VII. ANALYSIS

Site Stratigraphy

Geomorphological analysis was conducted to aid in understanding how sediments were formed at the site and how artifacts had become incorporated within them. This study included analysis of existing stratigraphy in various sections of the site as well as a reconstruction of the form of the ancient landscape. The Lums Pond soils were classified using standard descriptive techniques and nomenclature. The uppermost unit of a soil profile is typically referred to as an "A"-horizon, an organic and mineral rich surface layer. When minerals and fine particles such as clay are leached from the A-horizon, soil formation occurs in the underlying layer in which the material accumulates. The soil that results is referred to as a "B"-horizon. Lower still in the profile, below the level of soil formation, is the "C"-horizon, unaltered sediments such as sand. Subscript letters are used to refine the classification. Thus a plowed A-horizon, such as was found across the Lums Pond site, is referred to as an "Ap"-horizon and a developed soil containing a considerable amount of leached or translocated clay is referred to as a "Bt"-horizon.

An additional classification describes what are referred to as lithological units. These are merely groups of soil horizons that have originated from similar processes or transportation agents such as water, wind, or gravity. Lithological units are represented by numerals, with sub-units identified by letters. Thus, for example, historic floodplain deposits may be designated "2a" and historic slopewash designated "2b".

Stratigraphic profiles and landscape reconstructions were developed for the site on the basis of field observations and extensive laboratory analysis of sediment samples (Figure 6). The main findings of these studies may be summarized as follows:

Area 1 lay on the edge of a low hill at the crest of the site, the highest and oldest portion of the landscape. Archaeological assemblages were preserved in the plow zone, which rested on a developed clayey soil (Bt horizon). This in turn overlay the C-horizon gravels of the Pleistocene age Columbia Formation, the uppermost portion of which consisted of weathered aeolian sediments.

Area 2 lay on the midslope south of Area 1. Archaeological assemblages were preserved in the plow zone and occasionally in sub-plow zone contexts. Intact prehistoric activity areas and features were present within a developed soil, or Bt horizon. The subsurface preservation observed in Area 2 was part of an ongoing process of soil formation and the upbuilding of the clay-rich Bt-horizon on and within aeolian sediments. The thickness of this horizon increased upslope, to the north. Features were preserved within the Bt-horizon in part because soil formation tends to impede erosion and seal in the cultural assemblages. Sections of the Area 2 sequence had been stripped by slope retreat over the last few thousand years. This process accelerated with erosion resulting from historic period land clearing and cultivation of the surface deposit.

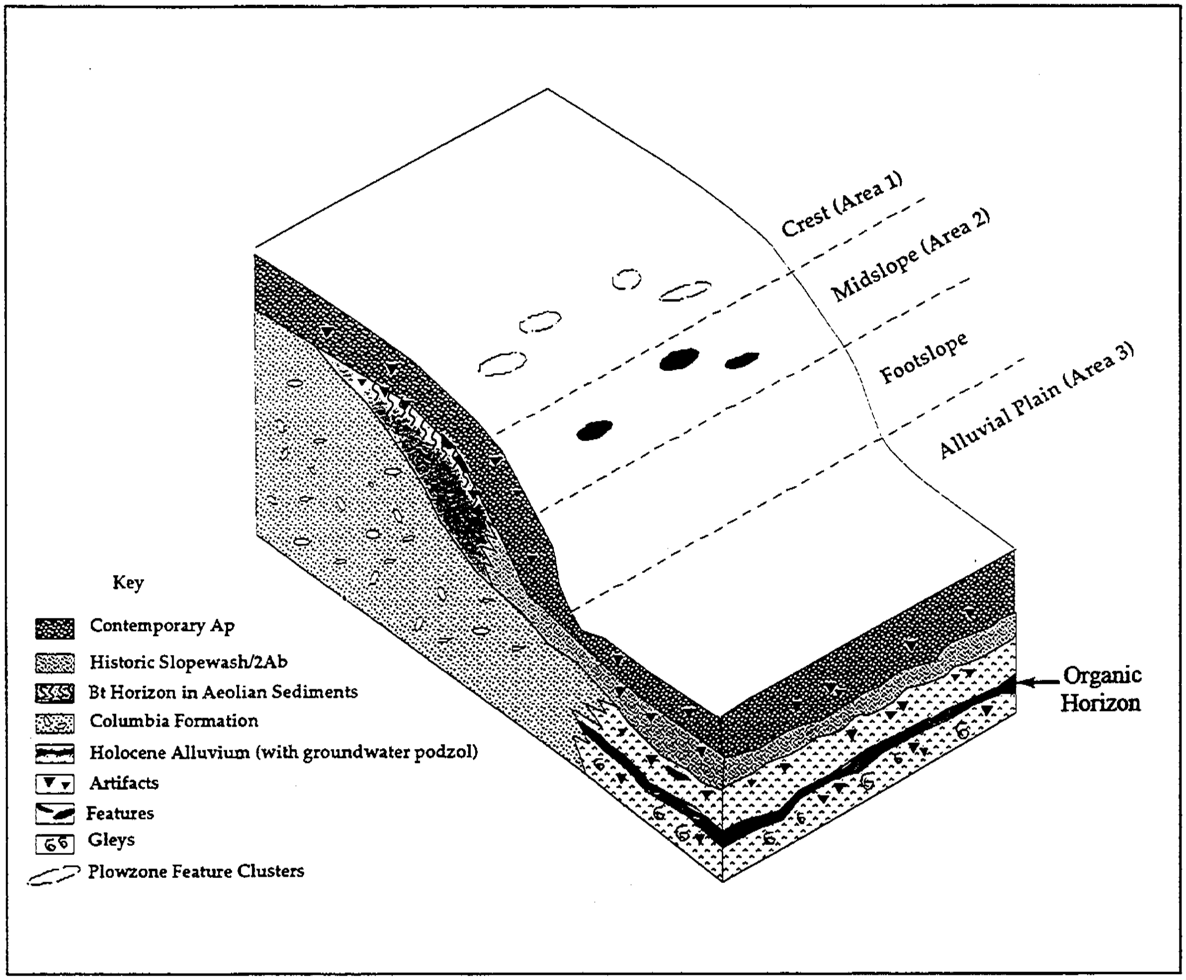

Figure 6. Three-Dimensional Rendering of the Lums Pond Landscape

Area 3 lay adjacent to the active alluvial plain, or floodplain, of the stream at the south edge of the site, and within the ancient floodplain of that watercourse. Clusters of prehistoric artifacts were contained in what sediment analysis confirmed to be alluvium. The sediments ranged in size fine material such as clay-silts to coarse sandy loams. Artifact assemblages appeared only minimally disturbed by ongoing over bank or flood episodes. Overlying the prehistoric sequence is a 50 cm deep layer comprised of a modern plow zone and redeposited historic slopewash. There were two buried surface deposits, or A-horizons in the floodplain profile, labeled 2Ab and 3Ab (Figure 7). Both were rich in organic material, and artifacts were present in the upper zone, 2Ab. The two horizons bracketed a 50 cm thick sediment layer, broken analytically into several segments that were labeled 2AC, 2C1, 2C2, 2Cg on the basis of mineral and organic content. The lowest levels were gleyed, referring to the deposition of minerals, particularly iron and manganese, by a rising and falling water table. The 2C layers taken together contained the majority of the prehistoric artifacts in the floodplain deposit.

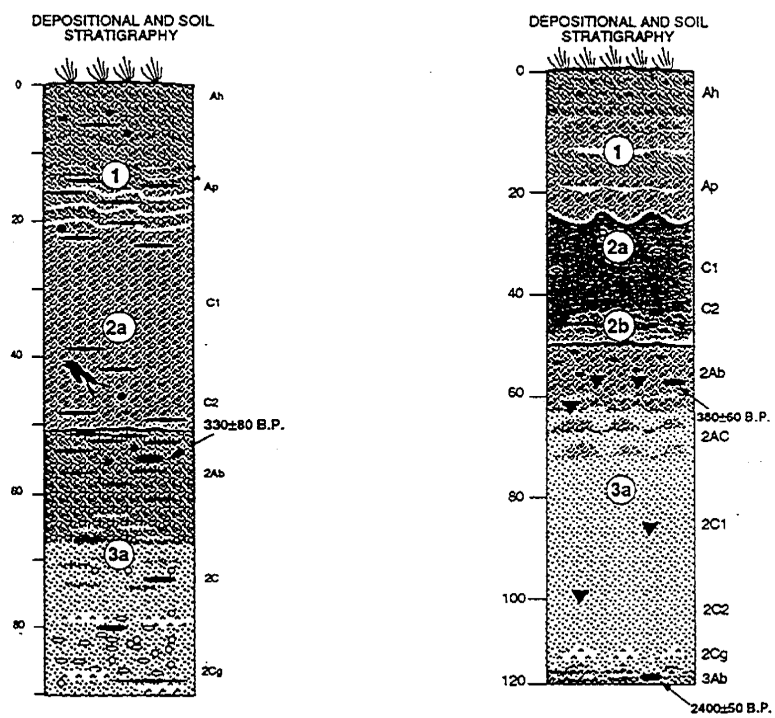

Figure 7. Stratigraphy in Area 3, Block A and Block B

The upper buried A-horizon, 2Ab, was comparable with archaeological Stratum C, while the underlying sediments corresponded to archaeological Strata D and E (Figure 8). Diagnostic artifact assemblages and radiocarbon dates indicated that Stratum C was Woodland II in age. The same data indicated that Stratum D/E was Woodland I in age. The lowermost 3Ab horizon may be considered to be Archaic in age, based on geomorphological evidence of point bar formation associated with lateral variations in the channel of the stream. No direct corroborating evidence was recovered in the form of artifacts from the layer, and a series of radiocarbon dates provided a range of temporal data. Sedimentary evidence suggests the earliest stream was braided and later was a more stabilized meandering stream, the latter linked to the Woodland I and II prehistoric sequence.

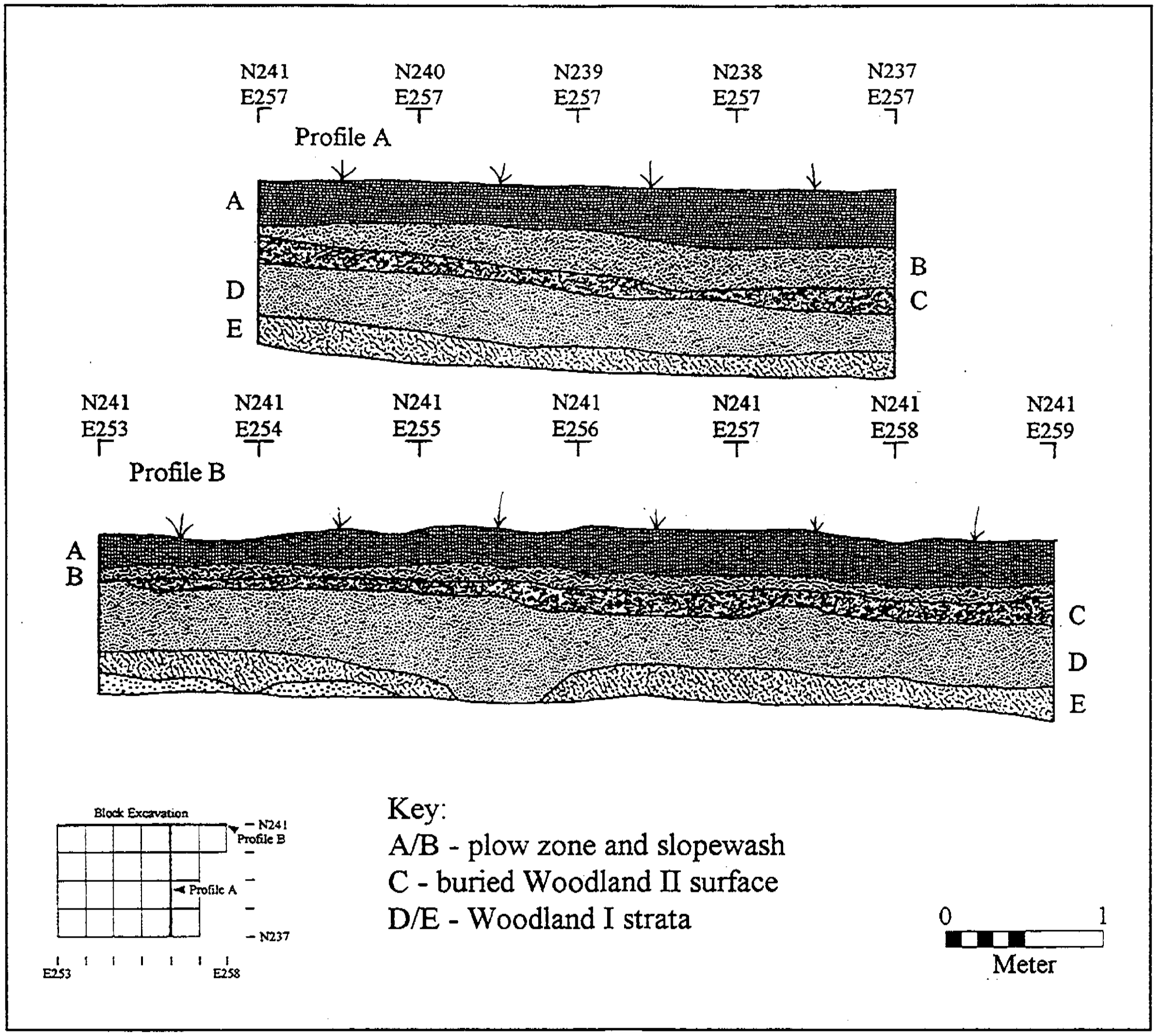

Figure 8. Archaeological Stratigraphy in Area 3, Block B

The basal sediments throughout the site consisted of a sandy horizon which either directly represented or graded into the coarse sand and gravel deposit referred to earlier as the Columbia Formation. This material is an alluvial deposit formed during the Pleistocene age, and it is found throughout most of the Delaware Coastal Plain. Since human occupation of the region began after the end of the Pleistocene, the deposit marks the level below which cultural deposits are not found.

Radiocarbon Dates

Radiocarbon dating is a laboratory technique based on the observation that the ratio of carbon isotopes in organic materials changes through time. The rate of change is known, and thus the isotope ratio in an archaeological sample can be measured and the result compared against established sequences to provide an age approximation. The age is usually reported as a date and a range, or margin of error.

Twenty radiocarbon samples were submitted for dating from the Lums Pond site. The samples were from a variety of locations, including six samples from feature fill, and 14 from general stratigraphic proveniences. Most of the material analyzed was carbonized wood, or charcoal; six samples consisted of non-carbonized organic sediments. All of the samples were collected in sterile conditions which were maintained throughout the course of processing. The materials were sorted and cleaned before being submitted to the radiocarbon laboratory at Beta Analytic, Inc., in Miami, Florida. There the samples were chemically treated to remove any extraneous material, ensuring the maximum reliability of the dates. The weights of the samples determined the exact procedure used to date material. Fifteen of the samples were of sufficient size for standard counting procedures (three of those were given extended counting time to reduce the margin of error reported in the dates). Five samples were small and required the use of accelerator mass spectronomy, or AMS, a more intensive process that uses nuclear technology to read isotope ratios on a very small scale. The dates returned from the assays are detailed in Table 5. The results are reported in both uncalibrated radiocarbon years (BP) and calibrated calendar years (BC/AD).

