barge hull lodged with its centerline oriented north/south beneath Feature 23, the nineteenth-century bulkhead. The hull measured in excess of 73 feet 6 inches in length, with about two-thirds of that length (46.5 feet) north of the bulkhead. The exact length of the hull could not be determined with precision. The southern end had been truncated, and, due to logistical problems at the end of the field portion of the study, the northern end was not completely exposed. In terms of total length, both ends of the hull appeared to have begun to fair inward, and thus it may be assumed that if the vessel were blunt ended, only a few feet were missing from either end. If the ends were pointed, it is estimated that the hull originally extended an additional 8 feet at either end.

The vessel measured 16 feet in the beam as measured at the deteriorated remnants of the first strake above the turn of bilge, the highest remaining portion of the hull. The vessel was longitudinally planked. The bottom planks were fashioned of White Oak (*Quercus spp.*), 2 inches thick and varying from 7 to 21 inches in width, with most measuring around 15 inches. Several holes, pegged with dowels 2 inches in diameter and as much as 5 inches in length, were observed in portions of the bottom planking.



Source: Engineering-Science

Figure 56. Feature 30:
Barge Hull, Plan View

Internal framing consisted of 3- by 8-inch transverse floor frames of White Oak (*Quercus spp.*). The floor frames were set on consistent 16-inch centers, and the ends were shaped to fit the curved turn of bilge. Two sets of limber holes, measuring 3 inches wide and 1 inch deep, ran the length of the hull on lines situated approximately 18 inches off the centerline. Several of the limber holes had been plugged with wooden chocks. Ceiling planking was in evidence in the form of a small section of 1-inch-thick planking spanning three floors, and from occasional nails observed in the upper surfaces of the floors. The ceiling planking displayed circular saw marks on the visible surfaces. Three-inch-thick knees or futtock ends had been attached with cut nails to the end of each floor timber to support the side planking of the hull.

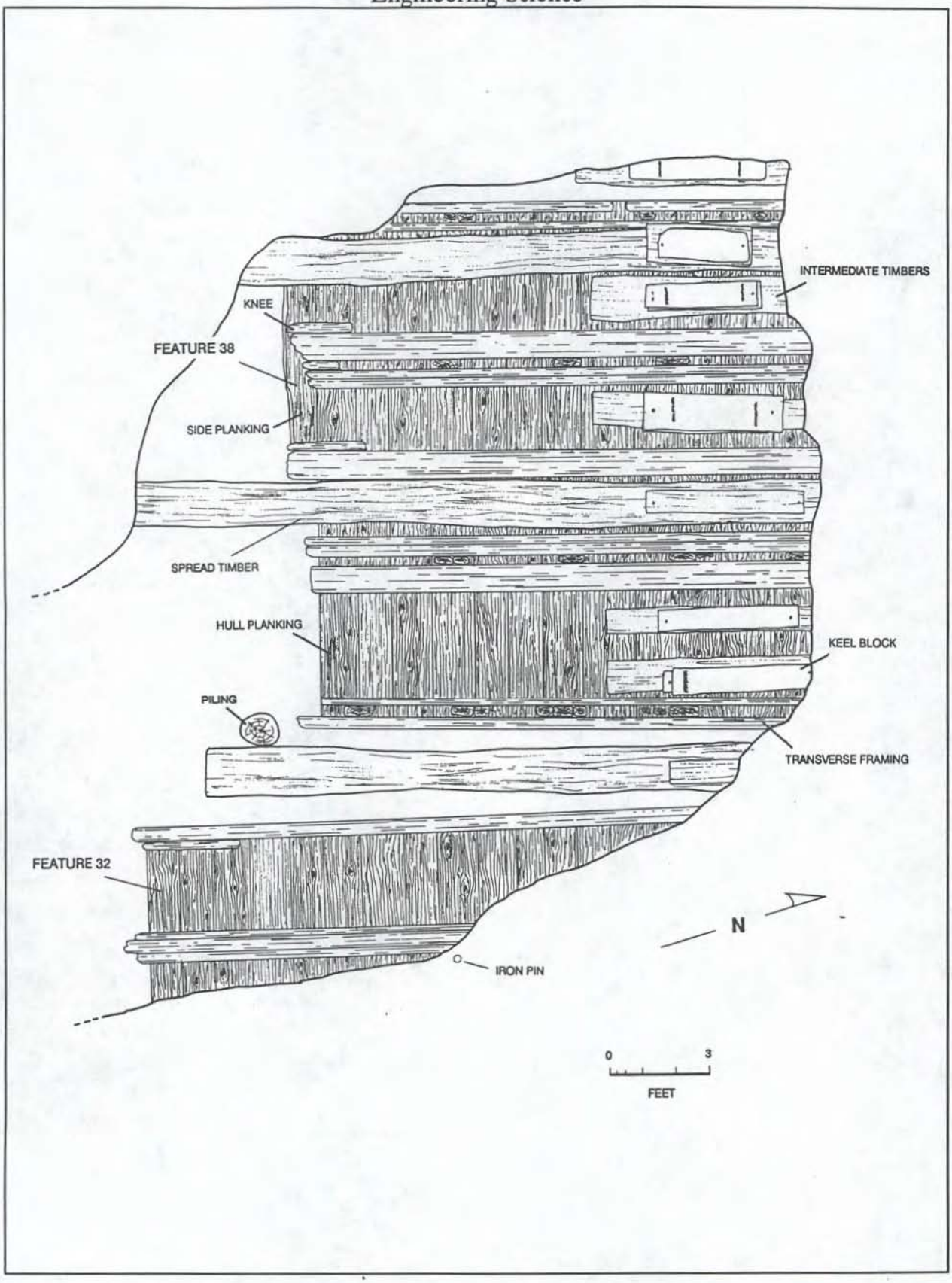
A large segment of what appeared to have been side planking lay flat in the cove bottom sediments, level with the hull to the east. The section measured 27 feet in length and consisted of planks 2 inches thick, 7 to 14 inches wide, and secured to 3- by 6-inch vertical framing timbers with cut nails. Double hull construction, or ceiling planking, was again suggested by nails protruding from the interior faces of the frames. The planking was probably not from the immediately adjacent portion of the hull, and may not even have been an integral part of the side planking of the vessel. One end of the planking assembly tapered, as if following the curve of the hull to bow or stern, but the opposite end was finished with rounded edges, suggesting that the planks were not the side planks of a vessel over 73 feet in length. In addition, the vertical frames were attached at uneven intervals -- several were on 16-inch centers, but others were spaced more widely. On the hull bottom, the knees or futtock ends were generally attached to the same side of the floor frames, the north side. Futtocks were attached to the opposite sides of several frames, possibly as part of the original design of the vessel or as a result of later repairs. Uneven spacing of the futtock timbers such as this could produce an apparently odd alignment of upright frames on the hull sides, but both the hull and the segment of side planking remaining were insufficiently well preserved to allow a match up to be made.

A large stone, 15 inches in diameter, was wedged between the floor frames at the south end of the hull, and represented either part of a final cargo or was intrusive.

As indicated in the description of, Feature 23, the nineteenth-century bulkhead, Feature 30 had been partially sawn through along a line immediately south of the bulkhead, as if for removal. The sawing had been abandoned and repairs to the bulkhead were completed directly atop the hull. Individual floor frames had been cut out, usually with an axe, as evidenced by cut marks on the remaining ends of the timbers, to allow the bulkhead timbers to rest firmly on the bottom planking of the hull. Similarly, north of the bulkhead the frames had been cut away to make space for the timbers associated with Feature 1, the nineteenth-century shipway. Of final note, a 6-inch hole had been cut through the hull planking and the edge of one of the shipway spreaders. The location was consistent with a bore hole drilled by geotechnical surveyors in 1988, and thus the hole represented a modern disturbance.

Feature 32

Feature 32 (*Figure 57*) was one of two barge fragments used in the construction of the eastern end of Feature 1, the nineteenth-century shipway, in Trench 13 Section J. This particular fragment consisted of at least two sets of framing timbers, fashioned of Eastern White Pine (*Pinus strobus*), and underlying bottom planking of Southern Yellow Pine (*Pinus spp.*). The orientation of the vessel, that is, whether transverse or longitudinally framed, was not immediately apparent. A slight upturn was noted at the exposed southwest corner of the barge suggesting longitudinal planking sheering upward toward the bow or stern. Were this the case, the framing would have been transverse, in the form of floors, and the hull would have displayed a curved turn of bilge similar to that of Feature 30, the barge lodged beneath the nineteenth-century bulkhead. The westernmost frame was single, measuring 5 inches by 12 1/2 inches. The second frame, separated from the first by 2 feet 8 inches, was triple laminated, the pieces measuring 2 inches, 3 1/2 inches and 4 inches wide and 12 inches deep. The remains of long, knee-like timbers (3 by 10 inches) were observed at the end of the first floor, secured with cut nails. The exposed portion of the hull measured 18 feet 3 inches from the centerline of the shipway. Assuming that the components of the ways were centered, the width of the hull at the turn of bilge could be calculated at 36 feet 6 inches. Hull bottom planking continued to the east for an undetermined distance, but the position of the trench excavation near the modern shoreline and the unconsolidated nature of the trench walls made excavation to further expose the feature too hazardous to attempt.



Source: Engineering-Science
Ford's Landing

Figure 57
Feature 32 and Feature 38:
Barge Hull Fragments, Plan View

Feature 38

The second barge fragment (*Figure 57*) used to support the shipway consisted of a heavily retimbered hull section lying west of Feature 32. The original framing of the vessel was comparatively light, the timbers, of Eastern White Pine (*Pinus strobus*), measuring 2 to 3 inches wide by 8 inches deep. Some were double laminated, possibly representing earlier repairs. All were deteriorated, but appeared to have been hewn and dazed to shape. From the size and location of the frames, *i.e.*, they were positioned relatively close together, it is assumed that the hull was longitudinally planked, in the manner of Feature 30. Thus the frames were in fact transverse floors and the turn of bilge curved. As measured from the centerline of the shipway, the hull extended 12 feet to the turn of bilge, for a calculated width of 24 feet at that point.

Uprights, or stanchions, fashioned of Spruce (*Picea spp.*), were attached to the frames with wrought and cut nails and with wooden pegs, or trunnels. The uprights were usually paired, but also occurred singly or tripled. Measurements varied from 9 by $2^1/_2$ inches to 11 by $2^1/_2$ inches. Many were badly deteriorated, and all had been cut flush with the surface of the frames, some sawn off and others cut out crudely with an axe.

The original frames of the hull were placed on 4-foot 3-inch to 4-foot 9-inch centers. Newer 9- by 9-inch frames, also of Eastern White Pine (*Pinus strobus*) and saw-cut (though no markings were present to indicate the type of saw used), were attached to two of the older frame sets, against the uprights. A third 9- by 9-inch frame lay between the others, producing new framing on roughly 3-foot 6 -inch centers, heavily reinforcing the center of this section of the hull. A single limber hole, 3 by 1 inch, was noted through one set of new and old frames. The spaces between the frames and stanchions were packed with coal, suggesting that the vessel had served spaces between frames and stanchions packed with crushed coal, suggesting that the vessel had served as a collier during its later use.

Knees or futtock ends were attached to both the new and old frames at the curved turn of bilge. The newer braces were cut from 3- by 15-inch planks and were attached with cut nails of various size. At least one older knee remained. It measured $2^1/_2$ inches in thickness and was very deteriorated.

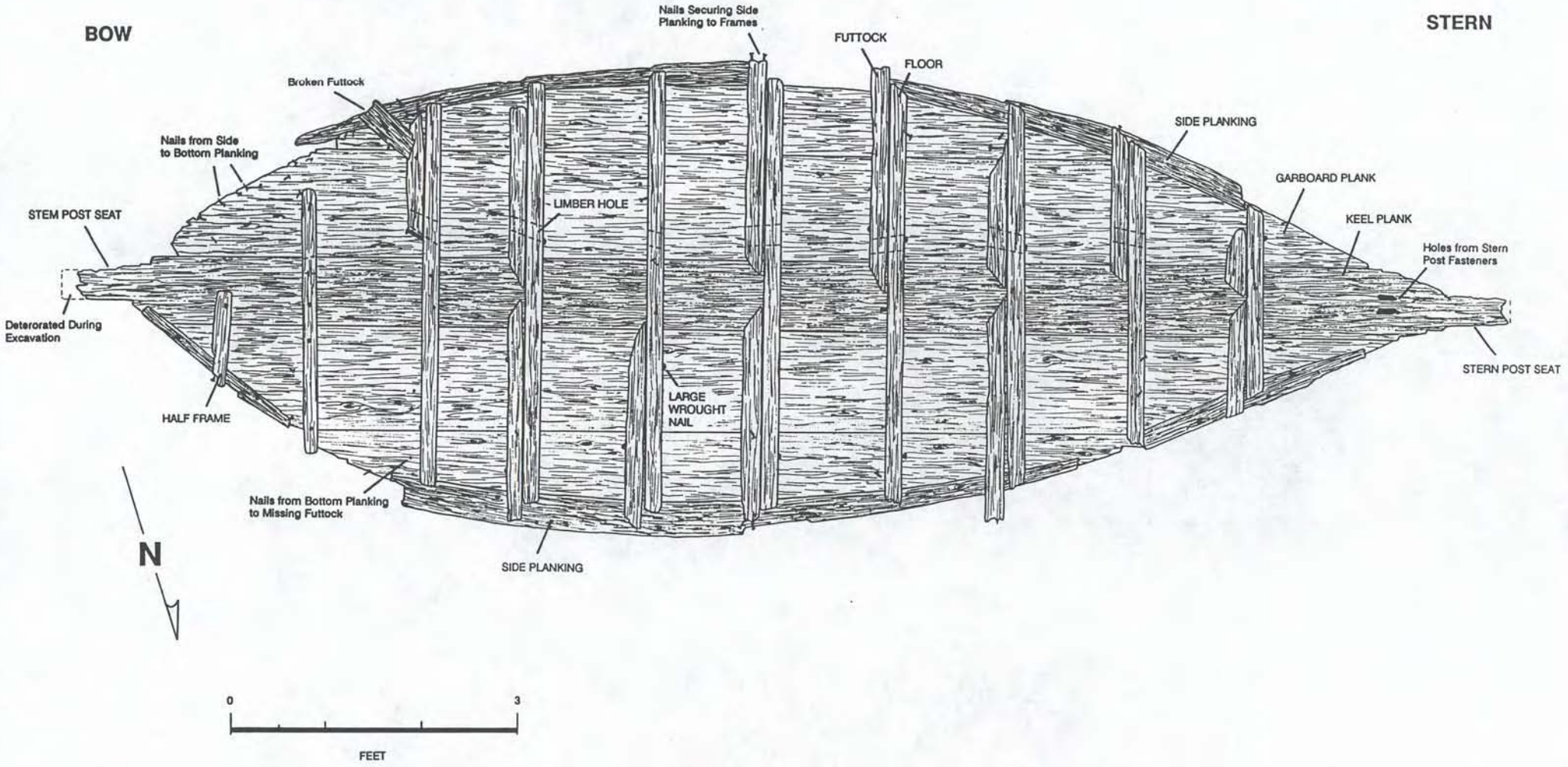
Hull bottom planking measured 1 1/2 inches thick and varied from 11 to 19 inches in width. The first run of planking after the turn of bilge likewise measured 1 1/2 inches in thickness, though in easternmost segment, the planking had been replaced with thicker wood, measuring 2 1/2 inches. In both cases the planks were incomplete, and thus the widths could not be measured. The thicker planking had been notched to receive one of the large shipway spreaders.

The presence of stanchions lining the older framing timbers suggested that the vessel had originally been decked. Uncommon design characteristics, in particular the use of fore and aft planking, as well as certain construction techniques, including hewn and dazed timbers and wrought nails, suggested an early date of construction, possibly the early nineteenth century (*cf.* Terrell, this volume). It appeared that the hull had been refurbished, with the decking removed, the stanchions cut out and heavier transverse timbers added to reinforce the hull for heavy loads, at least one of which seemed to have been coal. Eventually the hull was broken up and part of it placed in its present location to support the shipway as it entered the water. The construction of the shipway is assumed to have taken place in the late nineteenth century. The vessel had by then seen what appeared to have been long years of use, lending support to the notion that the barge was originally constructed in the early nineteenth century or before.

Feature 35

Feature 35 (*Figure 58*) consisted of the remains of the hull of a small bateau or dory, lying near the nineteenth-century shoreline in Trench 14. Much of the pertinent description of Feature 35 is contained in Appendix C. In addition to the description presented there, the following data are considered of note.

As indicated in Appendix C, the vessel was longitudinally planked, with a keel plank serving in place of a formal keel. As recorded in the field, the vessel measured 15 feet from the end of the stem post seat on the keel plank to the end of the stern post seat. The stem and stern post seats consisted of rectangular protuberances, 8 to 10 inches in length and 3 1/2 to 4 inches in width (note that many measurements have been extrapolated from existing lines, due to the relatively advanced state of deterioration of the vessel's timbers, but all are assumed accurate to 1/2 to 1 inch). The keel plank was fashioned of White Oak (*Quercus*



Source: Engineering-Science

Figure 58. Feature 35:
Bateau Hull, Plan View

spp.), and measured 8 inches in width, 1 inch thick at the edges and 1 1/2 inches at center, the additional thickness appearing along the bottom surface. Furthermore, the plank had been planed or warped upward 3/8 inch at the edges to increase the curvature of the bottom surface. The remaining longitudinal planks appeared flat, and thus the vessel exhibited a negligible deadrise (the vertical distance between the bottom of the keel, or keel plank in this case, and the turn of bilge): the boat was virtually flat bottomed.

Two additional hull planks lay on each side of the keel plank. All were of Southern Yellow Pine (*Pinus spp.*) and measured 1 inch thick. The garboard plank (next to the keel plank) measured 12 inches in width and ran the full length of the vessel to within 2 to 3 inches of the stem and stern post seats, with the ends faired inward with the lines of the hull. The second plank displayed a maximum width of 8 1/2 inches near midships, and was cut fair along most of its length, running inward toward the bow and stern. The maximum length of these planks was 8 feet 9 inches. As noted, the craft was longer aft of beam than forward.

The floors, the internal frames crossing the keel plank as described in the appendix, were 2 inches wide and 3 inches thick, fashioned of White Oak (*Quercus spp.*). The futtocks, also of oak, attached to the forward sides of the floors, beginning near the centerline and extending up the side wall of the hull to support the side planking. They were of the same sectional dimensions as the floor timbers, and had been roughly beveled where the ends met near the center of the keel plank. The hull planking was attached to the floors and futtocks with hand wrought iron nails driven through the bottom of the hull. The futtocks were attached to the floors with larger wrought nails (see *Plate 39* for sample of nails). The tenth frame, as numbered from the narrow, stern end, was fragmentary, but appeared to have been a half frame, indicating that it did not cross the centerline of the vessel. The half frame served more in the role of a futtock, supporting the forwardmost hull planking as it faired in toward the stem post. Rough cut limber holes were noted through each floor/futtock assembly from the second through eighth frames immediately to starboard of the keel plank. The first frame had no limber hole; the ninth, of which only the floor remained, was holed at the starboard edge of the keel plank; the tenth, the half frame, was missing on the starboard side. The limber holes were triangular, 2 1/2 to 4 1/2 inches wide and sloping down to starboard. The holes ran at varying angles, either parallel with or skewed from the centerline: the angle was probably not functional, but a matter of expediency.

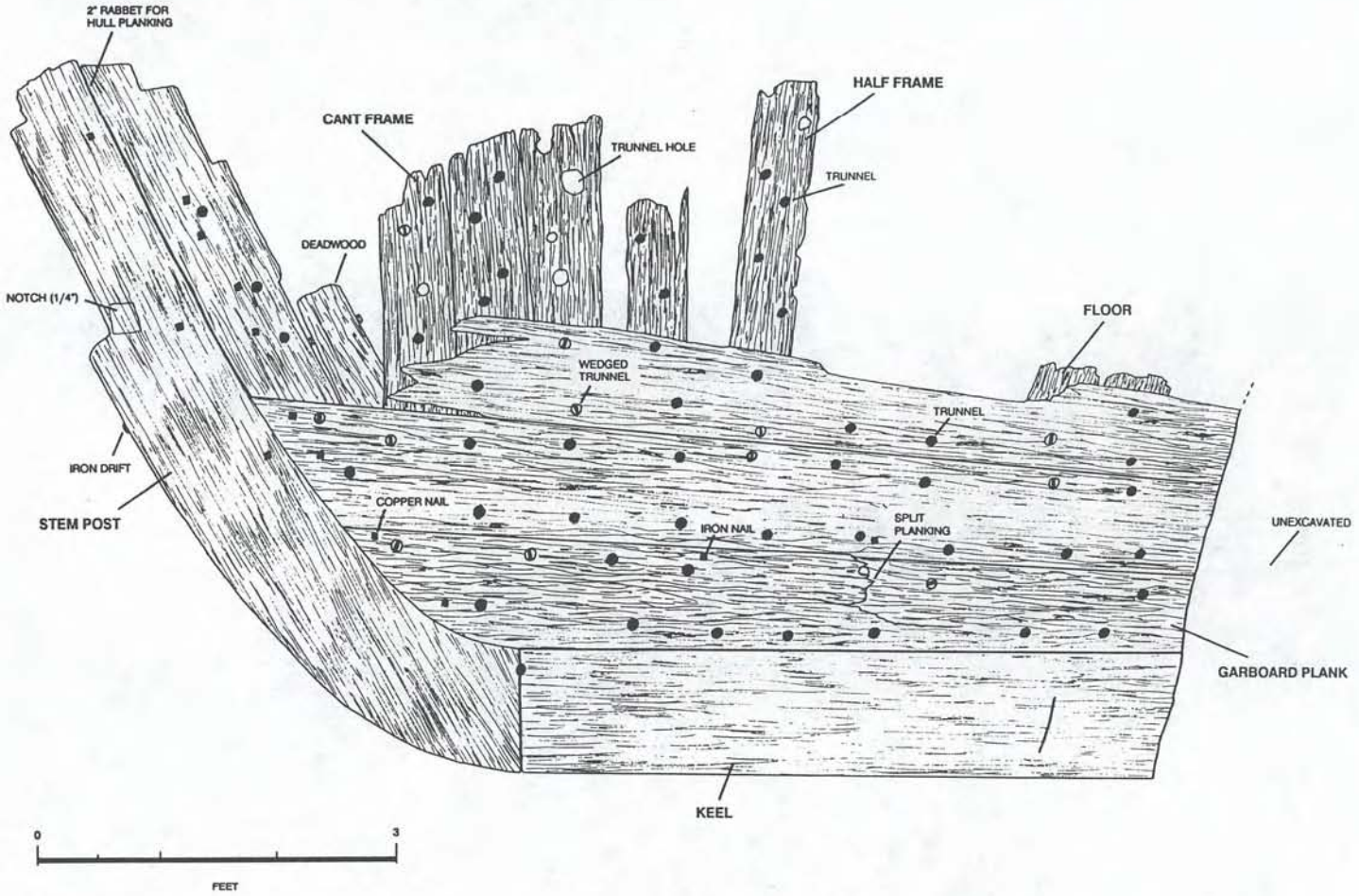
Part of the first strake of side planking above the turn of bilge remained on each side of the hull. The planks were of yellow pine, 1 inch thick. The poor state of preservation made it difficult to determine if any portion represented the original width of the planks: the maximum remaining width was 5 inches. The planking was seated on the edge of the bottom planking which extended beyond the floor/futtock assemblies and appeared to have been rabbeted, or seated in a groove, to the stem and stern posts. The planks were nailed directly to the hull planking from below, with wrought nails used throughout. Estimates of the depth of the hull and dimensions of the stem and stern posts appear in Appendix C.

Feature 37

Feature 37 (*Figure 59*) consisted of the forward section of a shallow drafted, keeled vessel, possibly a tug or small river steamer lying as much as 12 feet below grade. Portions of the bow stem were preserved, along with a relatively small segment of deadwood, the keel and keelson, several single and paired framing timbers, including cant frames, half frames, floors and futtocks, portions of the lower hull planking, ceiling planking and several non-structural longitudinal stringers aft.

The hull was exposed over a total length of 37 feet 9 inches in the archaeological trench, beginning at the deteriorated remnant of the bow stem, lying 7 feet 1 inch below surface grade (-0.86' msl), and running aft to a point at which excavation was halted due to unstable trench walls near the present high tide line, the base of the keel calculated at 12 feet 4 inches below grade (-6.11' msl). It was estimated that at least 1/3 of the length of the vessel was exposed. The entire remains of the bow section to the first floor and futtock pair (a distance of 9 feet 7 inches) was completely excavated, while the remainder of the hull was exposed only aport of the keelson.

The majority of the wood comprising the vessel was oak. Several of the timbers were sampled for wood species identification. The cant frames were identified as White Oak (*Quercus spp.*), the hull planking as White Oak (*Quercus spp.*), the stem as Red Oak (*Quercus spp.*), and the knee reinforcing the junction between the keelson and bow stem Soft Maple (*Acer spp.*).



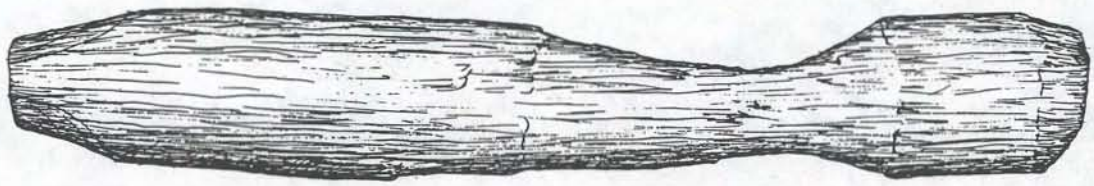
Source: Engineering-Science

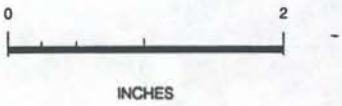
Figure 59. Feature 37:
Keeled Vessel, Port Bow, Elevation

Appendix C notes that several frames were missing near the bow end of the vessel. At least one additional framing member did not survive. Not shown on the half breadth drawing included in the consultant's report was a half frame to starboard of the keelson between the fifth and sixth frames, as counted on the port side. Thus, the first four frames from the stem were cant frames (*i.e.*, leaning forward, or canted, out of perpendicular). The next three were half frames (perpendicular to the keel and keelson, but not crossing the centerline). Floors (running beneath the keelson) and their paired futtocks began after of the half frames.

The existing portion of the stem had been rabbeted, or notched, to receive the hull planking, to present a smooth line of transition from frame to planking. The method of assembling the planking was typical of nineteenth-century wooden ship construction, in which the planks, warped to fit the curve of the hull, were initially secured to the framing timbers with headless iron nails (brass nails were used at the bow stem; samples of both are illustrated in *Plate 40*). Holes were then drilled through the planks and frames, and oak trunnels, 1 inch in diameter, pounded into place. A number of the trunnels at the bow of Feature 37 a had been reinforced with wooden wedges. Extended and heavy use of the vessel was evidenced by the many enlarged holes visible in the frames, suggesting that the vessel had been replanked after the previous trunnels had loosened, wallowing out oversized holes. One such worn trunnel was removed from the third frame on the port side, and is shown in *Figure 60.*

The forward ends of two complete hull strakes were visible at the port bow: the garboard strake, next to the keel, and the second. Portions of a third, deteriorated plank remained above the second. The planks measured $1^1/_2$ inches in thickness and 12 inches in width. The garboard plank had been damaged, ruptured outward at the point of the missing half frame between the existing fifth and sixth frames; the plank may have been split as the frame was torn loose, with the keelson serving as a fulcrum on which the timber levered against the hull plank. Ceiling planks were visible aft of the tenth frame on the port side of the keelson and beginning at the fifth frame on the starboard side. Like the hull planking, the ceilings were $1^1/_2$ inches thick and 12 inches wide, and were attached to the framing members with cut nails.





Source: Engineering-Science
Ford's Landing

Figure 60
Oak Trunnel from Feature 37

A lath-like stringer, measuring 3 by 3 inches in section, lay parallel with the keelson approximately 19 inches off the centerline of the hull in the after portion of the excavation. A similar stringer was situated approximately 6 feet off the centerline. This second timber was identified as a foot wale, used to aid in walking in the hold of the vessel, and thus presumably lay near the turn of bilge. Between the keelson and stringer, and in places covering both, was a compact deposit of iron slag, mixed with a small amount of coal and brick; the material is assumed to have been the remains of ballast.

With more time than was available to the maritime consultants, it was possible to take more extensive measurements of the bow of the vessel. These measurements indicated that the bow stem did not rise at a particularly steep angle. In fact, the stem was raked at an angle of approximately 63 degrees, suggesting that the vessel was not necessarily plum bowed. While there was no indication of additional heavy deadwood supporting the stem, other than the single maple knee, notches were observed on both the forward and aft faces of the stem post which could have been the remnants of scarfs or steps for other forward timbers.

A photograph taken by the Corps of Engineers in 1911, during the infilling of Battery Cove, shows a large derelict hull near the recently constructed riprap wall at the north end of the bay (*Plate 13*). Feature 37 lay in approximately the same location as the vessel in the photograph, yet several inconsistencies make positive identification difficult. For example, the vessel in the photo was in poor condition, and thus the original shape of the hull is unclear. The framing was similar to that of Feature 37, but the bow appeared almost perpendicular. Considerably more of the hull in the photograph appeared to have remained intact than remained of the excavated portion of Feature 37. Since the photo was taken in 1911, when the cove was partially filled, the vessel probably did not remain for a lengthy additional period in the open air, and thus would have been subject to little further deterioration. Yet despite the uncertainties, the vessels do appear to lie in the same location. The stern of the vessel in the photograph butts against the riprap wall. Thus, if the two vessels are the same, the length of the hull would have been approximately 170 feet, the distance from the bow of Feature 37 to the wall.