Radiocarbon dating is often referred to as a form of absolute dating. In practice, the data used in radiocarbon analysis are less precise than that term suggests. The degree of precision involved in the measurements has significant implications for the ability to compare several radiocarbon dates from a single site. As indicated above, the dates listed in the tables are actually approximate measurements based on the known rate of decay of the radioactive carbon isotope, C^{14}. While the dates are reported as single points, the points are merely average values within a range (the margin of error or ± portion of the date). The single point date may be misleading considered on its own, since the actual date has an equal probability of lying anywhere within that range. It is because of this that the range, known formally as the standard deviation, or sigma, is reported along with the mid-point. To adequately compare of a series of dates, therefore, it is necessary to examine the ranges, or sigmas, not merely the single point date. Several procedures were used in analyzing the dates from Lums Pond, including graphic displays and statistical analysis of the dates and ranges.

Sample #	Provenience	Radiocarbon Age (1-Sigma)	Material	Analysis
AREA 2				
88100	Feature 2	2670±90 BP	charcoal	standard
88101	Feature 10	1150±90 BP	charcoal	standard
88102	Feature 14	2660±100 BP	charcoal	standard
88103	Feature 16	2780±60 BP	charcoal	standard
88104	Feature 19	2720±90 BP	charcoal	standard
88105	Feature 23	2960±60 BP	charcoal	extended count
88111	Blk D, B2	810±60 BP	sediment	extended count
92103	Area 2 85-90cm	10,710±80 BP	organic sediment	standard
AREA 3				
88106	Blk A, C1	400±50 BP	charcoal	AMS (ETH)
92101	Blk A, C1	330±80 BP	sediment	standard
88107	Blk A, D1-2	640±50 BP	charcoal	AMS (ETH)
88108	Blk A, D3-4	6350±60 BP	charcoal	AMS (ETH)
92099	Blk A, 153-160cm	4310±60 BP	organic sediment	AMS (CAMS)
88109	Blk B, C1	700±80 BP	charcoal	standard
92102	Blk B, C1	380±60 BP	sediment	standard
91398	Blk B, D1	3440±90 BP	charcoal	standard
88110	Blk B, D2	3320±70 BP	charcoal	standard
91399	Blk B, D3	3240±90 BP	charcoal	extended count
92100	Blk B, 159-164cm	2400±50 BP	organic sediment	AMS (CAMS)
83166	N220/E237	230±50 BP	organic sediment	standard

Table 5. Lums Pond Radiocarbon Assay Results

Area 2

Eight radiocarbon dates were returned from Area 2, two from non-feature proveniences, and six from feature fill. The two dates from non-feature proveniences varied widely providing bracketing dates for the main period of occupation in Area 2. An assay from the sub-plow zone layer in Block D returned a date of 810±60 BP, later than expected based on artifact data in the overlying deposit. The sample that was dated consisted of a low-carbon soil sample, and the resulting date appeared to be associated with soil formation processes which occurred after the artifacts in the layer were deposited and buried. A second sample from Area 2 consisted of organic material extracted from gravel deposits that were located immediately above the Pleistocene sand. The date from the sample was 10,710±80 BP, and represented a period during which sand and gravel were being laid down by fast moving water from streams in the area, prior to human occupation of the site.

Assays were conducted on radiocarbon samples from six features. The sample from Feature 10 consisted of dispersed charcoal from a level provenience within the feature. The date returned was 1150±90 BP. There were relatively few artifacts recovered from the feature, none of which were chronologically diagnostic, and there was little other temporal data from surrounding deposits. Thus there was no corroborating evidence for the radiocarbon date, and no objective means of determining whether or not it was valid.

The remaining five assays were from the main cluster of features in the eastern part of Area 2. The dates ranged from 2660±100 BP to 2960±60 BP, and were similar enough to suggest the possibility of contemporaneity. Statistical tests were run on the assays from the features, and the results implied that Features 2, 14, 16, and 19 were contemporary. There was a low probability that Feature 23 was not contemporary the others.

A second study, known as aggregation analysis, was conducted to further assess the dates from the features for their implications for continuity and contemporary site occupation. As noted earlier, radiocarbon dates are reported as probability distributions. Aggregation analysis combines the probabilities of all of the dates and calculates an overall probability curve representing the occupations implied by each date. The shape of the curve can provide an indication as to the continuity of occupation. Assuming that the dates represent the entire range of site activity, a curve with one peak might imply a single episode of occupation, while a more complex curve might imply one or more breaks in activity.

Figure 9 illustrates the results of an aggregation analysis performed on the data from the Area 2 features. The chart displays the expected frequency of dates on a 50-year interval. The curve appears essentially unimodal, i.e., having only one peak. A small, secondary peak at 2950 BP, to the left of the main peak at 2650 BP, corresponding to the data represented by Feature 23.

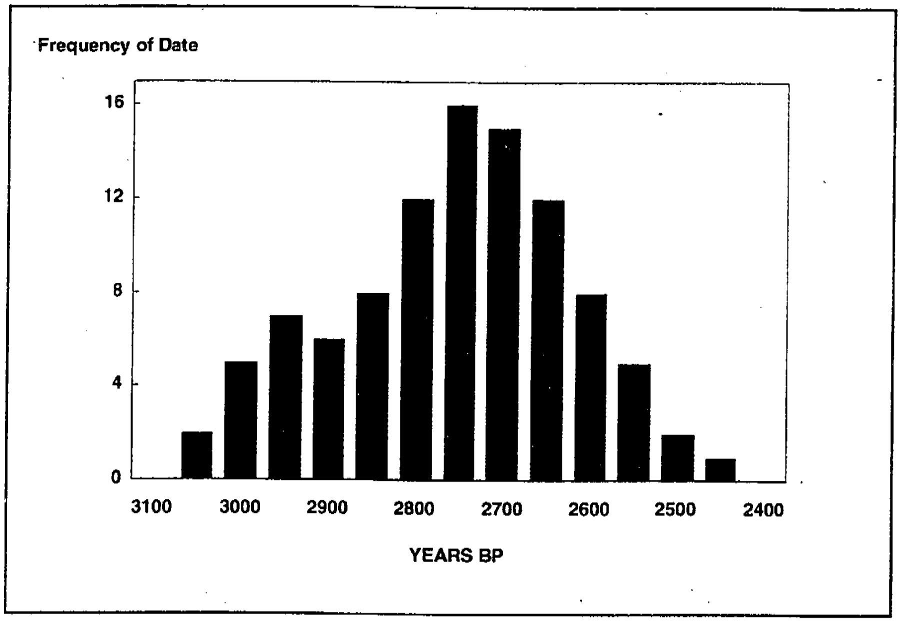

Figure 9. Graph of Aggregation Analysis of Radiocarbon Samples from Features in Area 2 (Showing Continuity of Activity as Probability Percentages on a 50-year Interval).

In a final display of the data, the 2-sigma ranges of the dates were graphed (Figure 10). The 2-sigma range represents the span within which there is a 95 percent probability that the date actually occurs. This analysis showed that there was a potential for temporal overlap among all of the features.

On the basis of these studies, it was concluded that the sampled features in the cluster were contemporary. Furthermore, several factors suggested that the remaining features in the group were likewise contemporary. All ten of the pits were clustered together in one relatively small portion of the site, lying within a radius of 4 m or less. In spite of their proximity, there was a general lack of physical overlap, such as might be expected if some had been excavated later than the rest, cutting through existing pit outlines. Finally, the approximate regularity of shape of the pits and the general uniformity of their contents, as described in the feature analysis below, suggested that the features had all been in use at the same time and for the same general purpose. With no basis for selecting one feature as more representative of the occupation than the rest, the feature dates were averaged. The calculation used is a form of weighted average that balances the individual dates according to the size their reported range. The averaged date calculated for the feature cluster was 2802±33 BP.

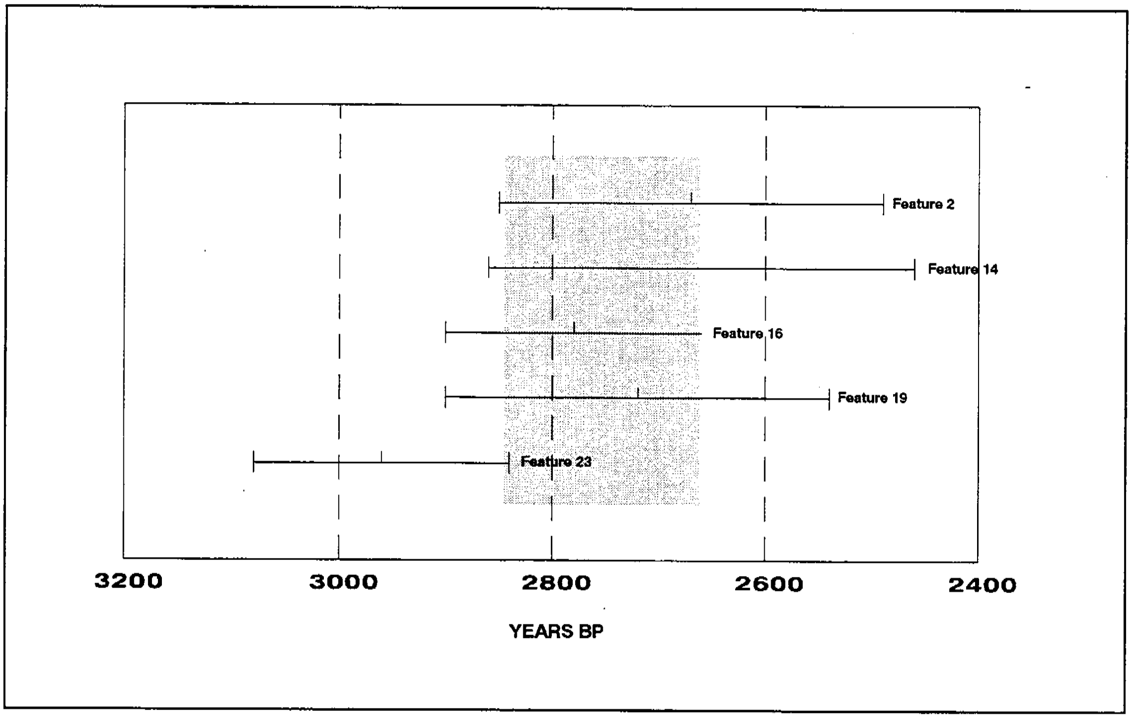

Figure 10. Radiocarbon Assay Results from Area 2 Features (Dates Displayed with 2-Sigma Range, Shaded Region Indicates Potential Overlap)

Area 3

Twelve dates were obtained for Area 3, five from Block A, six from Block B, and one from the floodplain edge south of Block A. Four dates were from Stratum C, the buried A-horizon, 2Ab, that occurred in Block A and Block B. There was no evidence of stratification within the deposit in either block, and so each sample from the stratum was assumed to have been equally likely to be representative of the mean period of occupation. The dates—330±80 BP, 380±60 BP, 400±50 BP, and 700±80 BP—were thus combined using a weighted average formula. The mean date of occupation for Stratum C was considered to be the averaged date of 431±32 BP.

A cluster of three dates was returned from successive levels of Stratum D in Block B — from Level 1, 3440±90 BP; from Level 2, 3320±70 BP; and from Level 3, 3240±90 BP. While not in chronological order with depth, the three assays were relatively close in terms of their reported ranges. Statistical tests suggested that all three were similar. As with the data from Stratum C, each sample from Stratum D appeared as likely as the rest to be representative of the mean period of occupation, and thus the dates were averaged. The mean date of occupation for Stratum D was considered to be 3331±47 BP.

A final assay was returned on a sample of peat recovered from the base of a test unit on the southern edge of Area 3. The date returned was 230±50 BP, implying that the material had been deposited comparatively recently. This location represented the edge of the active stream during the historic period where it had cut into the earlier, prehistoric floodplain, filling in with water-borne debris.

There were four inconsistent dates from Area 3. Consideration of the validity of these dates involved archaeological decisions regarding stratigraphic contexts or spatial associations rather than statistical decisions.

- 640±50 BP from D1-2 Block A — this sample was combined from two proveniences, with most of the material (almost 80 percent) coming from the uppermost level of the stratum, clearly raising the possibility of contamination from the overlying Stratum C; therefore the date was disregarded
- 6350±60 BP from D3-4 Block A — this date appeared early compared with the dates from the same levels in Block B; yet there was no additional evidence from that part of the profile to suggest that the date was in fact invalid; the sample was from combined provenience, possibly making it less reliable than more concentrated samples; this date was also disregarded
- 2400±50 BP from a depth of 160 cm in Block B, the lower buried A-horizon, 3Ab — this date was later than three statistically consistent dates occurring in a contiguous unit considerably higher in the profile; the material dated was organic sediment; this date was assumed to be less reliable than other dates from the block
- 4310±60 BP from a depth of 160 cm in Block A, the lower buried A-horizon, 3Ab — if the 6350 date were assumed to be good, this date would fall well out of sequence in a similar manner to the 2400 date in Block B; were the 6350 date considered aberrant, this date may be acceptable; there was no additional data, radiometric or artifactual, to corroborate either assessment

The most secure dates, and those which were used in the interpretation of the archaeological assemblages in Area 3, are the dates from Stratum C, which averaged 431±32 BP, and Stratum D, which averaged 3331±47 BP. The date of 4310±60 BP from the gravelly 3Ab horizon may be a bracketing date for the early end of the continuum. It appeared acceptable in spite of a lack of corroborating evidence.

Results of an aggregate analysis of the accepted dates for Stratum C and D in Area 3 are shown in Figure 11. The dates are arranged stratigraphically on the left-hand, or Y-axis of the chart, and illustrate the two main periods of occupation implied by the radiocarbon analyses.