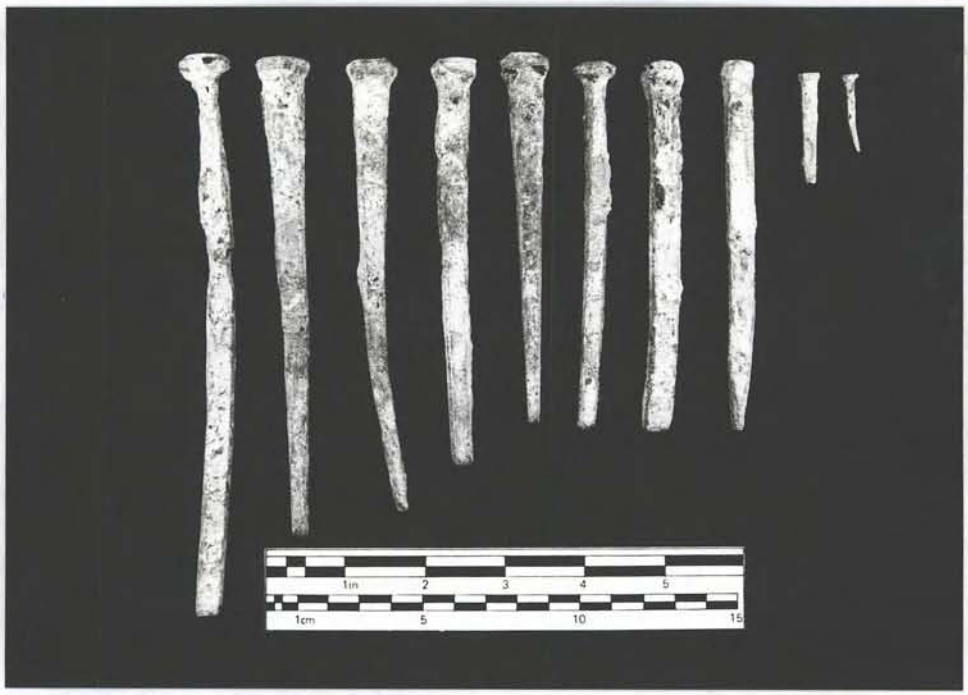


Plate 38. Nail Sample, Feature 27

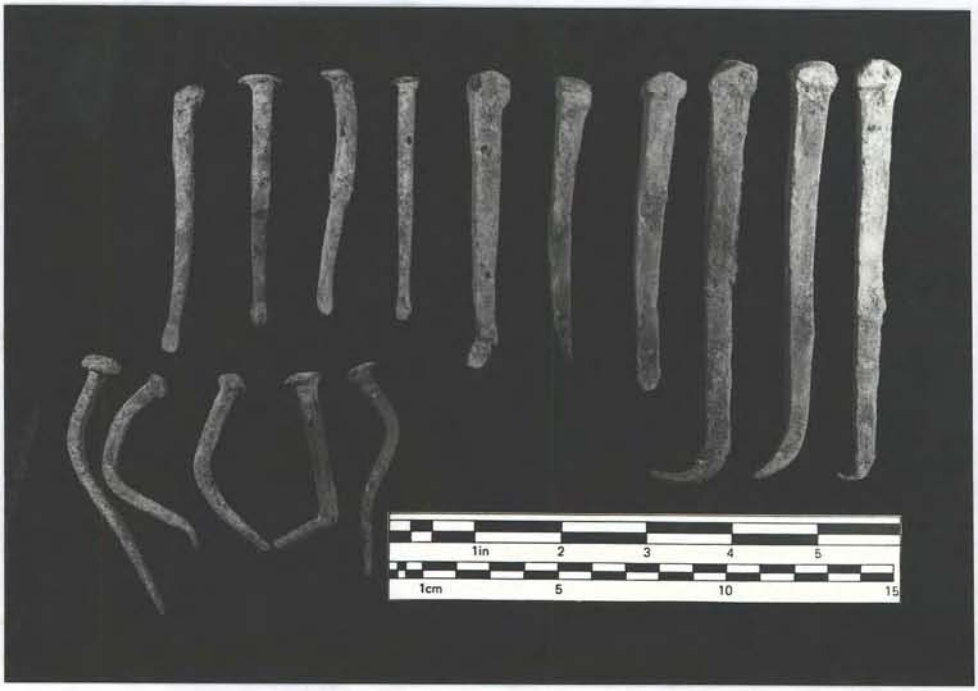


Plate 39. Nail Sample, Feature 35

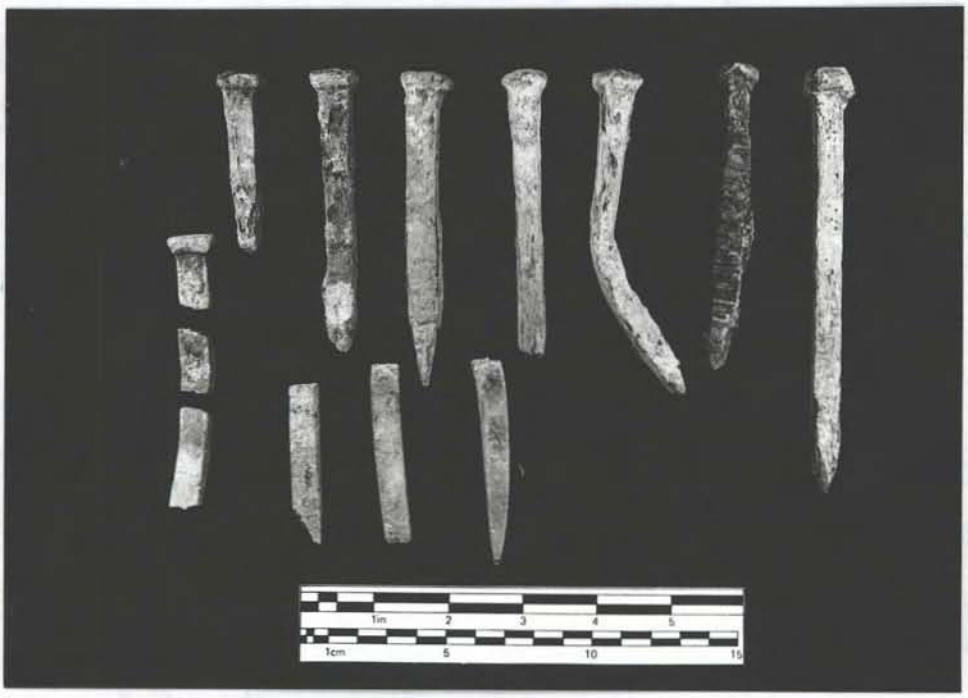


Plate 40. Nail Sample, Feature 38

Plate 41. Feature 27, Starboard

Plate 42. Feature 27, Stern

Plate 43. Feature 27, Midships, Port Quarter

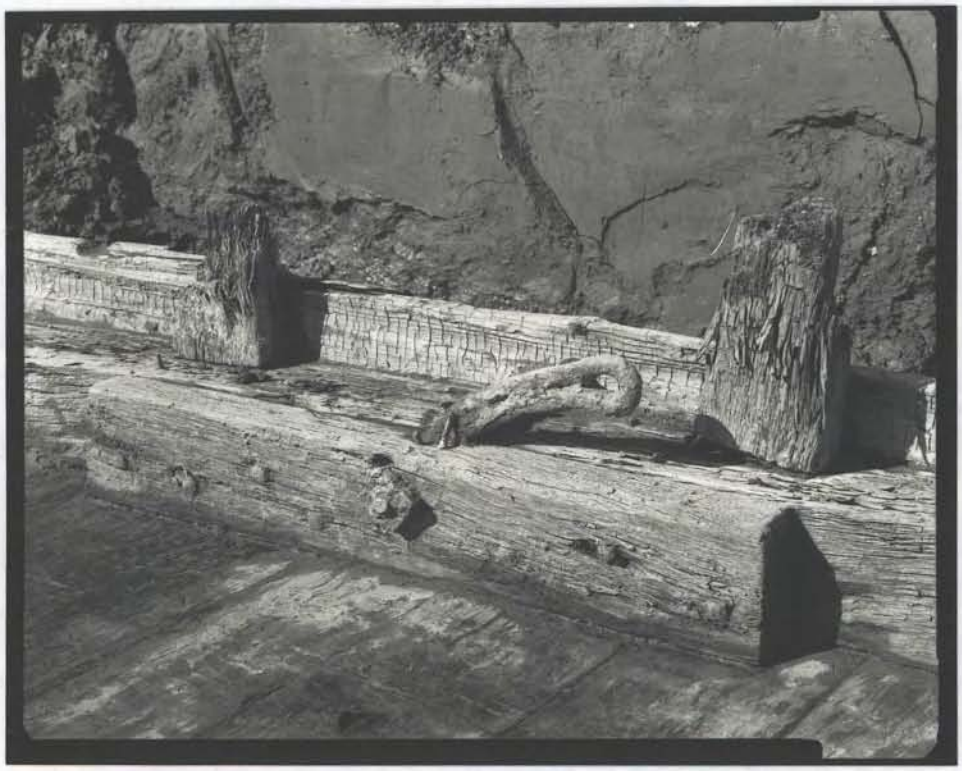


Plate 44. Feature 27, Hogging Loop, Inboard Starboard Profile

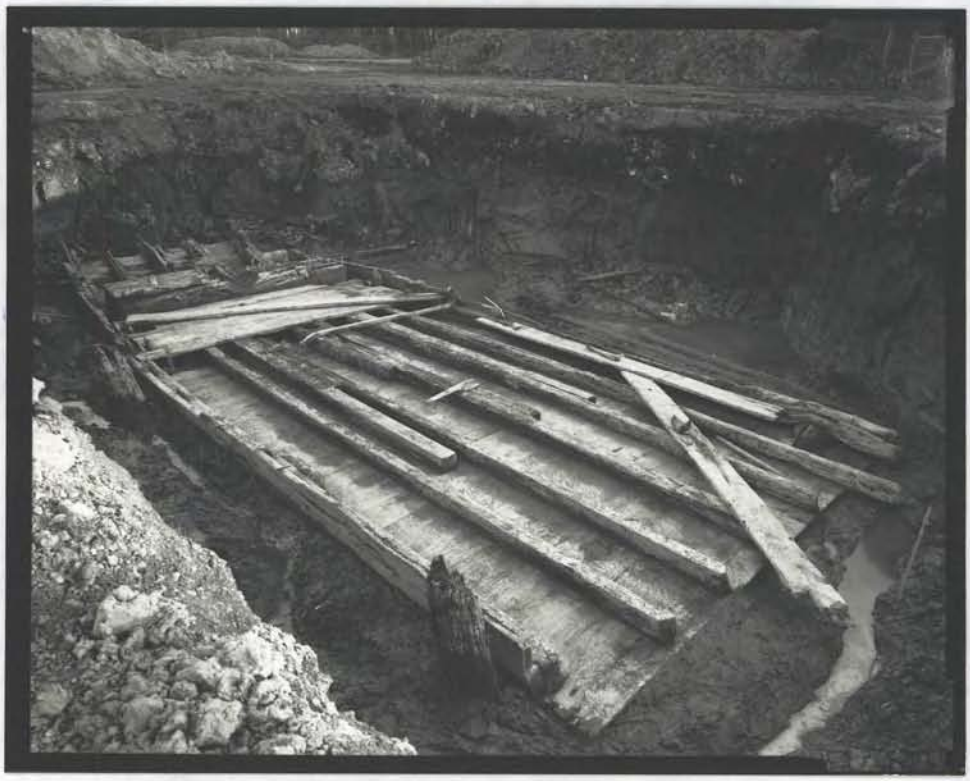


Plate 45. Feature 34, Midships, Starboard Quarter

Plate 46. Feature 34, Stern

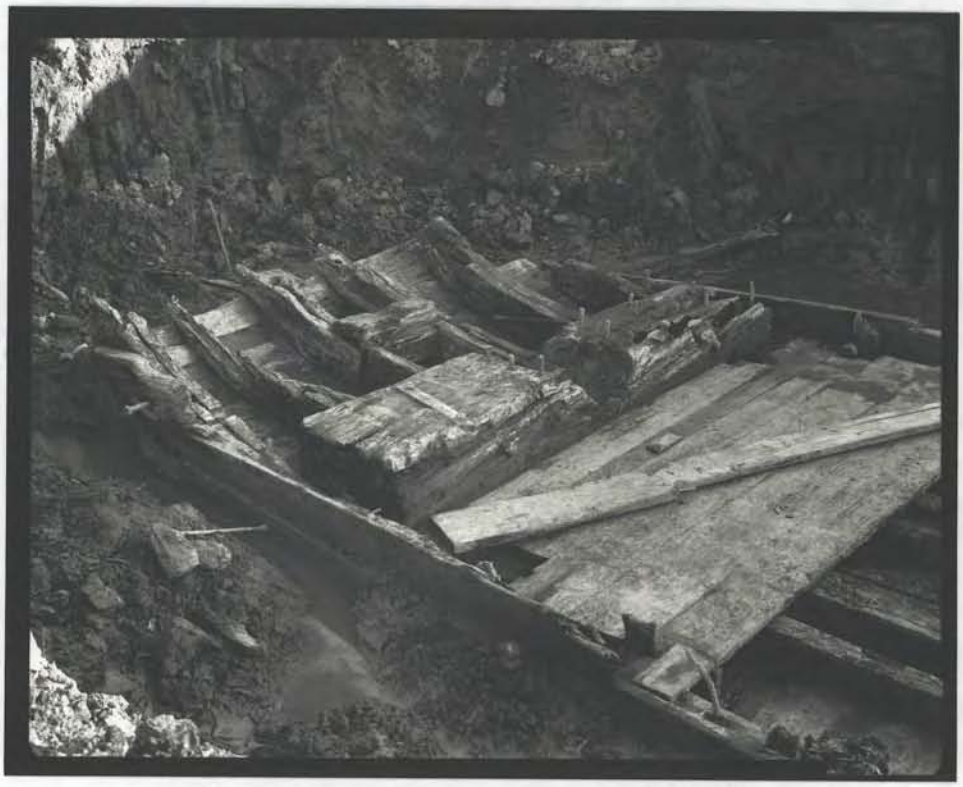


Plate 47. Feature 34, Machinery Cradle, Starboard Quarter

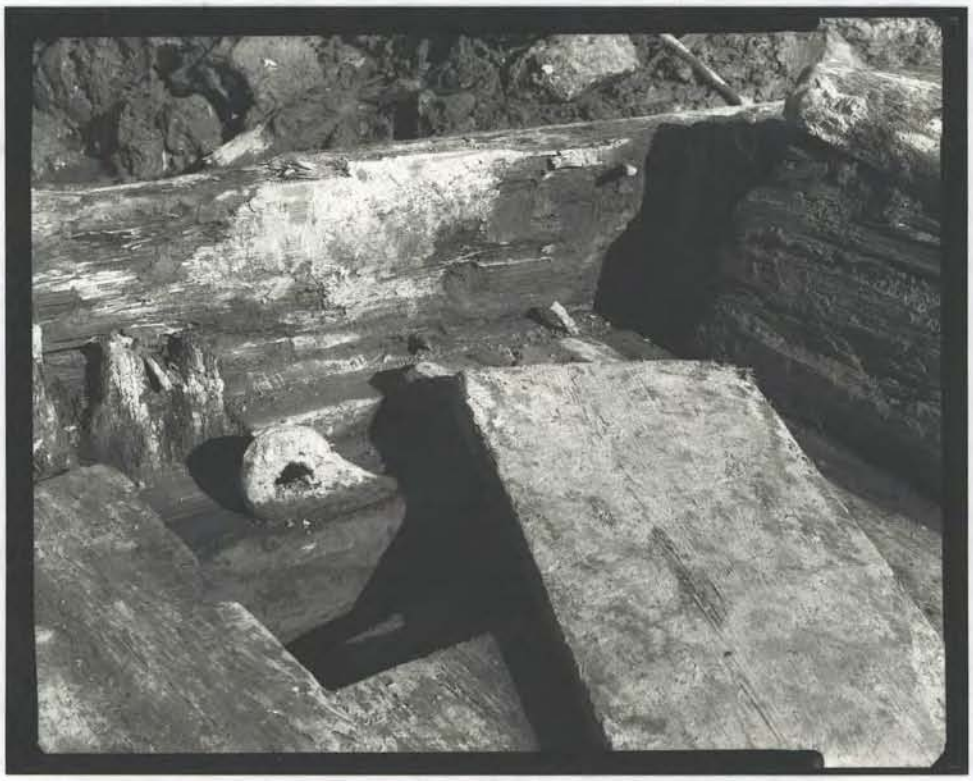


Plate 48. Feature 34, Hogging Loop, Inboard Starboard Profile

Plate 49. Feature 2, Bow

Plate 50. Feature 2, Stern

Source: Engineering-Science
Ford's Landing

Plates 49 & 50

Plate 51. Feature 2, Bow, Interior Framing

Plate 52. Feature 2, Stern, Metal Corner Repair

Plate 53. Feature 31, Bow

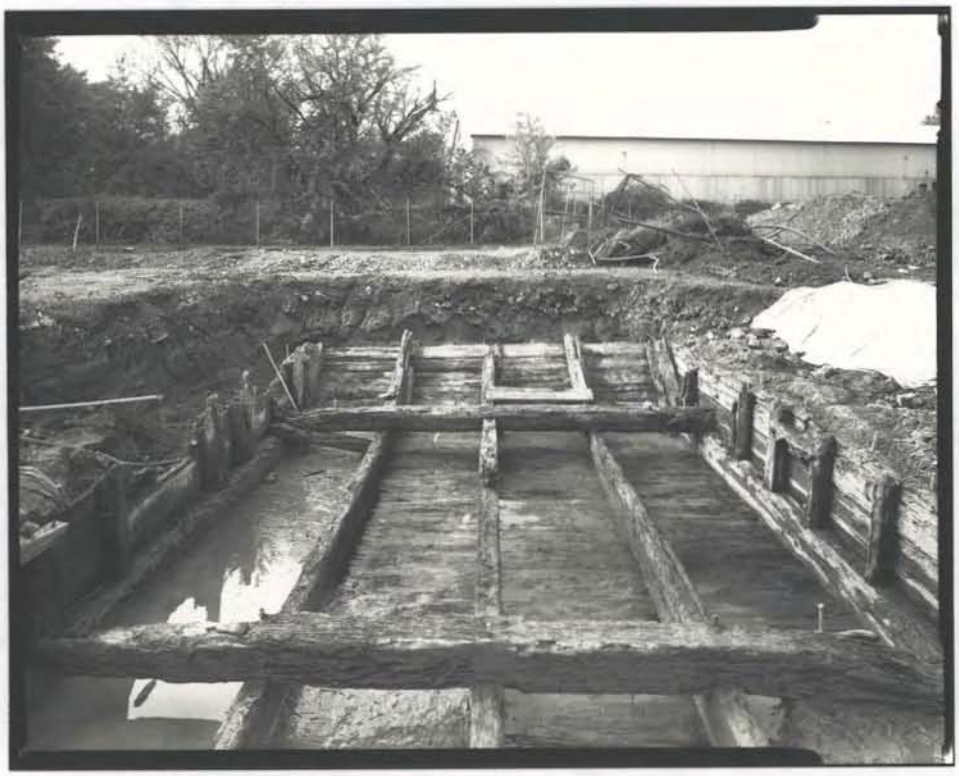


Plate 54. Feature 31, Bow From Midships

Plate 55. Feature 31, Bow, Interior Framing

Plate 56. Feature 31, Bow, Ramp Framing

Plate 57. Feature 30, Side View, Nineteenth-Century Bulkhead to Right

Plate 58. Feature 30, Quarter View, Bulkhead in Foreground

Source: Engineering-Science
Ford's Landing

Plates 57 & 58

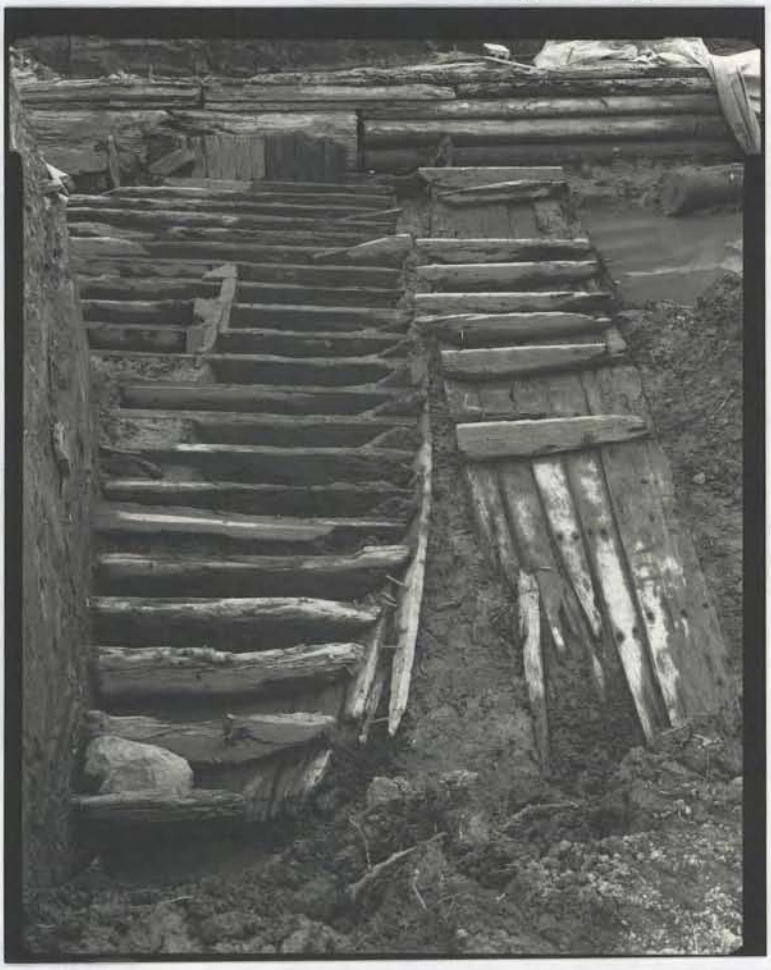
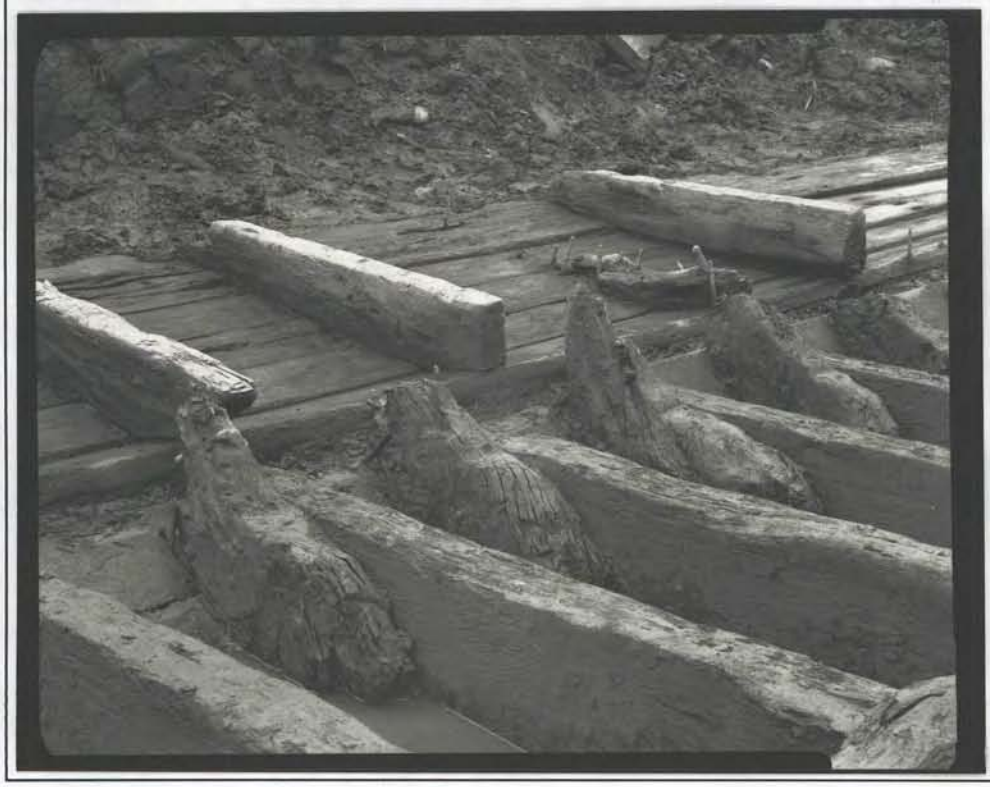


Plate 59. Feature 30, End View, Bulkhead in Background

Plate 60. (Below) Feature 30, Knees and Side Planking



Source: Engineering-Science
Ford's Landing

Plates 59 & 60

Plate 63. Feature 35, Stern Post Seat

Plate 64. Feature 35, Port View, Eighteenth-Century Bulkhead in Foreground, Feature 31 in Background

Plate 65. (Above) Feature 37, Bow

Plate 66. Feature 37, Plan View of Bow Framing, Showing Keelson, Cant Frames, Deadwood and Bow Stem

Source: Engineering-Science
Ford's Landing

Plates 65 & 66

VIII. ARTIFACTUAL EVIDENCE

Predictions made as to the amount and type of artifactual material recoverable from both Phase II and Phase III excavations at Ford's Landing were disappointingly accurate. A relatively large number of artifacts were in fact recovered -- 3,400 in total -- yet most were from obviously disturbed late nineteenth- or twentieth-century contexts; *i.e.*, from redeposited, or secondary fill.

As indicated in the descriptions of individual depositional units -- the eighteenth-century wharf fill, nineteenth-century shipyard deposits, and Battery Cove deposits -- artifacts from the site consisted of a variety of materials from the late eighteenth through twentieth centuries, as well as from several prehistoric periods. Due to the relatively low artifact counts from well-defined contexts, the materials will not be described in great detail. Rather, the general run of artifacts from specific contexts will be discussed and brief descriptions of unusual or otherwise noteworthy items provided. Descriptions of specific artifact types mentioned in the text may be found in a Glossary provided in Appendix A. A complete artifact inventory appears in Appendix I.

Lab Methodology

All artifacts were cleaned on arrival in the laboratory. Prehistoric lithics and ceramics were lightly washed. Non-organic historic materials, such as ceramics, glass and metal, were also washed. Organic materials, such as shell, bone or leather, were lightly dry brushed if removed from a dry soil environment; otherwise they were rinsed to remove wet sands or clays. All non-organic artifacts were dried on mesh screens prior to further processing.

After consultation with conservation experts associated with Alexandria Archaeology, it was decided that waterlogged wood and leather objects should be slow dried. Selected leather objects were sewn into mesh bags to retard deformation during the process. A number of wood samples had been collected in the field from bulkhead components, shipway timbers and portions of the several vessels excavated in the Battery Cove deposits. Of these samples, 39 were chosen for species identification analysis. Segments measuring approximately 2 by 2 by 6 inches were cut from each sample and were bagged with

provenience information and sample number (bag inventory number). The samples were sent to The Thomas M. Brooks Forest Products Center at the Virginia Polytechnic Institute and State University, in Blacksburg, where they were sectioned and examined microscopically for identifying anatomical features. The results of the analysis are presented in the text.

All artifacts and samples were inventoried onto computer disk, using dBase III Plus data base management software. Artifact labeling was carried out according to procedures specified by Alexandria Archaeology for eventual curation at its storage facility. Glass and ceramic materials from selected proveniences were cross-mended. All processed artifacts were stored in resealable polyethylene bags by material type in order to facilitate retrieval and minimize damage to fragile objects. Each bag was labeled with site name and bag number. An acid free tag with complete provenience information was placed in each provenience bag. Bags were stored in bag number order in archival quality boxes. An acid free label was attached to each box with site name and the number of the box in the series.

Eighteenth-Century Wharf Fill

As the preceding descriptions indicate, the soil matrix which constituted the main body of the fill of Keith's Wharf was, in general, relatively uniform and free of inclusions of any sort -- either natural, in the form of gravels or cobbles, or cultural. In some of the areas sampled thin, refuse containing strata were apparent, as for example in Trench 10B, where a layer of gravels and woody debris (Trench Stratum E) was recorded. But on the whole, the eighteenth-century fill appeared to consist of clean, redeposited subsoil. This finding tends to corroborate documentary evidence which suggested that the bulk of the earth used to fill Keith's Wharf was derived from the bluffs nearby, between Union and Water Street (now Lee Street). In contrast, many wharves of the period were filled with secondary deposits, refuse laden soils originating from occupied sites lying further inland or from dredging conducted along nearby docks and wharves. These often artifact-rich deposits have in many instances provided archaeologists with a valuable source of analytical data applicable to the study of refuse disposal patterns and general site use. In the present case, the wharf builders appeared to have had a ready source of clean fill close at hand: the material would have been cheap (involving little transportation cost), of known quality (not full of wood or other light debris which would rot and settle) and easily procured.

Yet artifacts did appear within the portions of wharf fill sampled during both the survey and data recovery excavations at the Ford's Landing site. These materials consisted of 1) small amounts of late eighteenth-century domestic refuse, providing physical evidence of the date of wharf construction, 2) industrial debris from the late nineteenth and early twentieth centuries, and 3) prehistoric artifacts, indicating the presence of prehistoric activity along the margins of the river, activity spanning several thousand years, from the Middle Archaic period through the Late Woodland. The following paragraphs will briefly summarize the findings.

Artifacts

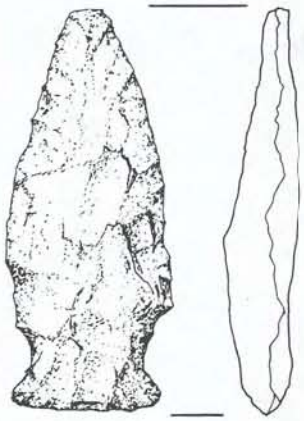
While there was little artifactual evidence from the northern sections of the trenches excavated across the site, artifacts, mostly prehistoric, were recovered from wharf fill deposits nearer the south edge of the wharf. Test Unit 4, excavated within Universal Stratum C, the wharf fill, beneath the centerline of the nineteenth-century shipway in Trench 10E, yielded 27 prehistoric artifacts, listed below:

1 quartz biface	8 quartzite flakes
10 quartz flakes	1 quartzite chip
6 quartz chips	1 chert chip

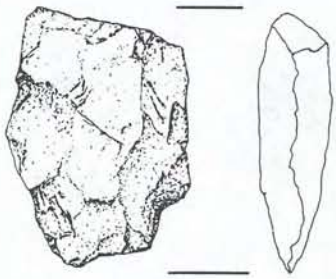
Also occurring within the deposit were 1 fragment of undecorated creamware, 2 brick fragments and 2 fragments of wood, all recovered from the uppermost levels of the unit, suggesting that the materials may have been intrusive from the overlying fill. From the general excavation of the wharf fill in Trench 10E, a quartz Calvert point (*Figure 62A*) was recovered.

To the south, wharf fill taken from the sump at the end of Feature 1 in Section N of Trench 10 was kept separate after excavation. Trowel sorting resulted in the recovery of 58 prehistoric artifacts:

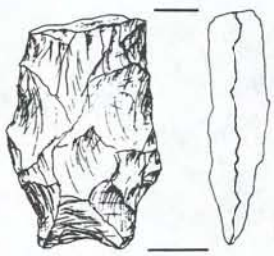
1 quartz uniface	19 quartzite flakes
27 quartz flakes	11 quartz chips



A (Trench 12F)



B (Trench 13G)



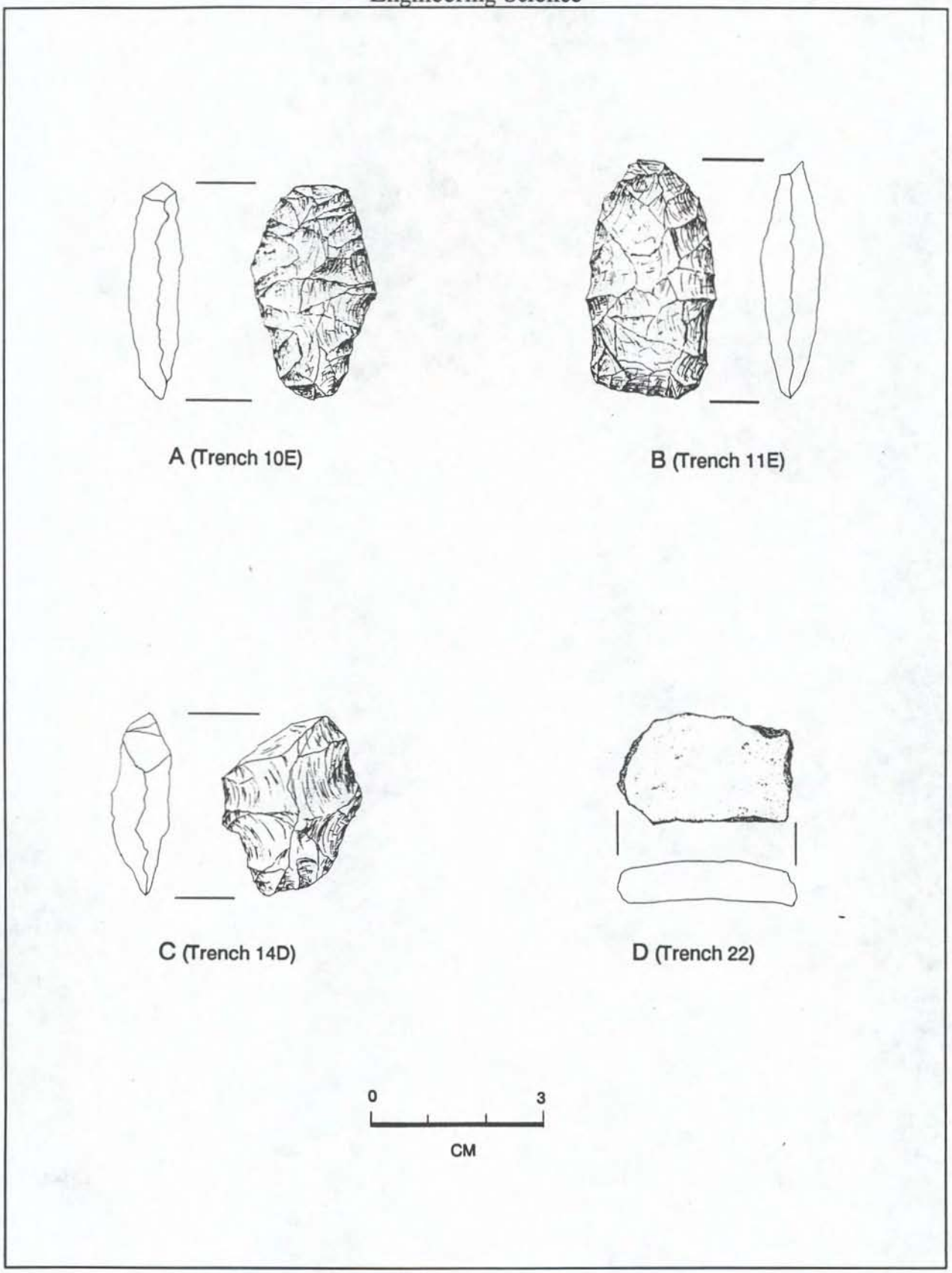
C (Trench 11E)

0 3

CM

Source: Engineering-Science
Ford's Landing

Figure 61
Archaic Projectile Points



Source: Engineering-Science
Ford's Landing

Figure 62
Woodland Projectile Points
and Ceramic

Southeast of Trench 10N, in Section E of Trench 11, a quartz Calvert point (*Figure 62B*) was recovered from the wharf fill deposit. A second point, a small, quartz Savannah River variant (*Figure 61C*), was taken from a deposit identified contextually as Universal Stratum E, the late nineteenth-early twentieth-century cove bottom deposit which lay directly over the eighteenth-century wharf fill. This deposit also contained a small amount of historic material of varying date, and was considered to represent a mixed provenience. It thus seems likely that the projectile point originated within the wharf fill below, and eroded from the fill under the force of tidal action as the cove waters overran the wharf margin in the nineteenth century.

Farther to the southeast, a similar situation was recorded in Trench 12, Section F. Trench Stratum I was identified in the field as wharf fill (Universal Stratum C), yet along with a small amount of prehistoric material, it contained late eighteenth, nineteenth and early twentieth-century artifacts, suggesting mixing of the wharf fill and later cove bottom sands. The main body of the wharf fill deposit in this location yielded 66 prehistoric artifacts:

3 quartz bifaces	1 quartzite projectile point (Halifax) (*Figure 61A*)
37 quartz flakes	10 quartzite flakes
13 quartz chips	2 quartzite chips

In Section G of Trench 12, excavated along both sides of Feature 33, the wharf bulkhead, 13 prehistoric artifacts were recovered north of the bulkhead in Universal Stratum C:

3 quartz flakes	1 quartzite biface
6 quartzite flakes	3 fragments of fire cracked quartzite

Prehistoric materials were also recovered from the sandy deposits lying below the early twentieth-century Corps fill, directly south of, or outside the bulkhead in Trench 12G. Prehistoric artifacts included:

4 quartz flakes	1 chert chip
8 quartzite flakes	3 fragment of fire cracked quartzite
1 rhyolite flake	1 fragment of fire cracked quartz
1 quartz chip	

A single quartz flake was recovered from the same deposit in Test Unit 5, excavated over the line of the bulkhead beneath Feature 27. Historic materials generally diagnostic of the mid-to-late eighteenth century occurred along with the prehistoric artifacts in the sandy deposits outside the bulkhead. The relative dates of the materials suggested that both the historic and prehistoric artifacts had eroded from the wharf fill as the bulkhead timbers deteriorated and fell away.

No artifactual evidence was recovered from the wharf fill in the north sections of Trench 13. To the south, in Section E of the trench, a small amount of prehistoric material was found intermixed with late eighteenth, nineteenth and early twentieth-century artifacts in Universal Stratum E, the later cove bottom sands, in a situation seen earlier in Trench 11E and Trench 12F. In Section F of Trench 13, 13 prehistoric artifacts were recovered from Universal Stratum C:

2 quartz bifaces	1 quartzite flake
1 quartzite biface	1 rhyolite flake
7 quartz flakes	1 quartz uniface

The upper portions of the fill here were mixed with late cove bottom deposits, containing a relatively large amount of late eighteenth- and nineteenth-century artifactual material.

In Section G of the trench, 1 rhyolite point fragment (small Savannah River variant) (*Figure 61B*) , 2 quartz bifaces, 1 quartzite flake, 1 quartzite chip, and 1 fragment of fire cracked quartzite were recovered from Trench Stratum F, a variegated nineteenth-century fill intermixed with wharf fill. From a the same mixed deposit in Test Unit 3, 1 quartz and 2 quartzite flakes were recovered, along with a small amount of late eighteenth-century historic material.

To the southwest, in Trench 14, Section D, a single fragment of fire cracked quartz was recovered from wharf fill north of the bulkhead. Immediately south of the bulkhead, 1 quartz point fragment (Calvert) (*Figure 62C*) , 4 quartz flakes, 1 quartzite flake and 1 quartz chip were recovered from within the late cove bottom sands, the artifacts possibly having eroded from the wharf as the bulkhead deteriorated, as was the case in Trench 12G.

In Trench 22, to the east, 17 prehistoric artifacts were recovered from wharf fill deposits 20 to 25 feet north of the bulkhead:

1 quartz biface	1 rhyolite flake
1 quartzite biface	1 fragment of fire cracked quartzite
5 quartz flakes	1 fragment of fire cracked quartz
6 quartzite flakes	1 fragment of sand and crushed quartz tempered ceramic (*Figure 62D*)

Farther to the east, in Trench 23, 3 quartz and 3 quartzite flakes were recovered from the wharf fill deposit along with fragments of eighteenth-century ceramic and glass. South of the bulkhead, and eroded from the body of the wharf deposit, 1 quartz flake and 12 quartz chips were recovered along .

Prehistoric Artifact Summary

In total, 262 prehistoric artifacts were recovered from various portions of the wharf fill. The ultimate proveniences of these materials are, of course, impossible to determine with precision, since all were recovered from fill deposits -- either primary wharf fill or a mixture of eroded wharf fill and nineteenth-century alluvium. No prehistoric artifacts were recovered from the intact alluvial deposits below the eighteenth-century wharf fill. Sources indicate that most, if not all, of the earth used to fill Keith's Wharf was derived from the cutting of the high bank along Lee Street. Thus it may be assumed that the artifacts present in the fill represent the remains of one or more prehistoric occupation sites along the former shoreline.

Diagnostic artifacts indicated occupations ranging from the Middle Archaic period, represented by a Halifax projectile point, the Late Archaic, by a small Savannah River variant projectile point type, the Early Woodland, by Calvert points, to the Late Woodland, by a fragment of Potomac Creek ceramic. An extensive study of the prehistoric artifacts in the collection was not undertaken, but examination of the material indicated that a variety of biface types, flakes and flake tools and fire cracked rock were present, suggesting that portions of several sites were represented. Alternatively a single, large site was present, probably in the form of a base camp which would have served as a long-term occupation site, permanently inhabited for extended periods or seasonally revisited, and from which forays

for particular resources would have been conducted. Excavation of the Lee Street bank in the late eighteenth century was presumably confined to a relatively small area, and thus the latter was probably the case.

In Section IV of this report, which reviewed the previous archaeological investigations which have been conducted within Alexandria and particularly along the waterfront, it was noted that few prehistoric sites have been recorded within the city. This situation is most likely a matter of sampling bias, and not a reflection of actual prehistoric settlement patterns, since so few surveys have been carried out within the city, and since there is relatively little ground remaining which has been undisturbed after more than 250 years of historic urban development. Prehistoric occupation of the river shoreline was certainly extensive and repeated during the 10,000 years or more that man has inhabited the Middle Atlantic region. Regional survey data amassed in the past 20 years have indicated that prehistoric populations were drawn to the resource-rich areas at the confluences of fresh water and estuary streams. The potential for prehistoric occupation of the area around Ralph's Gut, at the foot of Oronoco Street, for example, is high, though historic land use has probably disturbed most direct evidence of its presence. Other, smaller streams would have flowed into the Potomac along portions of the waterfront, and thus sites would be expected at locations all along the river, particularly on the high, well-drained and relatively sheltered bluffs. It is, then, not unlikely to find indications of an extensive prehistoric site along the bluffs east of Lee Street.

Historical Artifact Summary

Historical materials were encountered in several areas within the eighteenth-century wharf fill deposit, both in place within the wharf and eroded into the cove over the deteriorating bulkhead. In most cases, artifacts were recovered in small quantities and in relatively isolated areas. Artifact types diagnostic of the late eighteenth and early nineteenth century included fragments of delft, white salt-glazed stoneware, Shaw stoneware, Chinese porcelain, creamware, pearlware, gray stoneware and free-blown wine bottle glass. The artifacts represented materials deposited behind the bulkhead either in 1785, during the original construction of the wharf, or somewhat later, around the turn of the nineteenth century when the upper courses of the bulkhead were retimbered and the fill replenished. All

of the artifacts occurred as very small fragments indicative of incidental inclusion in the fill and redeposition from areas of original discard.

A relatively large amount of material was recovered from wharf fill deposits in Trench 12 Section F, near the south central edge of the wharf. Artifacts included fragments of creamware, pearlware and free-blown wine bottle glass, along with prehistoric materials and a number of nineteenth-century artifacts, the latter probably mixed in from the overlying cove bottom deposits and pressed downward by the Corps dredging spoil which was introduced atop the alluvium in the early twentieth century. In Test Unit 5, in the same area along the southern edge of the wharf, a fragment of white salt-glazed stoneware was recovered along with pieces of creamware and pearlware. A similar situation was recorded in Trench 13F, with numerous fragments of the same refined earthenwares recovered in combination with non-diagnostic artifacts such as kaolin pipe stem and bowl fragments, a doll's head, a bone toothbrush and an oarlock. In Test Unit 3, excavated in Trench 13G in the east central portion of the wharf, fragments of free blown wine bottle glass, creamware, shell edged and hand painted pearlware and gray salt-glazed stoneware were recorded. To the south along the bulkhead in Trench 22, creamware, pearlware and Chinese porcelain were recovered. Near the southeast corner of the wharf, in Trench 23, undecorated creamware, hand painted, transfer printed and annular decorated pearlware, and free blown wine bottle glass, were recorded along with assorted non-diagnostic construction materials and animal bone. Late eighteenth-century historic materials were also recovered from a similar provenience in Trench 23X, including the same refined earthenware types, and fragments of hand painted, overglaze Chinese porcelain, gray salt-glazed stoneware wasters and kaolin pipe stem.

As noted previously, wharf fill was observed outside the bulkhead line, having eroded through gaps in the joinery as the timbers settled over time or over the top edge of the timbers as the bulkhead itself deteriorated. In Trench 12G, for example, diagnostic items included mid-to-late eighteenth-century ceramic and glass fragments, including white salt-glazed stoneware, creamware, pearlware, Chinese porcelain and free blown wine bottle glass. Roseheaded, handwrought nails and fragments of hand painted pearlware were recovered south of bulkhead in Trench 23.

Cove Bottom Deposits

In general little artifactual material was recovered from the silty, sandy sediments which comprised the alluvial deposits on the cove bottom. Three areas stand out: 1) the area examined in Trench 15, near the late nineteenth- and early twentieth-century cove shoreline, which contained a number of small artifact fragments washed out from either the wharf, to the north, or from fast land, to the west; 2) the area directly adjacent to the eighteenth-century wharf bulkhead (Trenches 14, 22, 12G, the south end of 23, and 23X), which contained a variety of ceramic, glass, iron and prehistoric artifacts lost over the wharf edge or eroded outward with the wharf fill; and 3) the later cove bottom formed north of the eighteenth-century bulkhead line as the cove waters rose over the deteriorating bulkhead, this in Trenches 12F, the north end of Trench 23, and in Trench 13F-L.

The material from Trench 15 included fragments of Chinese export porcelain, hand painted pearlware, lead glazed and unglazed redware, a smaller amount of whiteware and ironstone, wine bottle and mold blown container glass, lamp chimney glass, construction material and bird and mammal bone. Also recovered was a quartzite flake. All of this material may in fact have originally been derived from the wharf, which lay a short distance to the north. The artifacts may have been contained in fill which eroded from the main body of the structure, or may have been material discarded or lost over the side of the wharf: eventually, all appeared to have washed out into the cove on the tide or during storms.

Several larger ceramic pieces, partially reconstructed from fragments (*Plates 67-68*), were recovered outside the bulkhead, suggesting loss over the side of the wharf into the waters of the cove as opposed to intentional deposition as wharf fill and later erosion over the bulkhead line. A number of pins, spikes and large nails, along with several smaller, roseheaded nails, were also recovered off the side of the wharf, either lost or resulting from the deterioration of the bulkhead itself.

Also related to deposition on the cove bottom were the several derelict vessels encountered along the wharf bulkhead and cove shoreline. Detailed treatment of the vessels themselves appears below in a separate section of the report and in Appendix C. Few artifacts were recovered in association with the vessels, a not unexpected finding, considering the fact that each of the vessels was derelict, stripped of useful material prior to

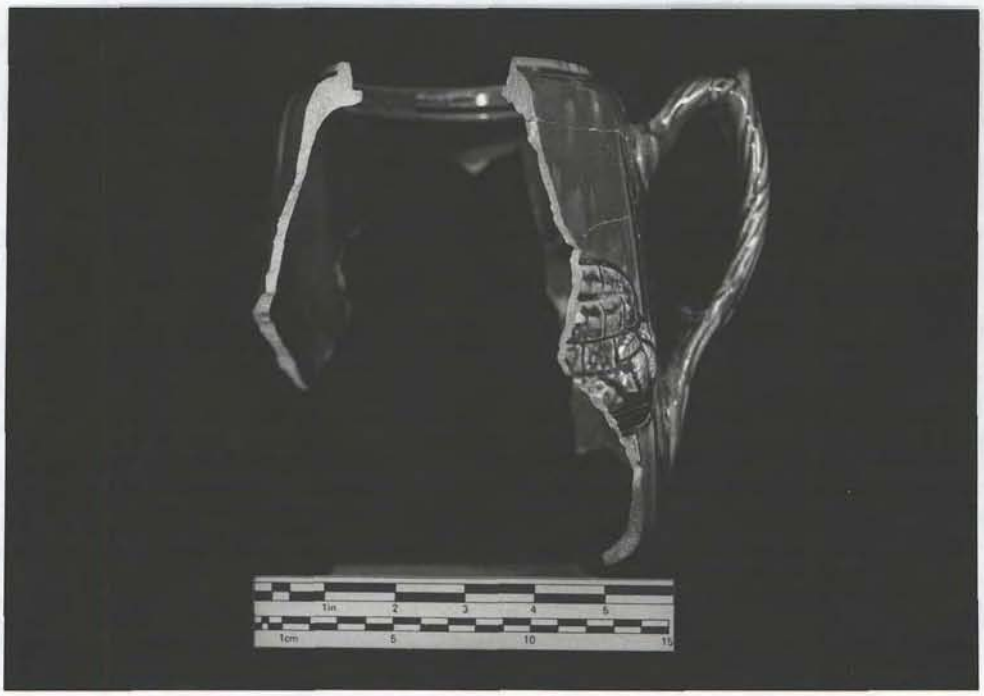


Plate 67. Rockingham/Bennington Pitcher from Trench 22, Stratum I

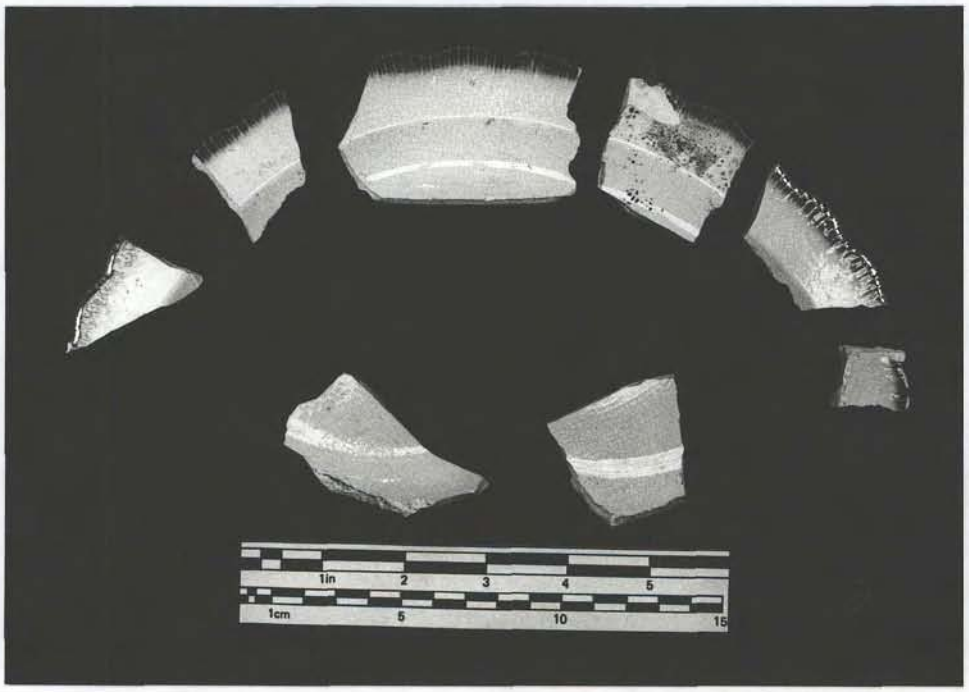


Plate 68. Shell-Edged Pearlware Plate from Trench 12G, Stratums G-H

Source: Engineering-Science
Ford's Landing

Plates 67 & 68

abandonment. With the exception of a deposit of coal in Feature 34, the scow hull in Trench 22, and slag ballast in the hold of Feature 37, the keeled vessel in Trench 24, no artifacts recovered from within the vessel hulls could be directly attributed to their use. The hulls or hull fragments typically contained a thin layer of gray sand, often slightly coarser than the general run of sand on the cove bottom, within which small fragments of ceramic, glass or metal were observed, occasionally along with larger artifacts. For example, several large iron fittings and a drill bit were recovered from sandy deposit within base of the hull of Feature 37 (*Plate 69*). Feature 34 held construction material such as brick, pressboard, window glass, nails (mostly cut, though one wire nail was recovered), bolts, wire, washers (few of the metal artifacts were of copper alloy), rubber gaskets, strips of leather, a free blown wine bottle base with iron tipped pontil mark, mold blown container glass, the deflector plate from a small lamp or lantern, a threaded hydraulic or fuel line coupling, a small round valve handle and a glass and copper automatic oiler used to provide continuous lubrication to machinery bearings (the latter four illustrated in *Plate 70*). All of the material from Feature 34 was recovered from alluvial sand mixed with coal in a layer above the frames of the vessel's hull.

A final item of interest from the cove bottom was a glass lens (*Plate 70*) recovered from the sands immediately below the Corps spoil in Trench 12 Section F. The lens was similar to a deck light, also referred to as a bull's eye, which was set into the wooden planking of a vessel to allow sunlight below decks (Melville 1849; Desmond 1984). A comparable light was recently recovered from a brig in Lake Ontario (Crisman 1991). A narrow shelf or seat around the rim also suggests the possibility that the object may have been an ordinary lantern lens.

Shipyard Debris

Surprisingly little in the way of shipyard related construction material was recovered from the site, considering the span of time during which the wharf served as a yard. The type of materials expected were tools typical of the trades involved -- carpentry, cooperage, sailmaking, caulking, and smithing, among others. The tools would have been made of metal, wood or even leather, represented by saws, axes, adzes, a brace and bit, spar planes, draw knives, plumb bobs, trammels, various mauls or wedges, the distinctive, long-headed caulking mallet, or possibly a palm, a leather patch with a metal slug at the center for

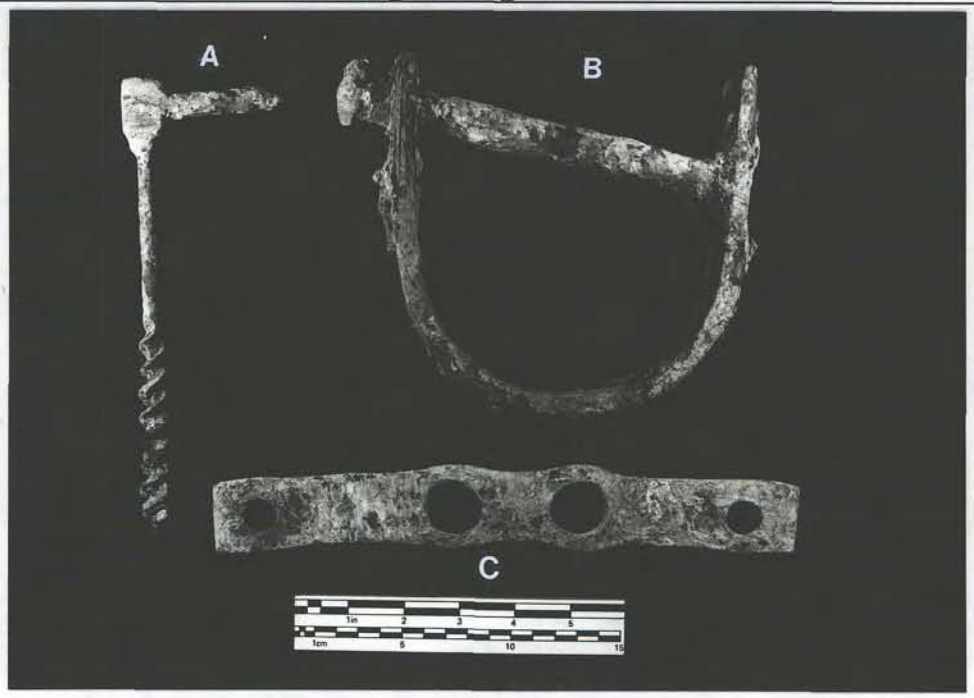


Plate 69. (Left): Drill Bit; (Upper Right): Pipe Hangar; (Bottom Right): Machinery Fitting; A & B from Trench 24, Stratum H; C from Trench 24, Feature 37

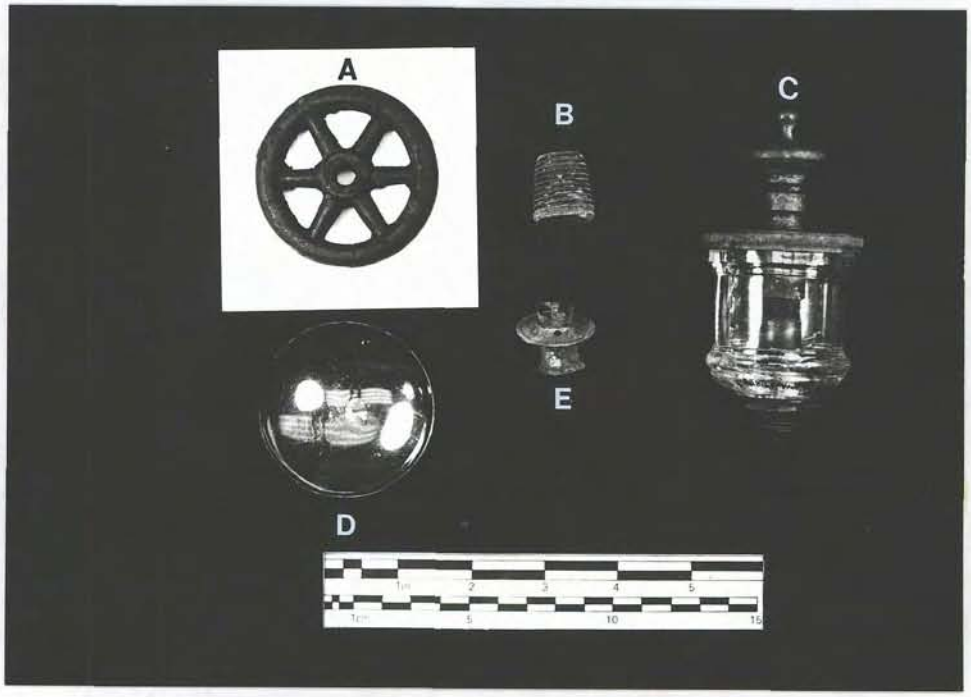


Plate 70. (Top Row, Left to Right): Valve Handle, Threaded Coupling, Automatic Oiler; (Bottom Row): Deck or Lantern Lens, Lantern Deflector; A, B, C & E from Trench 22, Feature 34; D from Trench 12F, Stratum E

pushing needles through tough canvas. Also expected were material remnants of the work itself, bits of wood and rope, oakum, blocks or dead-eyes, canvas remnants or fasteners of wood, iron or copper.

Almost no such material was encountered in the archaeological excavations. Little characteristic of ship construction or repair was recovered from the trenches excavated within the portion of the shipyard proper which was available for survey during the present study -- those sections of Trenches 10 and 12 excavated over the shipway, as well as sections of Trenches 11 and 12 excavated over the marine railway. The materials found in association with the marine railway, particularly several files, the small amount of sheet metal and various cut and wire nails and spikes encountered in Trench 13B,C and D, were not necessarily typical of any particular light industrial activity, and thus may have been remnants of any of the turn of the century uses of the structures in that portion of the site.

Several oarlocks, two of ferrous metal alloy with pintle-type bases, which could be slotted or driven into the gunwale of a small boat, and one of lathe-turned wood with a wire stabilizing brace, were recovered from the sandy deposits south of the late nineteenth-century bulkhead, Feature 23, as was a double pintled eye-bolt (*Plate 71*). Also from the sand along the bulkhead was a deteriorated coal shovel and the lid from a large can of copper paint, such as was used as a sealant and to retard rust on ferrous metal -- the lid was embossed with the legend ". . .COPPER PAINT / PATENTED / JAN 24 1871. . ." (*Plate 72*). A variety of cut nails and spikes was also recovered, both from the upper layers of the wharf fill deposit and from the sands beyond the late bulkhead, presumably indicative of the type of fasteners used by the various shipwrights who worked at the yard. As a further point of interest, almost all of the metal fasteners were of ferrous alloy, with few examples of copper observed. This situation was probably less an indication of an unusually small percentage of copper fastenings in use in nautical construction at the yards, than of the relative costs of raw materials: copper nails were more expensive than iron, and thus were probably better conserved.

The later deposits near the western edge of the property contained a distinctive layer of oil-saturated woody debris and sawdust (Trench 10D-F, Stratum E; Trench 10H, Stratum G; and Trench 10M, Stratum F), from which a large number of threaded wooden pegs was recovered. The National Electric Supply Company occupied several structures on the wharf

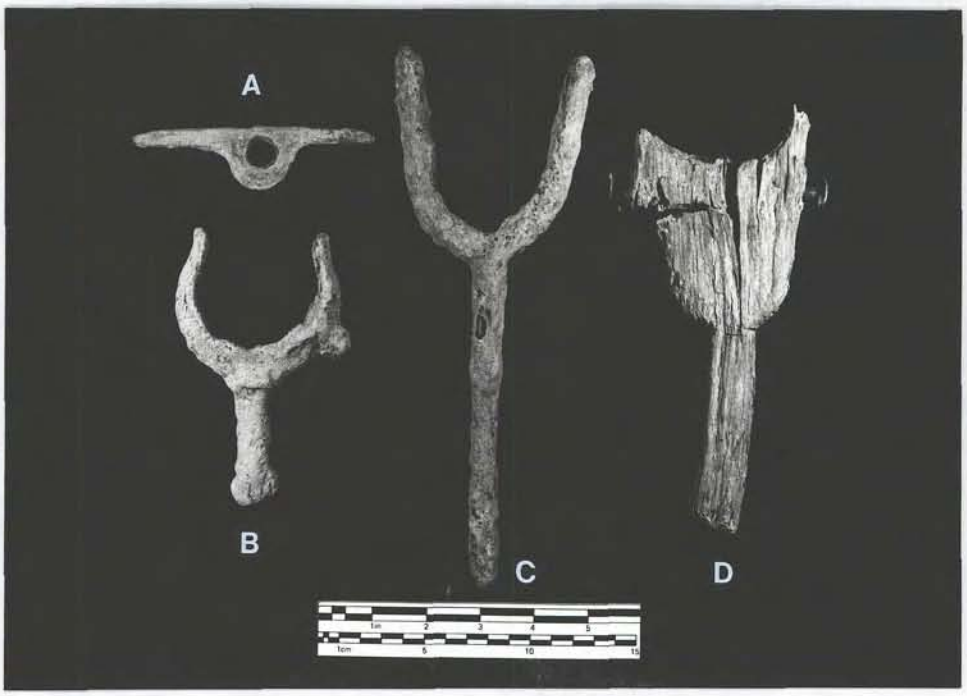


Plate 71. (Upper Left): Eye Bolt; (Bottom Row): Oar Locks
A from Trench 12F, Stratum F; B from Trench 13E, Stratum G;
C from Trench 13L, Stratum G; D from Trench 13F, Stratum G

Plate 72. Paint Can Lid from Trench 13F, Stratum G

during the years around 1910, manufacturing insulator pins for telegraph and power poles. The pins recovered from the excavations measured an average 9 inches in length, with a 4 inch shank, or tenon, measuring $1^1/_8$ to $1^1/_4$ inches in diameter (*Plate 73*). The remainder of the pin was tapered and threaded. The shank was designed to be mortised into the cross-member of a telegraph or power-line pole. Glass insulators, such as the examples recovered from the site, were then secured over the threaded end (*Plate 74*): the end of a pin remained threaded in one of the insulators recovered. Several wooden blanks from which the pins were made were also encountered. The blanks measured 9 by $1^3/_4$ by $1^3/_4$ inches and had been mill cut with a circular saw. The finished products appeared to have been lathe-turned, although several pieces which had been discarded in the early stages of manufacture showed signs of initial shaping with a draw knife. Sanborn Insurance Company maps from the period identified structures north of the marine railway engine house as operated by the Electric Supply Company for the manufacture of the pins (*v. Figure 19*). Fuel for the boilers powering the site at the time was listed as "shavings." The pins were permeated with oil, or creosoted, for preservation: an "Oil House" which appeared among the Electric Supply Company buildings may have been related to this process. The dense, compressed layer of oily sawdust, wood chips and discarded insulator pins, then, comprised the remnant of the Electric Supply Company use of the site, and the debris served as a *terminus post quem*, or date after which the layer was deposited.

Several items which may have been directly related to the marine railway were recovered. Two large cast iron spindles, which served as guides for the heavy, chain hawsers used to pull the cradle up the inclined rails, were recovered from the fill between the fieldstone track beds in Trenches 12B and 13B, along with a smaller cast iron follower wheel. The larger guides can be seen in the foreground in the early twentieth-century photo of the marine railway (*Plate 10*). Also recovered were two rail ties, with rail plates still attached with L-headed spikes, and a section of twisted, narrow gauge iron rail, all from the fill between the flagstone rail bed in Trench 13B. The ties were deteriorated, but measured approximately 8 feet 6 inches in length, with rail plates set on 5 foot centers. A large, semi-circular wooden bearing surface with a $3^1/_2$ inch diameter bearing race was recovered from the same deposit in Trench 12B. Finally, a large two-fold pulley (*Plate 75*) was recovered from the nineteenth-century fill in Trench 10E. The pulley was made of wood, with an iron axle, and was probably used in a variety of hauling and lifting tasks at the yard.

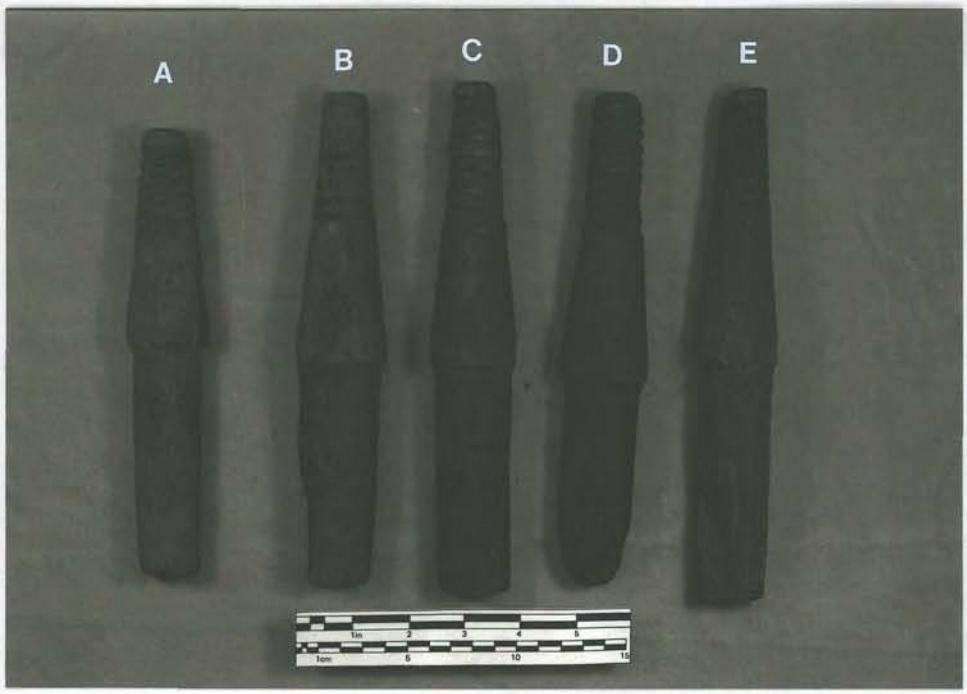


Plate 73. (Above) Threaded Insulator Pegs from Trench 10

Plate 74. Insulator Pegs with Glass Insulators; A from Trench 10N, Stratum D; B from Trench 11E, Stratum D

Plate 75. Wooden Two-Fold Pulley from Trench 10E, Feature 10

There is probably no single reason for the relative paucity of shipyard artifacts at the site. The yard was busy in the late nineteenth century, and historic photographs suggest that a typical amount of debris accumulated in most portions of the property.

Stratigraphic analysis, in contrast, suggested a relatively shallow amount of deposition during the late nineteenth century, with a thin build up of refuse: many of the nineteenth-century structural features observed lay relatively close to modern grade, for example. It may have been that the lot was left open for some period of time after the final marine railway ceased operation in 1923, allowing the scavenging of materials from the site. Another possibility is that the same ground surface was used throughout the life of the yard, so that nothing has been buried, and leaving open the probability that most materials from earlier yards had been salvaged during later site use. In the end, though, the most likely explanation may lie in extensive modern grading. Removal of debris and mechanical leveling of the property was probably carried out during the erection of the Ford Plant structure in the early 1930s. As a consequence, much of the material deposited on the wharf in the latter half of the nineteenth and the early twentieth century would have been removed.

The lack of shipyard materials may also be a matter of sampling. A large percentage of the shipyard operations were carried out north and east of the portion of the property to which the present study had access; that is, the area under the Ford Plant building, and the area to the east of the marine railway engine room complex, a part of the site which had been disturbed in the mid-twentieth century by the emplacement of a large storage tank and two concrete outbuildings. Thus, there may in fact still exist areas beneath the pilings on which the Ford Plant building was constructed which contain debris from the nineteenth- and twentieth-century shipyard.

As a final note regarding construction technology, the markings left by the sawing of wood may in some cases be diagnostic of the general period in which the material was cut. Much of the joinery seen on the eighteenth century wharf bulkhead, for example, had been carried out with an axe or adze. While not absolutely diagnostic features, hand hewn timbers or large timbers cut with hand saws are generally associated with pre-mechanized lumbering and construction technology. Saw mills employing straight, reciprocating saw blades, which leave more regularly spaced cut marks than hand saws, have been operated in North America since the early colonial period (Zimiles and Zimiles 1973; Apps and Strang 1980). The more

efficient circular saw, which leaves characteristic curved markings, was patented in England in the late-eighteenth century but did not see wide-spread use in this country until the mid-nineteenth century (Rawson 1970). Circular saw marks, the only actual sawing characteristic recognized on materials at Ford's Landing, were observed on several portions of the shipway and associated bulkhead, providing further indication of the general construction dates of those features.

Domestic Items

Contained within the later deposits in the shipyard area at the west edge of the property was an assortment of domestic and personal items. The heaviest artifact bearing strata, Stratum D of Trench 10N and Stratum C of Trench 13C, contained large amounts of bottle glass from the turn of the present century, much of which was embossed with legends ascribable to manufacturers in Alexandria, Arlington and the Washington, D.C. area. The nineteenth century, and in particular the latter half of that century, was somewhat of a transitional period in terms of glass manufacturing techniques. The great numbers of glass bottles and bottle fragments which are often recovered from sites of the late nineteenth century reflect the production of increasingly cheap, and thus expendable, glass articles (Ingersoll 1971). Until after the turn of the twentieth century, containers were still produced by a technique introduced early in the nineteenth century in which glass was blown by mouth into various types of mold. The partially completed container was removed from the mold and held at the base by a pontil, or later by a small frame known as a snap case, and finished with a clamp-like "lipping tool," which was fitted into the bore of the neck and then turned to form the lip or rim. By the early 1890s, wide-mouthed, semi-automatic machine made containers were entering into large scale production, using a multi-stage system which pressed and blew glass into molds. In 1903, Michael Owens patented the first fully automatic machinery for the production of glass containers (Jones and Sullivan 1985).

As would be expected from a glass assemblage from the late nineteenth and early twentieth centuries, most of the containers from the deposits in Trench 10N and Trench 13C were manufactured in 2 or 3-piece molds, some with a post bottom, a mold form which leaves a characteristic circular scar on the base pierced by a longitudinal seam. Few of the mold types were diagnostic of a specific date range, since most were used for comparatively long periods. In contrast, embossing has the obvious potential of relatively precise dating, if

the manufacturer can be determined and company records located. Early embossing techniques entailed the production of a mold incorporating reverse relief on one or more surfaces. In 1857, a removable base plate, which allowed the easy changing of lettered bases, was introduced as part of the so-called Ricketts mold. Similar interchangeable plates on the sides of vessels, occasionally referred to as slug plates, made cheaper embossed lettering on other standard bottle forms possible. The first examples, appearing in 1867, were square or rectangular shaped vessels, referred to as panel bottles (Lorrain 1968). Later bottle forms again incorporated embossing directly into the side of the mold. *Plate 76* illustrates a number of pharmaceutical bottles recovered from the site, and *Plate 77* a variety of beverage bottles. *Table 10* contains data from a selection of bottles or bottle fragments on which embossing could be read and interpreted -- most were recovered from mixed turn of the century deposits in Trenches 10, 12 and 13.

Many of the bottles from the turn of the century deposits were beer bottles, with a number of milk and liquor bottles also represented. Many of the beer bottles exhibited early crown cap finishes. The crown finish and cap, common until a few years ago on beer and soda bottles, was patented in 1892 (Jones and Sullivan 1985). The finish was originally applied with a lipping tool, the use of which is detectable by slight irregularities in symmetry and occasionally by an excess amount of glass pushed out onto the neck below the bottom of the tool. The crown cap did not become popular until the advent of automatic bottle machines (Ingersoll 1971), probably due to difficulties in producing a reliable seal on containers finished with a lipping tool. Both tooled and automatic crown cap finishes appeared among the examples at Ford's Landing. Much of the container glass from the deposits was solarized, resulting from the use of manganese to clarify or decolor the molten glass. Manganese reacts with the ultraviolet wavelengths occurring in direct sunlight, turning a light purple. The process was in use from about 1880 to 1915 (Munsey 1970: 55).

Most of the ceramics from the later deposits were utilitarian domestic wares with dates similar to the bottle glass from the same strata. They included late nineteenth-century whitewares, along with smaller amounts of ironstone and soft paste porcelain -- a single piece of Chinese export porcelain, usually occurring on sites with earlier occupation date ranges, was recovered from Trench 10N, Stratum D, but may have been intrusive from lower fill layers. Notably, the ratio of glass to ceramics was quite low, even considering the larger amount of container glass typical of turn of the century sites. Two table knives (*Plate 78*)

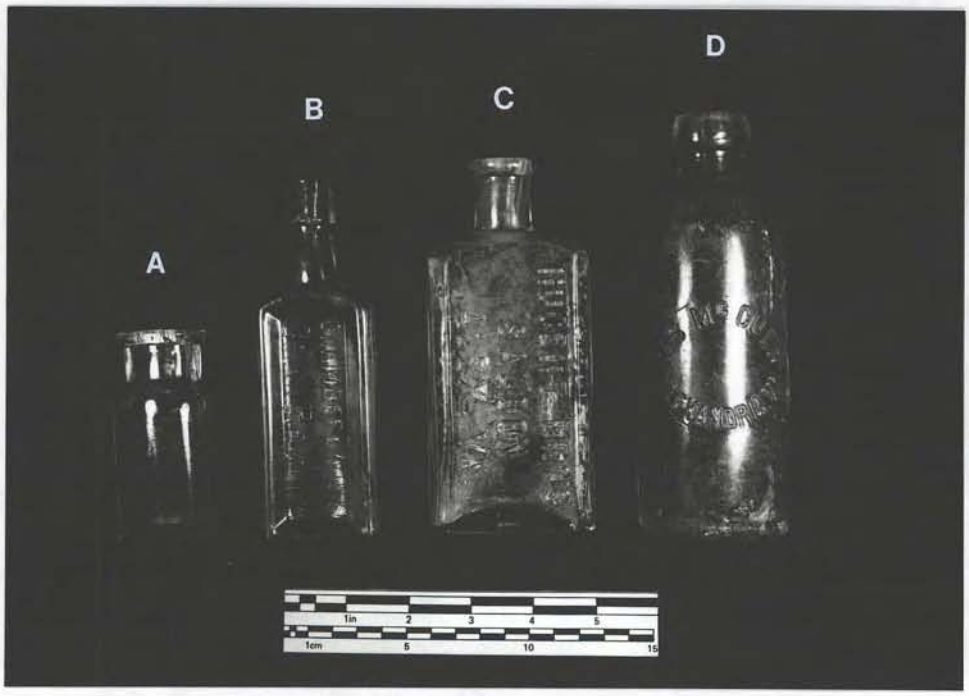


Plate 76. Embossed Pharmaceutical Bottles; A from Trench 12F, Stratum E; B from Trench 10F, Stratum D; C from Trench 14D, Stratum G; D from Trench 10N, Stratum D

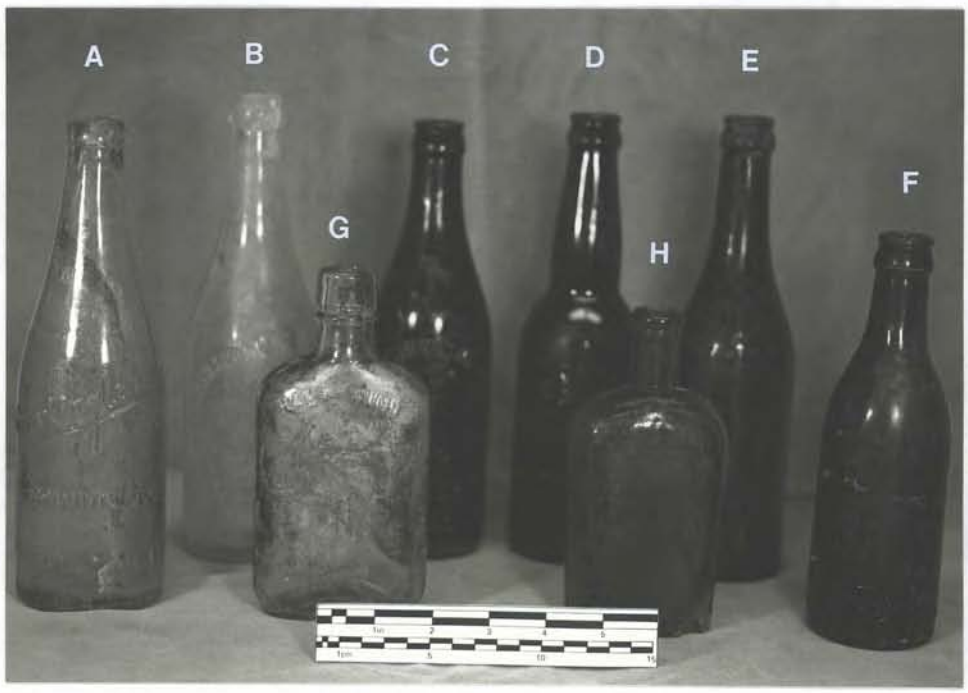


Plate 77. Beer, Soda & Liquor Bottles; A, B, F & G from Trench 10N, Stratum D; C & D from Trench 13C, Stratum C; E from Trench 12B, Stratum B; H from Trench 22, Feature 34

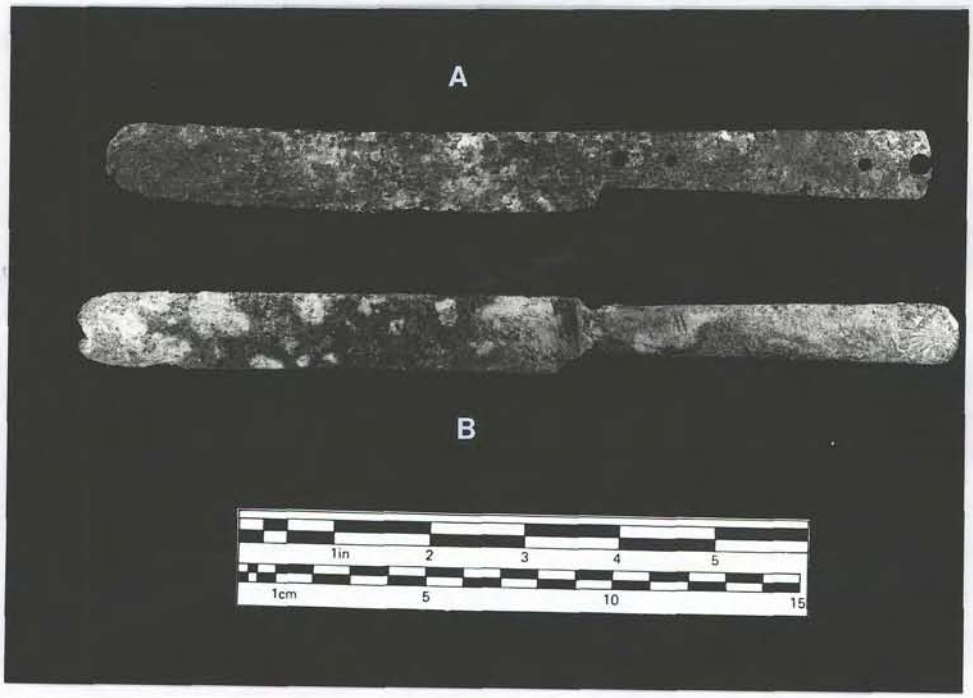


Plate 78. Iron Table Knives; A from Trench 13F, Stratum E; B from Trench 14D, Stratum F

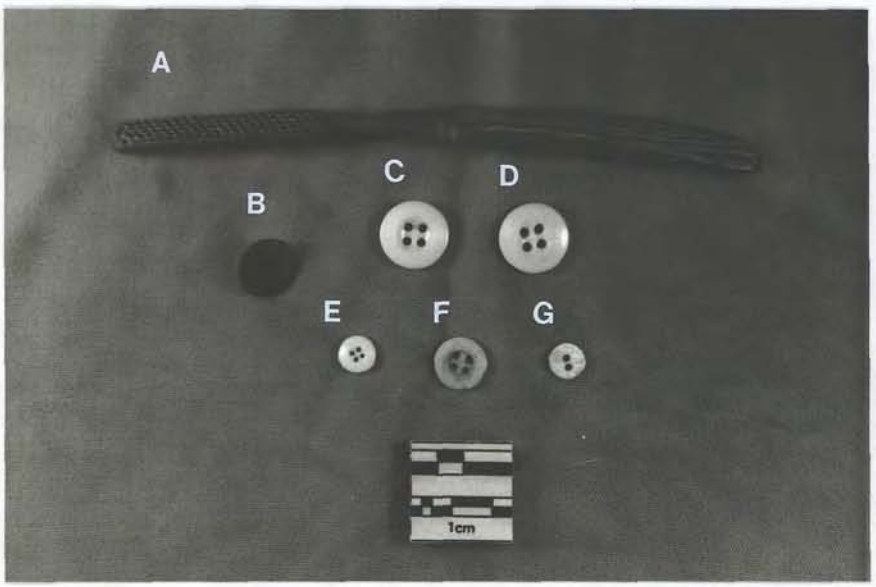


Plate 79. (Top): Bone Tooth Brush; (Middle): Copper Metal, Glass Buttons; (Bottom): Glass and Shell Buttons; A & D from Trench 13F, Stratum G; B from Trench 14D, Stratum G; C from Trench 22, Feature 34; E from Trench 12G, Stratum H; F & G from Trench 10N, Stratum D

were also recovered, as were several shell or opaque white glass buttons, a bone toothbrush (*Plate 79*) two small porcelain doll heads, a rubber baby bottle nipple (*Plate 80*) and a number of leather shoe fragments -- soles and heels, generally from handmade shoes (note: some of these items were recovered from the late cove bottom sediments off the edge of the wharf). Few kaolin pipe stems or bowl fragments (*Figure 63*) were recovered from these or any other deposits across the site, perhaps indicative of the late date range of site use. The lack of pipes may also have been related to a perceived fire hazard at the site, considering the amount of wood sawdust which was generated there during the later nineteenth century, though it is unclear how safety conscious an industrial establishment would actually have been during the period.