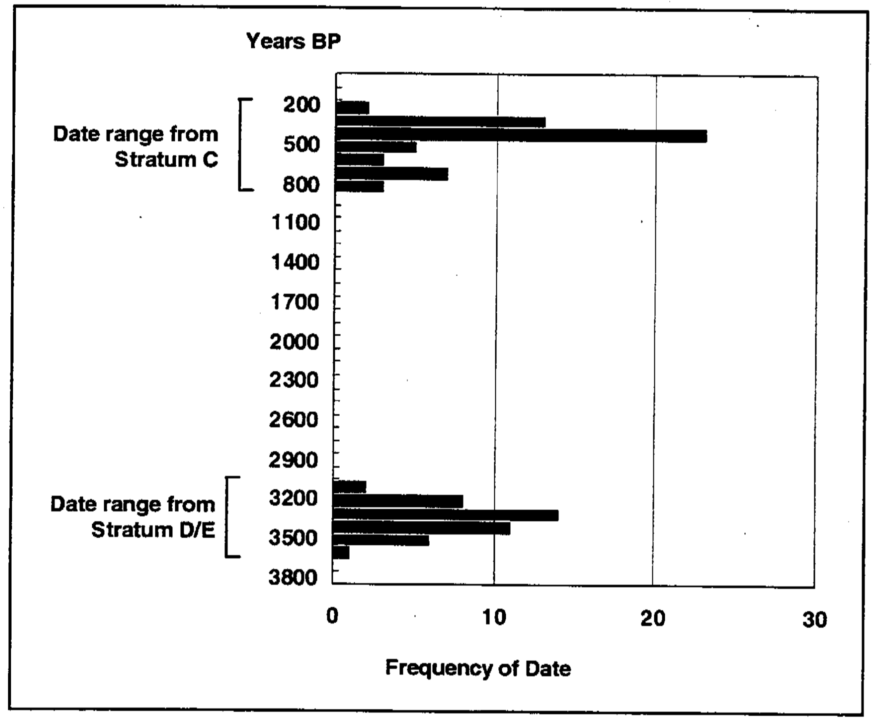

Figure 11. Graph of Aggregation Analysis of Radiocarbon Samples from Stratigraphic Proveniences in Area 3 (Showing Continuity of Activity as Probability Percentages on a 100-year Interval)

Features

Archaeological investigations at the Lums Pond site documented a total of eleven features, all of which were located in Area 2. Ten of the features were prehistoric pits in the eastern portion of Area 2 (Block C) (Plates 10 and 11) and one feature (Feature 10) was found in the western portion of Area 2 (Block E). A number of studies were conducted on the features, incorporating descriptive data, analysis of shape and size, and analyses of feature fill. The types of material analyzed from the fill included radiocarbon samples, macrobotanical or plant remains, and artifacts. Features were chosen for radiometric dating based on one of two factors: 1) the amount and quality of the carbonized material contained within them, to assure the most secure dates; and 2) the presence of potentially diagnostic artifacts, such as projectile points or ceramics. Macrobotanical analysis was conducted only on samples from dated features. Because of the comparatively small number of features present at the site overall, each is described individually.

Plate 10. Cluster of Pit Features in Block C of Area 2, View South

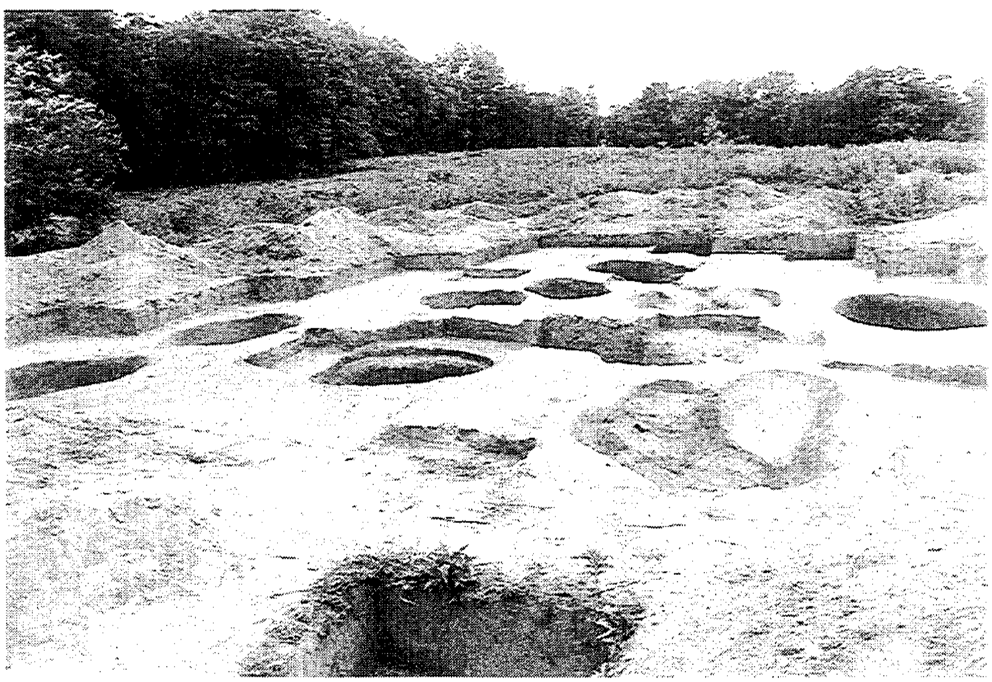

Plate 11. Cluster of Pit Features in Block C of Area 2, View East

Feature volumes were calculated using standard geometric formulae. All dimensional measurements were recorded from the base of the plow zone. Since each feature appeared to have been truncated by plowing, the dimensions calculated do not necessarily reflect complete volumes, and at least one of the analyses presented below suggested that the features had not been truncated proportionally. Archaeobotanical data are fully presented in Chapter XII. A summary of these data and their implications for subsistence and paleoenvironmental reconstruction are presented following the feature descriptions. Frequency statistics for fire-cracked rock were derived from the site artifact inventory.

Features were given numerical designations in their order of discovery in the field, and are listed here in that order. Missing numbers in the overall sequence represent features which, upon excavation, were found to be natural in origin.

Feature Descriptions

Feature 2

Location:
Area 2 / Block C
N 301.5/ E 338.5
Morphology:
Plan: round
Section Profile: straight sided, flat bottom
Radiocarbon Assay:
2670±90 BP

Dimensions:
Diameter: 130cm
Depth: 69cm
Volume: 605.0 liters
Artifacts:
1 projectile point (Lamoka)
20 flakes
9 chips
1161.5gm fire-cracked rock (mean 32.2gm)
Macrobotanical Remains:
nutshell fragments (*Carya*)
charcoal (*Quercus*)

Description: Feature 2 consisted of a deep, cylindrical pit with a flat bottom. The uppermost portion of the feature was truncated by the plow zone, and the base lay in the coarse sandy C-horizon. Feature fill consisted of dark yellowish brown loam with no visible stratification. Lithic raw materials represented in the flaking debris included quartz, chert, argillite, jasper, ironstone, and quartzite, in frequency order. Charcoal flecks were observed throughout the fill, along with several large chunks near the base of the pit. Samples for radiocarbon dating were collected from various level proveniences. The assay reported here was run on one of the lower, concentrated samples. One small flake was recovered from the flotation sample.

Feature 10 (Plate 12, Figure 12)

Location:
Area 2 / Block E
N 317.5/ E 290
Morphology:
Plan: irregular oval
Section Profile: steep sided basin
Radiocarbon Assay:
1150±90 BP

Dimensions:
Diameter: 110cm x 200cm
Depth: 90cm
Volume: 1113.4 liters
Artifacts:
9 flakes
6 chips
290.2gm fire-cracked rock (mean 96.7gm)

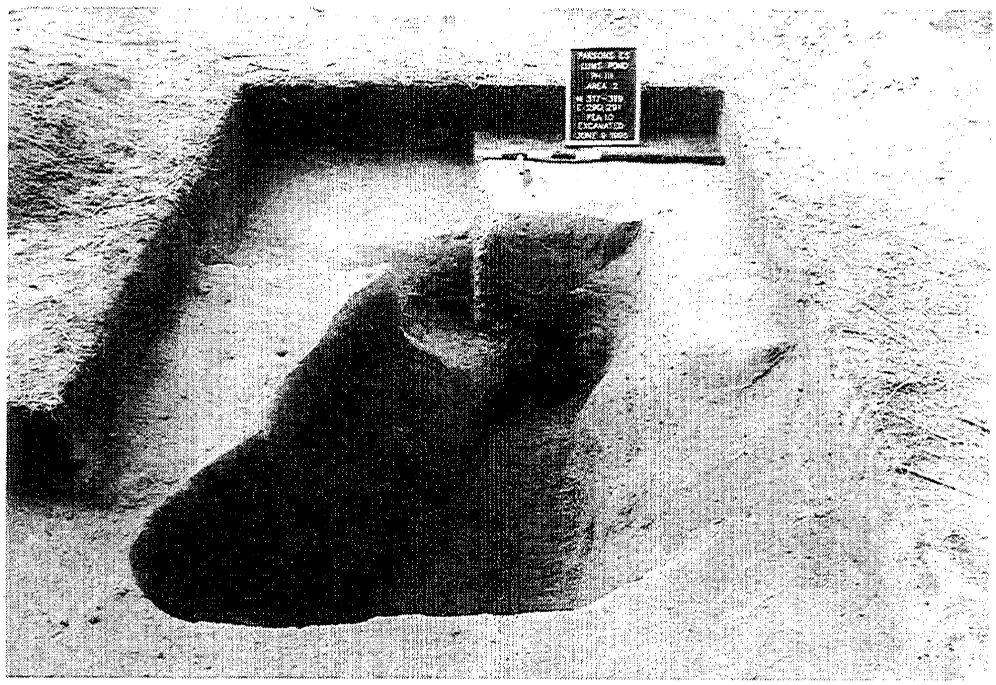

Plate 12. Feature 10, Fully Excavated

Description: Feature 10 consisted of a wide, deep pit with steeply sloped sides and a basin-shaped bottom. The uppermost portion of the feature was truncated by the plow zone, and the base lay in the coarse sandy C-horizon. Feature fill consisted of dark yellowish brown sand loam. Although there was no visible stratification within the pit, the fill was mottled with siltier patches of the same color (dark yellowish brown) and with reddish yellow coarse sand. The latter appeared to be C-horizon material mixed into the fill through postdepositional processes. Minor charcoal flecking was noted, and samples were collected from level proveniences. Irregularities in the walls of the pit suggested a considerable amount of biological perturbation (particularly, rodent burrowing). No macrobotanical sample was taken.

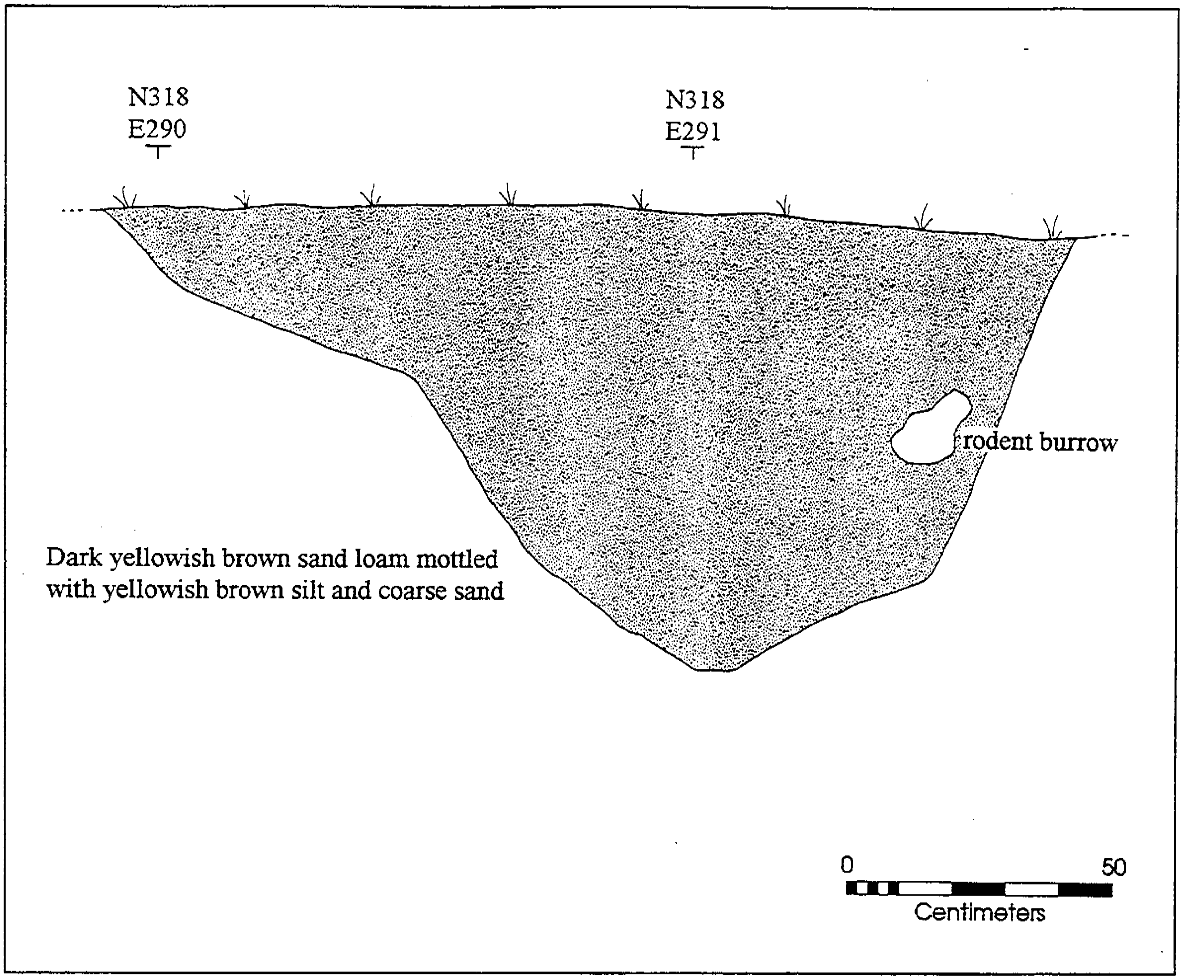

Figure 12. Feature 10, Profile Section

Feature 14 (Figure 13, Plate 13)

Location:
Area 2 / Block C
N 301.5/ E 336.5

Morphology:
Plan: round
Section Profile: steep sided basin

Radiocarbon Assay:
2660±100 BP

Dimensions:
Diameter: 150cm
Depth: 46cm
Volume: 439.3 liters

Artifacts:
1 projectile point (Teardrop)
35 flakes
8 chips
4188.6gm fire-cracked rock (mean 24.5gm)

Macrobotanical Remains:
nutshell fragments (*Carya*)
charcoal (*Quercus*)
charcoal (*Carya*)