Concerning the provenience of the domestic materials from Trench 10D and Trench 13C, there is in fact no evidence directly linking the domestic refuse to site use: the materials were not associated with any remnant structural feature, nor did they appear to be a primary trash midden or sheet refuse deposit. The material may in fact have been secondary fill brought in from another location for disposal, a common practice during the nineteenth century (*v.* Kardas and Larrabee 1980; Geismar 1985, for examples). Yet stratigraphic analysis suggests that the material did in fact originate from on-site use. The deposit within which the materials were contained corresponded with the debris from the National Electric Supply Company from the first decade of the twentieth century. Also associated with these deposits were Feature 10, the wooden structural debris from a small building, encountered in Trench 10E, and Feature 11, a wood stack, located in Trench 10F, which appeared to have been the remains of large stock from which insulator pin blanks were cut. Judging from the otherwise small amount of domestic material at the site, it would appear that the wharf was rarely, if ever, left open for dumping. The implication is that the material did in fact result from site use, primarily by workmen employed at the shipyard and at other companies operating on the wharf. The refuse material appeared to have been used as fill to level the area sometime after the Electric Supply Company ceased operations at the end of the first decade of the twentieth century.

There was little evidence that many of the workmen lived on the property with their families. The comparatively high ratio of glass to ceramics in the deposits (*Figure 64*) may have been related to the fact that few people, and in particular few families, were in residence on-site. Evidence from maps and other documentary sources indicated that the

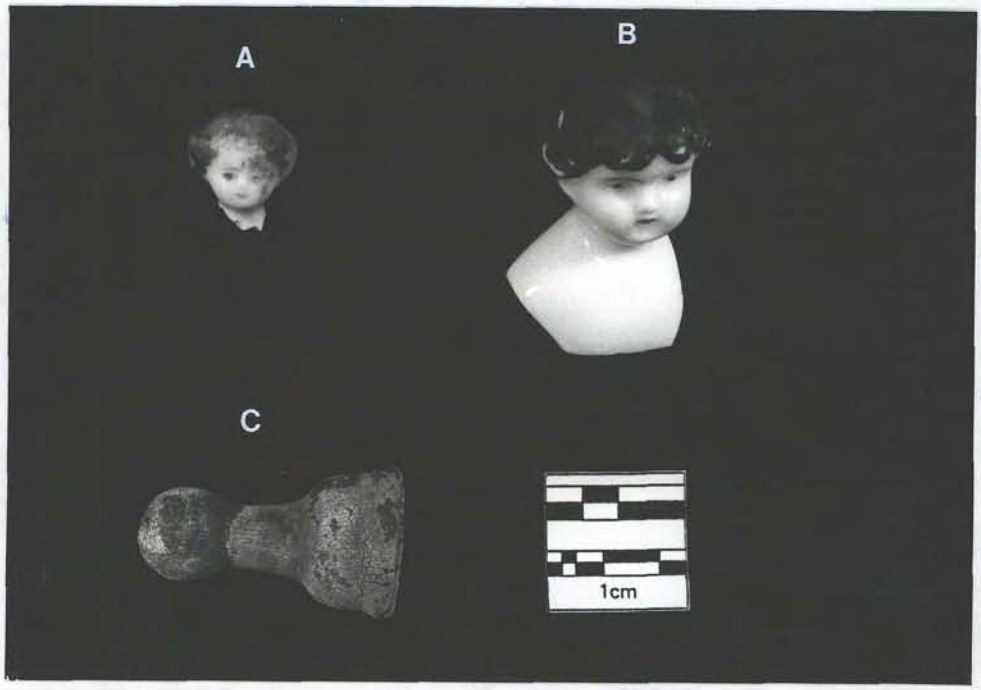
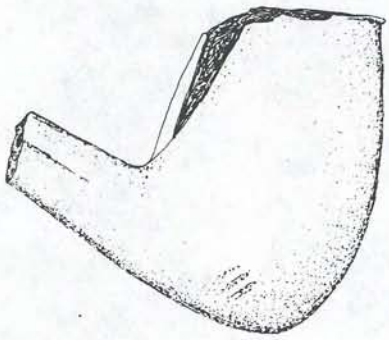
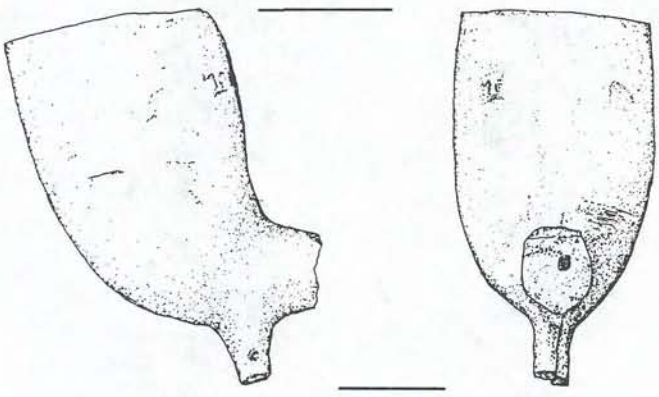


Plate 80. (Top): Porcelain Doll Fragments; A from Trench 7, Stratum D; B from Trench 13 F, Stratum G
(Bottom): Rubber Baby Bottle Nipple from Trench 22, Stratum F



(Trench 13G)



(Trench 12A)

Source: Engineering-Science
Ford's Landing

Figure 63
Kaolin Pipe Bowls

wharf was never used extensively, if at all, for commercial or residential purposes, as was commonly the case at other wharves along the eastern seaboard (*e.g.*, Cheapside, in Baltimore [Norman 1987], the wharves on the East River in New York City [Geismar 1985], or the Bank Street wharves in New London [Artemel *et al.* 1984]). The types of domestic and personal artifact observed in the deposits from the wharf at the Ford's Landing site were, in reality, more typical of daily use of the area by workmen -- beverage containers (mainly beer, liquor and milk bottles), a few pipe fragments and other domestic materials.

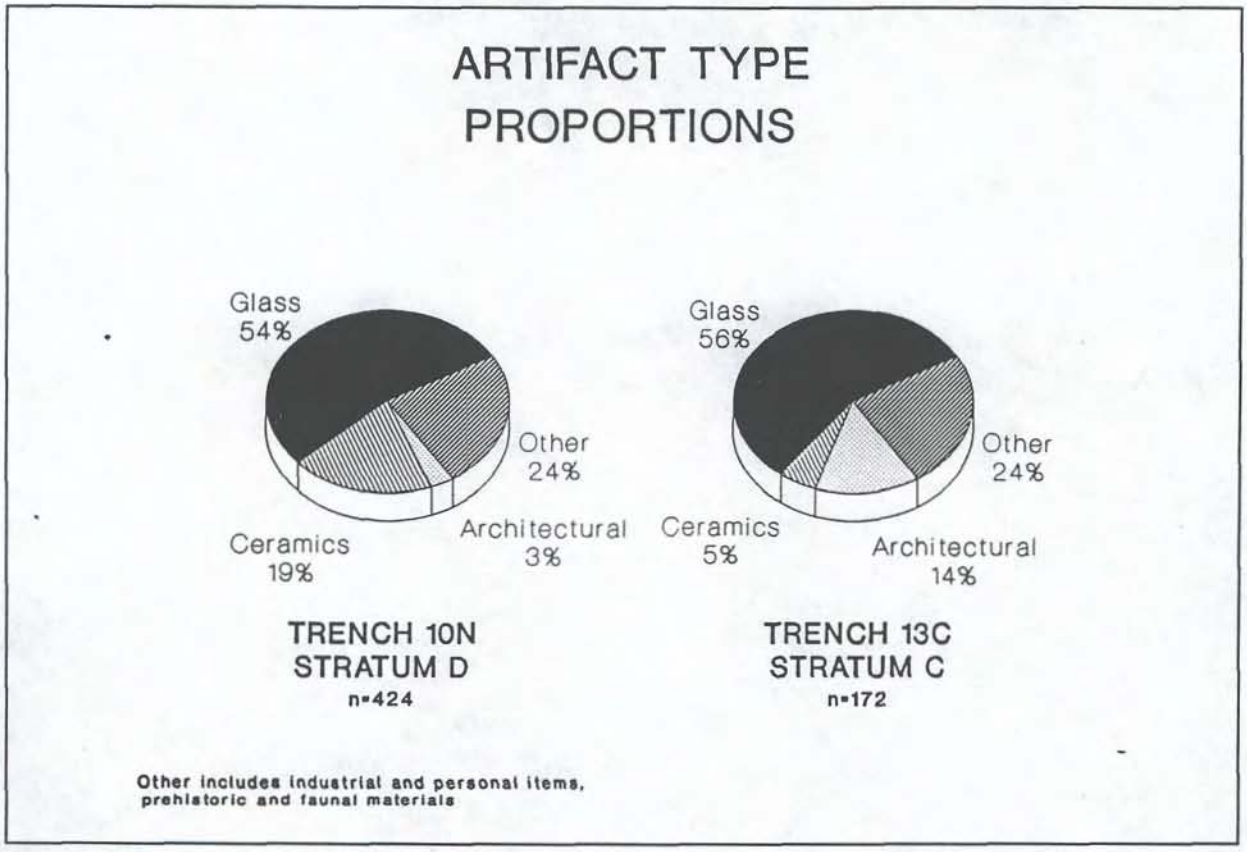


Figure 64 Relative Proportions of Glass and Ceramic Artifacts in Selected Turn of Century Deposits

ALEXANDRIA

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 10 Section N Stratum D	Body fragment, clear	"F.W. B... ALEXANDRIA"	**F.W. Brawner and Co.** Mineral water dealer, located at 320 N. Royal Street, 1897 to 1903. Originally listed as grocer at 1200 Prince Street, 1895. Brawner and Co. located at 410 Princess Street in 1905. 1910 to 1915, **Rammel Manufacturing Co.** appears as bottler at that address, with Brawner listed in 1915 selling crushed oyster shell at corner of Princess and Royal.[1]
Trench 10 Section N Stratum D	Complete, 2-piece mold, blob top, post bottom, aqua	"JAS. McCUEN ALEXANDRIA VA. REGISTERED, NOT TO BE SOLD"	**James McCuen.** Grocer and mineral water dealer from 1870 to 1903. Bottler at corner of Alfred and Gibbon Streets 1895 to 1900. By 1903, located 207 S. Payne Street. Bottle post-1906, according to embossing "THIS BOTTLE [NOT TO BE SOLD]" required by Pure Food and Drug Act. Directory listings unavailable 1903 to 1916. McCuen not listed by 1917.[1]
Trench 14 Section C Feature 31	Complete, 2-piece mold, separate base, cup bottom, patent lip, clear	"NUGENT BRO'S. SALOON ALEX. VA"	**Nugent Brothers Saloon.** Located at 534 South Pitt Street under this name 1910 to 1911. Previously, Patrick Nugent was grocer at corner of Gibbon and Pitt, 1876 to 1882. Owen Nugent was grocer at 253 King Street, 1860, at 305 King Street, 1870 to 1888, and 1301 King Street, 1889 to 1905, during which period ads indicate sale of tobacco, wine and liquor. Mrs. Ellen Nugent was grocer at 536 Pitt, 1890, and saloon keeper at 534 Pitt from 1904 to 1907. Saloon known as **Nugent and Bro.**, by 1908, and **Nugent Bro's. Saloon** by 1910.[1]

Table 10. Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 12 Section B Stratum B	Complete, automatic, crown cap, amber	"TIVOLI/ TRADE MARK/ ROBERT PORTNER BREWING CO./ ALEXANDRIA VA." "24" (near base)	**Robert Portner.** Brewer, located at St. Asaph and Wythe from 1861 to 1883.[1,2] Incorporated as the **Robert Portner Brewing Co.** and known as the **Tivoli Brewery** from 1883 to 1916.[1] Also a Washington, D.C. address at 626 Virginia Avenue S.W.[3]
Trench 10 Section N Stratum D	Body fragment, amber	"...RT PORTN... TRA.. TIV..."	**Robert Portner.** As above.
Trench 14 Section D Stratum F	Complete, automatic, crown cap, amber	"ROBERT PORTNER BREWING CO./ ALEXANDRIA VA./ TRADE MARK/ TIVOLI"	**Robert Portner.** As above.
ARLINGTON			
Trench 10 Section N Stratum D	Complete, crown cap, automatic, aqua	"...NGTON BREWING CO./ROSSLYN, VA." "EHE CO" (on back) "743/2" (on base)	**Arlington Brewing Company.** EHE may indicate a bottle manufacturer in Ohio.[4]

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 10 Section N Stratum D	Complete, blob top, 2-piece mold, post bottom aqua	"ARLINGTON BREWING CO./ROSSLYN, VA./ EHE CO" "Z43" (on base)	**Arlington Brewing Company.** As above.
WASHINGTON, D.C.			
Trench 13 Section F Stratum F	Body fragment, aqua	"...N BOTTLING CO./ ...OBSON PROP./ ...HINGTON D.C.'	**Arlington Bottling Company.** Charles Jacobson proprietor. Business in operation from 1886-1937 at the corner of K Street and 27th Streets N.W. (also listed as 2622 L Street N.W.).[3] Jacobson was vice president of the **Heurich Brewing Company** in the 1930s, and the Arlington Bottling Company was bottler for Heurich beer.[5]
Trench 13 Section F Stratum F	Body fragment, aqua	"...NGTON BOTTLING CO./TRADE MARK REGISTERED/A.B.CO./ ...NGTON D.C."	**Arlington Bottling Company.** As above
Trench 4 Stratum E (Phase IIa)	Complete, 2-piece mold, crown cap, aqua	"A.B. CO." "E4" (on base)	**Arlington Bottling Company.** As above

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 10 Section N Stratum D	Complete, mold blown, tooled crown cap, amber	"COCA-COLA REGISTERED WASHINGTON D.C." "O B CO." (on base)	**Coca-Cola Bottling Works.** Operated at 1418 E St. N.W. between 1908 and 1910; the company next listed 615-619 D St. S.W. in 1920, and 400 7th St. S.W. from 1925 to 1940. Bottle dates pre-1916. Lettering on base may refer to **O'Meara Bottling Works** 647 7th St. N.E. (1895-1910) and 227 10th St. N.E. (1915)[3].
Trench 10 Section N Stratum D	Body fragment, aqua	"... BOTT... ...08 10 12 MASS AVE. NE WASHINGTON DC THIS BOTTLE..."	**Finley and Son.** Bottlers. Frank H, Finley, proprietor. Located 208-212 Massachusetts Avenue N.E., from 1894 to 1916[3,6]. Originally located on Pennsylvania Avenue N.W., in 1879. Also operated from 1206 D Street N.W., 1893-1894[3]. Embossing "NOT TO BE SOLD" dates bottle post-1906.
Trench 10 Section N Stratum D	Body and base, automatic, aqua	"...SS AVE. NE WASHINGTON D.C. THIS BOTTLE NOT TO BE SOLD" "TRADE MARK F" (in triangle on base)	**Finley and Son.** Bottlers. As above.
Trench 10 Section N Stratum D	Body fragment, aqua	"...E NE WASHINGTON D.C. THIS BOTTLE NOT TO BE SOLD"	**Finley and Son.** Bottlers. As above.

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 10 Section E Stratum E	Body fragment, aqua	"...HERRMANN ...SUCCESSOR TO.. J.F. HERRMANN &... WASHINGTON DC REGISTERED ..IS NOT.."	**A.G. Herrmann.** August G. Herrmann, proprietor. Located 750-754 10th Street S.E. between 1906 and 1910. Chronology of Herrmann bottlers begins: **John F. Herrmann** (same address), 1890; **J.F. Herrmann & Son,** 1892 to 1905; **August G. Herrmann**, 1906 to 1910; **Herrmann Bottling Works**, 1911 to 1935[3].
Trench 13 Section C Stratum C	Complete, crown cap, automatic, amber	"WASHINGTON D.C. TRADEMARK CHR. HEURICH BREWING CO. REGISTERED"	**Christian Heurich Brewing Co.** Christian Heurich, proprietor. Located 25th and 26th Water and D Streets N.W., 1892 to 1917 and 1933 to 1956[3] (sold ice during Prohibition).[7] Originally located 1229 to 1235 20th Street N.W., 1872 to 1892. Bottlers included **James B. Butler** at 1237 20th Street N.W., 1878 to 1885,[8] and the **Arlington Bottling Company**, 27th and K Streets, 1886 to 1937.[5]
Trench 13 Section B Stratum C	Base, automatic, amber	"CHR. HEURICH BREWING CO. WASHINGTON D.C. REGISTERED"	**Christian Heurich Brewing Co.** As above.
Trench 13 Section F Stratum G	Body fragment, clear	"...T MAZINGER 359 M ST. SW WASHINGTON D.C. REGISTERED 1898"	**R.T. Mazinger.** R.T. Mazinger, proprietor. Located 359 M Street S.W., 1989 to 1916. Previously, **Smithson and Mazinger** located at 462 H Street S.W., 1895.[3]

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 14 Section D Stratum F	Finish and shoulder, crown cap, clear	"MAZING..."	**R.T. Mazinger.** As above.
Trench 11 Section F Stratum H	Body fragment, clear	"...ONNELL ...GTON D.C. ...ECIALTY ...WHISKEY"	**D.J. O'Connell.** Distiller at 636 Pennsylvania Avenue from at least 1915 until Prohibition in 1971. Both advertisements and bottles read "MY SPECIALTY ORONOCO RYE WHISKEY".[3]
Trench 13 Section I Stratum G	Body fragment, clear	"...'MEARA"	**John O'Meara.** Bottler, located 711 H Street N.E. in 1890, 647 7th Street N.E. from 1895 to 1910, and finally at 227 10th Street (rear) N.E.[3]
Trench 14 Section C Stratum B	Complete, automatic, clear	"EMBASSY/ EMBASSY DAIRY INC./WASHINGTON D.C./REGISTERED/ LIQUID"	**Embassy Dairy Farms.** Located 530 7th Street S.E. beginning 1935. This address previous location **Simpson Dairy Corp.**[3]
Trench 10 Section N Stratum D	Body fragment, clear	"SIMPSO..."	**Simpson Dairy Corp.** William Aubrey Simpson, proprietor. Located 530 7th Street S.E. from 1900 to 1915. Listed as **Walker Hill Dairy** from 1920 to 1930, and again as Simpson Dairy Corporation in 1930.[3]

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

BALTIMORE

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 13 Section C Stratum D	Body fragment, automatic, light green	"...NSCHMIDT STRAU... TRADEMARK GBS"	**Gottleib-Bauernschmidt-Straus Brewing Co.** Baltimore brewers, 1902 to 1915. Originally known as **George Bauernschmidt and Family**, from 1864 to 1900, and as the **Maryland Brewing Co.**, from 1900 to 1902.[9]

OTHER REGIONS

Trench 10 Section F Stratum D	Complete, 2-piece mold, cup bottom, aqua	"CHAMBERLAIN'S COUGH REMEDY/ CHAMBERLAIN MED. CO./DES MOINES IA. U.S.A."	**David S. and Izanna L. Chamberlain.** Manufacturers of "Pain Balm" in Marion, Iowa. Relocated Des Moines, 1881. Marketed at least 10 different products by turn of century. "Cough Remedy" sold 1886 to 1900+.[10]
Trench 10 Section D Stratum D	Complete, automatic, external screw clear	"CHESEBROUGH MANFC. CO. CD. NEW YORK"	**Robert A. Chesebrough.** Manufactured petroleum jelly in 1872. Retail trade 1887 to 1900+.[10]
Trench 10 Section N Stratum D	Complete, 2-piece mold, post bottom, blob top, aqua	"INDIANAPOLIS BREWING CO./ INDIANAPOLIS, INDIANA/USA TRADE MARK	**Indianapolis Brewing Co.** Operated from 1892 through 1940+ (except for Prohibition). One of only two breweries in Indianapolis after Prohibition.[11]

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

PROVENIENCE	BOTTLE TYPE	LEGEND	COMPANY
Trench 13 Section C Stratum C	Complete, automatic, crown cap, amber	"PABST/ MILWAUKEE/ THIS BOTTLE NOT TO BE SOLD" "2W" (on back)	**Pabst Brewing Co.** Brewery and bottling company located in Washington at 703-705 North Capitol Streets, 1890 to 1915.[3] Bottle post-dates 1906.
Trench 13 Section J	Complete, blown, crown cap, post bottom, amber	"PABST MILWAUKEE/ TRADE MARK/ REGISTERED" "JB" (on back) "W" (on base)	**Pabst Brewing Co.** As above. Bottle pre-1906

Table 10 (cont'd). Selected Bottle Legends and Manufacturer Data

References:

1 Alexandria City Directory
2 Brockett and Rock 1883
3 Boyd's Directory Company
4 Barbara Magid, Alexandria Archaeology, personal communication 1989
5 Coffin 1887 in Inashima 1980
6 Balicki 1991
7 Connolly 1980
8 Barton 1884
9 Kelly 1965
10 Wilson 1971
11 Polk's Directory Company

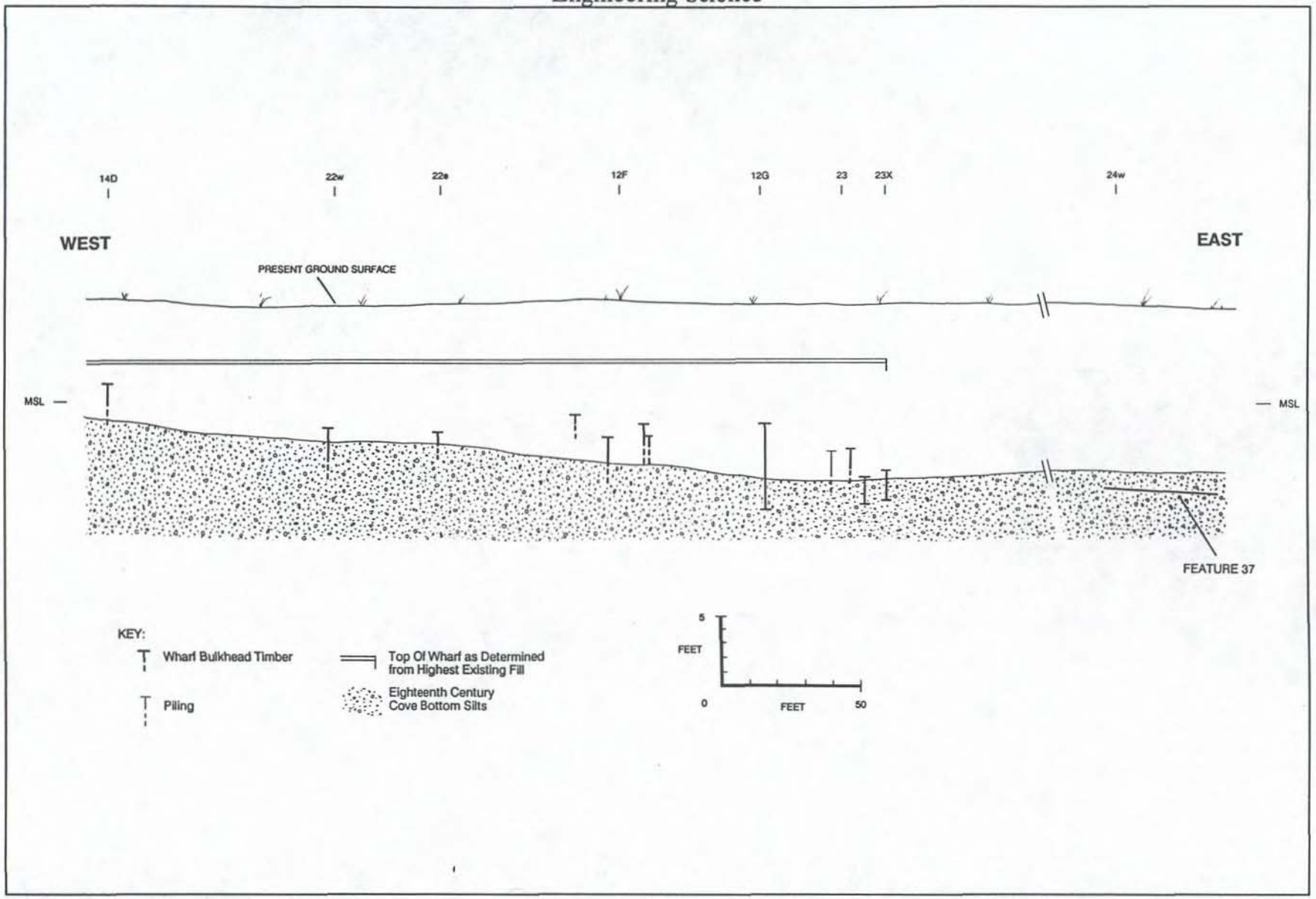
IX. ANALYSIS AND EVALUATION

Archaeological investigations at the Ford's Landing site resulted in the excavation and documentation of portions of a variety of maritime features: sections of the original wharf structure, built by Keith and associates in 1785 on a portion of tidal flats along the southern waterfront; several features related to the operation of shipyards on the wharf in the late nineteenth and early twentieth centuries; and a number of derelict vessels lying at the edge of Battery Cove, part of which forms the southern end of the study area. The discussions which follow will include a reconstruction of Keith's Wharf as it would have appeared in the late eighteenth century, and a short study comparing the wharf to similar structures known archaeologically on the eastern seaboard. Also included is an analysis of the characteristics and significance of the shipyard features and of the derelicts recorded in Battery Cove.

Original Configuration of Keith's Wharf

The upper limit, or topmost run of timber of the wharf bulkhead as seen during the current archaeological excavations was quite varied in elevation, and did not reflect the original configuration of the structure. The bulkhead was heavily disturbed in most places, in large part as a result of deterioration and lack of maintenance throughout the early nineteenth century. The material used as fill had eroded to the various levels of the remaining bulkhead timbers, leaving the central portion of the wharf much higher than the periphery and allowing the waters of the cove to overrun the edge of the structure (a schematic representation of the southern face of the feature is reproduced as Transect L, *Figure 65*). No conclusive documentary records -- written descriptions, period drawings or photographs -- which would provide a detailed account of the appearance of the wharf are known. Nor were eighteenth-century features or remnant surfaces from the period encountered during the archaeological investigations as direct evidence of the initial form of the structure.

The purpose of the following paragraphs is, then, to reconstruct analytically the original configuration of the wharf: to determine both its absolute height and its working height, *i.e.*, the height of the wharf surface above the contemporary waterline. Several types of data were available on which to base the analysis, including the current levels of wharf fill recorded in various portions of the structure, the elevation of the base of the cove in the eighteenth century, and relative water levels, both modern and eighteenth century, as seen



Source: Engineering-Science
Ford's Landing

Figure 65
Composite Profile Transect L,
Southern Face of Bulkhead

alongside the bulkhead. To lessen the potential confusion resulting from a welter of relative elevation measurements, an attempt has been made in the discussion to reconcile all important features with current mean sea level.

Elevation of the Wharf Surface

It is assumed that the surface of the wharf was level, and thus that originally the bulkhead reached at least as high as the highest level of wharf fill encountered in the archaeological trenches. In fact, the wharf probably stood somewhat higher, based on the supposition that a combination of settling, erosion and grading has occurred during the nineteenth and twentieth centuries.

The uppermost levels of wharf fill were difficult to define in the northern trench sections. On a line running west to east through Trench 10D and 10E/F, roughly 100 feet north of the bulkhead, the top of the fill was identified at approximately +2.75 feet msl. In excavations north of this line, the transition to later fill was ill-defined, with many small strata apparent within the sandy fill lying below the modern gravel and rubble layers. Due to the amount of disturbance from utility lines and from the nineteenth-century marine railway and associated features, it was unclear as to which, if any, of these small stratum breaks represented the top of the eighteenth-century fill. The most secure measurement appears to have been the +2.75 foot elevation recorded to the south, although there is some evidence that the fill reached as high as +2.95 feet, this in Trench 12B/C. Since no ground surfaces were observed associated with the wharf, it would appear that a degree of erosion or grading such as was postulated above had in fact taken place. Thus, the surface of the wharf probably lay higher than the level of the fill as presently observed, perhaps by a figure of 6 inches or more. This would place the top of the bulkhead some 3 feet 6 inches to 4 feet above the maximum levels recorded in the excavations along the bulkhead line, or 2 feet 9 inches to 3 feet 3 inches above current mean sea level.

The disappearance of the upper timber courses, and thus the unevenness of the bulkhead seen at present, can be attributed to age and the function of at least three processes: decay, salvage, and settling or compaction. The uppermost timbers, those exposed continually to the open air, were probably subject to rotting, particularly since many, lying at or above the waterline, were wet and dry in relatively closely spaced cycles associated with

the tides. There was little evidence of rotting in the remaining timbers, suggesting that they generally lay below the waterline (all were below current mean sea level). There was no evidence of soft rot, which results from fungal growth, probably due to the fact that the fungi involved are less prevalent in coniferous woods and are inhibited by constant submersion (*cf.* McNamara 1974). Nor were marine borers a factor in the nearly fresh water at the upper end of the estuary. In fact, the bulkhead timbers were in pristine condition: marks from dubbing were appeared as fresh as when originally made, with chips and splinters still in place within the axe and adze cuts. As evidenced by relative depth measurements, the topmost timbers in some portions of the bulkhead lay below the level of other timbers which showed little or no sign of deterioration, *e.g.*, in Trenches 22, 23 and 23X. It is possible, therefore, that some of the missing timbers from these areas had been salvaged or cannibalized for other building projects. Bent drift pins were observed extending from the upper runs of the bulkhead, indicating either wrenching as the timbers were pulled off or damage after the timbers were removed. Finally, the uneven slopes of the timbers as recorded in the excavation trenches suggested that the bulkhead had settled unequally into the cove bottom sediments, initially under its own weight and eventually under the weight of the Corps dredging spoil.

Thus, the surface of the wharf probably lay at an elevation approximately 3 feet above present mean sea level. No data remain as to how the wharf was surfaced. The fill was composed almost entirely of clean earth; the surface was probably packed earth, with the streets and alleys finished with cobbles.

Level of Cove Bottom and Base of Bulkhead

To determine the total height of the bulkhead, the base of the feature was calculated from those portions actually recorded in archaeological trenches and from the level of the bottom of the cove in the eighteenth century as extrapolated from measurements recorded inside and outside of the wharf. The base of the bulkhead was only seen in two locations: in Section G of Trench 12 and in Trench 23. The base of the wharf fill deposit was recorded in several locations north of the bulkhead and in the trenches south of the bulkhead in the cove itself.

The base of the bulkhead presumably lay no higher than the bottom of the cove in the late eighteenth century, since no evidence was encountered of a built up footing or other foundation. Bulkhead timbers exposed in Trench 12G actually lay buried as much as 2 feet below the level of the cove bottom in the eighteenth century. Two explanations are possible -- the bulkhead had settled into the bottom sediments, or the feature was laid in a trench to enhance stability at the base of the structure.

Sections of the bulkhead exhibited varying slopes which were presumably not part of the original design of the structure. A certain amount of settling is likely to have occurred, considering the nature of the sediments, the weight of the bulkhead and the weight of the overlying fill. Obvious settling of other features was observed in separate areas of the site, such as immediately behind the bulkhead, where back braces had been pressed into the wharf fill deposits, pulling several courses of bulkhead timber with them, or to the north, where the nineteenth-century shipway lay somewhat askew in several places. In these instances, the positions of the features was attributed largely to compaction of the underlying fill deposits resulting from the weight of the dense overburden. The actual degree to which the bulkhead itself had settled was difficult to assess precisely, since there were no sure reference points available. Settling probably did occur, though an extreme amount was not likely, since the cove sediments were loose, but not highly compressible. The material exhibited a fine, almost clay-like consistency and, lying in an embayment away from the river channel, was subject to slow deposition rates, allowing the silts themselves to settle and become relatively compact. The shallow depth of the cove may have further promoted compaction by allowing periodic drying at very low tides.

A shallow trench may in fact have been dredged into the bottom, and the initial timber run placed within it. A deposit of pine chips lay on the silty cove bottom surface (Trench Stratum H), which sloped downward to meet the bulkhead near the top of the first run. The chips did not continue below the intersection of Stratum H and the bulkhead, as would have been expected had the timbers originally sat level with the cove bottom and later sunk into it, pulling the surface sediments with them. Thus, while some deformation of the cove bottom may have been evident in the sloping transition from Stratum G to Stratum H, it would appear that a shallow trench had indeed been excavated for the lowest timber course along this portion of the bulkhead. The presence of the chips also indicated that the laying of the initial courses of the bulkhead was accomplished at low tide, not coincidentally the period

of best working conditions. With the cove bottom exposed above the waterline, alignment and leveling of the timbers would have been facilitated: the chips resulting from trimming would have become embedded in the silts rather than floating or washing away. This may in turn suggest a reason for burying the lowest course of the bulkhead; *i.e.*, as a hedge against undercutting by tidal currents. Farther to the east, toward the main channel of the river, where bottom depths were greater, a builder's trench to protect against erosion would have been unnecessary, not to mention difficult to excavate. In general, burying the base of the bulkhead would have enhanced the stability of the structure, helping avoid the type of dislocation of the lowest timbers seen at the Cheapside wharf in Baltimore (Norman 1987). Moreover, the buried timbers would have provided an effective block against the seepage of sandy fill from beneath the base of the bulkhead, particularly at low tide when pressure from the water outside the bulkhead would be lessened or absent, allowing the saturated fill deposits to flow outward. Even deeper foundations for the feature, such as the stone footing recorded below the bulkhead at the Forrester's Wharf (Central Wharf) in Salem, Massachusetts (Wilson and Moran 1980: 15), were probably not considered essential, due to what were in fact relatively compact bottom sediments and to the lack of severe tidal forces, channel currents or other agents of erosion.

The levels recorded for the bottom of the cove in the late eighteenth century were recorded in the profiles of trenches north and south of the bulkhead (*Table 11*). East/west transects across the cove showed a gradual slope downward toward the south, with a marked drop off beginning at the east end of Trench 19 and in Trench 24. These readings compare favorably with the range of depths recorded in the early nineteenth century (Topographic Engineer Department, U.S. Army 1836 -- *Figure 10*). Measurements of the bottom sediments below the wharf fill deposit, north of the bulkhead, also showed a gentle downward grade to the south and east, corresponding with the expected configuration of the cove bottom prior to wharf construction. While the base of the wharf fill was not observed immediately behind the bulkhead, due to the consistency of the fill and the limitations of the excavation equipment at hand, elevations were extrapolated from the depths recorded north and south of the feature. As was evident from those measurements, the cove bottom was relatively level north to south, taking into account irregularities in the surface caused by factors such as tidal eddies.

NORTH OF BULKHEAD		SOUTH OF BULKHEAD	
LOCATION	DEPTH (MSL)	LOCATION	DEPTH (MSL)
10B	-0.23'	14A	-3.89'
11B	-2.25'	15	-1.41'
12E	-3.15'	16 (north end)	-3.08'
23 (north end)	-3.57'	16 (south end)	-3.28'
22	-3.45'	17 (north end)	-3.02'
		18 (south end)	-3.28'
		19 (west end)	-3.01'
		19 (east end)	-5.00'
		20 (west end)	-2.23'
		20 (east end)	-2.53'
		21A	-1.75'
		21B	-2.23'
		24	-6.78'

Table 11. Elevations of Eighteenth-Century Cove Bottom Sediments

The depth of the transition from wharf fill to alluvium listed in *Table 10* was compared with Transect L, the south profile of the bulkhead as it appeared in the archaeological trenches intersecting it (*Figure 65*). The base timbers of the bulkhead were assumed by analogy from Trench 12G to have been set into the cove bottom silts along much of the southern extent of the wharf, extending 1 foot or more below the level of the fill they were designed to retain. Thus, the total height of the bulkhead may be calculated, working from the presumed depth of the feature to the top, the latter determined from the levels of wharf fill in the main body of the wharf, *ca.* 2 feet 9 inches to 3 feet above present mean sea level. It is estimated that the bulkhead originally stood up to 6 feet 3 inches from top to bottom in the area of Trench 14D (comprised of 5 to 6 courses of timber ranging from 12 to 15 inches in diameter), and just over 10 feet 6 inches at the east edge of the wharf in Trench 23 (from 9 to 11 timber runs).

No evidence remained as to whether or not the wharf was filled as the bulkhead was raised. Documentary evidence from the Cheapside wharf in Baltimore suggested that in the construction of that wharf, erection of the framing and the deposition of fill were considered separate and consecutive operations (Norman 1987). This would not have been unlikely since the frame was presumed to have been built ashore and later floated and sunk in place, as was the customary method for crib construction. The only contemporary description

which mentions the construction of Keith's Wharf was unspecific as to the order of assembly, merely stating that a frame was constructed and filled with earth. Filling the wharf concurrently with the erection of the bulkhead would have been possible, since the structural framework was constructed in place. Such a process would have provided two major advantages to consecutive construction and filling. Firstly, a mud wave, the heavy surge of saturated material which was often generated as fill was introduced from the landward edge of the structure, could easily displace a bulkhead line (Greene 1917: 48). Problems with such a phenomenon would have been minimized if only a portion of the bulkhead stack were constructed before filling began, since a lower structure could be more effectively braced, and a portion of the saturated material, which was less desirable as fill since it would not compact as well as dry fill, could be allowed to flow over the top of the low wall. A second advantage to continuous filling lay in the fact that the freshly introduced fill would have provided a solid platform from which to continue assembly of the bulkhead. Evidence indicating the order of construction was not recovered in the present excavations. For example, pine chips at various levels throughout the fill behind the bulkhead, deposited as the courses were trimmed in place, chips would have implied that filling had taken place concurrently with bulkhead construction. Such debris was observed in the fill directly behind the feature, but the unconsolidated nature of the soils precluded controlled excavation, and thus precise proveniences were not available.