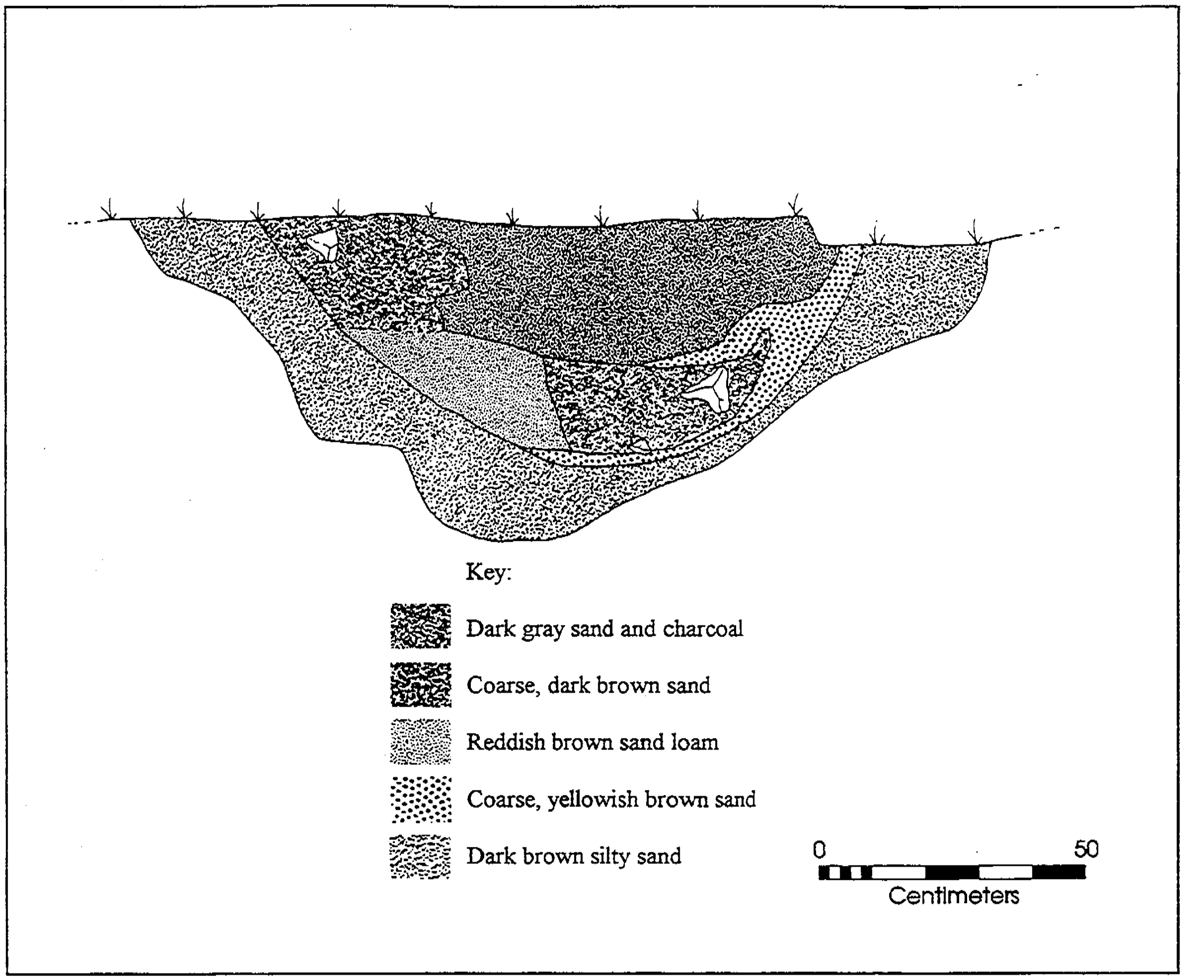

Figure 13. Feature 14, Profile Section

Description: Feature 14 consisted of a wide pit with moderately sloped sides and a basin-shaped bottom. The uppermost portion of the feature was truncated by the plow zone, and the base lay in the coarse sandy C-horizon. Feature fill was stratified. Dark brown coarse sand lay in the center of the pit to a depth of approximately 30cm, surrounded by several extensive patches of very dark grayish brown charcoal-rich loam extending to roughly the same depth. Below lay a finer grained brown silty sand, also mottled with extensive patches of very dark grayish brown charcoal-rich loam and reddish yellow coarse sand. At the base of the pit lay mottled strong brown and light brown loam and sand. The range of lithic raw material among the flaking debris included quartz, chert, Iron Hill jasper, ironstone, quartzite, jasper, and argillite, in order of frequency. Charcoal samples were collected from various stratum proveniences. The assay reported here was run on a dispersed sample from the central portion of the feature. Oak was the dominant species represented in the charcoal fragments. Two small flakes were recovered from the flotation sample.

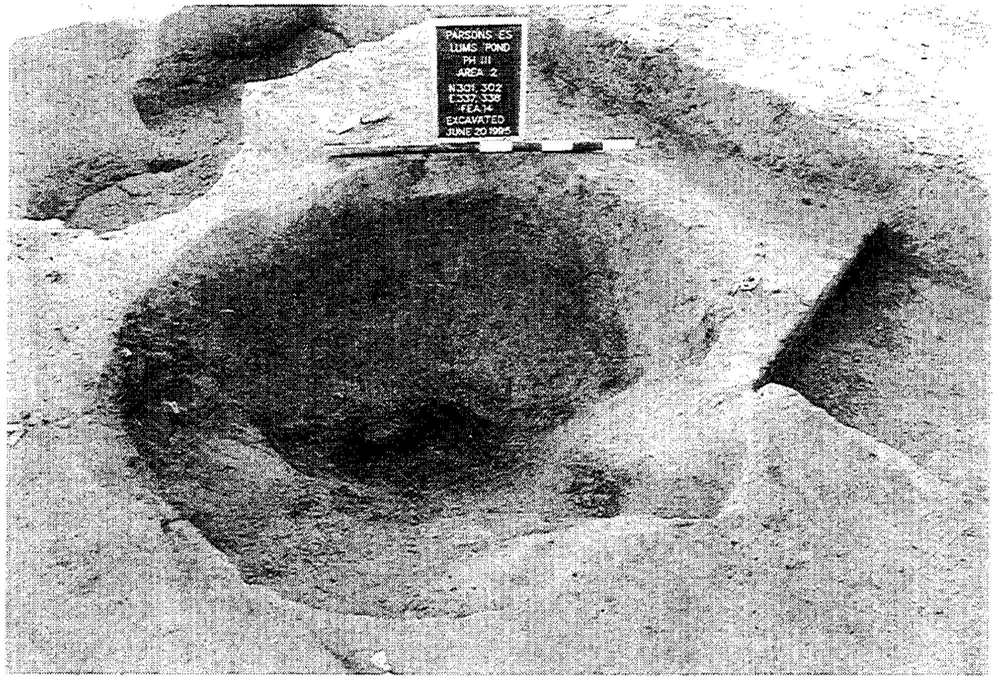

Plate 13. Feature 14, Fully Excavated

Feature 16

Location:
Area 2 / Block C
N 299.5/ E 336
Morphology:
Plan: sub-round
Section Profile: steep sided flat bottom
Radiocarbon Assay:
2780±60 BP
Dimensions:
Diameter: 100cm x 120cm
Depth: 55cm
Volume: 332.6 liters

Artifacts:
12 flakes
1 chip
2 bifaces
1 core
3 ceramic fragments
570.8gm fire-cracked rock (mean 30.0gm)
Macrobotanical Remains:
acorn fragments (*Quercus*)
charcoal (*Quercus*)

Description: Feature 16 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill was stratified. The uppermost stratum consisted of yellowish brown silty sand extending to a depth of approximately 30cm. Below lay a mottled strong brown sand, yellowish brown sandy silt, and compact brownish yellow silt with extensive charcoal flecking. Lithic raw material represented in the flaking debris included quartz, ironstone, chert, jasper, and argillite, in frequency order. Charcoal samples were collected from various level proveniences. The assay reported here was run on a dispersed sample from the lower levels of the feature.

Feature 17

Location: Area 2 / Block C N 302/ E 340.5 **Morphology:** *Plan*: oval *Section Profile*: steep sided flat bottom	**Dimensions:** *Diameter*: 150cm x 200cm *Depth*: 61cm *Volume*: 804.4 liters **Artifacts:** 22 flakes 2 chips 1300.9gm fire-cracked rock (mean 29.6gm)

Description: Feature 17 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill consisted of a relatively uniform yellowish brown sandy silt that showed no evidence of stratification. The walls of the pit sloped somewhat near the surface, perhaps an indication that the pit lay open and only partially filled for some time after abandonment allowing the edges to erode somewhat. A segment of the feature to the northwest was shallower than the rest and may have been excavated separately. This portion was also basin-shaped, roughly 80x90cm and 35cm deep, giving a volume of 116.6 liters. Fill was described as having the same color (yellowish brown) and texture (sandy silt) as the remainder of the feature, but with higher gravel content. Charcoal flecking was observed throughout the feature, and samples were collected from level proveniences. Radiocarbon and macrobotanical analyses were not undertaken.

Feature 19 (Figure 14, Plates 14-16)

Location: Area 2 / Block C N 303.5/ E 337 **Morphology:** *Plan*: round *Section Profile*: steep sided flat bottom **Radiocarbon Assay:** 2720±90 BP **Dimensions:** *Diameter*: 145cm *Depth*: 75cm *Volume*: 806.9 liters	**Artifacts:** 2 projectile points (Poplar Island, Teardrop) 62 flakes 8 chips 1 biface 1 uniface 1 hammerstone 12 ceramic fragments 20,189.7gm fire-cracked rock (mean 50.6gm) **Macrobotanical Remains:** charcoal (*Quercus*) charcoal (*Carya*)

Description: Feature 19 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill was stratified. The main body of the feature consisted of yellowish brown silty sand, extending to 50cm and grading to brown with depth. Cut into this deposit was a round patch of dark brown silty sand approximately 70cm in diameter and 40cm deep. Below the main body of the feature lay dark yellowish brown silty sand to 65cm, followed by yellowish brown silty sand that was heavily charcoal-stained in places. This latter deposit began at a depth of approximately 30cm in the south half of the pit, sloping sharply downward to the north and eventually forming the base of the feature. Lithic raw material represented in the flaking debris included quartz, Iron Hill jasper, chert, ironstone, quartzite, jasper, and argillite, in frequency order. Charcoal was observed throughout the feature, and samples were collected from level proveniences. The assay reported here was run on a dispersed sample from the central portion of the feature. Oak was the dominant species among charcoal fragments. Two small flakes were recovered from the flotation sample.

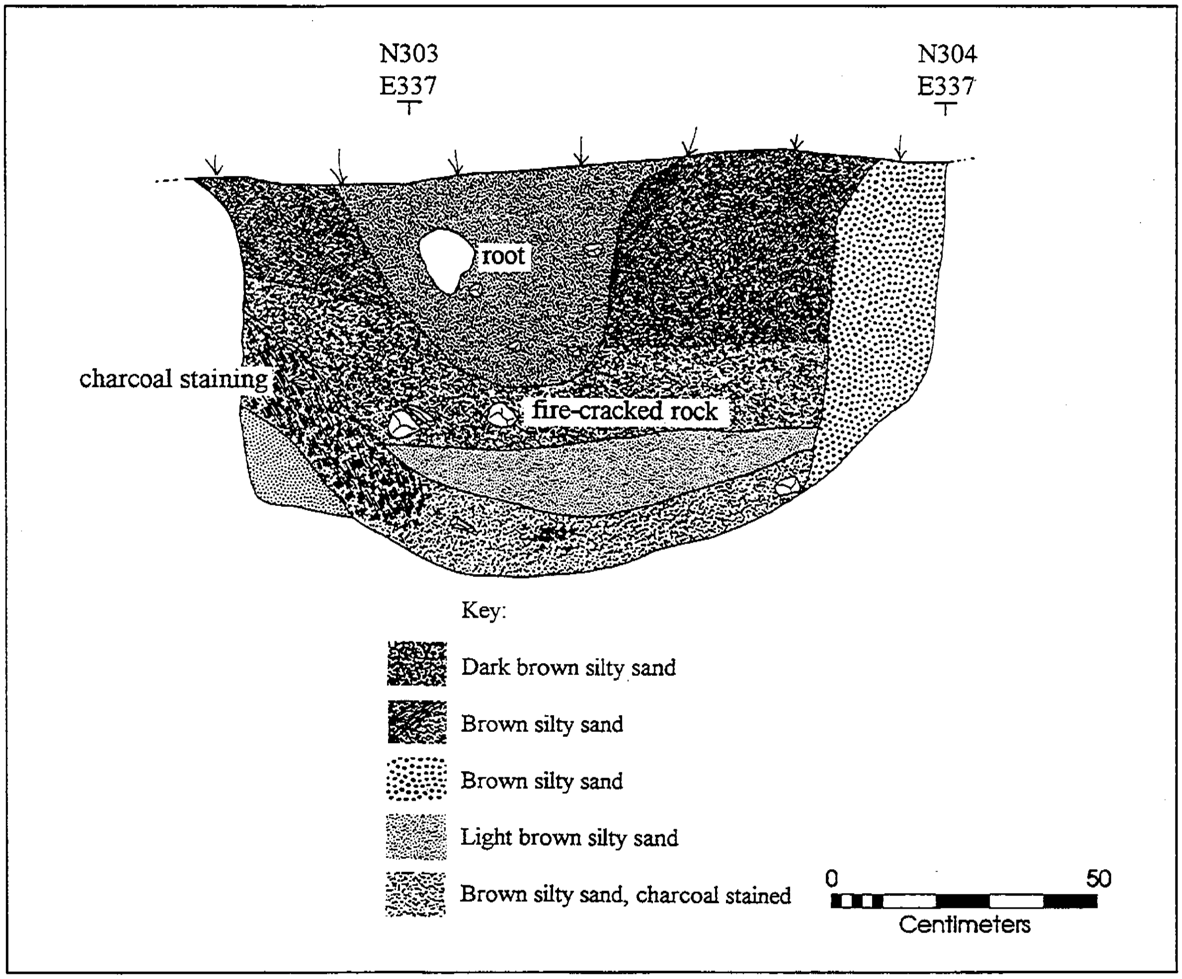

Figure 14. Feature 19, Profile Section

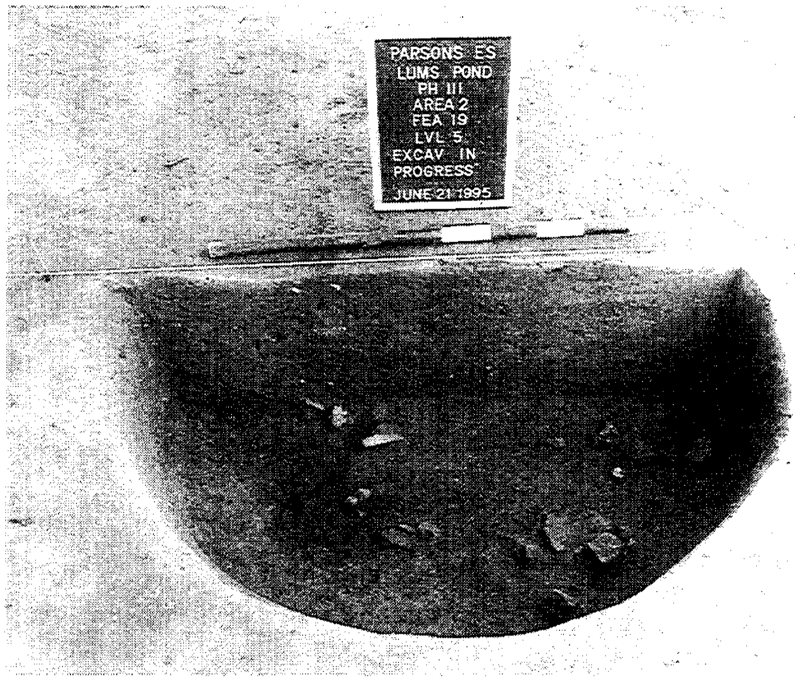

Plate 14. Feature 19, Partially Bisected

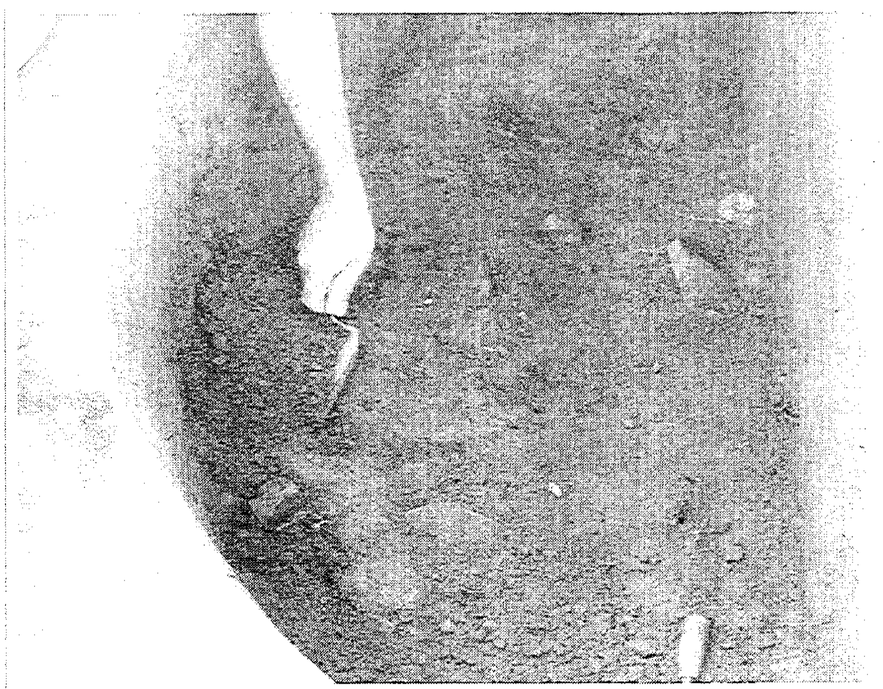

Plate 15. Feature 19, Trowelling Exposing Fire-Cracked Rock

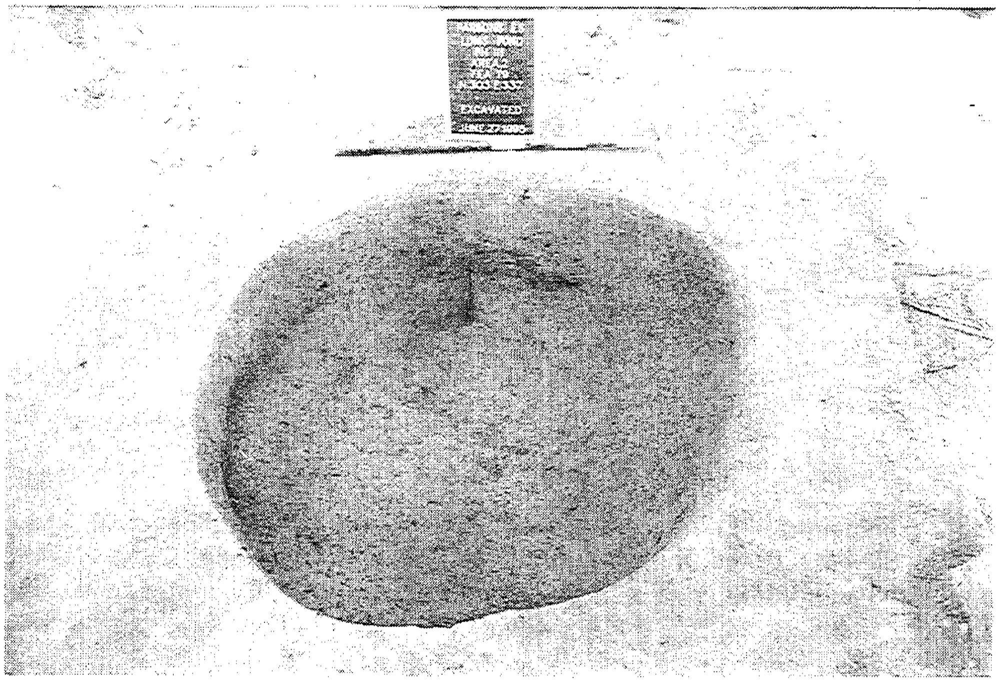

Plate 16. Feature 19, Fully Excavated

Feature 22

Location:
Area 2 / Block C
N 299/ E 337

Morphology:
Plan: sub-round
Section Profile: steep sided flat bottom

Dimensions:
Diameter: 110cm x 150cm
Depth: 55cm
Volume: 272.5 liters

Artifacts:
23 flakes
1 biface
932.5gm fire-cracked rock (mean 84.8gm)

Description: Feature 22 consisted of a wide pit with an irregular round opening, straight sides, and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill consisted of a relatively uniform yellowish brown sandy silt mottled with strong brown sand and small gravel, the latter being redeposited subsoil. There was no evidence of stratification. Flaking debris included ironstone, chert, Iron Hill jasper, jasper, and rhyolite, in frequency order. Charcoal was observed throughout the feature, and samples were collected from level proveniences. Radiocarbon and macrobotanical analyses were not undertaken.

Feature 23

Location:
Area 2 / Block C
N 300/ E 334.5

Morphology:
Plan: round
Section Profile: steep sided, flat bottom

Radiocarbon Assay:
2960±60 BP

Dimensions:
Diameter: 145cm
Depth: 55cm
Volume: 519.8 liters

Artifacts:
29 flakes
2 chips
6 ceramic fragments
1282.7gm fire-cracked rock (mean 45.8gm)

Macrobotanical Remains:
nutshell fragments (*Carya*)
charcoal (*Quercus*)

Description: Feature 23 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. The walls of the pit sloped somewhat near the surface, perhaps an indication that the pit lay open and only partially filled for some time after abandonment allowing the edges to erode somewhat. Feature fill consisted of a relatively uniform dark yellowish brown sandy silt. There was no evidence of stratification. Lithic raw material among the flaking debris included Iron Hill jasper, quartz, jasper, chert, ironstone, and argillite, in frequency order. Charcoal was observed throughout the feature, and samples were collected from level proveniences. The assay reported here was run on a dispersed sample.

Feature 24

Location:
Area 2 / Block C
N 299/ E 339.5

Morphology:
Plan: round
Section Profile: steep sided, flat bottom

Dimensions:
Diameter: 155cm
Depth: 43cm
Volume: 429.6 liters

Artifacts:
22 flakes
5 chips
1 ceramic fragment
1211.2gm fire-cracked rock (mean 75.7gm)

Description: Feature 24 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill was stratified. A central area approximately 55cm in diameter and 30cm deep consisted of brown fine silty sand. Surrounding this and extending to the base of the feature lay brown sandy silt. Lenses of yellowish brown silty sand lay at the sides of the pit sloping toward the base, suggesting a period of relatively slow infilling. Flaking debris included quartz, andesite, Iron Hill jasper rhyolite, quartzite, chert, and argillite, in frequency order. Charcoal flecking was observed throughout the feature, and samples were collected from level proveniences. Radiocarbon and macrobotanical analyses were not undertaken.

Feature 25 (Plate 17)

Location:
Area 2 / Block C
N 297/ E 339

Morphology:
Plan: round
Section Profile: steep sided
flat bottom

Dimensions:
Diameter: 140cm
Depth: 43cm
Volume: 357.9 liters

Artifacts:
8 flakes
3 chips
2 bifaces
1 core
137.9gm fire-cracked rock (mean 69.0gm)

Description: Feature 25 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill consisted of a relatively uniform yellowish brown sandy silt that showed no evidence of stratification. Lithic raw materials included in the flaking debris consisted of quartz, ironstone, Iron Hill jasper, chert, jasper, and slate, in order of frequency. Charcoal flecking was observed throughout the feature, and samples were collected from level proveniences. Radiocarbon and macrobotanical analyses were not undertaken.

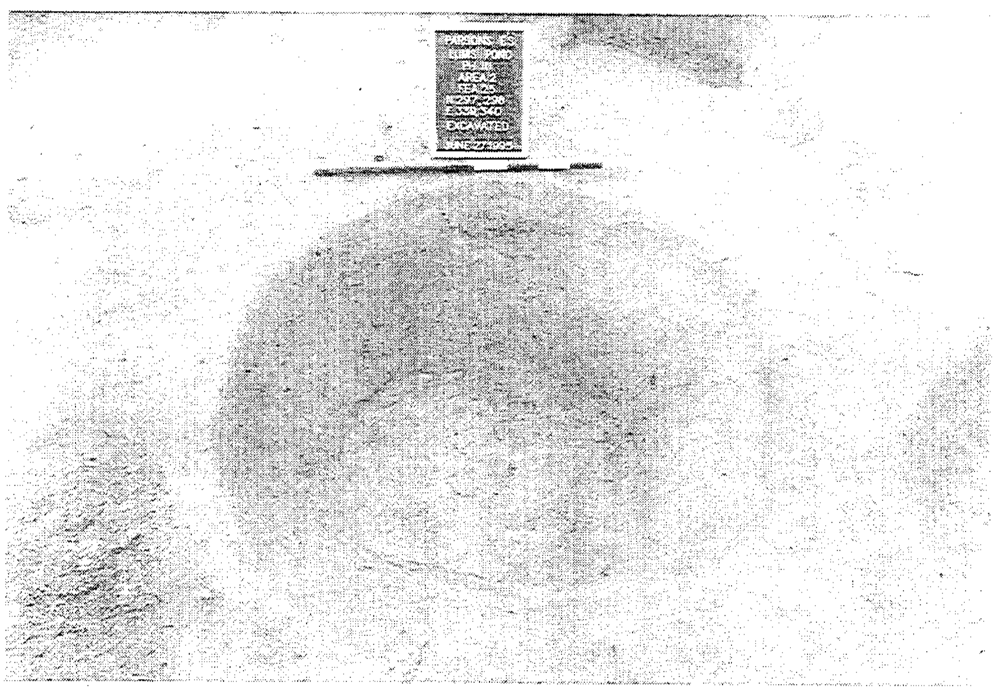

Plate 17. Feature 25, Fully Excavated

Feature 26

Location:
Area 2 / Block C
N 296.5/ E 340.5

Morphology:
Plan: sub-round
Section Profile: steep sided flat bottom

Dimensions:
Diameter: 140cm x 150cm
Depth: 50cm
Volume: 458.9 liters

Artifacts:
4 flakes
449.6gm fire-cracked rock (mean 74.9gm)

Description: Feature 26 consisted of a wide pit with straight sides and a flat base. The uppermost portion of the feature was truncated by the plow zone, and the base penetrated the coarse sandy C-horizon. Feature fill consisted of a relatively uniform yellowish brown sandy silt that showed no evidence of stratification, although an increase in small gravel with depth suggested extensive mixing with redeposited subsoil. Flaking debris consisted of quartz and jasper, in frequency order. Charcoal flecking was observed throughout the feature, and samples were collected from level proveniences. Radiocarbon and macrobotanical analyses were not undertaken.

Analysis of Pit Feature Cluster

Generally speaking, the pit features in the Area 2 cluster were large, with volumes ranging from 272.5 to 806.9 liters. Observations in the field suggested that the features in the southern part of the cluster were shallower than those to the north. It was theorized that erosion resulting from historic period land clearing and cultivation had lowered the ground surface on a southward tending slope, so that plowing would have disturbed some features more than others. This was an important question since the validity of size comparisons between the pits depended on whether the volumes seen archaeologically were proportional to the original volumes.

A series of analyses was conducted to investigate the issue. Feature volumes were plotted against north/south location, and it was found that pits with smaller volumes did generally lie farther to the south. The base and surface of each feature were then plotted against grid location, and it was evident that deeper features lay to the north. Surface elevations also tended to be higher to the north reflecting the general slope of the field in which the features lay. Of note was the difference in the slopes of the tops and bases of the features. A line representing the tops of the pits lay on a steeper slope than a line representing the bases, indicating that the features had been cut disproportionately by the plow zone. Comparative analyses between the pits based on volume alone were conducted with this finding in mind.

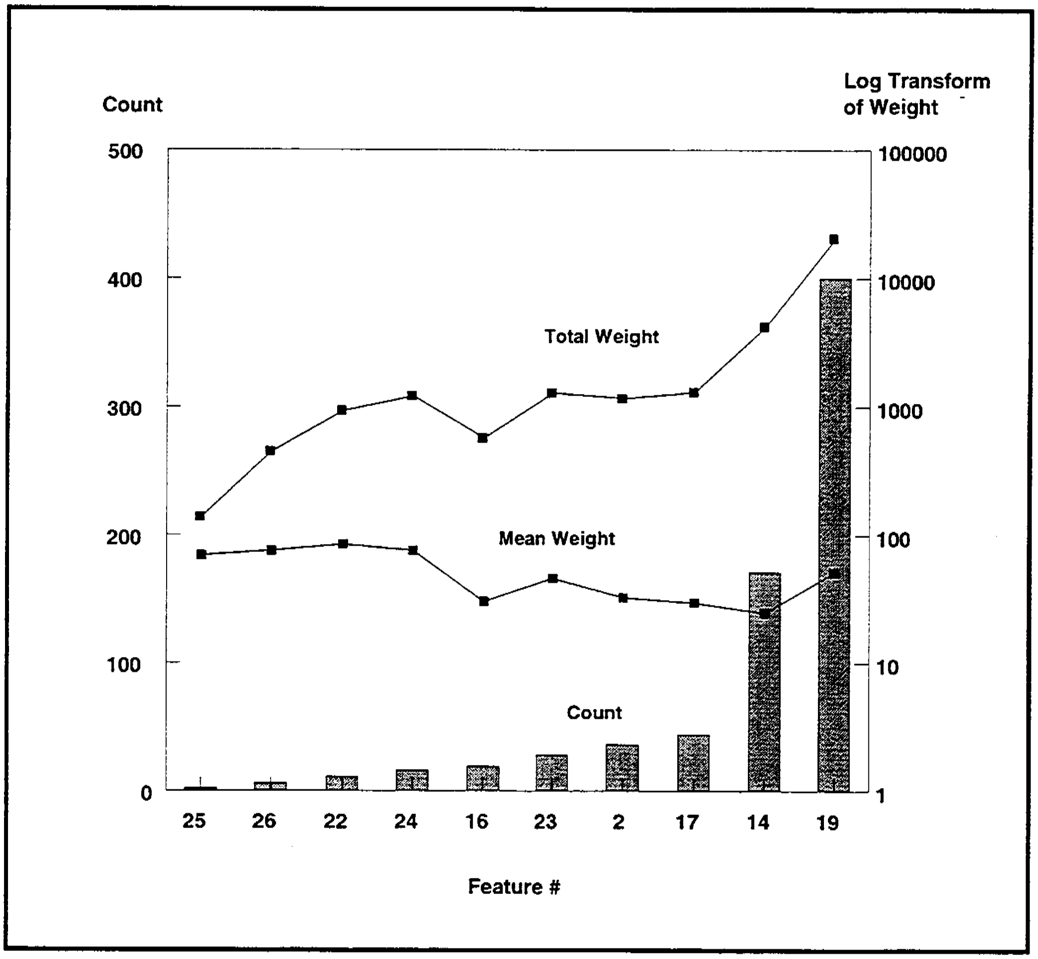

Figure 15. Comparison of Count, Weight and Mean Weight of Fire-Cracked Rock for Pit Features in Area 2 Cluster

Several artifact analyses were conducted to determine whether there were observable differences in the contents of the features that might indicate different functions. For example, concentrated amounts of fire-cracked rock in an archaeological site imply fire-related activity, and in a pit feature may indicate that the feature served as a hearth or cooking facility. The amount of fire-cracked rock in the features in the Area 2 cluster varied widely and bore no relationship to feature volume. Both the number of fragments and total weight of the fragments were analyzed. Overall the amount of fire-cracked rock was comparatively low. Yet features with the highest fire-cracked rock fragment counts had the highest weight figures as well, as indicated in Figure 15 where the bars denote fragment count and the top line denotes total weight per feature. This suggested that the size range of the pieces was generally similar throughout the features. The calculation of mean weight per feature, the lower line on the chart, suggested a slight tendency for fire-cracked rock in features with high counts to be small, and thus presumably highly fragmented.