Eighteenth-Century Mean Sea Level

To determine the effective or working height of the wharf, water levels during the period in which the wharf was in use must be established. As noted, the top run of the bulkhead appeared to have stood at a level between 2 feet 9 inches and 3 feet above current mean sea level. Thus, with the local average tidal differential of three feet, the surface of the wharf would have been situated only 1 foot 3 to 1 foot 6 inches above the high tide line, well below the minimum conventional level of 3 feet (*cf.* Taggart 1908). There was in fact ample evidence at the site to indicate that the level of Potomac, and thus of the cove waters surrounding the wharf, had risen considerably over the 200 years since the wharf was constructed, and thus that the wharf originally stood higher than the 18 inches above the high water mark calculated from current sea level data. This evidence existed on-site mainly in the form of cove bottom deposits lying at increasingly higher elevations along the edges of the wharf as it deteriorated throughout the nineteenth century. The cove sediments were identified as gray, relatively coarse grained sands mixed with organic material brought in on

floodwaters. In addition, later deposits, in particular several of the vessels abandoned in the cove and the bulkhead associated with the late nineteenth-century shipyard, all lay above the level of the wharf as presently observed near the bulkhead line, further indicating an on-going change in water level.

Several clues were available as to the water level in the cove in the late eighteenth century. Pine bark, which had sloughed from the bulkhead timbers and collected on the bottom of the cove, was recorded at various levels within the trench excavations. For example, bark appeared at -4.07' msl in Trench 12G, -2.12' msl in Trench 23X and at -4.63' msl in Trench 24. Judging from the varying depths recorded, these figures would appear to represent low water marks at several periods in the early-to-mid nineteenth century, when the cove sediments were exposed for long enough periods to allow the organic material to settle into the sandy silt bottom without being washed away on the tide.

Two other measurements are available which may also be relevant. The pine chip remnants of adze work carried out on the bulkhead timbers as they were being fitted into place were observed at a depth of -5.56' msl along the edge of the bulkhead in Trench 12G. In addition, a bollard, or piling, was encountered adjacent to the bulkhead in Trench 23. On the piling, a water mark was observed at a depth of -2.47' msl, presumably representing either a water or sediment line.

Mean sea level in the late eighteenth century was estimated working from the top of the wharf down. It was reasonable to assume that the top of the bulkhead lay at least as high as the highest remaining level of wharf fill as seen in archaeological trenches near the center of the wharf; *i.e.*, 2 feet 9 inches to 3 feet above present mean sea level. Further, assuming that the bulkhead was designed to rise at least 3 feet above the eighteenth-century high water mark, *that* high water level would have been at or as much as 3 inches below *present* mean sea level. Subtracting an additional 1 foot 6 inches to account for half of the tide differential, mean sea level during the time the wharf was constructed would have been about 1 foot 6 inches to 1 foot 9 inches below its present elevation.

A median waterline at a level 1 foot 9 inches below present sea level[1] would have seen most of the surviving bulkhead timbers lying within a few inches of the water, as a tally of the highest remaining timbers, listed west to east in *Table 12* indicates. And it would appear from the evidence of the timbers themselves that the waterline was never much below this elevation. Little deterioration of the wood was observed, suggesting that they were in fact submerged most of the time, and that the average level of water in the cove rose relatively quickly to submerge those timbers periodically above the waterline. This conclusion appears to contradict the material presented earlier concerning the excavation of a shallow trench for the first course of bulkhead timbers as a guard against tidal erosion. Erosion may still have been a key factor in a decision to place the bulkhead in a trench for part of its length. It appeared, though, that the base of the bulkhead was not exposed to the drying effects of air for extended periods, but lay below the eighteenth-century waterline along its entire length.

LOCATION	ELEVATION OF BULKHEAD TIMBER RELATIVE TO:	
	PRESENT MSL	18TH-CENTURY MSL
Trench 14	-8"	+13"
Trench 22 west of Feature 34	-23"	-2"
Trench 12 west of Feature 27	-10"	+11"
Trench 12 east of Feature 27	-18"	+3"
Trench 12G	-18"	+3"
Trench 23 waterline on bollard	-30"	-8"

Table 12. Relative Elevations of Remaining Bulkhead Timbers

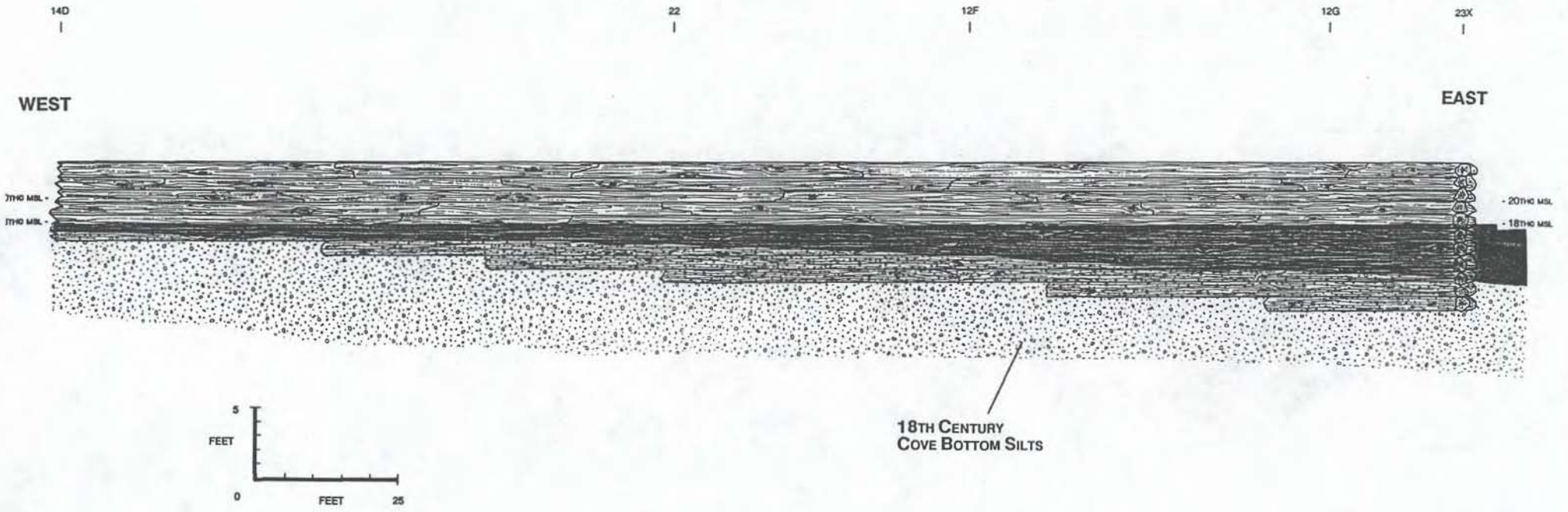
If the elevation calculated as mean sea level in the late eighteenth century were correct at 1 foot 9 inches below current mean sea level, it would presume a rise in the level of the cove of between 1 and 2 feet in the 200 years since the wharf was constructed. Recent studies of regional sea level rise, as evidenced in the lower portions of the Potomac estuary

[1]choosing the lower, more reliable figure, calculated from the currently observed level of wharf fill near the center of the wharf

basin, appear to confirm the finding. For example, the rate of burial of marsh surfaces in southern Maryland, as extracted from measurements of core samples and correlated with observed tidal gauge data from the Chesapeake Bay, suggest an average rise in sea level of 27.4 centimeters per century over the past 300+ years (Froomer 1980). Several mechanisms have been cited to account for the rise in water level: global warming (this, though timely in the 1990s, is from an article published in the 1960s [Donn and Shaw 1963]); changes in the velocity of the Gulf Stream; and even the addition of new water through the pumping of land based aquifers for irrigation. The Maryland study instead suggests the more likely combination of eustatic (world-wide) sea level rise, estimated at 15.0 centimeters per century, and regional subsidence of the continental crust, accounting for the remaining 12.7 centimeters. The total, 27.4 centimeters per century, is equivalent to 10.79 inches, or between 21 and 22 inches over 200 years (Froomer 1980: 302-303). The rate has probably been fairly constant, since tectonic processes are involved, though a slight increase, to 28 centimeters, is noted in the present century. Another study from southern Maryland reports a gradual increase in the rate of rise from an average 12.5 centimeters around 2000 years B.P. to as much as 36 centimeters per century, the latter calculated over the 30 years preceding the study -- the rate of increase appears to have jumped drastically only in the very recent past (Kraft and Brush 1981: 12).

An apparent rise in regional sea level of 21 to 22 inches over the last 200 years falls well within the precision of the data available from the Ford's Landing site: the Alexandria data suggest that the mean water level in the upper Potomac estuary lay 18 to 21 inches below current levels during the late eighteenth century. It would thus appear safe to assume that the wharf did in fact rise approximately 3 feet above the existing high water mark, a working height consistent with contemporary standards (*Figure 66*).

A final note on the configuration of the wharf concerns the apparent misalignment of the southern bulkhead. As is evident from the site plan, the several sections of the Feature 33 exposed in the archaeological trenches did not follow a straight line from the corner, revealed in Trench 23X, to the western edge of the property, beyond Trench 14. The feature lay as much as 10 feet south of a line drawn parallel with property line. The maximum displacement appeared to fall between Trenches 12 and 22, where the angle of orientation changed from slightly south of east/west (site grid) to slightly north. Individual timbers were not skewed, since all of the stacks which were observed appeared solid (the only exception



Source: Engineering-Science

Figure 66. Conceptualized Reconstruction of Wharf Bulkhead

was at west end of Feature 34, where a clear break in the timbers was documented at a butt lap, yet the breach did not appear to have affected the overall orientation of the bulkhead line).

Misalignment of wharf margins was not a particularly uncommon phenomenon. Similar situations were recorded at Cheapside in Baltimore, for example, attributed there to drift during the original sinking of the crib sections (Norman 1987: 72-76), and at Forrester's Wharf (Central Wharf) at Salem, where the cribbed portion of that wharf appeared to have drifted after construction as a consequence of currents and soft bottom sediments (Wilson and Moran 1980: 14-16, Plate 1; Heintzelman 1985: 197).

The deviation in the present case may have been the result a combination of other factors. It is unlikely that the bulkhead failed through damage, since the shallow draft of the cove would have prevented large vessels from mooring alongside. It is possible, though, that the bulkhead line moved during filling, displaced by the pressure of saturated soils (the "mud wave" mentioned earlier [Greene 1917: 48]). Yet the amount of displacement over the entire southern line of the feature suggests that other factors were involved. There may, for instance, have been other problems during original construction. Work may not in fact have proceeded above the low waterline, as theorized above, and though alignment stakes seen throughout length of feature, there may have been some difficulty in keeping proper alignment while laying the initial timbers in the shallows.

Perhaps the most likely explanation is that the bulkhead gave outward at a structurally weak point, despite scarf joints and pinning, as it settled somewhat into the cove bottom sediments. The outward pressure may well have been increased with the addition of the dense Corps dredging spoil in the early twentieth century, forcing the already weakened bulkhead even further out of line.

Horizontal Configuration

As indicated in the background review of historical documentation of Keith's Wharf, few contemporary descriptions of the structure are known. Those documents which do exist

contain conflicting data in terms of the horizontal dimensions of the wharf, none of which correspond with the data resulting from archaeological field investigations conducted at the site.

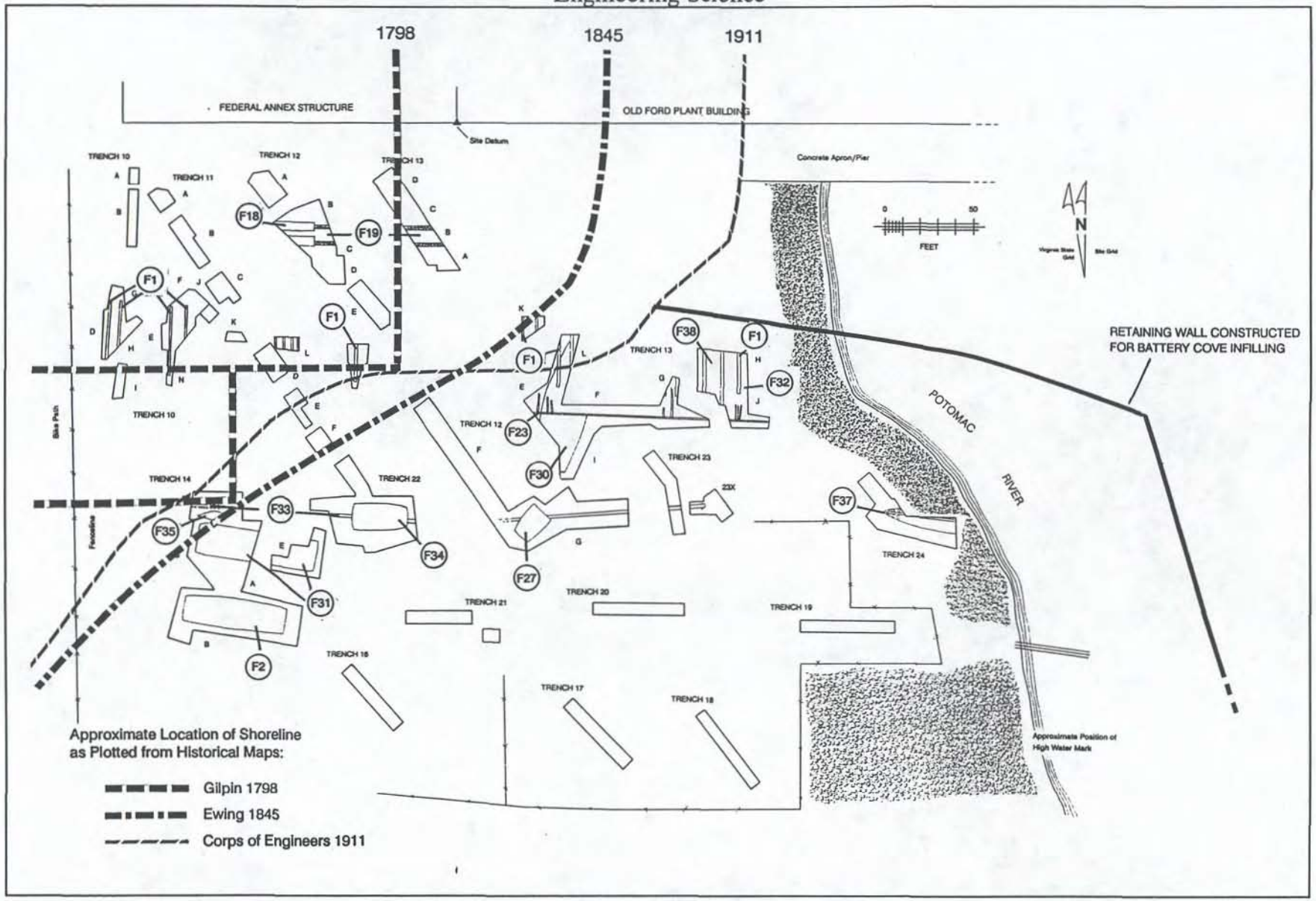
To review, the earliest reference, the 1785 Virginia Legislature petition, characterized the wharf as 400 feet in length from "the high water mark," and 124 feet east of Madison Street, one block east of Union Street. Comparison of several maps from the late-eighteenth and nineteenth centuries suggested that the structure extended approximately 300 feet east of the center of Union Street, the measurement ranging from 225 feet on maps dated 1798 (Gilpin) and 1803 (Anonymous), to 325 feet on Ewing's plan of Alexandria dated 1845. With regard to the second measurement given on the petition, "124 feet east of Madison Street," it was only in the beginning of the mid-nineteenth century that land was depicted as extending more than 10 to 40 feet beyond the location of Madison, this on the Ewing and Hopkins maps of 1845 and 1877 respectively.

The north/south dimensions of the property, paralleling the shoreline, were considerably less variable on the same maps, with the eastern or river edge of the wharf measuring approximately 300 feet in length, and the western edge, along Union Street, about 400 feet. The small block at the southwest corner of the wharf depicted on the earliest maps (Gilpin 1798; Anonymous 1803) appeared to have either eroded or become enveloped by sediment by the mid-1830s (U.S. Army Topographical Engineering Department 1836; Ewing 1845).

Three representative historical maps -- from the turn of the nineteenth century (Gilpin 1798), the mid-nineteenth century (Ewing 1845), and the early twentieth century (from a U.S. Army Corps of Engineers survey conducted in 1911 prior to the infilling of Battery Cove) -- were redrafted with matching scales and superimposed on the archaeological site map (*Figure 67*). The resulting overlay emphasized the differences between each map and the dimensions of the wharf recorded during the current investigation.

As indicated in the background review, ambiguities exist with regard to both the description of the wharf on the early petition and the depiction of the structure on the various historical maps. As a consequence, plotting the outline of the wharf on modern maps was

Engineering-Science



Source: Engineering-Science
Ford's Landing

Figure 67
Shoreline Changes

problematical. When transposing the locations of structures from historic to modern maps, difficulties are often produced by the relatively large scales at which early maps were typically drawn, making measurements over small distances imprecise. Small errors in plotting, either on the original map or in the calculation of distances from the given scale, are magnified, producing error margins which may be too large to reconcile systematically in the field.

Another difficulty lies in the determination of reference points. In this case, the Virginia Legislature petition indicated that the length of Keith's Wharf was measured eastward from the shoreline, defined as the "high water mark." Yet, the location of the eighteenth century high water line is uncertain. Maps drawn before the erection of the wharf are not adequately detailed to allow precise delineation of the shoreline with reference to later landmarks, but it appears that the bank lay well to the west of what is now Union Street. This contention is supported by the petition which referred to the two lots purchased by Harper and his associates east of Water Street:

> part of the two lotts of ground...which lay below high water mark within...which they have extended four hundred feet forward into the river and are now engaged in filling it with earth at a very heavy expense (Harper *et al.* 1785).

The differences in east/west dimensions on mid-nineteenth and early twentieth century maps appear to be connected, at least in part again, with problems of scale. In addition, there appear to have been actual changes in the shoreline associated with silting and sediment build-up around the breakwater represented by the wharf structure . These latter were due to a combination of factors including lack of bulkhead maintenance allowing wharf fill to spill out toward the channel and into the cove; natural, on-going silting of the cove; and a gradual rise in water level.

Throughout the nineteenth century, then, the edges of the wharf eroded and the waters of the cove overran the margins of the structure. In spite of uncertainties involving scales, the overlay maps provide some indication of the incursion. Photographs of the wharf taken during the Civil Water provide further evidence, depicting shallows east of the wharf

bulkhead, toward the main river channel (*Plates 1-6*). Piers were used by this period (and probably before) for access to navigable portions of the river. The sinking of a massive barge in the main channel of the Potomac at the north end of the waterfront in the late-nineteenth century resulted in alterations in the flow of the river, augmenting silting along the length of the waterfront. The direct effects of this event on the southern waterfront, where Keith's Wharf was situated were probably less dramatic than to the north, since the southern wharves were already heavily silted, and the main channel of the river lay well to the east. Feature 23, the late-nineteenth century bulkhead, lying 50 to 60 feet north of the original bulkhead, appears to represent the cove edge during that period. Evidence of alluvial deposition north of that bulkhead suggests that cove waters may have encroached even farther to the north during the early twentieth century, though these deposits may only represent periods of seasonal flooding, which are well documented along this portion of the river and continue to the present day.

Wharf Technology: Comparative Survey

A number of eighteenth- and early nineteenth-century wharves located on the East Coast of the United States have been investigated archaeologically during the last ten to twelve years (Rockman *et al.* n.d.; Faulkner *et al.* 1978; Wilson and Moran 1980; Pendery 1982; Geismar 1983; Heintzelman-Muego 1983; Bradley *et al.* 1983; Artemel *et al.* 1984; Bower *et al.* 1984; Huey 1984; Artemel *et al* 1985; Geismar 1985; Heintzelman 1985; Henn *et al.* 1986; Geismar 1987; Louis Berger and Associates, Inc. 1987; Norman 1987; Artemel *et al.* 1988; Weber 1988; Knepper and Prothro 1989; Louis Berger and Associates, Inc. 1990). The published results of each of these investigations were reviewed for the following analysis. Of the studies, only a few have dealt with materials from ports in the Middle Atlantic: Artemel *et al.*, on the Georgetown waterfront; Heintzelman, at the Carlyle-Dalton Wharf in Alexandria; Knepper and Prothro at Roberdeau's Wharf, also in Alexandria; and Norman at Cheapside in Baltimore.

Researchers have used data from these archival and field studies to a variety of ends, examining patterns of construction technology and the social and economic histories of the cities in which the wharves were located. While these socioeconomic analyses often tend to be fairly site specific, technological evaluations have allowed regional comparisons. The general finding of these comparative studies has been that few if any geographically or

temporally related patterns in the choice of construction techniques or materials can be recognized (*e.g*, Louis Berger and Associates, Inc. 1990: V-24).

General Structural Technology: Types of Wharves in the Region

Examples of most of the wharf types documented along the eastern seaboard are known to have existed in Virginia and the Chesapeake Bay area. An extensive terminology has been developed concerning wharf design and construction, which may be used to classify or order descriptions of the structures. Yet, as was pointed out earlier, the majority of the terms are not derived from contemporary accounts, but result from modern research into the craft. And thus, it is not always clear what methods were being described in records of waterfront activity. For example, William Byrd's 1728 description of the Norfolk wharves notes that:

> The Method of building Wharffs here is after the following Manner: they lay down long Pine Logs, that reach from the Shore to the edge of the Channel. These are bound fast together by Cross-Pieces notcht into them, according to the Architecture of the Log-Houses in North Carolina (Byrd 1929: 36).

Elsewhere he expands on his description:

> The Wharfs were built with Pine Logs let into each other at the End, by which those underneath are made firm by those which lye over them (*ibid.*: 37).

To illustrate the capacity of period accounts for inviting multiple interpretations, Norman (1987: 11) has suggested that Byrd's narration refers to a grillage-type wharf. The present analysts, in contrast, understand the description to conform to reports of cribbing, known to be widely used during the period.

In 1762, the town of Georgetown built a public wharf measuring 60-foot in width and projecting into the Potomac River a sufficient distance to provide a 10 foot draft at its end. The description of the structure suggests a bulkhead wharf:

> the outsides are to be of hewed logges, 12 inches thick Laped and the Joints broke, braced and girded with hewed logges 10 inches thick and 15 feet long and dovetailed into the outsides. The front to be dovetailed at the outsides and the end of every dovetail to be sawed off. The distance from the front to the first brace not to exceed 10 feet and the distance between every brace the same for the whole length of the wharf . . .(Minutes of the Georgetown Commissioners, 1762)

The public wharf lay at the foot of present-day Wisconsin Avenue. Archaeological testing conducted a block to the east, along 31st Street, resulted in the documentation of construction related to a slightly later private wharf. The raft-like timbering recorded there was identified as a form of grillage structure (Artemel *et al.* 1985).

In 1773, Neil Jamieson, a merchant, signed a contract for the construction of a wharf in southern Virginia (whether Portsmouth or Norfolk is unclear). This wharf consisted of a U-shaped framework of cribs. The sides were 160 feet long and 16 feet wide, while the end crib measured 54 feet by 40 feet. The twenty-foot space between the lines of cribwork forming the sides was probably filled with earth (Jamieson Papers 1773, Manuscript Division, Library of Congress).

In Alexandria, two wharves have been investigated archaeologically. The wharf built by John Carlyle and John Dalton in 1759 at the foot of Cameron Street, near the center of the waterfront, was reportedly of crib construction. A small section of the structure was excavated during salvage work in 1982, at which time pine and oak timbers were found forming what appeared to be a crib unit measuring 23 feet in width, 17 feet 6 inches in length, and standing at least 8 feet high. The complete size of the wharf was not established. The fill was reported to consist of cobbles and gravel (Heintzelman 1985; site files, Alexandria Archaeology).

At Roberdeau's wharf, constructed between 1785 and 1791 near the southern end of the waterfront between Wilkes and Wolfe Streets, limited test excavations in 1989 sampled sections of earth fill and several surface features: no evidence of structural members was documented (Knepper and Prothro 1989: 88). Based on the lack of internal structural framing and the configuration of the relatively shallow embayment in which the wharf was erected, it was theorized that the wharf had been formed using a simple perimeter frame of bulkheading, possibly stabilized with piles. This latter notion was suggested by advertisements in the *Alexandria Gazette* placed by Daniel Sharon, wharf builder from Baltimore. Sharon listed Roberdeau's new wharf as the site at which he could be contacted, and thus was presumed to have built the structure. It may have been, then, that pilings employed in construction of that wharf were used as examples of his capabilities.

It is, in fact, often difficult to distinguish wharf bulkheads from cribbing. While period descriptions typically do not distinguish between the various types of construction, certain characteristics may be evident archaeologically. Bulkheads were not self-contained structures, as were the box-like cribs, nor were bulkheads furnished with interior flooring. Because of their design, bulkheads would have been assembled in place, rather than on shore to be floated into position when completed. The actual method of construction used for early bulkhead wharves is not usually described, and probably varied from locale to locale depending on particular site conditions. One of the few contemporary depictions which seems to show a wharf bulkhead under construction is a view of the Delaware River waterfront at Philadelphia, one of a series engraved and published by William and Thomas Birch in 1800 (*Plate 81*). The illustration shows stacked timbers extending outward from the shoreline, supported by struts or braces reaching back into what appears to have been earth fill.

Two sets of bulkheading, one from the late eighteenth century and one from the late nineteenth or early twentieth century, were encountered at the Ford's Landing site. In 1785, the builders of Keith's Wharf described an apparent bulkhead structure, indicating that:

> . . . your Petitioners . . . began to construct a frame to include the street . . . and are now engaged in filling it in with earth at a very heavy expense (Harper *et al.* 1785)

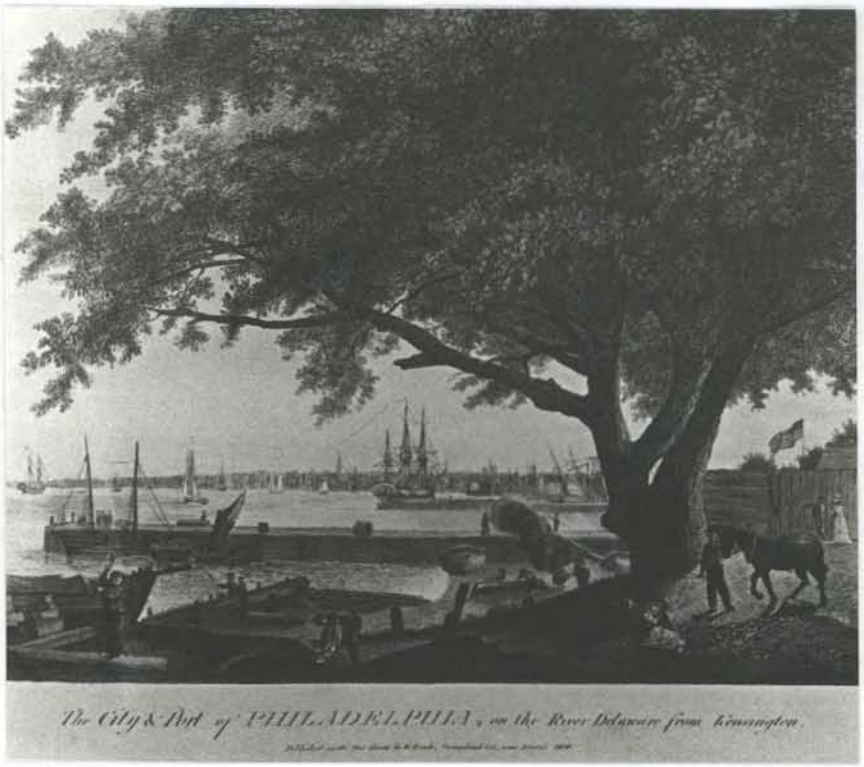


Plate 81. Wharf Construction on the Delaware River at Philadelphia

Source: Engraving by William Russell Birch and Thomas Birch, 1800 Plate 81
Ford's Landing

Keith's Wharf at the Ford's Landing site exhibited many features recognized in wharves of the period. Like the almost contemporary wharf at Cheapside in Baltimore, the structure was formed of large diameter, hand-hewn logs, left rough in the lower courses, below the water level, and somewhat more finely finished above. The similarities with the Baltimore wharf were not extensive, though. The internal structure of the Cheapside wharf was reportedly crib-related, while at Keith's Wharf, structural support was rendered by tie-back braces. The ties were attached to bollards and deadmen in the fill, as was typical of bulkhead construction during the period. There were no piles reinforcing the southern face of the bulkhead of Keith's Wharf. Little of the eastern face of the bulkhead, paralleling the river channel, was exposed archaeologically, and thus exterior supports may have been used along that margin of the wharf. Pilings were suggested by the Baltimore contractor, Sharon, as an appropriate system along this portion of the Potomac waterfront, where the drop off to the channel was steep. Other wharves along the river were not supported in such a manner; *e.g.*, the earlier, Georgetown public wharf, whose otherwise detailed specifications had included no provision for piles. The east bulkhead line of the Keith's Wharf remained well back from the steep slope, as evidenced by early maps and by the original petition in 1785, which cited plans to build piers out to navigable waters (Harper *et al.* 1785). Photographs of the wharf taken during the Civil War showed portions of the eastern bulkhead at high and low tides (*Plates 3-6*). Gaps in the timber courses visible in the photograph suggested that the bulkhead had deteriorated substantially, and that as a consequence the top remaining run of the bulkhead lay below the original, the eighteenth-century level. In spite of this, no evidence of structural pilings could be seen. Thus, pilings may not have been considered necessary along any portion of the structure.

Joinery

A review of documented wharf construction techniques in the eighteenth and nineteenth centuries has indicated that there were no generally accepted methods of connecting specific structural members. A wide variety of joint types has been recorded, many adopted from ship construction. In one instance, a single property, excavated at the Washington Street Urban Renewal area along the Hudson River in Manhattan, contained examples of scarfed, pinned, saddle-cut, cross-lapped, mitred, shouldered and cleated joints (Geismar 1987: Fig. 25). Well-made dovetail joints, such as those specified in the contract for the Georgetown public wharf, needed no further strengthening, though they were frequently pinned, as evidenced by examples among the back braces on the bulkhead of

Keith's Wharf. Other types of joint were customarily pinned for stability using treenails (wooden dowels commonly known as trunnels), or using spikes or dowels of wrought or cast-iron, referred to as drifts. Timbers running the length of a wharf, whether cob, crib, or bulkhead, were usually spliced, the most structurally sound joint being the overlapping scarf joint. Scarf joints appear to be one of the few chronologically sensitive features of wharf construction, having been observed only on wharves constructed after about 1778 (Louis Berger and Associates, Inc. 1990: V-23-4). This circumstance may be related to the decreasing availability after the mid-eighteenth century of long, heavy timbers which did not need splicing. Half-lap and scarf joints were almost invariably pinned (except for individual examples which can usually be attributed to oversight during construction). Corner joints were usually chosen from a variety of notching techniques.

Using joinery typical of general wharf construction, the builders of Keith's Wharf employed simple scarf joints pinned with iron drifts to splice the main structural timbers of the bulkhead. The corner of the structure was roughly finished. In contrast with dovetail joints trimmed flush with the outer structural line, such as were specified for the Georgetown public wharf (Minutes of the Georgetown Commissioners, 1762), or trimmed half-lap joints documented on a corner of the bulkhead of the roughly contemporary Central Wharf at Salem, Massachusetts (Wilson and Moran 1980), the surviving portion of the corner of Keith's Wharf exhibited cross-lap or saddle-cut joints, with the ends of the timbers left projecting well into the dock space. This type of corner construction was similar to that documented at a cribbed wharf, also from the turn of the nineteenth century, along West Street and the Hudson River in New York (Geismar 1987), and was apparent in illustrations of a corner of cribbing at the Cheapside wharf in Baltimore (Norman 1987). There was no evidence of structural stabilization of the corner at Keith's Wharf -- no pins through the lap joint, and no indication of diagonal braces as have been recorded on most similar structures. This could merely be a factor of the depth of the remaining portion of the corner; that is, the lowest timbers may not have been as heavily braced as the higher courses. Yet angle of the corner was well out of square, roughly 87 degrees, suggesting that the entire structure had moved, probably as a consequence of settling over time. The resulting distortion of the corner suggested that it had not been braced. A final observation based on the configuration of the corner concerns the function of the wharf. Considering the protrusion of the bulkhead timbers at the corner as well as the lack of fender pilings protecting the portions of the bulkhead recorded in the archaeological trenches, it may be presumed that vessels were not

intended to tie up directly to the edge of the wharf, an assumption supported by the shallow draft alongside the structure.

Wharf Fill

Variety also characterized the materials used for filling wharves. Stone was used as a major component of fill for wharves throughout the East Coast. The material usually consisted of locally available cobbles, though occasionally, exotic stone, arriving as ballast in ships sailing unladen from Europe or the Caribbean, would also be used. Cob wharves may indeed have derived their name from their cobble filling: at times any wharf filled with cobbles was referred to as a "cob" wharf (Heintzelman 1985: 10; Louis Berger and Associates, Inc. 1990: V-3.) The public wharf in Georgetown was to be "filled up with stone within two feet of the wharf one foot of which is to be filled with clay or dirt, the other foot with gravel" (Minutes of the Georgetown Commissioners, 1762). The Carlyle-Dalton Wharf on the central Alexandria waterfront was also reportedly filled with cobbles and gravel (Heintzelman 1985: 186). Stone fill was, however, most common in New England and New York, where timber began to be relatively scarce and expensive by the mid-eighteenth century. South of New York, where wood was plentiful and cheap, and stone often more difficult to obtain, cord wood or driftwood was frequently used. In 1791, Daniel Roberdeau advertised for driftwood and "any kind of sound wood" to use in filling his wharf north of the Ford's Landing site (*Alexandria Gazette*, March 10, 1791; May 12, 1791), though no evidence of wood fill was observed in the portion of that site which was tested archaeologically.

Another, sometimes major component of wharf fill was garbage. Refuse and garbage has been found in virtually every wharf which has been excavated (Louis Berger and Associates, Inc. 1987: Table VIII.14). Wharves often represented extensive land reclamation projects. The wharf builder, needing to fill in a large volume, was frequently willing to receive household and other refuse in quantity, a situation which in many cases simplified an increasingly difficult trash disposal problem in larger cities (Geismar 1987: V-5). Several wharves along the Georgetown waterfront were found to contain fill varying from construction rubble to industrial waste (Artemel *et al.* 1985). Disposal of another sort was documented in late eighteenth-century Alexandria by a Rhode Island merchant residing in the town:

> Last Autumn a negro Woman drowned in the harbor, supposed by design -- a few days after she was taken up and laid on the shore in the most public part of the Town, where she lay untill some Negros that were filling a Wharf nearby, was ordered to put her into the Wharf, and cover her up, which humane deed they performed (Windsor Letters, 1786-88).

The exact wharf indicated has not been determined, but is presumed to have been one of the central waterfront structures.

Many wharf filling projects seem to have been part of wider programs to restructure the city landscape. Material obtained from the grading of hills and bluffs, and soil from building foundations was systematically used to fill wharves by the mid-eighteenth century (Geismar 1987: V-5-8; Rockman *et al.* n.d.: 77-80). A report on New York's wharves in 1840 specifically describes the fill as "earth obtained in the operation of levelling sites and excavating foundations for the dwellings and warehouses of the city" (Hunt 1840: 313, in Norman 1985: 21-22). Clean fill, soil without artifactual inclusions, used in wharf construction, seems often to have originated from nearby grading projects (Geismar 1987: V-8). Stoddert's Wharf, at the foot of 34th Street in Georgetown, was filled with unmixed earth of local origin (Artemel *et al.* 1991). Clean fill appears to have been used almost exclusively in construction at the south end of the waterfront in Alexandria. At Roberdeau's Wharf, two blocks north of Keith's, a deposit of stoneware wasters from a local pottery was recorded in one relatively small area of the site, but the dates of operation of the pottery indicated that the deposit was secondary fill, used to re-establish or possibly to raise the original surface level of the wharf (Knepper and Prothro 1989). A small amount of artifactual debris from the early nineteenth century was recovered from portions of the fill at Keith's Wharf. These materials date slightly later than the original construction of the wharf, and thus indicate similar refurbishing. The main body of the fill comprising both wharves on the southern waterfront, though, consisted of clean sandy clay obtained through the grading of the banks immediately west of the properties. That the material for both structures was probably derived from the same location is suggested by the presence of prehistoric artifacts scattered throughout the portions sampled.

By the late nineteenth century, dredging came to be one of the principal sources of fill material for wharves. The earliest form of dredge was a scoop worked by hand, a method with fairly clear limitations in terms of depth. By the seventeenth century, buckets mounted on continuous chains and powered by treadmills or horse power were being used in Europe (Norman 1987: 91-93). In New York, slips were dredged as early as the mid-eighteenth century. "Fifty scow loads of mud and filth" were removed from one New York slip in 1766, with additional dredging needed in 1768, 1769 and 1772 (Rockman *et al.* 1987: 38). A steam operated bucket dredge, designed by the industrial inventor Oliver Evans, was operated in Philadelphia by 1805 (Ferguson 1980: 41). Also at the turn of the nineteenth century, the city of Baltimore had acquired a "mud machine," apparently consisting of one large scoop, which was used to keep the main channel of the harbor open, with the resulting spoil employed as fill for surrounding land reclamation projects (Weeks 1987: 20, Fig. 21). Most docks in Baltimore employed private dredgers, a highly expensive proposition. Clearing one dock in 1817, for example, was reported to have cost over $5000 (Norman 1987: 97). Again, it took the widespread use of steam power to bring this technology within the range of most wharf owners. After the introduction of the steam-powered dredge, spoil cleared from adjacent docks became a standard wharf fill material. Refuse was dumped regularly into the dock areas between wharves, and thus was often included in the dredged fill. There is some evidence that the rate of such dumping decreased overall in the early nineteenth century, as interest in urban sanitation rose (Geismar 1987: V-1).