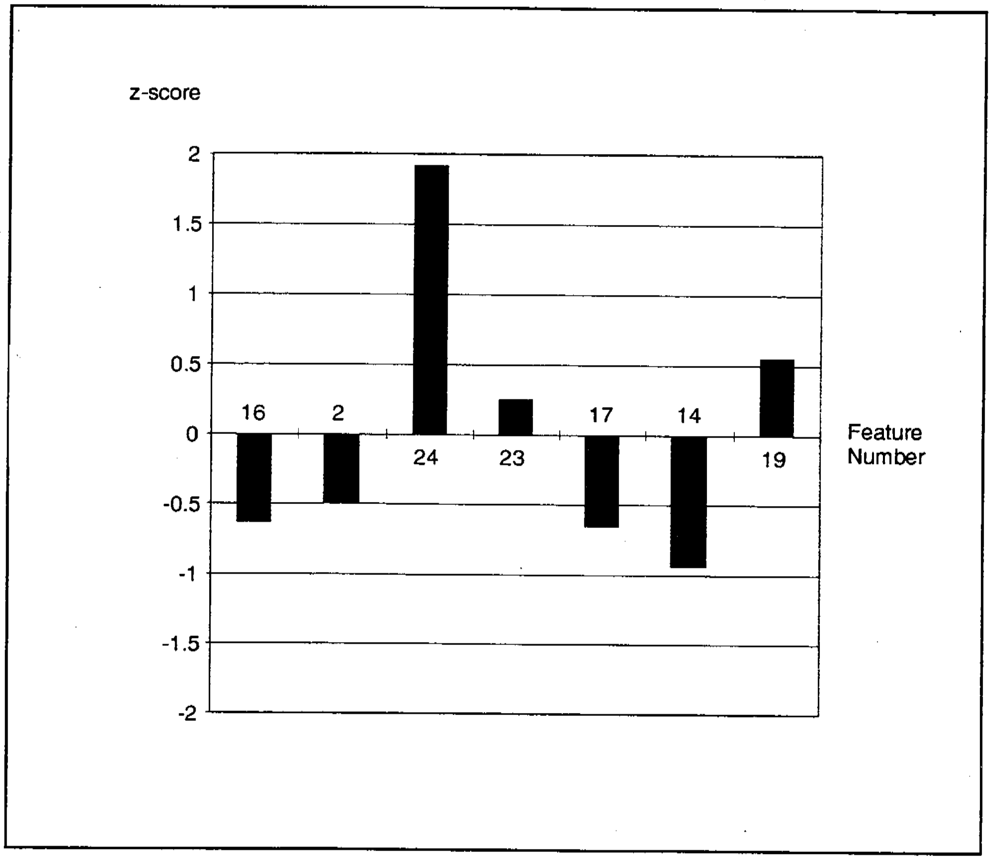

Figure 16. Mean Fire-Cracked Rock Weight Variation in Area 2 Feature Cluster

A second analysis focused on the mean weight of fire-cracked rock in each feature, charting the variation based on the average weight across all of the features. A pattern of variation observed in the data might indicate functional differences between the pits. The results of the analysis are shown in Figure 16. The length of each bar represents how different each feature was from the typical fire-cracked rock size at the site. A positive bar indicates larger fragments than was typical, a negative bar indicates smaller fragments. Only features with 15 or more fragments were used in the calculations to avoid bias from small samples. The data suggested that none of the features was particularly far from average. The feature displaying the greatest variation was Feature 24, with a high mean weight measurement. Notably, this was the smallest sample size among the features analyzed (n=16), and among the fragments from the feature were two weighing around 200 gm each, driving up the mean fragment weight for the feature. In general, though, each of the features contained fire-cracked rock fragments of similar size based on a calculated mean. The implication was that the fills were similar in origin, suggesting secondary cultural deposition.

In most features, stone material types were similar, implying little difference in the way that the features had filled in. Typically 30 and 50 percent of the artifacts in the pit fill were quartz. Several features contained material in different proportions. Feature 22, for example, contained almost 60 percent ironstone and no quartz, Feature 23 contained 40 percent Iron Hill jasper and 20 percent quartz. Yet overall, the variation among the pits was not substantial.

Heating or burning of some of the stone types at the site—specifically Iron Hill jasper, jasper, or chert—could be identified through changes in color (red or gray) or surface texture (potlids). Using these materials and attributes as indicators, the amount of burned flakes in the pits was tabulated, and relatively little variation was observed between the features. In addition, there was no correlation between the amount of fire-cracked rock and burned flakes in the feature fill. For example, in Feature 19, with the largest fire-cracked rock frequency, 24 percent of the jasper or chert flakes were burned, while in Feature 16, with a considerably lower fire-cracked rock frequency, 25 percent were burned. The data suggested little difference in feature contents in terms of artifact burning.

Seed and nutshell remains were recovered from flotation samples taken from several of the features. A variety of factors, including soil acidity and bacterial growth, render the preservation of uncharred plant material unlikely in most archaeological contexts. Uncharred material, including seeds of *Portulaca* (purslane) and *Polanisia* (clammy weed), was in fact recovered from the feature samples, and they were assumed to have been modern in origin. No charred seeds were recovered from the pits. In contrast, two varieties of charred nutshell were identified in the samples: hickory and oak. The same wood types were represented in charcoal from the features. Figure 17 shows the results of an analysis of the proportion of features containing each material.

The absence of seed remains and the relatively low frequency of nutshell supported artifact analyses that indicated that feature fill was unpatterned and probably not primary. Yet the finding did provide indirect evidence of feature function, when combined with the relative lack of fire-cracked rock or burned flakes in the features. The absence of these materials suggested that most of the features, with the exception of the shallow basin, Feature 14, had not been used for activities directly associated with roasting or cooking of foodstuffs which would have left behind relatively large amounts of charred debris.

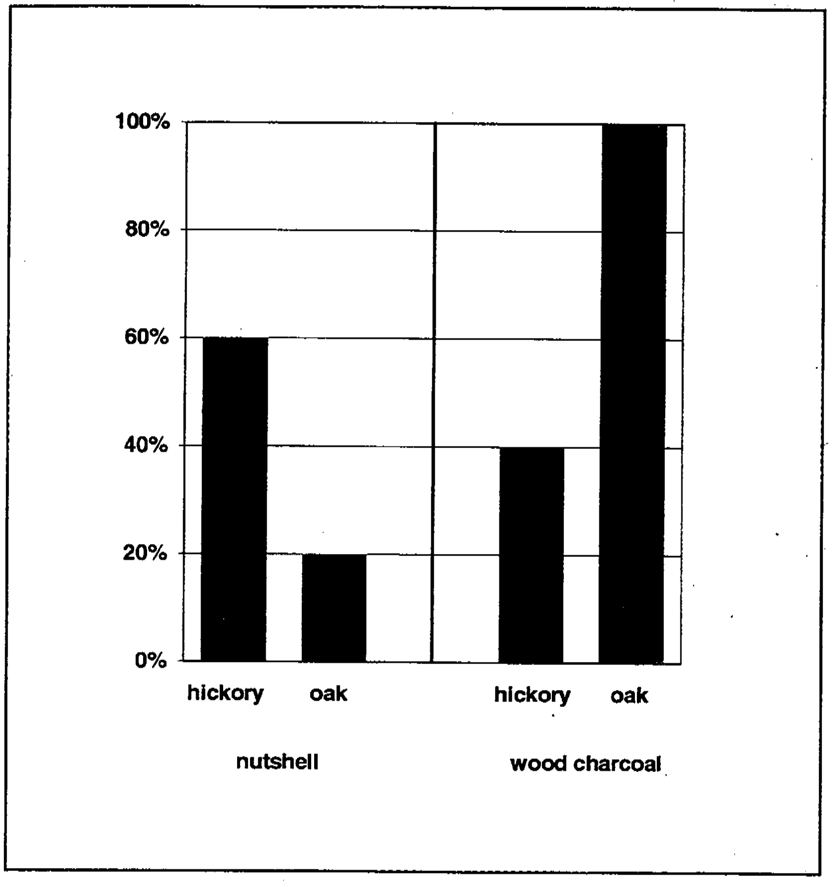

Figure 17. Frequency of Nutshell and Wood Charcoal in Area 2 Feature Cluster

Five pits from the feature cluster were radiocarbon dated. The dates ranged from 2660±100 BP to 2960±60 BP, and were similar enough to suggest that the pits might have been contemporary. Several analyses were conducted to examine the validity of this supposition (see the Radiocarbon section above), and on the basis of these studies it was proposed that the excavation and infilling of the features were indeed part of a single episode of site use. Moreover, the remaining features in the cluster were assumed to have been from the same period because they lay in the same cluster, they generally did not overlap physically, they were of similar shape, and as seen in the preceding paragraphs, they bore the same general contents. An average date was calculated for the feature cluster as 2802±33 BP.

Geochemical analysis of feature fill provided both chronological and functional information. Phosphate signatures from the pits were read as a relative dating tool. Similarities between the readings suggested that the pits were contemporary, supporting the results of radiocarbon analysis. Geochemical similarities also argued that pit fill was comparatively uniform and probably not primary. The geochemical data did not conform to patterns known to result from extensive occupational activity, implying short term or even single episode site use.

Summary

Most of the pits in the cluster in Area 2 were roughly silo-shaped, straight-sided and relatively deep in relation to their surface opening. All had been excavated into the coarse sandy subsoil layer, the C-horizon. Their most likely function was long-term storage, with drainage a premium quality in their construction. Most of the features appeared to have been filled in with debris from the site after their original use. While none of the features preserved large amounts of organic material, there was wood charcoal present and occasionally, charred macrobotanical remains. Few artifacts were recovered from the pits. Two pits, Features 17 and 23, had slightly sloping walls near the surface, suggesting that they had been only partially filled for a period of time after abandonment, allowing the edges to erode somewhat. Feature 23 was also partially stratified as an indication of slower infilling.

Based on shape, all but Feature 14 served the same original purpose. Feature 14 was shallower than the other features in the cluster, was basin-shaped, and contained more concentrations of charcoal and fire-cracked rock than most of the straight-sided pits. Based on its shape and contents, it likely served as a hearth or roasting pit. Feature 19 was straight-sided, but differed in its contents, with more charcoal and higher artifact counts, especially fire-cracked rock, than the surrounding pits. While the shape of the feature suggested a similar primary function as the other silo-shaped pits, its contents implied that it had eventually been filled in deliberately with a different form of refuse.

The final feature in Area 2, Feature 10, lay some distance away from the cluster of round pit features. It was a different type altogether, dissimilar in shape, size, and content. Radiocarbon and geochemical analyses indicated that it dated to a different time period. Geochemistry also implied a natural origin for the pit, as well as long-term infilling, and disturbance throughout.

Stone Artifacts

As is typical of prehistoric archaeological sites in northern Delaware and elsewhere in the Middle Atlantic, the majority of the artifactual material recovered from the Lums Pond site consisted of chipped stone. A number of tool forms and flaking debris were recovered. Formal definitions of the artifact types used in the text are contained in a glossary at the end of the report. As part of the artifact analysis, studies of artifact style and shape, as well as manufacturing technology, were conducted to allow comparison between artifact assemblages from different parts of the site and assemblages from other, regional sites. Classification of projectile points as an aid in dating site occupations was conducted using as references several of the standard typological studies for the Middle Atlantic and Northeast (e.g., Ritchie 1971; Broyles 1971; Kinsey 1972), along with recent research focused on the Delaware region (Custer 1989, 1994, 1996).

After flaking debris, the most common artifacts recovered at the site were bifaces. As a class, bifaces were subdivided into two categories, *early stage* and *late stage*. This classification was made on the basis of a combination of attributes which describe the level of completion of the artifact. Early stage bifaces result from the initial efforts at producing a working edge on a cobble, pebble, or flake blank. Typically, early stage bifaces exhibit random flaking that was produced by hard-hammer percussion and appears as wide and deep flake scars. The bifaces are usually relatively thick in cross-section and often bear patches of remnant cortex. In contrast, late stage bifaces are typically thinner than early stage bifaces and exhibit a greater degree of shaping and straighter edges in profile. The work indicates more designed and patterned flaking, and as the name suggests, a more finished look. A distinction was also made in the analysis between manufacturing rejects and discards. This distinction was based on the observation of a range of characteristics which suggest at what point in the cycle of manufacture and use a biface is deposited as part of the archaeological site. It may have been broken and rejected during manufacture, or the artisan may have been unable to overcome flaws in the stone or to recover from manufacturing errors, and so rejected the piece before completion. Bifaces that appeared to have been finished tools were assumed to have been discarded after breakage or when exhausted through use and resharpening.

In addition to flakes, the detailed analysis of which is discussed below, a second category of debitage or flaking debris was recognized, chips. Chips are debris that do not bear the specific attributes of stone knapping such as a striking platform, bulb of percussion, or distinctive dorsal and ventral surfaces. The frequency of chips at a site may have implications for several aspects of stone tool production, including the manufacturing techniques in use or the flaking tools used. A subset of chips were referred in the analysis as potlids, fragments of stone spalled from an artifact or pebble by heat. All of the potlids identified at the site were from cryptocrystalline material, such as chert or jasper. Heated or baked stone was often considered easier to flake, and indeed, the deliberate heat treatment of stone during tool manufacture was observed in many of the artifact assemblages from the site. While some of the potlids may have resulted from the accidental burning of artifacts. Yet their occurrence was systematic enough to suggest that most resulted from intentional heating, and thus they were included in the chipped stone artifact totals.

Flake Analysis

Analysis of flaking debris was conducted for insights into the manufacturing processes involved in the production and use of stone tools at the site. The analysis was performed simultaneously on two levels, one a detailed study of a series of attributes on a flake-by-flake basis, the other characterizing the debris in groups based on relative size.

Most archaeological studies of flaking debris document the physical and technological attributes of individual flakes. They record a sometimes exhaustive variety of information about the shapes of flakes and the residual marks on their surfaces. Previous studies have cited more than 30 different attributes deemed to be pertinent to the proper interpretation of stone tool flaking. In a recent survey of these studies, Michael Shott (1994) culled the lists evaluating the attributes for reliability and redundancy. The attributes documented on the Lums Pond flake debris were chosen using Shott's findings as a basis. Because the existing database for sites in northern Delaware has been developed largely by researchers at the University of Delaware, several additional characteristics used by that group were recorded for the sake of comparability between site assemblages. The following general flake attributes were recorded during the cataloging of artifacts from the site:

- *weight*—as an indicator of overall size
- *size grade*—an additional measure of size, recording maximum linear dimension on an interval scale
- *remnant cortex*—recording the amount of the original material remaining from the outer surface of the cobble or pebble
- *segment*—recording whether the flake is whole or broken
- *dorsal scar complexity*—documenting both the number and intricacy of flake scarring on the back of each flake, indicating the amount of previous flaking

- *platform data*—including the type of platform and implying the form of percussion and to some extent the intended artifact; the platform angle was recorded as a potential indicator of the shape of the nodule from which the flake was detached
- *raw material*— recorded as a sign of assemblage variability

A second form of analysis is referred to as mass analysis, which describes the characteristics of groups of flakes rather than individual flakes. Mass analysis depends largely on size graded data, classifying or grading flakes according to established size intervals. The analysis relies on several intuitive concepts associated with stone tool manufacture. The primary notion is that the process is one of subtraction, in which flakes are systematically removed from what is initially a large piece of stone to produce a desired form. In the process, both the tool and the flakes chipped from it become progressively smaller. In analyzing the flaking debris that resulted from this procedure, several simple count and weight measurements are made for each graded sample, along with relative counts within and between grades. Weight variation within a size-grade, for example, becomes a measure of artifact shape—heavy flakes within a size-grade will tend to be thicker than light ones in the same grade. The data may then be used to make inferences as to the manufacturing techniques represented—thin flakes are characteristic of the finishing of a fine biface, while thicker flakes were typically removed from a blocky core. In addition to weight, the frequency of remnant cortex is recorded within each size-grade. This information is recorded on the assumption that along with a reduction in flake size, there should be an observable progression in the removal of cortex as the reduction process continues.

Because mass analysis treats groups of flakes rather than individual artifacts, it is a more efficient analytical procedure, avoiding the tedious and labor-intensive process of measuring each individual piece. It does not allow the researcher to determine the origin of a particular flake, but by describing the characteristics of a group of flakes permits interpretations about the range of technological activity represented in the assemblage.

Projectile Point Typology

In dating an archaeological site—placing it in time—researchers have several important tools at their disposal. Laboratory techniques such as radiocarbon analysis provide specific dates based on the chemical properties of organic material. A more widely used means of dating site occupation is the identification of distinctively styled artifacts with dates associations known from other contexts. The most commonly used artifact is the projectile point. Research suggests that while projectile point styles changed with time, they did tend to be stable over relatively long periods and wide geographic ranges. Comparatively late in prehistory ceramics were manufactured and used, and they can serve the researcher as similar chronological markers.

Unfortunately, a large proportion of the projectile points recovered in northern Delaware and throughout the region cannot be confidently or consistently placed into accepted stylistic categories. Indeed, agreement on the categories is far from unanimous among researchers. Moreover, many of the point styles which are agreed on are not associated with well-dated deposits. One of the specific issues in the analysis of Delaware regional chronology is the apparent proliferation of point types near the start of the Woodland I period. Jay Custer (1989, 1994), at the University of Delaware, has begun an effort to reclassify certain point varieties recovered in Delmarva, utlizing an approach developed by Barry Kent. Dropping many of the traditional type names, he adopts an alphabetical labeling that recognizes four main point types:

Type I	side-notched
Type D	stemmed
Type E	stemmed
Type B	contracting stem, also associated with broadspears

Custer studied the occurrence of these points at a number of sites with well-dated contexts in the Middle Atlantic region and developed a relative sequence or seriation, which resulted in the sub-division of the Clyde Farm/Barker's Landing complexes of northern Delaware into three subperiods: Clyde Farm I 3000-2000 BC, Clyde Farm II 2000-1200 BC, Clyde Farm III 1200-500 BC.

This analysis is a worthy attempt at sorting out a complex chronological problem, reassessing existing databases using site specific contextual data rather than relying solely on artifact shape or style. One aim of the Lums Pond study was to assess the proposed typology by examining the temporal contexts of projectile point styles recovered from the site. Based on data retrieved from preliminary work at the site, good chronological information was expected in the form of: 1) projectile points and ceramics for intrasite seriation and comparative analysis with regionally specific sequences; 2) charcoal expected from a variety of feature and intact stratigraphic contexts allowing absolute dating of depositional sequences; and, 3) depositional association of diagnostic artifacts and radiometric data. Previous work suggested that the major occupations at Lums Pond occurred during the Woodland I period, which is the core of the problem time period as identified by Custer.

Area 1

The total count of prehistoric artifacts recovered from Area 1 was 1199, of which approximately 88 percent consisted of chipped stone debris, the remainder being fire-cracked rock fragments and a single sherd of prehistoric ceramic. Artifacts recovered from the excavation block in Area 1 were considered to be a discrete assemblage, and detailed analysis of artifact attributes within that assemblage was conducted. The total count of artifacts from the block was 901. Tables 6 and 7 display artifact type frequencies and lithic raw material frequencies for the block assemblage. Over 90 percent of the material consisted of chipped stone, and of that amount more than 60 percent consisted of Iron Hill jasper debitage.

Artifact Type	Count	Frequency(%)
Flakes	700	77.4
Fire-Cracked Rock	82	9.1
Chips (Potlids)	98	10.8
Early Stage Bifaces	8	0.9
Late Stage Bifaces	7	0.8
Points	5	0.6
Cores	3	0.3
Unifaces	1	0.1
Total	901	

Table 6. Artifact Frequencies, Area 1 Excavation Block

Raw Material	Count	Frequency(%)
Iron Hill Jasper	522	63.5
Quartz	168	20.4
Jasper	60	7.3
Chert	30	3.6
Quartzite	23	2.8
Argillite	10	1.2
Andesite	6	0.7
Chalcedony	2	0.2
Rhyolite	1	0.1
Total	822	

Table 7. Chipped Stone Raw Material Frequencies, Area 1 Excavation Block

Projectile Points

Six projectile points or point fragments were recovered from Area 1. Four complete points or typable fragments are illustrated in Figure 18. Two of the artifacts were made from Iron Hill jasper, one whole point (1019-1) and one snapped midway along the blade (1096-1). Both were straight-stemmed, narrow-bladed points with rounded bases. While neither point fit well into Woodland I stylistic types, they were similar to two from the series, Types E and B. The round based stems on the Lums Pond points were characteristic of either the traditional Poplar Island or Bare Island types, or descriptions of some varieties referred to as Lackawaxen stemmed. Thus while the points were not classic examples of accepted styles, they appeared to be related to several narrow-bladed, stemmed varieties from the early part of the Woodland I period.

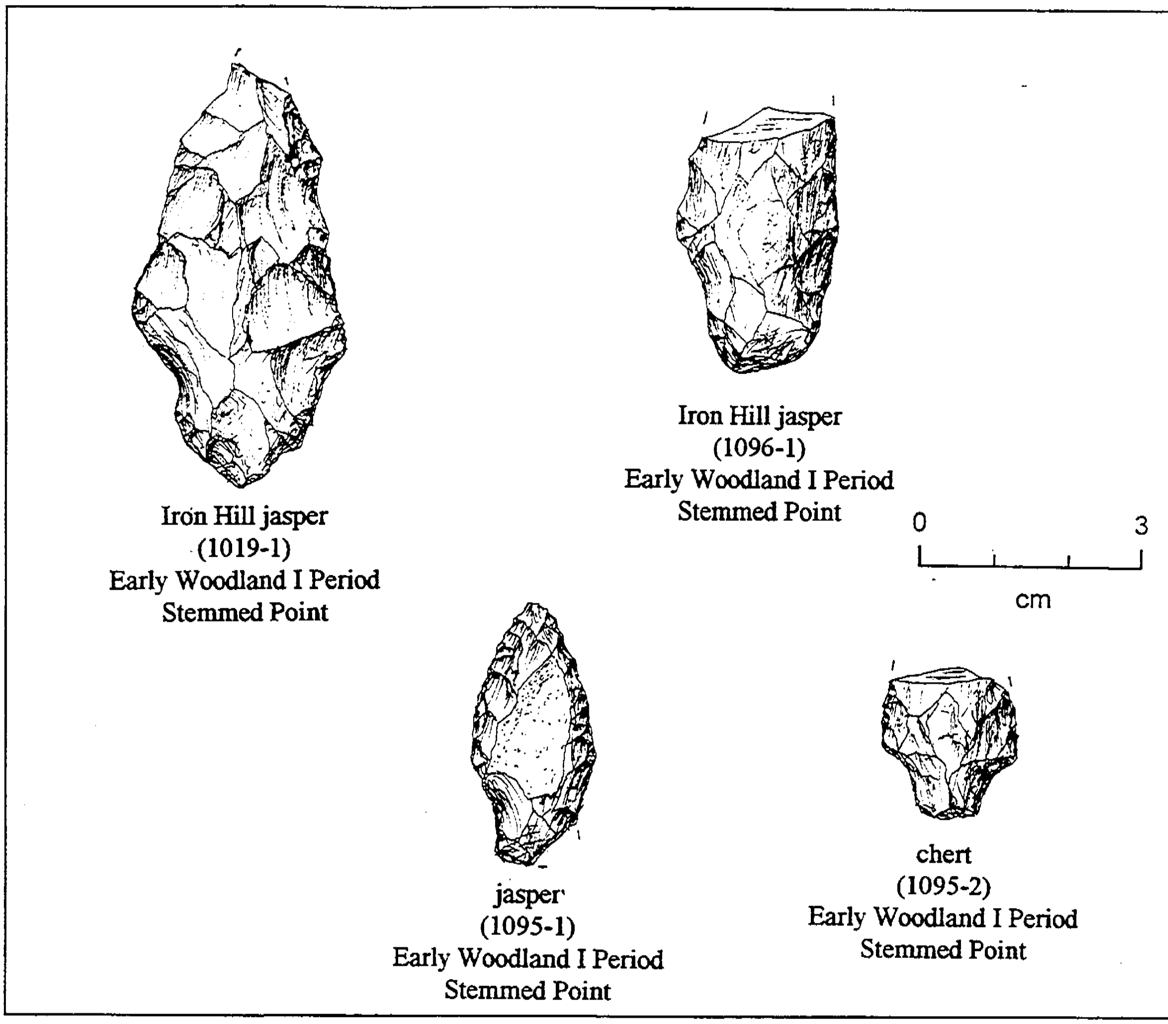

Figure 18. Projectile Points Recovered From Area 1 Excavation Block

Bifaces

Fifteen bifaces were recovered from the block excavation in Area 1, eight classed as early stage and seven as late stage. Width:thickness ratios—how thin an artifact is in relation to its width—is often recorded as an indicator of the degree to which an artifact was finished. The ratios for bifaces from Area 1 were similar across both early and late stage varieties. The average for the early stage bifaces was 2.5 (with a range of 1.8-3.3), and for late stage bifaces 2.45 (with a range was 1.6-4.4) (in both cases the measurable sample was 5). The lack of distinctiveness in the thinness of the bifaces probably indicated that they were manufacturing rejects, discarded because they could not be thinned and shaped any further (Plate 18).

Analysis of stone material types among bifaces indicated that all but one of the early stage bifaces were of quartz. The majority of late stage bifaces were of Iron Hill jasper, although quartz and chert were represented (Figure 19; Plate 19). The proportion of late stage bifaces manufactured from Iron Hill jasper was almost identical to that of projectile points. This indicated that Iron Hill jasper was brought to the site in a relatively finished state and that little preliminary knapping of the material was carried out, while finished tools were removed from the workshop area. Quartz may have been reduced for flake tools, implying that the early stage bifaces were actually flake cores. Confirmation of these explanations was sought from analysis of the character of the flaking debris recovered from the excavation block.