In Alexandria, the earliest known reference to private dredging dates from 1875 (*Alexandria Gazette*, 7 April 1875). After that date, dredging was carried out both by private dock owners and by the U. S. Army Corps of Engineers, and continued well into the twentieth century. As noted earlier, a major dredging project undertaken by the Corps of Engineers from 1911 to 1912, supplemented by private dredging conducted at about the same time by the owners of the Marine Railway, Ship Building and Coal Company, was responsible for the infilling of Battery Cove.

Wharf Construction as Craft

Relatively little is known about the craftsmen who actually built the wharves which have been documented historically and archaeologically. Most sources agree that wharf construction was probably not recognized as a specific trade until the nineteenth century. In

records of the initial period of the development of the City of Washington in the 1790s, for example, there were indications that the men contracted for the construction of wharves were often the same as those who built bridges, canals and major public buildings (Arnebeck 1991).

Skilled wharf builders were rare outside major seaports, and the craftsmen seemed prepared to travel to sources of work. David Sharon's advertisement of 1785, for example, indicated that he and his work force were itinerant:

> being here for the present season, and desirous to be as useful as possible to the inhabitants whilst he stays, [he] invites the earliest application to him at Mr. Roberdeau's wharf, of such who would not be disappointed, when it may not be in his power to serve them, as now he can command any reasonable number of good workmen from Baltimore, who await his orders (*Alexandria Gazette*, 21 July 1785).

Before the late eighteenth century, wharves were probably constructed by joiners or, perhaps, by shipwrights. A number of sources have suggested that one of the advantages of crib or cob type construction was simplicity: little by way of specialized tools or expertise beyond the scope of contemporary carpentry was required to assemble the structures and float them into place. The prevalence of scarf joints, which were common in ship-building, has been taken as an indication that shipwrights may initially have been involved in wharf construction. Isaac Fleming, for example, who operated Alexandria's oldest shipyard, and the largest during the Colonial period, was also considered the town's most experienced wharf builder at the time of his death in 1786 (Shomette 1985: 84).

By the end of the eighteenth century, wharf building seems to have become a somewhat more specialized trade. Directories of that period begin to include men listing themselves specifically as wharf builders -- sometimes these were the same men who had been listed as carpenters in earlier years. One study has suggested a reason for the growing standardization of wharf construction techniques in late eighteenth-century New York:

> the increase in the demand for wharves could have created openings for entrepreneurs, specializing in wharf construction, who could compete favorably with master general carpenters (Henn *et al.* 1986: 4).

Writing on the origins of civil engineering in the U.S., another researcher noted that during the early nineteenth century, engineering underwent a transformation from an avocation to a discipline, from a "non-literate, apprenticed craft to a literate, learned field" (Calhoun 1960). By the 1830s, the notion of the traditional craftsman or folk engineer as the sole source of knowledge and experience was disappearing. The field became increasingly mannered, texts on the design and fabrication of various types of structure began to appear, and construction techniques began to be codified.

Other observers have noted that, while standards were in the process of forming during this period, they were not necessarily broadly applied, particularly within the craft of wharf construction. Norman thus described the working methods of wharf erection in Baltimore:

> While wharfbuilders appeared to have acknowledged rules for wharf construction, uniformity in the application of these rules did not apply below a certain level. It was not unusual to find differing arrangements of ties and piles, various kinds of joinery, woods, piles, and so forth utilized to build two very similar-looking structures (Norman 1987: 101-2).

Local craft traditions and ethnic backgrounds have also been suggested as factors in the wide variations seen in wharves built in the same city or during the same period (Louis Berger and Associates, Inc. 1990: V-24).

In the end, though, the ability to understand the needs of a site and to design a wharf specifically to fit those needs was probably the wharf builder's most valuable asset. The choices that were made from the variety of techniques available appeared to have been based on the specific characteristics of the site and on economics. One such local or site-specific characteristic was the availability of construction materials. Other factors included the tide

differential, the speed of the current, the salinity of the water, the depth of the harbor, and bottom characteristics such as sediment types and slope. Because wharf builders left no written records, however, the relationship between these conditions and the design of individual wharves has generally been lost.

The specifics of the Ford's Landing site are known. The Potomac at Alexandria is wide, tidal, and slow moving. Though the river is notoriously subject to flood, the tidal range averages only three feet, with a tidal current of one-half to one knot. The bottom of firm mud and clay, well compacted and mixed with sands and gravels, is covered with a heavy build-up of silt, intensified historically by land-clearing activities. From the shallows near the banks, the bottom slopes steeply to the main channel of the river, which until the late nineteenth century was as deep as forty feet: Sharon's plan to drive piles along the outer or channel edge of the bulkhead of Roberdeau's Wharf seems to have been formulated to account for this situation. The deep channel was close to the shore along the northern and central parts of Alexandria's waterfront, but veered eastward, the drop-off beginning 200 to 300 feet from the edge of Keith's Wharf in the early-to-mid nineteenth century (U.S. Army Topographic Engineer Department 1836). Reference in the original petition (Harper *et al.* 1785) to the construction of piers in addition to the wharf, indicated that the 400 foot-long wharf did not extend to deep water when initially constructed.

Because the tidal range in the upper Potomac estuary is relatively low[2] and the riverfront embayments at Alexandria shallow, many of the town's wharves, particularly on the southern waterfront, did not require the massive vertical structures needed for the typical wharf erected in harbors farther north (Wilson and Moran 1980: introduction; Greene 1917: 26). Extensive internal structural support was not essential, and thus the cheaper alternative of bulkheading was possible. The slowness of the Potomac current may also have made elaborate stabilization through the use of openwork framing or piles unnecessary. In contrast, the current at Portsmouth, New Hampshire ranges between four and six knots. A wharf constructed there by Nicholas Follet in the early eighteenth century was of open cob construction, allowing the free passage of water beneath the upper surface and thus avoiding erosion or even dislocation of the structure (Heintzelman 1985: 195). The base of the

[2]the figure of 3 feet compares with equivalent ranges for Boston of 10 feet, for Salem of 9 feet, Philadelphia of 6 feet and New York of 4.25 feet

bulkhead of Keith's Wharf appeared to have been laid within a shallow trench to slow the erosion of loose fill, but otherwise currents were not a significant factor in the design of the structure.

The Economics of Wharf Construction and Operation

Private Profit versus Public Good

Wharf building was one of the many elements of urban development which was delegated to private interests during the Colonial and Federal periods of American history. The pattern of allowing the owners of waterfront property unlimited rights to expand their landholdings by building wharves had been established by medieval times along the Thames River in London (Milne and Milne 1978: 103). English colonies in America followed the same common law precedent.[3] In Alexandria in 1760, for example, the trustees confirmed the rights which had been understood but not spelled out in the original sale of lots in the town:

> we find an Ommission in not entering what was agreed on before the sale of any of the said Lotts, that is, that every purchaser of River side Lotts by the terms of the sale was to have the benefit of extending the said Lotts into the River as far as they shall think proper without any obstruction from the Street called Water Street (*Proceedings of the Alexandria Trustees*, Sept, 1, 1760).

The assignment of what would later come to be seen as public works to private agency was consistent with the economics of the period, which assumed that the actions of individuals pursuing private profit would automatically contribute to the public good. This assumption was probably valid initially. New wharves encouraged the general prosperity of the port by attracting commerce. The men who had the assets to purchase waterfront lots, which were often expensive properties in the heart of the commercial waterfront, were typically the same men who could command sufficient resources, in a society chronically

[3]New York seems to have been an exception to this rule, perhaps reflecting its Dutch background. In that city, municipal authorities sold rights to lots under water as separate transactions, deriving considerable revenue from the sales, and maintained certain rights over the wharves which the purchasers were required to build (Rockman *et al.*: 15-17).

short of capital, to build wharves on those lots. Municipalities, with limited powers of taxation, were usually incapable of the substantial capital investment necessary for wharf construction. The town of Alexandria, for example, could not itself have financed the twenty-six wharves which lined its waterfront in the mid-1790s (Miller n.d.: 12).

Towns and cities did retain some interest in the land created on the wharves. Public rights-of-way were generally included in construction plans, either as extensions of existing streets, as was the case with Keith's Wharf, or as public landings, as at the Carlyle-Dalton Wharf, where one-half of the original construction remained public (*Proceedings of the Alexandria Trustees*, July 10, 1759). The fact that Keith and his colleagues were compelled to petition the state government for permission to maintain Franklin Street at a 50 foot width on their wharf, rather than the 100 foot width west of Union Street, pleading excessive cost, implied that the government held authority over the matter (Harper *et al.* 1785).

Continuous extension of land through wharf construction ultimately added substantial amounts of land to major ports. In what was probably one the most extreme instances, over half the land area of lower Manhattan was created through the building of wharves and the filling of docks (Kardas and Larrabee 1980: 15). This type of landfilling activity clearly assisted in the expansion of the city and increased tax revenues. But by the late eighteenth century, the unrestricted construction of private wharves was beginning to create problems in many ports. Over-building in some harbors undoubtedly reduced what one analyst in the early twentieth century referred to as the "tidal prism," described as the "body of water between mean high and mean low water levels, which enters and leaves a harbor with each tide" (Greene 1917: 27). By the early twentieth century, engineers recognized that interfering with this daily flushing action contributed to both the pollution of harbors through the accumulation of garbage and sewage and to increased silt build-up. Wholesale land reclamation had the additional effect of reducing the size of the adjacent navigable waterways, an important consideration in ports on narrow river channels. In 1787, for example, Baltimore acknowledged such a problem by giving its Board of Port Wardens authority to establish a line limiting the extent to which private wharves could be extended into the basin of the harbor. That authority was confirmed in 1797, when the city was incorporated (Norman 1987: 50-51).

In 1831, the Alexandria Common Council enacted similar restrictions on wharf length, limiting the maximum projection to 320 feet east of Union Street at the north end of the town (north of Oronoco Street), and 514 feet at the south end (south of Wilkes Street). In the main portion of the waterfront, between Oronoco and Wilkes Streets, existing wharves already projected from 350 to 540 feet east of Union (Shomette 1985: 155). Although the differences in length have been interpreted as an attempt to favor the commercial heart of the city, economically depressed in the 1830s, the range of the restrictions may also reflect different distances between the shore and the main channel of the river.

By the 1830s, the assumption that the actions of individuals seeking private profit automatically contributed to the public welfare was being questioned. Municipal governments were beginning to take over certain functions -- the control of water supplies, for example -- which had hitherto been considered private responsibilities. When the U.S. Army Corps of Engineers assumed control over rivers and harbors, it too established lines of limitation for waterfront structures, delineating an inner "bulkhead line" and outer "pierhead line," shown thenceforth on all navigation charts for Alexandria and other ports under Corps jurisdiction.

Wharf Profitability

Decisions on wharf construction were ultimately based on calculations of the cost of construction versus potential profits. Little information is available on the actual cost of wharf erection and maintenance. As in Alexandria, the owners of waterfront lots in most cities had unlimited rights to create new land through wharf construction. Additional property could thus be obtained for the cost of constructing and filling the wharf, a cost which may well have been less than that of purchasing additional land.

Wharves could generate substantial profits in a number of ways. Owners who were also merchants and shippers could use the wharves themselves for shipping and storage. They could, moreover, collect fees, referred to as wharfage, from other shippers using the wharf to load or unload goods or passengers. The construction of warehouses and stores on the wharf, which might then be leased to maritime craftsmen, innkeepers, and merchants, may in fact have constituted the principal return on investment. Finally, the newly created property could itself be sold at substantial profit if the area prospered. The potential for

profit in wharf construction can often be gauged by the sale prices of property which included the right to build wharves. Such data was not available for Alexandria. In Baltimore, however, property on the newly constructed Cheapside wharf, which included the right to extend the wharf still farther into the basin, rented at three times the going rate per foot in 1783 (Norman 1985: 57).

There was risk in wharf construction, however. The erection of a wharf did not guarantee its use. The success of the venture depended on many factors beyond the control of any individual or group of investors, including periodic crises within the business community, international political developments and various other factors which may influence the relative growth of urban centers. The original investors in Keith's Wharf gambled on the continued expansion of Alexandria in the late eighteenth century. The venture did not prove commercially successful. Yet the early failure of the wharf was not necessarily unique. Other wharves, both contemporary and earlier, experienced often long periods of disuse. The wharves built on the Telco Block site in Lower Manhattan in the 1730s, for example, were "moribund" into the 1760s (Rockman *et al.* n.d.: 24). The west side wharves in New York City, completed in the first years of the nineteenth century, were underutilized for many years (Geismar 1987: 14).

Even commercially successful wharves were not without problems. Silting was an issue everywhere, particularly before the development of efficient dredging techniques, and even with mechanical dredges silt build-up constituted a significant maintenance expense. Fill leakage from between wharf timbers increased the problem as well as necessitating the frequent refilling and regrading of the structure to maintain a level working surface. The early nineteenth-century reference to Keith's Wharf being "lately logged and filled up and now . . . in complete repair" (*Alexandria Advertiser*, May 18, 1803) suggested that subsidence was as great a problem at that location as at other wharves. The changing configuration of the shoreline south of the structure through the late eighteenth and early nineteenth centuries indicated that fill leakage and silt build-up continued to have been major concerns. The problems were eventually left unaddressed, resulting in the deterioration and erosion of the edges of the wharf, as evidenced by maps from the mid-nineteenth century and later, and by archaeological remains.

The wooden structure of a wharf also needed frequent repair. Timbers were occasionally treated to enhance preservation -- saturated with oil or coal tar, for example -- though these efforts did not ordinarily provide protection far beyond that of untreated material (Stevenson 1874: 181). Yellow pine, though soft, was naturally resinous and thus somewhat resistant to deterioration. The wood was common in the Middle Atlantic and the South, and thus was used regularly in wharf construction. The lower timbers of the wharf, which were constantly submerged, were often attacked by marine borers in salt water environments, but due to the relatively anaerobic environment were not subject to rapid decay. Bark was commonly left on the lower timbers as an added protection. The upper timbers, however, which were exposed to the air either continuously or cyclically (at low tide), decayed rapidly and required periodic replacement (Greene 1917: 5). Repairs were expensive; in 1803 repairs to Kirk's Wharf, at an unidentified location in Alexandria[4], were reported to have cost almost $2,000 (Alexandria County Will Book, Orphans Court A:302-304).

Wharves were usually not considered permanent, long-term structures. Newly built wharves were often replaced soon after construction either by larger wharves, extending further into harbor, or by wharves in another portion of the harbor or in another port altogether. Thus, construction was often a matter of expediency: the advantages of quality construction and low maintenance over a long life could not be expected to outweigh initial high costs. Even as recently as the early twentieth century, studies of wharf construction stressed the importance of just such a calculation:

> In the economical design of wharves and piers an estimate of the commercial life of a structure is of the first importance. In most places experience has shown that traffic shifts from place to place and that localities may become obsolete as far as their desirability for wharves and piers is concerned. Entire industries die out and new ones take their places, and new methods and machinery are adopted for handling freight and for construction work, making it uneconomical to spend money for

[4]Note: This is the only known reference to Kirk's Wharf. Based on the likeness of spelling and the date given for the repairs, it is possible that Kirk is a mistranscription of Keith. If so, this would be the sole record of actual costs incurred in the construction or maintenance of Keith's Wharf.

> great permanence of construction where permanence of usage cannot be definitely foreseen (Greene 1917: 19).

As noted previously, the lack of city-wide systems of garbage disposal tended to lead to the use of the docks and slips alongside wharves as garbage dumps. Thus, wharf areas were constantly criticized as health menaces, detrimental to adjacent residences. The desire to remove these "nuisances" created additional pressure for the extension of ports farther out into the harbors. Wharves often succeeded each other within twenty-five years or less, transforming waterfront areas into interior blocks.

Builders not anticipating a long life for their wharves may also be responsible for the comparatively insubstantial quality of American wharf construction, which was noted by a number of European observers. David Stevenson, an Englishman describing American wharves in 1838, observed that:

> all the works connected with the formation of the harbors in America [are] of so rude and temporary a description, that, but for the sheltered situations in which they are placed, and other circumstances of a no less favorable nature, the structures would be unfit to serve the ends for which they were intended (cited in Norman 1985: 99).

Americans, too, commented on the impermanence of American wharf building techniques. William Byrd, in 1728, noted that wooden wharves in Norfolk were destroyed by marine borers within "several years," but could be easily replaced because timber was so readily available (Byrd 1929: 36).

With regard to investment expenditures and quality of construction, Keith's Wharf appeared typical. The men who built the wharf were not poor. They were each ambitious community leaders and successful entrepreneurs. In 1785, they reported that they had purchased their lots at a "very extravagant rate" and were engaged in filling in the wharf at "a very heavy expense" (Harper *et al.* 1785). The enterprise was speculative, however, and the investors built no more carefully than did wharf developers in other cities, in this case finding that a bulkhead structure, apparently supported only by internal tie-back bracing, was

sufficient for their needs. In the end, the original speculation did not succeed. The city did not continue to expand as had been predicted, and the location at the south end of the waterfront never ceased to be marginal. By the mid-nineteenth century, the original bulkhead of the wharf had deteriorated, and the wharf edges had eroded and been covered with silt deposited by the rising waters of the cove to the south. The wharf did eventually see successful business ventures. In the later nineteenth and early twentieth centuries profitable shipyard industries were developed on the site. Yet by that period the operators of the yards may well have been unaware of the location and extent of the earlier structure.

Shipway

The earliest building ways used in this country were not permanent, but were erected for the construction of a specific vessel (Goldenberg 1976: 69). As the size and numbers of vessels under construction increased, building slips came to be designed for re-use, and thus certain standards for construction developed. Yet, in contrast to the large amount of data available on the construction of wooden ships and boats, little contemporary information exists on the form and use of nineteenth-century ways. Much of the detailed data which has been published concerning shipway configurations is based on the construction of the considerably more massive, metal ships of the late nineteenth and early twentieth centuries, the weight of which requires more precise engineering to ensure adequate balance and support during construction and launching. Thus, there is relatively little direct comparative data on which to base an analysis of the Ford's Landing feature.

As noted earlier, the proper or required slope of a shipway was calculated according to the desired launching speed, which in turn was a factor of the size of the vessel and the depth of the harbor at the base of the slip. In fact, the slope of the building slip itself was less important than that of the groundways, on which the cradle and sliding ways moved during launch. The building slip functioned as the base or foundation on which construction was undertaken, and thus the major criteria for its design would have been stability during the fabrication of the hull, and an incline which would not hinder the configuration of the launching apparatus. The figures suggested in the literature for the inclination of the building slip in wooden ship construction range between 5% and 7%.

The slip documented at Ford's Landing exhibited an overall slope of only about 2% (a difference of 7.28 feet over the total length exposed in the excavations, 368 feet). In reality, this figure may be somewhat misleading, due to several factors. For example, when inclination figures are cited in the literature it is often unclear which ways are being considered. As noted, there was not necessarily a close correlation between the permanent ways and the launching apparatus. Since the permanent ways need not have been constructed on as steep an incline as would have been needed to launch the vessels, the range of actual slopes may have been greater than that recommended.

Also a factor in the observed inclination of the Ford's Landing shipway were indications that the elements of the slip had settled somewhat over time. This was not an unexpected occurrence given 1) the nature of the underlying soils -- old wharf fill which had become saturated and unconsolidated; 2) the means of support -- spread timbers, essentially floating on waterlogged fill; 3) the amount and character of the overlying fill; and 4) the length of time the feature had lain beneath the fill. In no area was a sufficiently extended section of the slip exposed along the centerline to allow determination of the evenness of the incline down to the river; *i.e.*, whether or not there were dips or sunken areas. There were variations in the slope throughout the length of the feature, though. Between Trenches 10D and 10M, a distance of 153 feet, the slip fell 2.07 feet, a slope of 1.35%. Between Trenches 10M and 10L, a distance of 115 feet, the fall was 1.85 feet, a 1.61% slope. The incline was markedly greater between Trenches 10L and 13J, 3.36 feet over a distance of 100 feet, a 3.36% slope, and within Trench 13J, 1.9 feet over 75 feet, 7.8%. As would be expected, the incline of the slip increased to the east, toward the river, with the more marked slope near the end of the wharf representing the final rundown to the river channel.

Other evidence suggested that the feature may indeed have settled unevenly to some extent. Various discrepancies in elevation were apparent along the north/south, or perpendicular, axis of the slip, most noticeably in the long spreader timbers. Since these data were more complete than those along the central axis, they were examined in some detail as a possible indication of the amount of vertical displacement which may be expected in various segments of the slip.

Table 13 details the elevations and the calculated slopes of portions of the slip in sections of Trench 13. In all cases, the elements were lower to the north. In Section K of

Trench 13, settling appeared to have been nominal. Though only a relatively small amount of two spreaders was exposed near the north edge of the slip, a one-half inch change in elevation from south to north was measured over a distance of 10 feet. It is possible that such a difference could have been a factor of the level of precision achieved in measuring elevations, or of inconsistencies in the surfaces of the shipway materials themselves, but the effects of these factors is presumed to have been minimal.[5] Thus, it is assumed that the perceived settling of the spread timbers in Section K was indeed real.

In Section L of Trench 13, the westernmost spreader lay on a more distinct slope downward to the north. The southern half of the timber lay over Feature 30, the barge hull lodged beneath the nineteenth-century bulkhead, while the north half lay on sandy fill. Yet the barge did not seem to provide adequate support for the timber. It may in fact have been that the north end of the spreader had settled, forcing the longitudinal planking of the barge hull down with it, since the intermediate plank adjacent to the spreader to the east lay on an apparently identical slope.

TRENCH/ SECTION	SLIP COMPONENT	DIFFERENCE IN ELEVATION	DISTANCE BETWEEN MEASUREMENTS	CALCULATED SLOPE
13/K		0.04' ($^1/_2$")	10'	0.4%
13/L	spreader	0.21' ($2^1/_2$")	13'	1.6%
13/L	intermediate plank	0.12' ($1^1/_2$")	7.5'	1.6%
13/G	west spreader	0.19' ($2^1/_4$")	12'	1.6%
13/G	east spreader	0.19' ($2^1/_4$")	12'	1.6%
13/J	west spreader	0.29' ($3^1/_2$")	10'	2.9%
13/J	middle spreader	0.81' ($9^3/_4$")	18'	4.5%
13/J	east spreader	0.33' (4")	14'	2.4%
13/J	east edge of Feature 38	0.53' ($6^1/_3$")	11'	4.8%
13/J	west edge of Feature 32	0.18' (2")	10'	1.8%

Table 13. Lateral Settling of Building Slip -- Relative Elevations

[5]Regarding survey precision, multiple, independent measurements were made of several features throughout the site during the course of the project which indicated that elevations taken were precise to within $^1/_4$ inch or better. While no tests could be implemented to control for lack of uniformity in the apparently planed surfaces of the slip elements -- inconsistencies due to workmanship or warping, for example -- it was estimated that inaccuracies were probably not much greater than $^1/_4$ to $^1/_2$ inch, since the spreaders had been machine-cut and were composed of heavy, stable sections of pine timber.

Toward the river, in Section G of the trench, both spread timbers, as measured independently, had settled to the north similar amounts, and on the same 1.6% slope as the materials in Section L. In contrast to the timbers in Section L, the timbers in Section G appeared to lie directly on sandy fill.

In Section J, at the east end of the slip, the depths of three spreaders and portions of the supporting barge hulls, Features 32 and 38, indicated different degrees of settling to the north. Settling appeared greater toward the east end of Feature 38, with a slope approaching 5%, or $^1/_2$ inch in 12 inches. The easternmost spreader lay between barges and exhibited a less pronounced slope, as did Feature 32 to the east.

This fairly detailed analysis was undertaken to determine the amount of localized variation in the level of the slip which might be expected. The data indicated that a noticeable degree of settling had indeed taken place in some portions of the slip. The amount of vertical movement recorded along the north/south axis (along the spreaders) was uneven, suggesting that a variety of factors was probably involved. For example, variations in the depth, and thus the weight, of the overburden lying atop the slip were noted at different points along its length, as well as differences in the composition and consistency of the underlying fill. As a consequence, the amount of pressure on different portions of the slip would have varied, as would the amount of substructural support. The eastern third of the slip, for example, where the slope of the feature was most pronounced, lay at or beyond the edge of the wharf in the late nineteenth century, and below as much as 5 additional feet of modern fill, in comparison with the north end of the feature. Some of the perceived increase in slope at the east end of the feature may, then, have been a factor of settling.

Yet due to the length of the feature, the effects of localized displacement may in the end have had a minimal effect on the overall slope of the shipway: the incline recorded in the archaeological excavations was probably a close approximation of the original configuration. That is, the slip was probably built on a negligible incline near the west end, where vessels would have been erected, with keel blocking used to raise the hull sufficiently to allow the ground and sliding ways to be more steeply angled for launching. The incline of the slip would have increased gradually to the east to a point at which the slope was approximately equal to that needed for the launching ways as the feature entered the water.

The estimate provided in Appendix C (*q.v.*) for the width of vessels which could be constructed on the ways may in fact be somewhat long (the consultant was unable to visit the site, and his analysis was conducted from drawings, photographs and written descriptions). The surfaces of the spread timbers were planed down their total 40 foot length. The spreaders had been laid on 8 foot centers, rendering the gap from edge to edge approximately 7 feet. It seems unlikely that the ground and launching ways would have spanned these gaps. Thus the intermediate timbers, measuring 8 feet in length, may provide the appropriate dimension from which to calculate the maximum width of the ways: with the ways separated by 8 feet, the largest vessel which could safely be built on the slip would have had a 24 foot beam.

The slip showed few signs of use. There were no spikes, nails, nail holes or other marks visible on the surfaces of the spreaders or the intermediate timbers, such as would have been left by the attachment of the ground and launching ways, shores or other paraphernalia. Several stakes were noted in the ground around the slip timbers, but they were not large enough to have served as shores, and thus may have been associated with alignment during the original construction of the feature. The keel blocks running along the centerline of the slip did appear to have been used, exhibiting notches and paint traces typical of the painting of the keel of a late nineteenth-century schooner (Reiss, this volume). The paint was probably not from the keel of the last vessel down this particular slip, though. Keel blocks were normally stacked, a procedure which would have been necessary in this case to attain a sufficient slope for the launching apparatus, since the slope of the slip foundation was nearly level. The blocks were somewhat unusual in that they were nailed securely to the slip. In general, keel blocks were not fastened. Quick removal of the blocks was required just prior to launch: speed was important so that the vessel was on the launching ways as short a time as possible, since the weight of the hull could force the lubricant from between the ground and launching ways, or the launching apparatus could slip or settle. Thus it would appear that the blocks attached to the present slip were not meant to directly contact the keel of the vessel to be built. They may, for example, have been intended to form the base of cribbed blocking stacked between pairs of foundation timbers.

The bulkhead associated with the building slip appeared to be somewhat atypical of its assumed late-nineteenth- century period of construction, probably due in large part to its size and limited function with regard to retaining fill. There was no indication that the complete

structure had exceeded four feet in height, and thus pile construction, which was by that period something of a standard in bulkhead design, may not have been considered necessary. Simple butt joints, as opposed to more structurally sound scarf joints, were employed between timbers. Slippage was apparent in the separation observed in a number of these joints, despite iron drifts used along the length of the structure for stability. The back bracing system was similar to that employed in the construction of the eighteenth-century bulkhead, though the smaller size of the embankment allowed for lighter construction -- relatively thin planks were used in many cases, attached to large logs serving as deadmen, or to simple stakes driven into the fill. Most of the braces were of reused wood, while the timbers forming the bulkhead itself appeared to have been new. These newer pine boles had been selected for straightness and consistency in diameter, and were well planed on upper and lower surfaces for a proper fit. In contrast, the patched area above Feature 30, the long, narrow barge hull lodged in the wide breech in the bulkhead line, consisted of scraps of oak and pine of various sizes, presumably scavenged or salvaged from other parts of the yard. The largest oak timbers were probably quite old, since few trees of that size remained in the later nineteenth century: valuable new hardwood would probably not have been used in repair work of this nature (Donald Shomette, personal communication 1989).

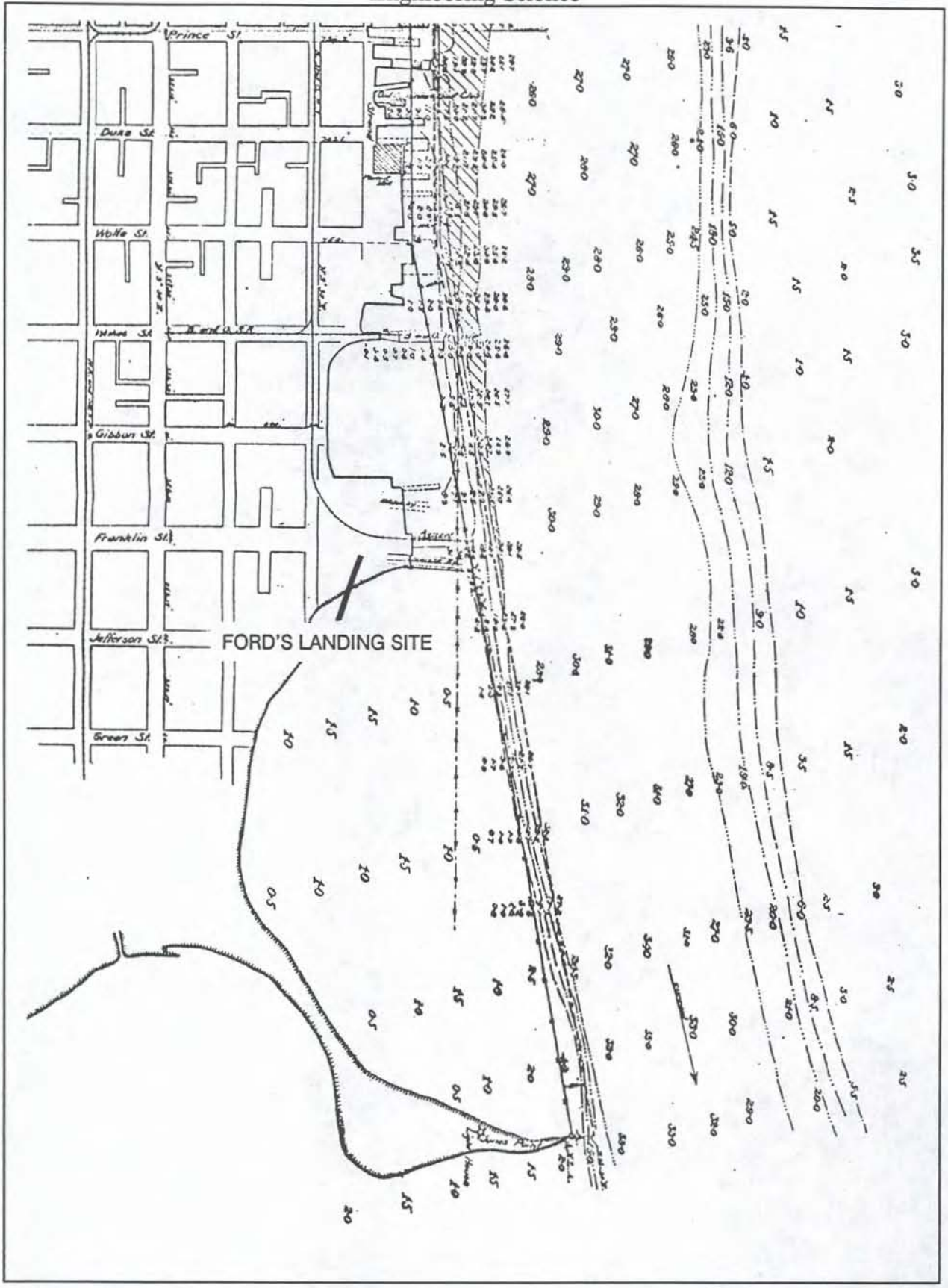
Marine Railway

Few examples of marine railways have been examined archaeologically in this country. Several operational railways exist along the eastern seaboard: among them are the Crandall Marine Railway, in Wilmington, Delaware; the Gloucester Marine Railway in Gloucester, Massachusetts; and a small working replica at the Chesapeake Bay Maritime Museum in St. Michael's, on the Eastern Shore of Maryland. As was the case with shipway construction, most of the literature dealing with marine railways is concerned with modern examples which are for the most part larger than the version documented at the Ford's Landing site. The Gloucester Marine Railway dates to 1849, approximately the same period as the earliest railway established by the Alexandria Marine Railroad Company on Keith's Wharf. Though somewhat earlier in date than the archaeological remains represented by Features 18 and 19, the Gloucester ways were used for comparative analysis. The data were provided by John Harper and Harry Cusick.

The larger of the railways at Gloucester measures some 300 feet in length. Less than one-half of that distance, 120 feet -- the length of the cradle, and thus of the longest vessel which can be accommodated -- lies above the waterline. Data on the slope of the ways was not available, but as noted previously, several sources in the literature indicate that an incline of 1 foot in 12 to 25 was adequate. The two tracks of the Gloucester railway are set 11 feet apart and are mounted on concrete foundations, though granite stonework may have been used originally. The ways are capable of feet hauling out vessels with a beam of 30 to 32 feet and a capacity of 600 tons.

In comparison, the railway observed at the Ford's Landing site extended at least 200 feet above the waterline, the distance from the engine house to the edge of the wharf. The extent the rails below the waterline is not known, but may be estimated from bottom depths marked on period maps. A navigation chart produced by the Corps of Engineers in 1908 (*Figure 68*) indicated that depths ranged from 3 to 5 feet for a distance of as much as 250 feet off the east end of the wharf. Bathymetric contour lines suggested that a deeper channel had been dredged inward at this point to meet piers extending from the south end of the wharf: depths were shown as $12^1/_2$ feet, dropping quickly to approximately 20 feet. The tracks from the railway, then, may have extended a total of 450 to 500 feet from the engine house to the dredged channel, to allow the ways to accommodate vessels of moderate draft. The length of the rails above the waterline was such that more than one vessel could use the ways at one time, a common practice as evidenced by newspaper accounts and photographs of the yard.

To estimate the slope of the ways, elevations at the surface of the stone track foundation were measured at the greatest extension exposed in the archaeological excavations, a distance of 60 feet (this from the center of Trench 12B to the east edge of Trench 13B). The difference in elevation, 2.32 feet, indicated a slope of 3.9%, or just under 1 foot in 26. While this figure was slightly above the accepted averages, several factors may have introduced an element of error to the measurement. Since the tracks themselves were no longer present, the actual slope of the railway could only be inferred from the remains of the foundation, which consisted of uncoursed fieldstone. Portions of the bed may have been removed during later construction on the site, which could have altered the apparent grade. A truer indication of the incline may thus have been represented by the base of the masonry,



Source: U.S. Army Corps of Engineers, 1908
Ford's Landing

Figure 68
Bottom Depths
East of Wharf, 1908

assuming that the ground had been graded prior to construction to approximate the required slope. In fact, the base of the stonework exhibited an almost identical slope to that seen at the surface.

Alternatively, the track bed may have settled unevenly, for reasons similar to those outlined above in connection with the remains of the building slip. The railway lay particularly close to the Ford Plant structure, and thus a degree compaction of the ground surface in the area may have occurred as a result of heavy equipment used in construction of that and later buildings. In Trench 13B, there was in fact evidence that the feature had settled as much as 10 inches into the fill. The southern foundation sat several inches lower than the northern bed, both at surface and base.

The minimum separation of the tracks in the railway would have been 6 feet 3 inches, the distance between the inside edges of the stone foundations. More likely, the track was centered over the stonework, producing a separation of from 10 feet to 10 feet 6 inches, similar to that reported at the larger Gloucester ways. Two observations may be made based on this measurement. First, the wooden ties recovered from the fill between the foundations in Trench 13B were too small to have been directly connected with the operation of this marine railway (at $8^1/_2$ feet in total length, with the rail plates on 5 foot centers). More importantly, the figure allows an estimation of the size of vessels which could be accommodated on the ways. Using the standard calculation of three times the width of the rails (Reiss, this volume), the maximum beam of vessels which could be hauled up the ways would have been around 30 feet, similar to that of the Gloucester ways. While a 30 foot beam represents a vessel of considerable size, 600 tons or so, the railway appears to have been smaller than that operated in Agnew's heyday, which was reported to have been capable of handling with ease ships of 1000 tons (*Historical Review* 1887). The three-rail ways shown on maps north of Feature 18/19 may have been the larger ways referred to in the report.

Contemporary photographs of the railway show little detail. *Plate 10*, taken in the early twentieth century, included the tracks as they appeared at that time, wide and flat, similar to the rails described on the Gloucester ways. While scale within the photograph can only be estimated, the track separation appeared to be between 10 and 12 feet. The spacing of the track beds in Trenches 12B and 13B lay within this range, and also corresponded with

the rail spacing depicted on Sanborn maps, from the 1880s through 1920. Several other photos suggested that the rails of the ways were at one time elevated on trestle-like supports above the waterline, near the engine house. Thus, as with the building slip, the slope of the foundation of the ways might not necessarily have represented the slope of the rails.

DATE	ENGINE ROOM DESCRIPTION[1] (Trench Section B)	NORTH OF ENGINE ROOM (Trench Section A)	SOUTH OF ENGINE ROOM (Trench Section C)
1885	Engine Head Ho[use]	Joiner Shop/Saw Mill (large)	no structures
1891	Engine Head Ho[use]	Woodsawing	boilers, unlabeled
1896	Engine Capstan	Shed	boilers, unlabeled
1902	Engine and Capstan Room	Dissolving Room Wash Ho[use] (to north)	boilers
1907	Engine and Capstan Room	Sawing 1st [story] Pin Machines 2d [story] Storage and Oil House (to north)	Wood Sawing boilers
1912	Engine and Capstan Room	adjacent building gone those to north, empty	Wood Sawing boilers
1921	Capstan	no structures	boilers, unlabeled

[1]based on descriptions listed on Sanborn Insurance Company maps

Table 14. Summary of Functions of Buildings Associated with Marine Railway

The floors and foundations of several structures were encountered adjacent to the railway. For example, structures appeared on either side of the engine house in Trench 12B. *Table 14* lists the functions of these structures as recorded on Sanborn maps. The building south of the engine room housed boilers at least as early as the 1880s and, through 1912, contained wood sawing equipment. The thick deposit of sawdust, coal and ash over the remains of the brick floor of the structure indicated its long use as both boiler and saw room. The structure immediately north of the engine room was last occupied by the National

Electric Supply Company, the ground floor used for sawing. Features tentatively identified as machinery foundations were the only remnants of activity there. The building was removed by 1912.

No documented structures corresponded with Feature 29, the coal blackened wood flooring in Trench 13D. A small tool shed, measuring roughly 10 by 15 feet, was shown on Sanborn maps in 1907 and 1912 north of the rails, but was in a location well north and east of Feature 29. While some of the buildings surrounding the engine house were visible in contemporary photographs, no structures appeared in this area, suggesting that the building was much older than the nearby features, or, as is more likely based on stratigraphic evidence, that it was a temporary storage facility. Likewise, Feature 28, the wooden gutter fragment, could not be directly associated with any known period of site use. Its stratigraphic position suggested that it was either related to the construction of the marine railway or was possibly a remnant of earlier activity on the wharf.

X. CONCLUSIONS

Landfilling Along the Southern Waterfront and the Construction of Keith's Wharf

Keith's Wharf, at the Ford's Landing site, consisted of a solid fill wharf composed of a simple bulkhead revetment and earth fill. The bulkhead was constructed of large pine timbers, trimmed on-site sufficiently to produce a stable structure and prevent excessive leakage of fill material. Joints were simple half-lap scarfs reinforced with iron dowels, a technique typical of wharf construction in the late eighteenth century. Presumably because of the relatively low height of the wharf, massive pilings were not used to support the bulkhead. In their place, back braces were mortised into the bulkhead timbers and attached to anchors in the fill. Corner construction was also uncomplicated, consisting of intersecting timbers locked in place with cross-lap notches, with no secondary or diagonal timber reinforcement apparent. The edges of the wharf exposed in the archaeological trenches were deteriorated, and the bulkhead timbers disturbed in some areas. Analysis of the changes in water level in the Potomac over the last two hundred years, and of the level of fill remaining in the central portion of the wharf, indicated that the structure originally rose approximately three feet above the mean high water mark in the late eighteenth century (a level approximately 1 feet 6 inches below the current high tide line).

Landfilling south of the central waterfront in Alexandria was generally a private concern, funded with venture capital, and as such was typical of the Indigenous Commercial Capitalist period of the city's historical development. The two major land reclamation projects in the area, Keith's Wharf, constructed in 1785, and Roberdeau's Wharf, built north of Keith's Wharf less than a decade later, were both financed solely by private commercial interests. The actual techniques of landfilling at both waterfront locations appeared to have been nearly identical, with bulkheads constructed and fill, consisting mainly of clean earth, introduced to build to a desired level. The body of data existing as to wharf construction techniques in Alexandria, Georgetown and other local waterfronts is not extensive. Nevertheless, it appears that the techniques and materials used in the construction of the wharves on the southern Alexandria waterfront were not unique. They were, though, suited to the configuration of the alluvial deposits along the shoreline south of the city, consisting of shallow embayments at comparatively little remove from navigable waters, and to the construction materials which were readily available, pine timber for structural members and earth fill.

Keith's Wharf was originally constructed as a speculative investment. Waterfront lots were purchased for the purpose of expansion into the shallows east of the existing high water mark. Land development of this sort was spurred by an earlier ruling of city Trustees confirming the right of riverside lot owners to extend their lots into the river as far as they deemed appropriate, thus encouraging the privately funded development of the waterfront. In this, Alexandria was little different from most ports which developed within the English Colonial system. Few activities, commercial or other, have been positively documented at Keith's Wharf during the early portion of its existence, in contrast with Roberdeau's wharf to the north, which saw immediate use by Roberdeau as a warehousing and goods transshipment facility and as a shipyard. Practically no physical evidence remained at Keith's Wharf which could be attributed to the early period of use, though it is assumed that less substantial structures such as would not appear on tax assessment rolls or other official listings did exist. The wharf was in fact retimbered and the fill replenished in the early nineteenth century, indicating that some reasons remained for continued investment in the facility. But in the main, the construction of the wharf appeared to have been a speculative venture, and one which saw only limited immediate success.

Wharves of the eighteenth and nineteenth centuries were typically considered to be relatively temporary structures, periodically expanded or reconstructed, and Keith's Wharf was no exception. Construction features were not sophisticated. Short-cuts had been taken during construction -- the use of a simple bulkhead revetment, rather than a more substantial cribbed structure, for example; back braces anchored to deadmen within the structural fill, rather than pilings or a system of struts and frames; or the apparent lack of corner reinforcements. Yet in general, workmanship was of good quality, and the wharf provided a structure which, with maintenance, remained stable over a comparatively long period of time.

There is little evidence for connection between Keith's Wharf and enterprises near the center of the town. The wharf had originally been part of a greater development scheme which had envisioned a second commercial center rivaling the central waterfront. The wharf was planned as an entry point, a landing site for goods to be transported up the wide avenue of Franklin Street to a market area at the intersection of Franklin and Washington. The plan did not bear fruit, for a variety of reasons involving local, regional and national-wide economics.

Recent studies of the historical development of Alexandria have focused on the notion of a core-periphery relationship existing between the central and outlying areas of the town, using a model based ultimately on geographic and economic studies of generalized urban development. The Alexandria research has combined settlement patterns, as perceived in documentary records, and the study of artifact assemblages derived from residential sites (Cressey *et al.* 1982; Cressey and Stephens 1982). The separation recognized in these studies between core and peripheral areas is viewed in terms of both physical distance and distance from economic and socio-political power. Analysis has indicated that the city core has been dynamic in extent, expanding and contracting in response to local and regional economic conditions. The southern waterfront, while close to the core area in comparison with the western periphery of the town, has remained in a peripheral or semi-peripheral situation.

The plan for the development of the Franklin Street corridor in the late eighteenth century would, in effect, have expanded the core, or would have led to the development of an independent core-related area, and would have included the once peripheral southern waterfront. A series of events, generally linked with the economic hard times looming in the early decades of the nineteenth century, conspired to keep Keith's Wharf and the hoped for Franklin Street corridor on the economic and geographic periphery. The situation may have resulted in part from a form of core-periphery stratification within the waterfront itself. Sectoralization, or the specialization of land use, is seen as an integral mechanism operating within the core-periphery relationship (Cressey *et al.* 1982). The phenomenon tended to become intensified throughout the period of industrialization in the latter nineteenth century, and thus the core area never shifted away from the central waterfront. Properties on the north and south peripheries of the riverfront remained at best semi-peripheral, containing, at the southern end, light or, occasionally, heavy industry: foundries operated by Smith, and later by Smith and Perkins, at Roberdeau's Wharf; and shipyards at Roberdeau's and Keith's Wharf (by this period referred to as Agnew's Wharf). Yet industry was not as significant an aspect of the city's economy as it was in other regions of the country. In spite of lying across the Potomac from the capital of the Union, and being occupied by the Union Army throughout the Civil War, Alexandria was and remained both economically and sociologically a Southern city. The town did not experience industrialization on the scale seen in the Northeast, due to a combination of factors including the prevalence of the southern slave economy and the financial depredations of the war. Thus, the industrial

centers on the waterfront periphery did not attain the economic importance they might otherwise have enjoyed.

Late Nineteenth- and Early Twentieth-Century Use of the Wharf

The most extensive use of the wharf came after the mid-nineteenth century, when the site saw concentrated maritime industrial activity over a period which lasted into the early decades of the twentieth century. A series of shipyards, originally linked with the New England coal trade, operated on the wharf during the last quarter of the century. The yards were fairly advanced for the late nineteenth century, apparently relying on steam to power much of the mechanized equipment. Steam is generally considered a twentieth-century technology in maritime industry, but was in use at the yards on the wharf by at least the mid-1880s. A number of slips, both permanent building ways and marine railways, were in operation, and most were capable of accommodating the largest vessels plying the coastal and riverine routes.

Disappointingly little physical evidence of the yards remained on-site, other than the bases of several structural features associated with one of the marine railways and the remains of a building slip at the southern edge of the yard, the latter appearing to have been unused. On the basis of stratigraphic analysis, the lack of other shipyard materials, and especially of tools or construction debris, was credited to extensive grading during later twentieth-century development of the property. Thus, scant evidence was available of the particular equipment or construction methods employed during a given period of ownership, or of changes in technology at the site through time. Similarly, little evidence was encountered of domestic activity at the site, but for seemingly different reasons. Documentary evidence suggested that, in fact, few structures on the property were used as residences. The types of artifact recovered from the area, consisting of either industrial materials of non-specific use, such as nails, spikes, wire or sheet metal, or of bottle glass -- mostly beer, liquor and milk bottles -- as well as a small amount of domestic ceramic material, suggested the presence of non-residential laborers around the turn of the twentieth century.

Shoreline Changes

Data recovered from excavations at the Ford's Landing site provided indications as to the changing configuration of Battery Cove, from the construction of Keith's Wharf in the late eighteenth century to the present. Changes in the shoreline throughout this period were the result of a combination of natural and cultural forces, the latter including both the direct and indirect results of historic period land use.

Originally, the shoreline of Battery Cove probably lay some distance to the west of the centerline of Union Street, bending eastward to form a small point situated approximately below the Ford Plant building. The line is somewhat conjectural, but was suggested by early-eighteenth century maps and supported by analysis of stratigraphic profiles of excavations near the western edge of the property. Construction of Keith's Wharf in the late eighteenth century truncated the north end of the cove and altered natural siltation patterns, already intensified by run off from agricultural land clearing throughout the northern end of the Potomac watershed. With the rise in water level brought about by physiographic developments involving sea level rise, tectonic movement, and silt build-up in the river channel, the north edge of the cove slowly regressed further northward. The process was hastened by economic factors, which led to the virtual abandonment of the wharf by the early nineteenth century, producing a lapse in bulkhead maintenance. Thus, throughout the nineteenth century, the southern edge of the wharf eroded and the waters of the cove overran the edges of the structure. The effects of the sinking of a massive barge in the main channel of the Potomac on the southern waterfront in the late nineteenth century were probably relatively minor. Eventually, in 1910 and 1911, the river channel was dredged by the Corps of Engineers to restore navigable areas off the wharves on the central waterfront and to alleviate silting. The extensive dredging project produced the last major shoreline change in the Ford's Landing study area: the infilling of Battery Cove. This effort brought the shoreline essentially to its present location -- portions of the riprap wall erected by the Corps to retain the fill may still be seen at low tide.

Derelict Vessels

Battery Cove was a flat, shallow and relatively isolated embayment in the late nineteenth and early twentieth centuries. Like open lots or fields which lie near the edges of populations centers and are used as trash dumps, such tidal flats tend to attract derelict

vessels, *i.e.*, vessels which have seen long use, are stripped clean of useful fittings and other materials and abandoned. Such disposal areas are sometimes colorfully referred to as ships graveyards, and are common along nearly any navigable waterway: well-known examples include Smoot Bay, on the Maryland shore of the Potomac opposite the mouth of Great Hunting Creek; Mallows Bay, on the Maryland shore opposite Quantico (Shomette 1985); and Shooters Island, north of Staten Island, one of several major examples in the Greater New York Harbor (Historic American Engineering Record 1987). The number of vessels encountered in Battery Cove indicated that it was not an extensive disposal area, on a scale with the examples cited above. This may have been due to its location, close to the edge of the working waterfront, and to the shallow depths in the bay, never more than one to two feet at any period. The vessel fragments in the cove were all discovered in fairly advanced states of deterioration, due to previous exposure. In the end, the data available from the vessels in terms of vessel type and construction techniques was limited.

The vessel fragments in Battery Cove appeared to mirror the northern advance of the cove edge through the nineteenth century. The bateau hull fragment, Feature 35, lay next to the wharf bulkhead, and judging from its depth, may have been abandoned there early in the nineteenth century. The vessel represented an amalgam of styles, the lines of the hull somewhat typical of boat construction in New England in the eighteenth century. The vessel may have been brought by one of the many coastal vessels involved in the coal and ice trade in the nineteenth century. It may also be an example of vernacular construction; that is, constructed by a boatwright transplanted from the Northeast, who adapted a non-local design to locally available materials.

The several barges and scow fragments documented in the cove deposits were for the most part indigenous, heavy transport craft typical of nineteenth-century river commerce. None bore evidence of self-propulsion, either mast steps or engine mounts, and so had presumably been either towed or pushed. All showed signs of hard and long-term use, and evidence of extensive repair, in some cases bordering on reconstruction. The two scows, Features 27 and 34, lay over the remains of the wharf bulkhead as it existed near the end of the nineteenth century, after it had deteriorated and much of the wharf fill along the edge of the structure had eroded into the cove proper. A layer of alluvial sediments lying between the vessel hulls and the bulkhead indicated that a number of years had elapsed from the time the bulkhead reached the configuration seen in the archaeological trench to the time the

vessels became lodged over the bulkhead line, indicating that by then the shoreline lay well to the north. Near the turn of the twentieth century, the western edge of the cove probably lay near the Union Street line, bending around the northern edge of Trench 14 toward the east end of Section F of Trench 13. The two large, square-ended barges, Features 2 and 31, were beached near the western cove edge as it existed at the turn of the twentieth century, and may indicate a slight westward movement of the shoreline as water levels rose. Feature 30 was less typical of scow or barge construction, being fore and aft, or longitudinally planked, and thus may have been built on an earlier design, less characteristic of local or regional barge construction. The hull had become lodged in a breach in the late nineteenth-century bulkhead, and along with the bulkhead itself, indicated the extent of the migration of the cove waters northward by that period.

The keeled vessel, Feature 37, which lay well away from the wharf edge near the riprap wall constructed in advance of the infilling of the cove, represented yet another indigenous form of river craft. An insufficient amount of the hull remained to warrant a search for the name of the vessel and other particular data (Bruce Terrell, personal communication 1989). Like the barges, the vessel appeared to have seen long-term and heavy use, possibly as a tug or ferry along this or other waterfronts, and as was common, the hull may have been used as a barge for heavy transport after the end of its original use-life (Billy Ray Morris, personal communication 1989).

In the final analysis, none of the vessels could be directly linked with specific chronological periods or with specific activities on the wharf. As indicated, the cove was a ships graveyard, and thus the vessels may have been hauled in from a variety of locations to be abandoned there. And yet all of the vessels documented in the excavations were typical of the types of vessel serving the wharf at various periods. Barges and scows hauled coal from the canal heads in Alexandria and Georgetown to load coastal vessels headed north to New England. Small boats, including the occasional dory or bateau, would have been common around the wharf, servicing large vessels anchored in the channel, for example. The two scow hulls had been intentionally cut apart, possibly for use on-site, as platforms for the repair of vessels careened or hauled down near the edge of the wharf, or as staging platforms or pontoons supporting machinery during the infilling of the cove. Some of the barges were eventually reused in the construction of new vessels at the site, as part of the supporting structure of the late nineteenth-century shipway as it entered the shallows running down

toward the channel. And thus a degree of symmetry can be seen in the nautical and other maritime features at the site. Vessels were constructed at the yards on the wharf; they were used to haul goods to and from the long-distance commercial vessels visiting the wharf; they were repaired on the marine railways at the yard; and eventually, they were used as foundations for the construction of new vessels.

Summary

The archaeological remains at Ford's Landing represent over 200 years of activity, albeit sporadic, along the southern waterfront in Alexandria. As the preceding descriptions and analyses have indicated, materials remain from all periods of the life of the wharf, from its original construction in the late eighteenth century, through its repair and eventual deterioration in the early nineteenth century, its use in the mid-to-late nineteenth century as a shipyard, coal yard and light industrial center, to its twentieth century use for warehousing.

The wharf's varied history tends to mirror the economic fortunes of the city of Alexandria. Most of the development at the wharf occurred during the periods of economic prosperity in Alexandria and was primarily a result of commercial investment by rather wealthy and ambitious men. Alexandria's economic development during the eighteenth and nineteenth centuries depended to a great extent on the development of her waterfront in order to ensure a competitive edge in the maritime trade. Keith's wharf, at the Ford's Landing site, was located near the southern end of the Alexandria's commercial waterfront. With the exception of a brief period during the late nineteenth century, this wharf remained on the periphery of the city's central waterfront.

During the period of Mercantile Capitalism (1659-1782), the Ford's Landing site lay outside of the boundaries of the original town of Alexandria. It was during this period, however, that the commercial waterfront, which extended from West Point to Point Lumley, was developed by enterprising merchants. The waterfront which had once contained several tobacco warehouses was transformed into an active port with both private and public wharves. The town itself, was also centered along this waterfront. Merchants and a variety of maritime craftsmen established their homes and businesses along a core which extended for seven blocks north and south along Fairfax Street, and from the waterfront west to Royal Street. Alexandria became an important link in the Colonial tobacco trade and a regional

market and international shipment center for northern Virginia farm products and other commodities. The southern end of the waterfront became the center of the city's ship-building activities during this period. Yards were located at the foot of Duke and Wilkes streets, several blocks north of the Ford's Landing site.

The Ford's Landing site enters Alexandria's waterfront history during the Indigenous Commercial Capitalism period (1782-1845). Alexandria's post Revolutionary economy expanded as a result of her participation in the international wheat and flour trade. Eager to take advantage of this prosperity, four ambitious men developed a plan to create a second commercial center which would rival the central waterfront. As a result, Keith's wharf was constructed in 1785, streets were laid out, lots divided up between the investors and some even sold on speculation. The central axis of this commercial center was to be the intersection of Franklin and Washington Streets where a market house and public buildings were to be located. Both of these streets were to be 100 feet wide providing ample room for the active trading anticipated.

Documentary and archaeological evidence reveal the limited extent to which these plans materialized. Tax records and references in local newspapers, for example, indicate that there was little commercial activity at the wharf. In 1804, the wharf was still considered as being located "to the south of the present harbor of this town." In addition, the frequent maintenance required on the causeway on Union street, at the foot of Wilkes, physically isolated the wharf from the central waterfront. Virtually no archaeological evidence was discovered of wharf use which could be attributed to this early period. The general economic collapse during the early nineteenth century also insured that the commercial venture would prove unsuccessful. The wharf appears to have lain virtually abandoned during this period, unused but for incidental activities such as the sale of fish and possibly the landing of a ferry from the Maryland shore (though this latter has not been shown to have actually occurred).

The most significant archaeological remains from the late eighteenth century are sections of the original wharf structure (Feature 33). The excavation and analysis of the wharf and wharf fill provided information regarding the wharf's location and configuration, construction technology and landfilling along Alexandria's southern waterfront.

By the end of the 1830s, attempts were made to revive Alexandria's economy. Investments were made in canal and railroad construction in order to improve Alexandria's connection with the fertile agricultural lands of the south and west. Activity at Keith's wharf remained limited. However, there was other activity along the southern waterfront. To the north of the Keith's wharf, at Hunter's Yard (on Roberdeau's wharf) ships were being constructed and, to the south, one of the longest rope walks in the Chesapeake region was established at Jones Point. By the end of the next decade, Keith's wharf was reborn as a shipyard, and from that time until the turn of the century, the Ford's Landing site experienced the period of its most intensive use.

The Alexandria Marine Railroad Company was established at the Ford's Landing site in 1849 and operated through the 1850s. The main business of the yard was the repair and refitting of vessels of all types, although some craft were built on-site as well. This appears to have been a rather modest business, although the construction of a smaller marine railway at nearby Roberdeau's wharf indicates that there was enough work to occupy both.

The Civil War, which marked a hiatus in almost all normal commerce and industry in the region, brought a flurry of military railroad and supply movement to the wharf. Alexandria served as a central distribution point for men and materiel for the Army of the Potomac, and as many as forty ships landed at her waterfront per day. To the south of Ford's Landing, on Battery Cove, Union forces constructed Battery Rogers on the bluff overlooking the river, and a slaughter house farther south on the cove bank. At the Ford's Landing site, General Haupt established a railroad wharf which became a vital link in the Union supply effort. A spur was constructed from the Orange and Alexandria and Alexandria and Western railroads to bring freight cars to the wharf. From this point they were loaded onto barges, which were assembled on-site, and floated down river to the railhead at Aquia.

During the early post-war period, the bustling activity along the Alexandria waterfront all but ceased. Few vessels plied the river or landed at the wharves. The Ford's Landing site, still the property of the Alexandria Marine Railroad, apparently lay idle. All that remained from the war years, were the rail lines which extended down Union Street and connected with western lines through the west end of the town.

Industry and trade in Alexandria recovered again during the 1870s and 80s, due to a great extent to the coal and ice trade with New England. Newly designed three and four masted, centerboard schooners which could carry high-bulk freight into relatively shallow river harbors began to appear at the ports in Alexandria, Georgetown, and Washington. Once again, in 1874, a group of businessmen invested money in the wharf at the Ford's Landing site, establishing the Alexandria Marine Railway and Ship Building Company. They subsequently built two railways, one perhaps over the early marine railway, and several fixed shipways. The company primarily performed repairs on coal and ice schooners. Three and four masted schooners, among them the largest built in Alexandria, were constructed at the yard in the 1880s.

The majority of the archaeological material remains found during excavations at the site were from this period of intensive use. Even so, little intact physical evidence of the yards remained on-site, with the exception of the bases of several structural features associated with one of the marine railways and the remains of a building slip at the southern edge of the yard. Twentieth-century grading appeared responsible for the lack of other structural materials, tools or construction debris related to the yard. Other artifacts recovered from the site included lighter industrial materials of non-specific use and bottle glass, which suggested the presence of non-residential laborers around the turn of the century.

The other significant archaeological finds dating to this period were nine derelict vessels discovered in the portion of the site which was once the north end of Battery Cove. It was concluded that Battery Cove served as a ships graveyard, and that the vessels found there may have been hauled in from a variety of locations to be abandoned. The vessels documented in the excavations were typical of the types of vessel which served the wharf at various periods.

Business again waned through the turn of the twentieth century as a variety of smaller industrial concerns made use of the property. A shipyard, though reduced in size, was still in evidence operating under various management throughout the period. By this time, the commercial and industrial focus of the waterfront had again shifted to the central wharves and piers. The southern waterfront, always an industrial periphery, again became a fringe area, and the wharf saw only limited activity, such as the storage and transshipment of locally quarried sandstone.

The property was acquired in the 1930s by the Ford Motor Company. As had been the case with the original developers of the site, Keith and his associates, economic hard times arrested the Ford Company's plans for the use of the wharf. Through the second and third quarters of the century, the wharf served mainly as a government storage area.

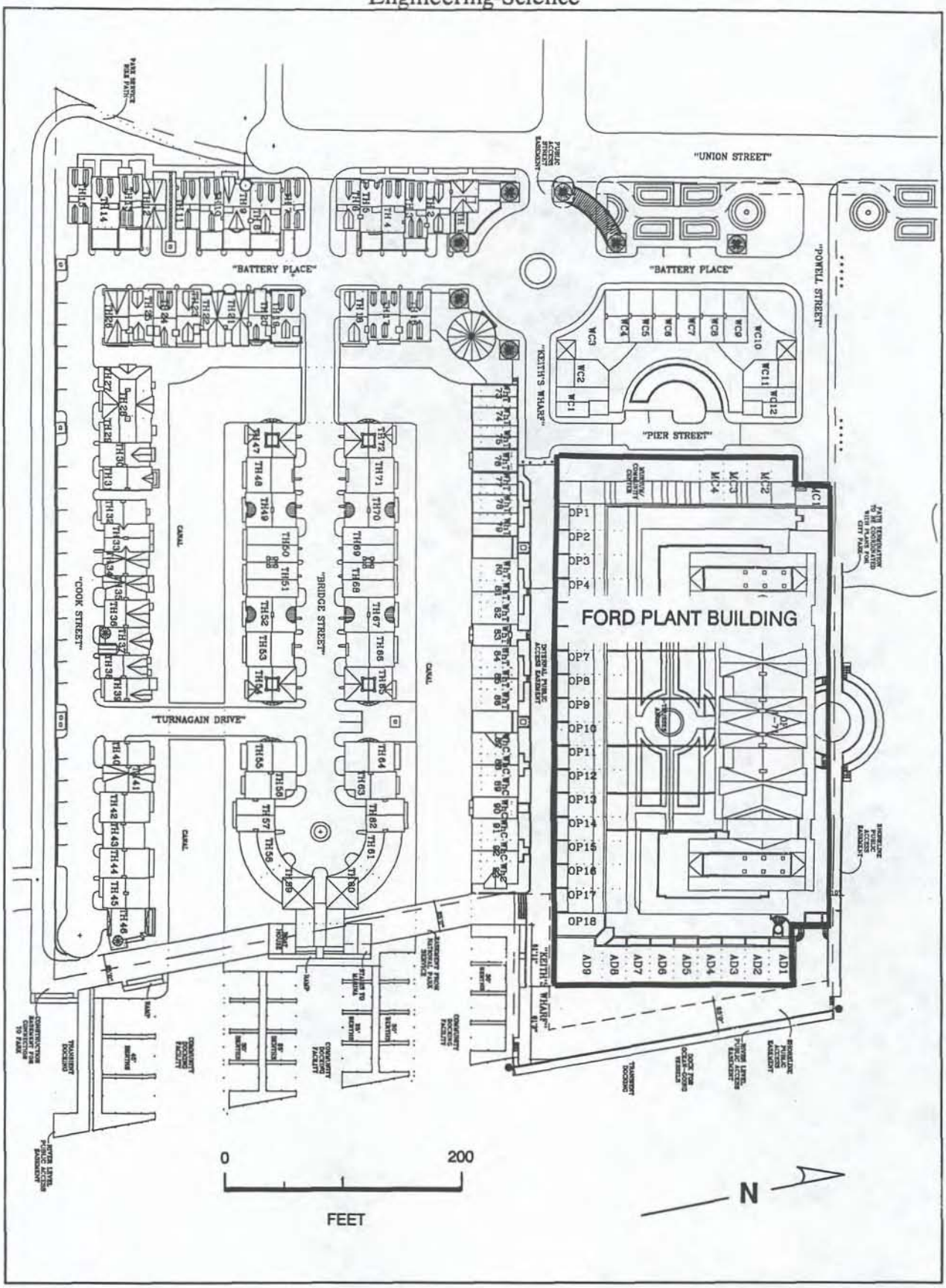
Recently, residential property within Old Town Alexandria has become a desirable commodity. Land developers have pushed beyond the limits of existing residential areas, and thus the southern waterfront has again become a focus of activity. It is this interest which has occasioned the present opportunity to examine in some detail the history of Keith's Wharf, to review the historical record and examine the physical remains at the site. The Ford's Landing site represents one of the most complete inland maritime sites surviving in this portion of the country, and thus has offered a unique opportunity for the study of commercial and industrial waterfront development. The study has revealed information about the construction of wharves in Alexandria in the late eighteenth century, the evolution of the shoreline along the southern waterfront, the vagaries of land speculation at the turn of the nineteenth century, and the various maritime technologies associated with ship construction and repair in the city in the nineteenth and early twentieth centuries. The research value of the site lies in its broad application to the public and professional research communities alike. It is thus hoped that the information contained within the study will contribute significantly both in quality and quantity to the accumulated knowledge of Alexandria's past.

Recommendations

It is held that the fieldwork and analysis represented by this document constitutes sufficient investigation of the cultural resources existing at Ford's Landing. Because development plans include only limited subgrade disturbance at the site, it has been concluded, in consultation with the Virginia State Historic Preservation Office and representatives of Alexandria Archaeology, that the most appropriate disposition of the large features at the site -- namely the remnants of the wharf bulkhead, and the vessels and vessel fragments at the cove edge -- consists of reburial. Features and other resources presumed to lie beneath the Ford Plant building in the northern half of the property, will remain at the site, undisturbed by present development.

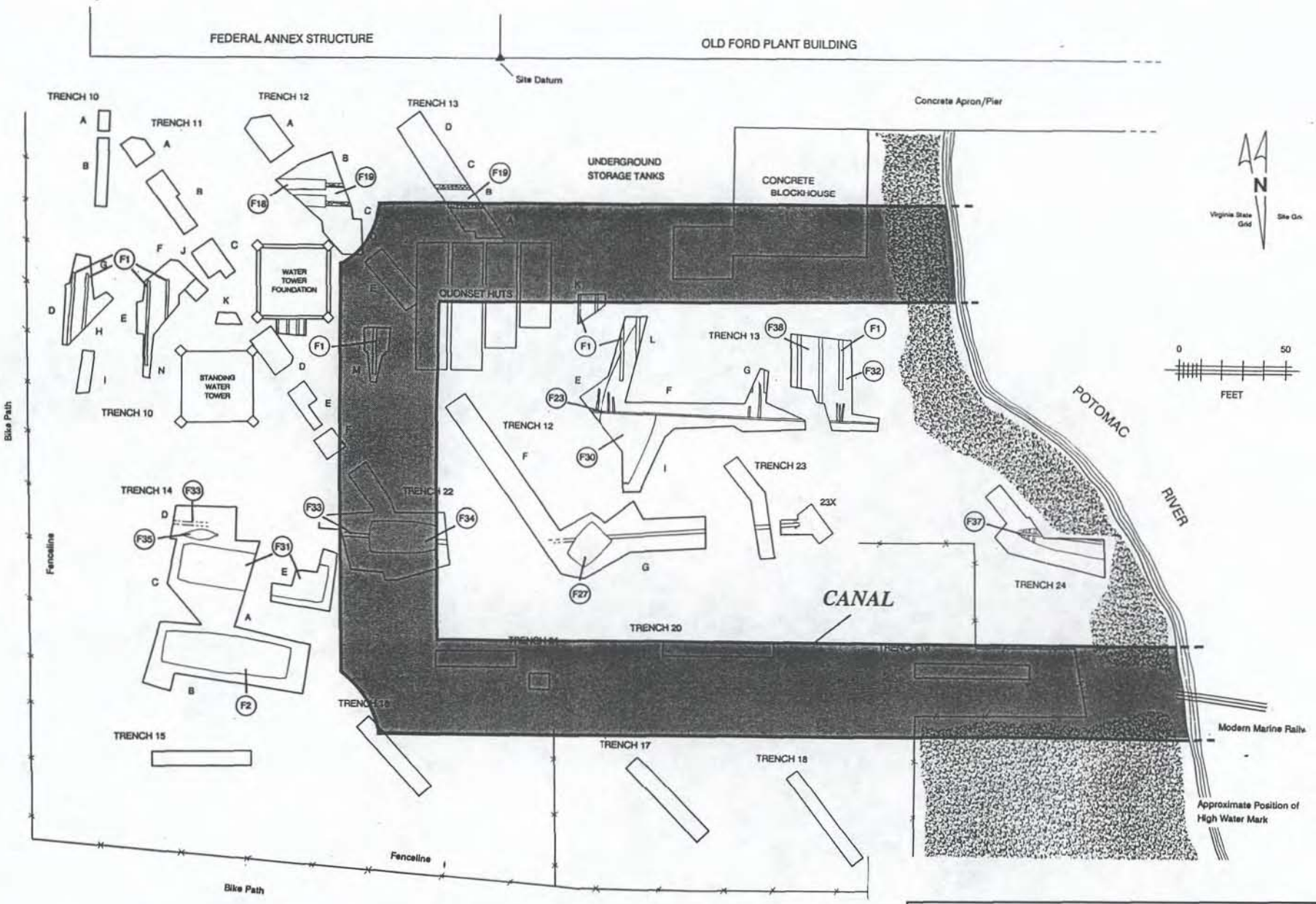
The single major disturbance to the site will entail the excavation of a canal through the center of the property (*Figure 69, 70*). Known features which lie within the disturbance area -- a portion of the eighteenth-century bulkhead (Feature 33), the larger scow (Feature 34) and portions of the nineteenth-century shipway (Feature 1) -- have been documented as a result of the current study. Due to the limited research value attached to those features as a result of that documentation, further study or preservation is considered inappropriate: development will have no adverse effect on these components of the site.

Finally, it is recommended that Alexandria Archaeology, as the representative of the State Historic Preservation Office, be consulted should any additional, undocumented archaeological features be exposed during excavation of the canal. Prior to construction, all building contractors should be informed of the potential for discovering archaeological features which have not been previously documented. Notice of this possibility should be given to all excavation personnel, as well as a description of what these undocumented archaeological features would look like. If such materials are encountered, workers should immediately notify Ms. Ruth Romeo or her designate at Paul Bennett and Associates, who will contact Dr. Pamela Cressey or her designate at Alexandria Archaeology at (703) 838-4399. Upon encountering such remains, all construction work should stop in that vicinity until a city archaeologist has inspected the site to determine if the find represents a previously discovered feature or if it is indeed a previously undocumented find. Should the discovery be an undocumented archaeological feature, decisions as to its appropriate disposition will be made by the city archaeologist.



Source: Arthur Cotton Moore, Associates
Ford's Landing

Figure 69
Development Site Plan



Source: Engineering-Science

Figure 70. Location of Canal and Archaeological Features

BIBLIOGRAPHY

Alexandria City Directory
1870-1932 *Alexandria Virginia Directories*. Lloyd House, Alexandria Library, Alexandria, Virginia.

Andrews, Harrison B.
1967 Launching. In *Principles of Naval Architecture*. John P. Comstock, ed., pp. 752-791. Society of Naval Architects and Marine Engineers, New York.

Anonymous
1823 Message from the President of the United States, Upon the Subject of Commodore Rodger's Marine Rail-way; or Inclined Plane, January 27. Gales and Seaton, Washington, D.C.

Apps, Jerold W., and Allen Strang
1980 *Mills of Wisconsin and the Midwest*. Tamarack Press, Madison.

Arnebeck, Bob
1991 *Through a Fiery Trial, Building Washington 1790-1800*. Madison Books, Lanham, Maryland.

Artemel, Janice
1978 Fairfax County, Virginia, A History 1800-1840. *Fairfax County, Virginia, A History*. Nan Netherton, Donald Sweig, Janice Artemel, Patricia Hicken and Patrick Reed, eds. Fairfax County Board of Supervisors, Fairfax, Virginia. pp. 152-248.

Artemel, Janice, G., Elizabeth A. Crowell, Donald A. Hull and Dennis A. Knepper
1988 *A Phase IIa Archaeological Study, Old Ford Plant Site, Alexandria, Virginia*. Submitted to URBCO, Hartford, Connecticut. Engineering Science, Washington, D.C.

Artemel, Janice G., Elizabeth A. Crowell and Norman V. Mackie III
1987 *Georgetown Waterfront Park Archaeological Overview and Assessment*. Submitted to the National Park Service, National Capital Region and Washington Harbour Associates. Engineering Science, Washington, D.C.

Artemel, Janice G., Andrea Heintzelman-Muego and Margaret Orelup
1984 *Bank Street Waterfront; New London Connecticut*. Submitted to the Federal Railroad Administration, Washington, D.C. DeLeuw Cather/Parsons, Washington, D.C.

Artemel, Janice G., Norman V. Mackie III, Elizabeth A. Crowell, and Edward J. Flanagan
1985 *Georgetown Waterfront Park Archaeological Testing Program: Phase I*. Submitted to the National Park Service, National Capital Region, and Washington Harbour Associates. Engineering Science, Washington, D.C.

Artemel, Janice G., Francine W. Bromberg, Dennis A. Knepper and Elizabeth A. Crowell
1991 *Whitehurst Freeway Phase I Archaeological Survey*. Engineering Science, Washington, D.C.

Baker, William Avery
1973 *A Maritime History of Bath, Maine and the Kennebec River Region.* Vol. 2. Anthoeson Press, Portland, Maine.

Balicki, Joseph
1991 Bottles, Bottles Everywhere and Not a Drop to Drink: Examining Washington, D.C. Bottles for Chronology and Function. Paper presented at the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Bandler, B.G.
1988 Anacostia: The Other River. Interstate Commission on the Potomac Basin, Rockville, Maryland.

Barber, Russell
1979 *A Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras, Final Report,* Vol. II, Institute for Conservation Archaeology, Peabody Museum, Harvard University.

Barton, Elmer Epenetus, ed.
1884 *Historical and Commercial Sketches of Washington and Environs.* Barton Publishing Company, Washington, D.C.

Baugher-Perlin, Sherene
1982 Analyzing Glass Bottles for Chronology, Function and Trade Patterns. *Archaeology of Urban America,* Roy S. Dickens, ed. Academic Press, New York. pp. 259-270.

Birrell, J. Fred
n.d. Recollections: The Alexandria Waterfront During the 1870s and 80s. On file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Blaker, Margaret C.
1950 Pottery Types from the Townsend Site, Lewes, Delaware. *Eastern States Archaeological Federation Bulletin* No. 9, July.

Bower, Beth Ann, Claire Dempsey, Stephen Mrozowski and Bryon Rushing
1984 Long Wharf: Archaeological Testing of Parcel D-10. *Occasional Publications in Archaeology and History #3,* Massachusetts Historical Commission.

Boyd's Directory Company
1860-1940 *Boyd's Directory of the District of Columbia.* Andrew Boyd, Washington, D.C. On file, Columbia Historical Society, Washington, D.C.

Bradford, Gershom
1972 *The Mariner's Dictionary.* Barre Publishing, Barre, Massachusetts.

Bradley, James W., Neill De Paoli, Nancy Seasholes, Patricia McDowell, Gerald Kelso and Johanna Schoss
1983 Archaeology of the Bostonian Hotel Site. *Occasional Publications in Archaeology and History No. 2,* Massachusetts Historical Commission.

Brennan, Louis A.
1982 A Compilation of Fluted Points of Eastern North America by Count and Distribution: An AENA Project. *Archaeology of Eastern North America* 10: 27-46.

Brewington, M. V.
1953 *Chesapeake Bay: A Pictorial Maritime History*. Cornell Maritime Press, Cambridge, Maryland.

Brockett, F. L., and George W. Rock
1883 *A Concise History of the City of Alexandria, Virginia, from 1669 to 1883, with a Directory of Reliable Business Houses in the City*. Printed at the Gazette Book and Job Office, Alexandria, Virginia. On file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Bromberg, Francine W.
1987 *Site Distribution in the Coastal Plain and Fall Zone of the Potomac Valley from ca. 6500 B.C. to A.D. 1400*. M.A. Thesis, Catholic University, Washington, D.C.

Broyles, Bettye J.
1971 Second Preliminary Report: The St. Albans Site, Kanawha County, West Virginia. *Report of Archeological Investigations* No. 3. West Virginia Geological and Economic Society.

Burnaby, Andrew (Reverend)
1963 *Travels through the Middle Settlements in North America in the Years 1759 and 1760 with Observations upon the State of the Colonies*. Cornell University Press, Ithaca, New York.

Byrd, William
1929 *History of the Dividing Line Betwixt Virginia and North Carolina*. William K. Boyd, ed. Duke University Press, Raleigh, North Carolina.

Calhoun, Daniel H.
1960 *The American Civil Engineer: Origins and Conflict*. Technology Press, Cambridge, Massachusetts.

Callahan, Errett
1979 The Basics of Biface Flintknapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. *Archaeology of Eastern North America* 7:1-180.

Carbone, Victor A.
1976 *Environment and Prehistory in the Shenandoah Valley*, Ph.D. Dissertation, Catholic University. University Microfilms, Ann Arbor, Michigan.

Chataigne, J. H., compiler
1876 *Chataigne's Alexandria City Directory 1876-77*. Lloyd House, Alexandria Library, Alexandria, Virginia.

Cheek, Charles D., and Cecile Glendening
1986 *A Phase I Archaeological Survey of the Old Ford Plant Property, City of Alexandria, Virginia*. John Milner Associates, Inc., Alexandria, Virginia.

Coe, Joffre Lanning
1964 The Formative Cultures of the Carolina Piedmont. *Transactions of the American Philosophical Society* 54(5).

Colson, Charles
1894 *Notes on Docks and Dock Construction*. Longmans, Green and Co., London.

Connolly, Steve
1980 Christian Heurich Brewing Co. *The Breweriana Collection: Journal of the National Association of Breweriana Advertising*. Vol. 28: 8-16.

Cornick, Henry F.
1968 *Dock and Harbour Engineering*, Vol 1. 2nd edition. Charles Griffin and Co., Ltd. London.

Coysh, A.W.
1974 *Blue and White Transfer Ware: 1780-1840*. 2nd edition. Newton Abbot, Devon.

Cressey, Pamela J.
1985 *The Alexandria, Virginia City-Site: Archaeology in an Afro-American Neighborhood: 1830-1910*. Ph.D. dissertation, University of Iowa.

Cressey, Pamela J., and John F. Stephens
1982 The City-Site Approach to Urban Archaeology. *Archaeology of Urban America*. Roy S. Dickens, ed. Academic Press, New York. pp. 41-61.

Cressey, Pamela J., John F. Stephens, Steven J. Shephard and Barbara H. Magid
1982 The Core-Periphery Relationship and the Archaeological Record in Alexandria, Virginia. In Roy S. Dickens, Jr., ed., *Archaeology of Urban America: The Search for Pattern and Process*. Academic Press, New York. pp. 143-174.

Crisman, Kevin J.
1991 Nautical Archaeology in the Americas: A View from 1990. *Maritime Archaeological and Historical Society Newsletter* 3(2): 5-6.

Cunningham, Brysson
1904 *A Treatise on the Principles and Practice of Dock Engineering*. Charles Griffin and Co., Ltd. London.

Curtis, W.H.
1919 *The Elements of Wood Ship Construction*. McGraw-Hill, New York.

Custer, Jay F.
1978 Broadspears and Netsinkers: Late Archaic Adaptation Indicated by Depositional Sequences From Four Middle Atlantic Archaeological Sites of the Ridge and Valley Province. Paper presented at the Middle Atlantic Archaeological Conference, Rehoboth Beach, Delaware.

1986 Analysis of Early Holocene Projectile Points and Site Locations from the Delmarva Peninsula. *Archaeology of Eastern North America* 14: 45-64.

1989 *Prehistoric Cultures of the Delmarva Peninsula*. University of Delaware Press, Newark.

1990 Early and Middle Archaic Cultures of Virginia: Cultural Change and Continuity. Theodore R. Reinhart and Mary Ellen N. Hodges, eds. Early and Middle Archaic Research in Virginia: A Synthesis. *Archaeological Society of Virginia Special Publication* 22.

Davis, Charles G.
1918 *The Building of a Wooden Ship.* United States Shipping Board Emergency Fleet Corporation, Philadelphia.

de Kerchove, Rene
1961 *International Maritime Dictionary.* 2nd edition. Van Nostrand Reinhold, New York.

Delcourt, Paul A. and H.R. Delcourt
1981 Vegetation Maps for Eastern North America: 40,000 yr B.P. to the Present. *Geobotany II,* Robert C. Romans, ed. Plenum Press, New York. pp. 123-165.

Desmond, Charles
1984 *Wooden Ship-Building.* Original edition 1919. Vestal Press, Vestal, New York.

Dickman, William J.
1980 *Battery Rodgers at Alexandria, Virginia.* MA/AH Publishers, Manhattan, Kansas.

Dodds, James and James Moore
1984 *Building the Wooden Fighting Ship.* Facts on File, New York.

Donn, W.L., and D.M. Shaw
1963 Sea-level and Climate of the Past Century. *Science* 142: 1166-1167.

DuPlat-Taylor, F. M.
1928 *The Design, Construction and Maintenance of Docks, Wharves and Piers.* Ernest Benn, Ltd., London.

Egloff, Keith T., and Stephen R. Potter
1982 Indian Ceramics From Coastal Plain Virginia. *Archaeology of Eastern North America* 10:95-117.

Elliott and Nye
1852 *Elliott and Nye's Virginia Directory and Business Register for 1852.* Elliot and Nye, Printers, Richmond, Virginia. Lloyd House, Alexandria Library, Alexandria, Virginia.

Estep, H. Cole
1983 *How Wooden Ships Are Built: A Practical Treatise on Modern Wooden Ship Construction with a Supplement on Laying Off Wooden Vessels.* Original edition 1918. W.W. Norton, New York.

Ewing, Maskell C.
1845 *Plan of the town of Alexandria, D.C. with Environs Exhibiting the outlet of the Alexandria Canal, the Shipping channel, wharves, Hunting Cr., etc.* Geography and Maps Division, Library of Congress, Washington, D.C.

Faulkner, Alaric, Kim M. Peters, David Sell, and Edwin S. Dethlefsen
1978 *Port and Market: Archaeology of the Central Waterfront, Newburyport, Massachusetts.* Interagency Archaeological Services, National Park Service, Atlanta, Georgia.

Feest, Christian F.
1978 Nanticoke and Neighboring Tribes. *Northeast*. Bruce G. Trigger, ed. *Handbook of North American Indians* Volume 15. William C. Sturtevant, gen. ed. Smithsonian Institution, Washington, D.C. pp. 240-255

Ferguson, Eugene S.
1980 *Oliver Evans, Inventive Genius of the American Industrial Revolution.* The Hagley Museum, Greenville, Delaware.

Fitzgerald and Dillon
[1874] *Business Directory of the Principal Cities and Villages of Virginia for 1873-4.* Benjamin Bates, Richmond, Virginia. Lloyd House, Alexandria Library, Alexandria, Virginia.

Flanagan, Edward J., Janice G. Artemel and Elizabeth A. Crowell
1989 *Barney Circle Archaeological Project*. Prepared for Fleming-Deleuw, Washington, D.C. by Engineering-Science, Washington, D.C.

Ford Motor Company
1941 History of the Alexandria Branch. Typescript courtesy of the Henry Ford Museum, Dearborn, Michigan.

Froomer, Norman L.
1980 Sea Level Changes in the Chesapeake Bay During Historic Times. *Marine Geology* 36: 289-305.

Gardner, William M.
1974 The Flint Run Complex: Pattern and Process During the Paleo-Indian to Early Archaic. *The Flint Run Paleo-Indian Complex: A Preliminary Report 1971-1973 Seasons.* Occasional Paper No. 1. William Gardner, ed. Department of Anthropology, Catholic University, Washington, D.C.

1978 A Comparison of Ridge and Valley Blue Ridge Piedmont and Coastal Plain Archaic Period Site Distribution, an Idealized Transect. Paper presented at Middle Atlantic Archaeological Conference, Rehoboth, Delaware.

1982 *Early and Middle Woodland In the Middle Atlantic.* Occasional Paper 3, Roger Moeller, ed. American Indian Archaeological Institute.

Gardner, William M. and Charles W. McNett, Jr.
1971 Early Pottery in the Potomac. *Proceedings of the Middle Atlantic Archaeological Conference*, C.W. McNett, Jr., and W.M. Gardner, eds. American University, Washington, D.C.

Geismar, Joan H.
1983 *The Archaeological Investigation of the 175 Water Street Block, New York City.* Professional Service Industries, Inc., Soil Systems Division for HRO International Tower 56, 126 East 56th Street, New York, New York 10022. July.

1985 Patterns of Development in the Late-Eighteenth and Nineteenth Century American Seaport; a Suggested Model for Recognizing Increasing Commercialism and Urbanization. *American Archaeology*, 5(3): 175-184.

1987 *Archaeological Investigation of Site 1 of the Washington Street Urban Renewal Area, New York City*. Louis Berger and Associates, Inc. for Shearson Lehman/American Express through the New York City Public Development Corporation, New York, New York.

Gilpin, George
1798 *Plan of the Town of Alexandria, in the District of Columbia, 1798. Alexandria, Virginia.* Geography and Maps Division, Library of Congress, Washington, D.C.

Godden, Geoffery
1964 *Encyclopedia of British Pottery and Porcelain Marks*. Bonanza Books, New York.

Goldenberg, Joseph A.
1976 *Shipbuilding in Colonial Virginia*. University Press of Virginia, Charlottesville, Virginia.

Greene, Carlton
1917 *Wharves and Piers, Their Design, Construction, and Equipment*. McGraw-Hill, New York.

Greenhill, Basil and Sam Manning
1988 *The Evolution of the Wooden Ship*. B.T. Batsford, London.

Guilcher, A.
1958 *Coastal and Submarine Morphology*. Methuen, London.

Guilland, Harrold
1971 *Early American Folk Pottery*. Chilton Book Company, Philadelphia.

Hahn, Thomas F.
n.d. Maritime Historical Report for the Alexandria Canal Tide Lock Project. On file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Hall, Henry
1884 *Report of the Ship-building Industry of the United States*. U.S. Government Printing Office, Washington, D.C.

Harper, John, Charles Simms, Levin Powell and James Keith
1785 Petition to the Virginia House of Delegates, Nov. 15, 1785. On file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Harrison, Fairfax
1987 *Landmarks of Old Prince William*. Volumes I and II. Second Reprint Edition. Gateway Press, Inc., Baltimore.

Haupt, Herman
1862 Letter to Brigadier General M.C. Weig, Quartermaster General, U.S. Army. National Archives, Washington, D.C .

Heintzelman, Andrea J.
1985 *Late Seventeenth and Eighteenth Century Wharf Technology: Historical and Archaeological Investigations of Three Eastern U. S. Examples*. M.A. Thesis, American University, Washington, D.C.

1986 Colonial Wharf Construction: Uncovering the Untold Past. *The Log of Mystic Seaport* 37(4): 124-135.

Heintzelman-Muego, Andrea
1983 Construction Material and Design of 19th Century and Earlier Wharves: An Urban Archaeological Concern. Paper presented at the Society of Historical Archaeology Conference, Denver Colorado.

Henn, Roselle E., Diana di Zerega Wall, Laurie Boros, Valerie DeCarlo and Jed Levin
1986 The Standardization of Wharf Construction in Federalist New York City. Paper presented at the Annual Meeting of the Society for Historical Archaeology, Sacramento, California.

Historic American Engineering Record
1987 *Shooters Island, Ships Graveyard.* HAER No. NY-162. Historic American Engineering Record, Mid-Atlantic Region. National Park Service, Department of the Interior, Philadelphia.

Historical, Descriptive and Biographical Review
1887 *Historical, Descriptive and Biographical Review: Industrial and Cultural Resources of Washington, D.C., Alexandria, Virginia, and the States of Maryland and Delaware.* Historical Publishing Company, New York and London.

Hodgdon, Frank W.
1923 Shore Protection and Harbor Development Work on the New England Coast. *American Society of Civil Engineers Transactions* 86: 437-442.

Holmes, William H., William Dinwiddie and Gerard Fowke
1891 *Archaeological Survey of the Tidewater Maryland and Virginia Area.* National Anthropological Archives, Manuscript 2125, Smithsonian Institution, Washington, D.C.

Hopkins Griffith M.
1877 *City Atlas of Alexandria, Virginia.* Geography and Maps Division, Library of Congress, Washington D.C.

Hranicky, W. Jack and Floyd Painter
1988 *A Guide to the Identification of Virginia Projectile Points.* Special Publication No. 17, Archaeological Society of Virginia, Richmond, Virginia.

Huey, Paul R.
1984 Old Slip and Cruger's Wharf at New York: An Archaeological Perspective of the Colonial Waterfront. *Historical Archaeology* 18(1): 15-37.

Hunt, Freeman
1840 The Harbors of North America. *Merchant's Magazine and Commercial Review* 2.

Inashima, Paul Y.
1980 *Analysis and Description of the Artifacts from Block 226, Washington, D.C.* Potomac River Archaeology Survey, Department of Anthropology, The American University, Washington, D.C.

1985 *Archeological Survey Report: An Archeological Investigation of Selected Construction Locales Along the Mount Vernon Memorial Highway.* Denver Service Center, Northeast Team, National Park Service.

Ingersoll, Daniel W., Jr.
1971 *Settlement Archaeology at Puddle Dock.* Unpublished Ph.D. dissertation, Harvard University, Cambridge, Massachusetts.

Jamieson Papers
1773 Plan of the Wharfe and Colo. Veales Proposals. Vol. 6, No. 1332. Manuscripts Division, Library of Congress, Washington, D.C.

Johnson, Jay K.
1979 Archaic Biface Manufacture: Production Failures, A Chronicle of the Misbegotten. *Lithic Technology* 8(2): 25-35.

Johnson, Michael F.
1982 *Phase II Archaeological Investigations of Loftridge.* Fairfax County Archaeological Survey, Fairfax County Office of Comprehensive Planning. Fairfax, Virginia.

1986 *The Prehistory of Fairfax County: An Overview.* Heritage Resources Branch, Falls Church, Virginia.

Johnston, Paul M.
1964 *Geology and Ground-water Resources of Washington, D.C. and Vicinity.* Geological Survey Water-Supply Paper No. 1776. Washington, D.C.

Jones, Olive
1971 Glass Bottle Push-Ups and Pontil Marks. *Historic Archaeology* 5: 62-73.

Jones, Olive, and Catherine Sullivan
1985 *The Parks Canada Glass Glossary for the Description of Containers, Tableware, Flat Glass, and Closures.* Parks Canada, Ottawa.

Joyce, Arthur A.
1988 Early/Middle Holocene Environments in the Middle Atlantic Region: A Revised Reconstruction. *Holocene Human Ecology in Northeastern North America.* George P. Nicholas, ed. Plenum Press, New York. pp. 185-214.

Kardas, Susan and Edward Larrabee
1980 Landmaking in Lower Manhattan. *Seaport Magazine*, 14(3): 15-19.

Kelly, William J.
1965 *Brewing in Maryland: From Colonial times to Present.* William J. Kelly, Baltimore, Maryland.

Kendrick, Grace
1966 *The Antique Bottle Collector.* Pyramid Books, New York.

Kengla, Louis A.
1883 *Contributions to the Archaeology of the District of Columbia. An Essay to Accompany A Collection of Relics.* R.A. Waters and Son, Washington, D.C.

Kilmer, Kenton, and Donald Sweig
1975 *The Fairfax Family in Fairfax County*. Fairfax County Office of Comprehensive Planning. Fairfax, Virginia.

Kinsey, W. Fred
1972 *Archaeology in the Upper Delaware Valley*. Anthropological Series, No. 2. Historical and Museum Commission, Harrisburg, Pennsylvania.

1978 *Archaeological Reconnaissance and Survey Along the Right of Way for Proposed I-195 in Anne Arundel and Baltimore Counties, Maryland, from I-95 to South of Maryland 170*. Submitted to the Maryland State Highway Administration Through Greenman-Pedersen, Associates, P.C. Annapolis, Maryland.

Kirkby, A. and M. J. Kirkby
1976 Geomorphic Processes and the Surface Survey of Archaeological Sites in Semi-Arid Areas. *Geoarchaeology*. D.A. Davidson and M.L. Shackleton, ed. Duckworth, London. pp. 229-253.

Klamkin, Marian
1971 *The Collector's Book of Bottles*. Dodd, Meade and Company, New York.

Klein, Terry H.
1979 *Archaeological Reconnaissance Report, Backlick-Cameron Run Impact Area*. Alexandria Regional Preservation Office, Alexandria.

Knepper, Dennis A., and Kimberly Prothro
1989 *Historical and Archaeological Investigation of Roberdeau's Wharf at Harborside, Alexandria, Virginia*. Submitted to 400 South Union Street Joint Venture, Alexandria, Virginia, Engineering-Science, Washington, D.C.

Knepper, Dennis A., and Madeleine Pappas
1990 *Cameron Mills: Preliminary Historical and Archaeological Assessment of Site 4AX112, Alexandria, Virginia*. Submitted to Hoffman Management, Inc. Engineering-Science, Inc., Washington, D.C.

Kraft, John C. and Grace S. Brush
1981 A Geological-Paleoenvironmental Analysis of the Sediments in St. John's Pond and the Nearshore Zone Near Howard's Wharf at St. Mary's City, Maryland. Ms. on file, Historic St. Mary's City, St. Mary's City, Maryland.

Kraft, John C. and Chacko J. John
1978 Paleographic Analysis of Coastal Archaeological Settings in Delaware. *Archaeology of Eastern North America* 6: 41-60.

LeeDecker, Charles H., and Amy Friedlander
1985 *Archaeological Survey of a Proposed Bike Path, Foot Path and Soccer Fields at Jones Point Park, Alexandria, Virginia*. Prepared for the City of Alexandria. The Cultural Resources Group, Louis Berger and Associates, Inc., Washington, D.C.

Lippson, A.F., M.S. Haire, A.F. Holland, F. Jacobs, J. Jensen, R.L. Moran-Johnson, T.T. Polgar and W.A. Richkus
n.d. *Environmental Atlas of the Potomac Estuary*. Environmental Center, Martin Marietta Corporation.

Lorrain, Dessamae
1968 An Archaeologist's Guide to Nineteenth Century American Glass. *Historical Archaeology* 2: 35-44.

Louis Berger and Associates, Inc.
1987 *Cultural Resource Investigations of the Barclays Bank Site, 75 Wall Street, Borough of Manhattan, New York City, New York.* Prepared for the London and Leeds Corporation and Barclays Bank PLC.

1990 *Archaeological and Historical Investigations at the Assay Site, Block 35, New York, New York*, Chapter 5 - Waterfront Technology. Draft copy courtesy of Terry Klein, Louis Berger and Associates, Inc., Raleigh, North Carolina.

Luckman, Eugenia
1984 Shell-Edge Pattern. Ms. on file at Alexandria Archaeology, Alexandria, Virginia.

Lyman, John
1952 Shipbuilding in Alexandria. *Log Chips*. Chapel Hill, North Carolina.

MacMaster, Richard K.
1966 Georgetown and the Tobacco Trade. *Records of the Columbia Historical Society* LXVI: 1-33.

McNamara, William S.
1974 Technical Report: Inspection of Historic Wood Structures, Central Wharf, Salem, Massachusetts. *Historic Structure Report: Central Wharf, Architectural Data and Archaeological Data.* Merril Ann Wilson and Geoffery P. Moran. National Park Service, Denver Service Center, Denver, Colorado.

McNett, Charles W.
1975 Excavations at the Spring Branch Site. *Quarterly Bulletin of the Archaeological Society of Virginia* 29(3): 97-123.

McNett, Charles W. and William Gardner
1975 Archeology in the Lower and Middle Potomac. On file, Department of Anthropology, American University, Washington, D.C.

Mack, Frederick, K.
1966 *Ground Water in Prince Georges County*. Maryland Geological Survey, Bulletin 29.

Macoll, John D. ed.
1977 *Alexandria: A Towne in Transition*. Alexandria Bicentennial Commission, Alexandria Historical Society, Alexandria, Virginia.

Magid, Barbara H.
1983 *Alexandria Archaeology: An Annotated Ceramic Code Book.* 2nd edition. Alexandria Archaeology. Office of Historic Alexandria, Alexandria, Virginia.

Magid, Barbara H., D. Katherine Beidleman and Richard P. Napoli
1982 *A Laboratory Manual for Alexandria Archaeology*. Alexandria Papers in Urban Archaeology Education Series 5.

Manson, Carl
1948 Marcey Creek Site: An Early Manifestation in the Potomac Valley. *American Antiquity* 13: 223-227.

Mason Family Papers
n.d. Library of Congress, Manuscripts Division, Washington, D.C.

Melville, Herman
1849 *Redburn: His First Voyage.* Robert Bentley, London.

Miller, George L.
1980 Classification and Economic Scaling of 19th Century Ceramics. *Historical Archaeology* 14: 1-40.

Miller, George L., and Catherine Sullivan
1984 Machine-Made Glass Containers and the End of Production for Mouth-Blown Bottles. *Historical Archaeology* 13: 83-96.

Miller, T. Michael
n.d. A Brief History of the Alexandria Waterfront. Ms. on file, Lloyd House, Alexandria Library, Alexandria, Virginia.

1987 *Pen Portraits of Alexandria, Virginia, 1739-1900.* Heritage Books, Bowie, Maryland.

1988a North End Wharves and Warehouses. *The Fireside Sentinel* 1(3): 21-28.

1988b Wandering Along the Wharves and Waterfront of Old Alexandria. *The Fireside Sentinel* 2(2): 16-20.

1988c The Adam and Hepburn Wharves. *The Fireside Sentinel* 2(4): 35-36.

1988d The A. W. Eastlock Shipyard. *The Fireside Sentinel* 2(5): 47-48.

1988e From Princess to Queen: Wandering Along the Alexandria Waterfront. *The Fireside Sentinel* 2(8): 78-84.

1988f Wandering Along the Waterfront: The Wharves of John Kirkpatrick and Benoi [sic] Wheat. *The Fireside Sentinel* 2(9): 92-95.

Milne, Gustav and Chrissie Milne
1978 Excavations on the Thames Waterfront at Trig Lane, London, 1974-76. *Medieval Archaeology* 22: 84-104.

Minutes of the Georgetown Commissioners
1762 Minutes of the Georgetown Commissioners, Board of Alderman Records. Manuscript Division, Library of Congress, Washington, D.C.

Mitchell, Beth
1977 *Beginning at a White Oak: The Patents and Northern Neck Grants of Fairfax County, Virginia.* Fairfax County Office of Comprehensive Planning. Fairfax, Virginia.

Mitchell, Mary
1986 *Chronicles of Georgetown Life, 1865-1900.* Seven Locks Press, Cabin John, Maryland, and Washington, D.C.

Moore, John Hammond
n.d. A Historical Background of the Alexandria Waterfront Controversy. Ms. on file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Morris, Paul C.
1973 *Four Masted Schooners of the East Coast*. Lower Cape Publishing Company, Orleans, Massachusetts.

Moxham, Robert M.
1974 *The Great Hunting Creek Land Grants*. Colonial Press, Springfield, Virginia.

Mudge, Jean McClure
1962 *Chinese Export Porcelain for the American Trade: 1785-1835*. University of Delaware Press.

Munsey, Cecil
1970 *The Illustrated Guide to Collecting Bottles*. Hawthorne Books, New York.

National Preservation Institute
1983 *Barney Circle Freeway Modification Study: Archaeology. Final Technical Report Number 12*. Prepared for District of Columbia Department of Transportation and United States Department of Transportation Federal Highway Administration.

Neill, Edward D., ed.
1876 *A Brief Journal of a Voyage Made in the Bark Warwick to Virginia and other Parts of the Continent of America by Henry Fleet in the Founders of Maryland*. Joel Munsell, Albany, New York.

Nelson, Lee H.
1968 Nail Chronology as an Aid to Dating Old Buildings. American Association For State and Local History Technical Leaflet 48, *History News* 24(11).

Newman, Walter, and Gene Rusnak
1965 Holocene Submergence of the Eastern Shore of Virginia. *Science* 148: 1464-1466.

Noel Hume, Ivor
1969 *A Guide to Artifacts of Colonial Virginia*. Alfred A. Knopf, New York.

Norman, Joseph Gary
1987 *Eighteenth-Century Wharf Construction in Baltimore, Maryland*. MA thesis, The College of William and Mary, Williamsburg, Virginia.

Peake, James
1851 *Rudiments of Naval Architecture*. John Weale, London.

Pendery, Stephen R.
1982 *Phase II Archaeological Site Examination of the Project Area for the Central Artery, North Area, Charlestown, Massachusetts*. Institute for Conservation Archaeology, Peabody Museum, Harvard University.

Peterson, Arthur G.
1932 The Alexandria Market Prior to the Civil War. *William and Mary Quarterly*, Series 2, 12 April.

Polk Directory Company
1892-1940 *Indianapolis City Directories*. R. Polk & Co. Press of C.E. Hollenbeck, Indianapolis, Indiana.

Porter, H.C., J.F. Derting, J.H. Elder, E.F. Henry and R.F. Pendleton
1963 *Soil Survey of Fairfax County*. United States Department of Agriculture, Washington, D.C.

Powell, Mary G.
1928 *The History of Old Alexandria, Virginia*. The William Byrd Press, Richmond, Virginia.

Preisser, Thomas M.
1977 *Eighteenth Century Alexandria, Virginia Before the Revolution, 1749-1776*. Ph.D. Dissertation, The College of William and Mary, Williamsburg, Virginia.

Proceedings of the Alexandria Trustees
1749-67 Proceedings of the Board of Trustees, Town of Alexandria, Virginia. Manuscripts Division, Library of Congress, Washington, D.C.

Rawson, Marion N.
1970 *Little Old Mills*. Johnson Reprint Corporation, New York. Original ed. 1963.

Ramsay, John
1947 *American Potters and Pottery*. Tudor Publishing Company, New York.

Ritchie, William A.
1965 *The Archaeology of New York State*. Natural History Press, Garden City, New York.

1971 *A Typology and Nomenclature for New York Projectile Points*, New York State Museum and Science Bulletin No. 384, Albany, New York.

1979 Some Regional Ecological Factors in the Prehistory of Man. *The Bulletins of the New York State Archeological Association* 75: 14-23.

Rockman, Diana, Wendy Harris and Jed Levin
n.d. *The Archaeological Investigation of the Telco Block, South Street Historic District, New York, New York*. Prepared for Jack Resnick and Sons, Inc.

Rothgeb, Ray Martin, Jr.
1957 *An Analysis of the Rise, Decline and Possible Determinants of Redevelopment of the Seaport of Alexandria, Virginia*. M.A. Thesis, College of the City of New York, New York.

Sanborn Insurance Company
1885-1921 Fire Insurance Maps of Alexandria, Virginia. Geography and Maps Division, Library of Congress, Washington, D.C.

Schlee, J.S.
1957 Upland Gravels of Southern Maryland. *Geological Society of America Bulletin* 68: 1371-1409.

Shelford, Victor E.
1963 *The Ecology of North America*. University of Illinois Press, Urbana.

Shephard, Steven J.
1991 The Resurrection of the Alexandria Canal Tidal Lock and the Role of the Canal in the City's Past and Present. Paper presented at the annual meeting of the Society for Historical Archaeology, Richmond, Virginia.

Shomette, Donald
1985 *Maritime Alexandria: An Evaluation of Submerged Cultural Resource Potentials at Alexandria, Virginia*. Report prepared for Alexandria Archaeology, Office of Historic Alexandria, Alexandria, Virginia.

Slattery, Richard C.
1946 A Prehistoric Indian Site on Selden Island, Montgomery County, Maryland. *Journal of the Washington Academy of Sciences* 36(8): 262-266.

Smith, Horace
1976 *Soil Survey of the District of Columbia*. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

Smith, William F., and T. Michael Miller
1989 *A Seaport Saga: Portrait of Old Alexandria.* Donning Company, Norfolk, Virginia.

Snell, Charles W.
1974 *Historic Structures Report: Derby Wharf and Warehouses*. National Park Service, Denver Service Center. Denver, Colorado.

Snow, Dean
1978 Late Prehistory of the East Coast. *Northeast*. Bruce G. Trigger, ed. *Handbook of North American Indians* Volume 15. William C. Sturtevant, gen. ed. Smithsonian Institution, Washington, D.C. pp 58-69.

Snyder, Kimberly and William Gardner
1979 *A Preliminary Archaeological Resource Reconnaissance of Prosed Sewer Lines in the Rock Run Area, Montgomery County, Maryland.* Thunderbird Research Corporation, Front Royal, Virginia.

South, Stanley
1977 *Method and Theory in Historical Archeology*. Academic Press, New York.

Stephenson, Robert, and Alice Ferguson
1963 *The Accokeek Creek Site: A Middle Atlantic Seaboard Culture Sequence*. University of Michigan, Department of Anthropology, Ann Arbor, Michigan

Steponaitis, Leslie Cameron
1980 *A Survey of Artifact Collections from the Patuxent River Drainage, Maryland.* Maryland Historical Trust Monograph Series No. 1, Annapolis, Maryland.

Stevenson, Thomas
1874 *The Design and Construction of Harbours: A Treatise on Maritime Engineering.* Adam and Charles Black, Edinburgh.

Strandberg, Carl H., and Roy Tomlinson
1969 Photoarchaeological Analysis of Potomac River Fish Traps. *American Antiquity* 34: 312-319.

Sweig, Donald
1978 Fairfax County, Virginia, A History 1649-1800. *Fairfax County, Virginia, A History.* Nan Netherton, Donald Sweig, Janice Artemel, Patricia Hicken and Patrick Reed, eds. Fairfax County Board of Supervisors, Fairfax, Virginia. pp. 5-149.

Taggart, Hugh T.
1908 Old Georgetown. *Records of the Columbia Historical Society* 11: 161-3.

Tallichet, Marjorie D., ed.
1986 *Alexandria City Directory 1791.* Heritage Books, Bowie, Maryland.

Tilp, Frederick
1978 *This Was Potomac River.* Privately published, Alexandria, Virginia.

1982 *The Chesapeake Bay of Yore.* Chesapeake Bay Foundation, Inc., Annapolis, Maryland, and Richmond, Virginia.

1983 The Maritime History of Alexandria, Prior to 1800. *The Alexandria Waterfront Forum: Birth and Rebirth 1730-1983.* Steven J. Shephard and Pamela J. Cressey, eds. Alexandria Urban Archaeology Program, City of Alexandria, Virginia. pp. 40-54.

1987 Shipbuilding in Alexandria. *Alexandria History* Vol II. The Alexandria Historical Society, Alexandria, Virginia.

Topographical Engineer Department, U. S. Army
1836 Map of the Potomac and Anacostia Rivers between Washington, D.C., and Alexandria, Virginia. Geography and Maps Division, Library of Congress, Washington, D.C.

Turner, E. Randolph
1990 Coastal Plain Region Overview. Paper presented at the Virginia Prehistoric Indian Symposium IV: Middle and Late Woodland Periods. Roanoke, Virginia.

U.S. Army Corps of Engineers
1911 *Report of the Chief of Engineers, U.S. Army.* Annual Reports, War Department. U.S. Government Printing Office, Washington, D.C.

1912 *Report of the Chief of Engineers, U.S. Army.* Annual Reports, War Department. U.S. Government Printing Office, Washington, D.C.

1926 *The Ports of Baltimore, Maryland, Washington, D.C., and Alexandria, Virginia.* Government Printing Office, Washington, D.C.

U.S. Coast and Geodetic Survey
1883 Potomac River. Survey of the Coast of the United States. Geography and Maps Division, Library of Congress, Washington, D.C.

1906 Potomac River, Mattawoman Creek to Georgetown, No. 560. Geography and Maps Division, Library of Congress, Washington, D.C.

1926 Potomac River, Mattawoman Creek to Georgetown, No. 560. Geography and Maps Division, Library of Congress, Washington, D.C.

Veloz, Nicholas F., Jr.
n.d. *Butcher, Baker, Candlestick Maker: The 1810 Census and Personal Property Tax Rolls for Alexandria, Virginia.* Ms. on file, Lloyd House, Alexandria Library, Alexandria, Virginia.

Vernon-Harcourt, L. Francis
1885 *Harbours and Docks: Their Physical Features, History, Construction Equipment and Maintenance.* Clarendon Press, Oxford.

Wanser, Jeffrey C.
1982 *A Survey of Artifact Collections from Central Southern Maryland*, Maryland Historical Trust Manuscript Series, No. 23.

Waselkov, Gregory A.
1983 *Shellfish Gathering and Shell Midden Archaeology*, Ph.D. Dissertation, University of North Carolina, Chapel Hill.

Washington, George
1748 *Plat of the Land where on Stands the Town of Alexandria.* Geography and Maps Division, Library of Congress, Washington, D.C.

1749 *A Plan of Alexandria now Belhaven.* Geography and Maps Division, Library of Congress, Washington, D.C.

Weber, Carmen A.
1988 *Interim Report: An Exploration of Philadelphia's Early Waterfront through the Hertz Lot Excavation.* Draft report prepared for the Philadelphia Historical Commission. Copy courtesy of the author.

Weeks, Barbara K.
1987 *Archival Investigation of the Archaeological Resources Associated with Harrisons's at Piers 5 & 6, Baltimore, Maryland.* Baltimore Center for Urban Archaeology, Research Series Report No. 26.

Wentworth, Chester K.
1930 Sand and Gravel Resources of the Coastal Plain of Virginia. *Virginia Geological Survey Bulletin* 32. Richmond, Virginia.

Wesler, Kit W.
1983 Typology and Sequence in the Maryland Archaic. *Southeastern Archaeology* 2(1): 21-29.

West, George
1763 *Map of Alexandria.* Geography and Maps Division, Library of Congress, Washington, D.C.

Williams, Ames
1977 "Transportation." In *Alexandria: A Towne in Transition.* Macoll, John D. ed. Alexandria Bicentennial Commission, Alexandria Historical Society, Alexandria, Virginia.

Williams, Marguerite T.
1942 *A History of Erosion in the Anacostia Drainage Basin.* The Catholic University of America Press, Washington, D.C.

Wilson, Bill, and Betty Wilson
1971 *Nineteenth Century Medicine in Glass.* Nineteenth Century Hobby & Publishing Co., Amador City, California.

Wilson, F.
1942 Composite Launching Curves. *Marine Engineering*, Vol. 47, February.

Wilson, Merril A., and Geoffery P. Moran
1980 *Historic Structure Report: Central Wharf, Architectural Data and Archaeological Data.* National Park Service, Denver Service Center. Denver, Colorado.

Windsor Letters
1786-88 Letters of Olney Windsor of Providence, Rhode Island, to his Wife Mrs. Hope Windsor--Written in Alexandria. Manuscripts Division, Virginia State Library, Richmond.

Winfree, R. Westwood
1967 The T. Gray Haddon Site, King William County, Virginia (44KW04). *Quarterly Bulletin of the Archaeological Society of Virginia* 22: 2-26.

Witthoft, John
1953 Broad Spearpoints and the Transitional Period Cultures in Pennsylvania. *Pennsylvania Archaeologist* 23(1).

Wood, W. Raymond and Donald Lee Johnson
1978 A Survey of Disturbance Processes in Archaeological Site Formation. *Advances in Archaeological Method and Theory* 1: 315-388. Michael Schiffer, ed. Academic Press, New York.

Woodhead, E.I., C. Sullivan and G. Gusset
1984 Lighting Devices in the National Reference Collection, Parks Canada. *Studies in Archaeology, Architecture and History.* National Historic Parks and Sites Branch, Parks Canada.

Wright, Catherine
1977 *Port O' Bladensburg: A Brief History of a 1742 Town.* Bicentennial Committee of the Town of Bladensburg.

Wright, Henry T.
1973 *An Archaeological Sequence in the Middle Chesapeake Region, Maryland.* Archaeological Studies, No. 1, Department of Natural Resources, Maryland Geological Survey.

Zimiles, Martha, and Murray Zimiles
1973 *Early American Mills.* Clarkson N. Potter, New York.