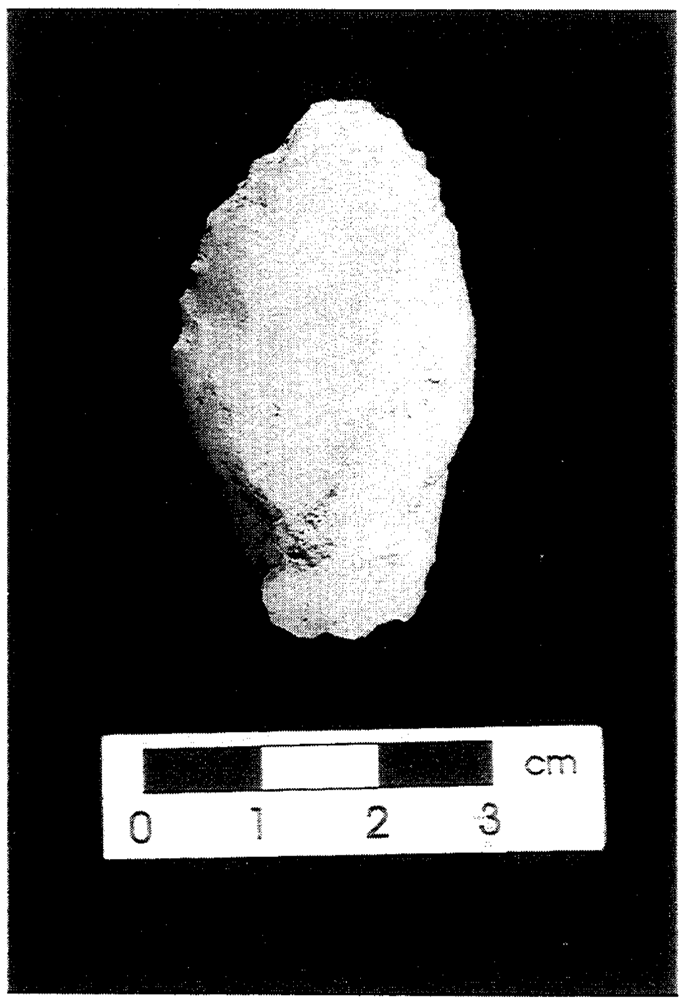

Plate 18. Early Stage Biface From Area 1 Manufactured from Quartz

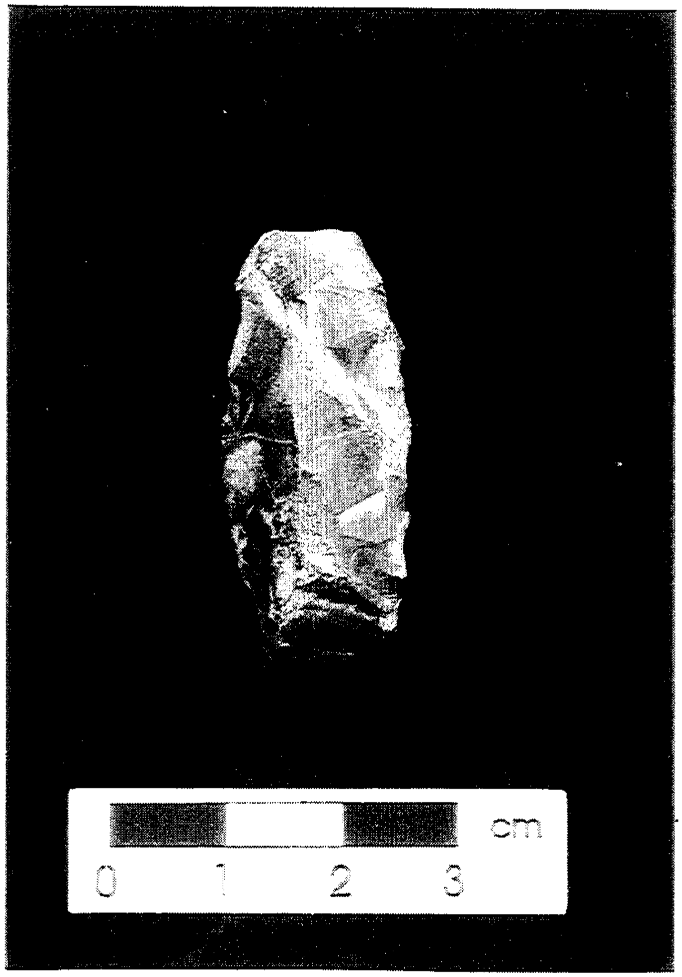

Plate 19. Late Stage Biface From Area 1 Manufactured from Chert

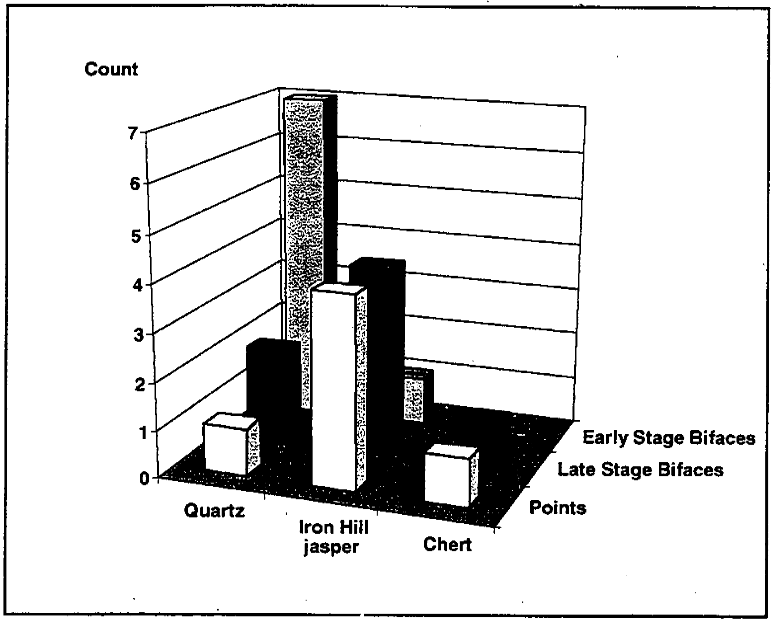

Figure 19. Raw Material Frequencies Among Bifacially Worked Artifacts, Area 1

Flakes

Flakes were well-represented in Area 1 assemblage, consisting of 77% of the artifacts (Plate 20). Iron Hill jasper comprised the majority of the flake assemblage from the Area 1 block, 70 percent (n=487), while quartz represented 19 percent of the debris (n=129). An additional category, referred to informally as pebble material, resulted from observations of flake-size and the presence of remnant cortex, which together suggested that most of the quartz, quartzite, chert, and non-local jasper (i.e., jasper not derived from Iron Hill) had originated as pebbles or small cobbles. On the assumption that reduction technologies would differ between outcrop jasper and pebble-based materials obtained from area stream beds, quartz, quartzite, chert, and pebble jasper were combined into a single analytical unit, representing 28 percent of the chipped stone (n=194).

A series of analyses was conducted on the flake categories testing for variations in the attributes discussed earlier that might indicate differences in manufacturing technologies. Cortical frequency and flake-size distribution data suggested that quartz and materials such as chert and some of the jaspers from Area 1 did indeed originate from pebbles and were less often associated with biface manufacture. Remnant cortex was less frequent on Iron Hill jasper flakes than on quartz or chert flakes. This finding was clearly related to the initial form of the material, since little or no cortex was expected among flakes from outcrop stone such as Iron Hill jasper, while higher frequencies of cortical flakes would be expected from pebble material. Mean flake weights calculated for each

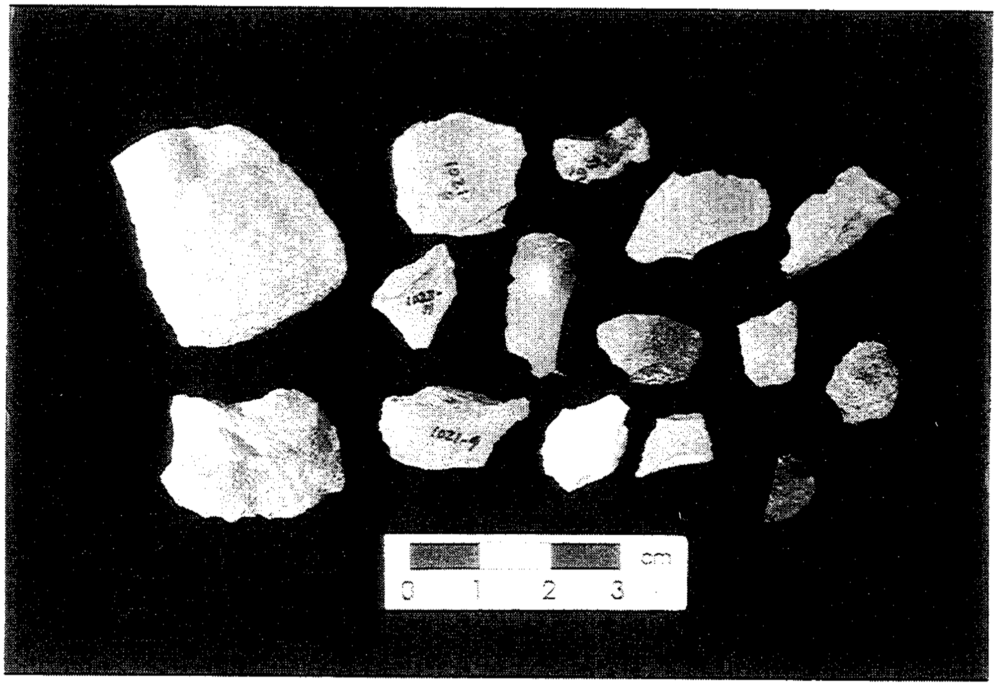

Plate 20. Sample of Flakes Recovered from Area 1

size grade implied that Iron Hill jasper flakes were on average lighter, and so were somewhat thinner than other flakes (Table 8). Flake platform characteristics indicated that more complex platform types occurred among Iron Hill jasper, including more with remnant bifacial edges. Crushed platforms, which are a common result of hard-hammer percussion in the initial stages of reduction or of bipolar reduction, were more frequent on quartz and chert. In addition, dorsal flake scar patterning was generally more complex on the Iron Hill jasper flakes. In all, these flake analysis implied that most of the Iron Hill jasper flakes in the Area 1 assemblage resulted from biface manufacturing while the quartz, chert, and other jasper occurred in pebble form and were generally used in a core/flake technology.

Size Grade	IH jasper	Quartz	Pebble
1	16.8	n/a	n/a
1.5	8.5	15.2	10.2
2	3.5	6.3	4.8
3	0.7	0.8	0.8
4	0.2	0.2	0.2
grades 1-3	2.0	2.4	2.1

Table 8. Mean Flake Weight (gm) per Size Grade, Area 1

In a comparison of the Iron Hill jasper assemblage from Lums Pond with jasper from two other Woodland I period sites, Brennan (Watson and Riley 1994) and Paradise Lane (Riley et al. 1994), variations were noted in flake attributes that suggested differences in knapping activities. The Lums Pond assemblage contained more small and broken flakes, as well as more flakes with greater dorsal flake scar complexity and remnant bifacial platforms. These findings supported an inference that the Lums Pond assemblage resulted from a later biface reduction sequence than did material from the either of the two comparison sites.

Area 2

The total number of prehistoric artifacts recovered from Area 2 was 5245, approximately 53 percent of which consisted of chipped stone debris, the remainder being fire-cracked rock fragments, hammerstones and anvil-stones, and fragments of prehistoric ceramic. Area-wide frequencies are listed in Table 9, and lithic material frequencies are detailed in Table 10. Detailed analysis of flake attributes was not undertaken for the general run of artifacts from Area 2 since the multicomponent nature of the collective material made separation of individual chronological assemblages impractical.

Artifact Type	Count	Frequency(%)
Fire-Cracked Rock	2440	46.5
Flakes	2292	43.7
Chips (Potlids)	309	7.5
Points	34	0.6
Bifaces	31	0.6
Ceramic Fragments	25	0.5
Cores	13	0.2
Unifaces	11	0.2
Hammerstones	6	0.1
Anvilstones	2	0.1
Total	5245	

Table 9. Artifact Frequencies, Area 2

Raw Material	Count	Frequency(%)
Quartz	1058	38.0
Iron Hill jasper	643	23.1
Chert	358	12.9
Jasper	229	8.3
Ironstone	158	5.7
Quartzite	186	6.7
Argillite	81	2.9
Chalcedony	35	1.2
Rhyolite	24	0.9
Andesite	7	0.3
Slate	1	<0.1
Total	2780	

Table 10. Chipped Stone Raw Material Frequencies, Area 2

Projectile Points

Forty-one projectile points or point fragments were recovered from Area 2. Typologically identifiable points were attributable to several portions of the Woodland I period, with the highest frequencies related to the Woodland I Clyde Farm complex

(Figure 20). Several long-bladed point fragments not assignable to a specific stylistic type have been included with the Woodland I material.

Selected diagnostic points from Area 2 are illustrated in Figures 21-23. Long and narrow-bladed, stemmed points manufactured of argillite, quartzite, ironstone, or quartz were the most frequently recovered types. Several bore snapped blades and at least two (2202-1 and 2395-1) had been resharpened for additional use. Narrow-bladed, stemmed points appeared to represent a major occupation at the site. Similar points are known regionally as Lackawaxen, Poplar Island, and Bare Island. All three are types originally defined in eastern Pennsylvania, in the Delaware and lower Susquehanna valleys. Their distributions outside of those regions are variable. They display a variety of stem and base configurations. The ambiguity inherent in their morphology is one of the factors that led to Custer's reconsideration of Woodland I period projectile point typology and chronology. He notes that few of these point types have good contextual data associated with them. Radiocarbon dates assigned to similar points span a nearly two-thousand year range from 4560 BP to 2650 BP. Also frequent across Area 2 were smaller, Teardrop points which have been reported with a similar date range.

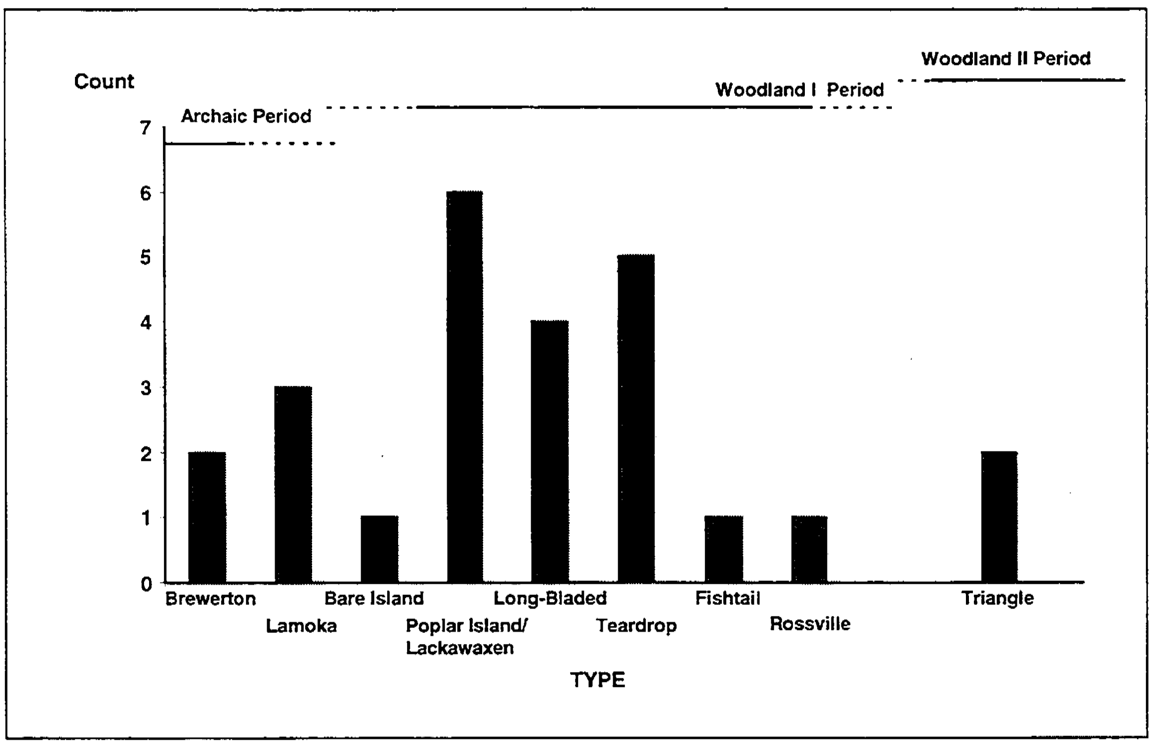

Figure 20. Counts of Chronologically Diagnostic Projectile Points from Area 2

More than one-half of the points were complete. The ratio of rejects to discards was examined as an indication of the extent of on-site manufacturing versus tool use and loss or abandonment. Nine points were identified as manufacturing rejects, in contrast to 20 discards (the remainder were too fragmentary for a judgment to be made). Most bore evidence commonly associated with use as cutting tools—asymmetrically resharpened blade edges indicating maintenance of a single, long cutting edge; or oblique or bending snap breaks typical of heavy force applied in a bending or prying motion. Only two specimens bore evidence that may have been associated with use as a projectile—an impact fracture at the tip of a small, quartz triangle (2063-1), and an extensive snap across the neck and shoulders of a corner-notched fragment made from quartz (2123-2). The evidence implied that most of the points had in fact been used in knife-like functions, not as projectile tips. Furthermore, most appeared to have been finished tools that were discarded or lost as a result of use, indicating little evidence of large-scale manufacture.

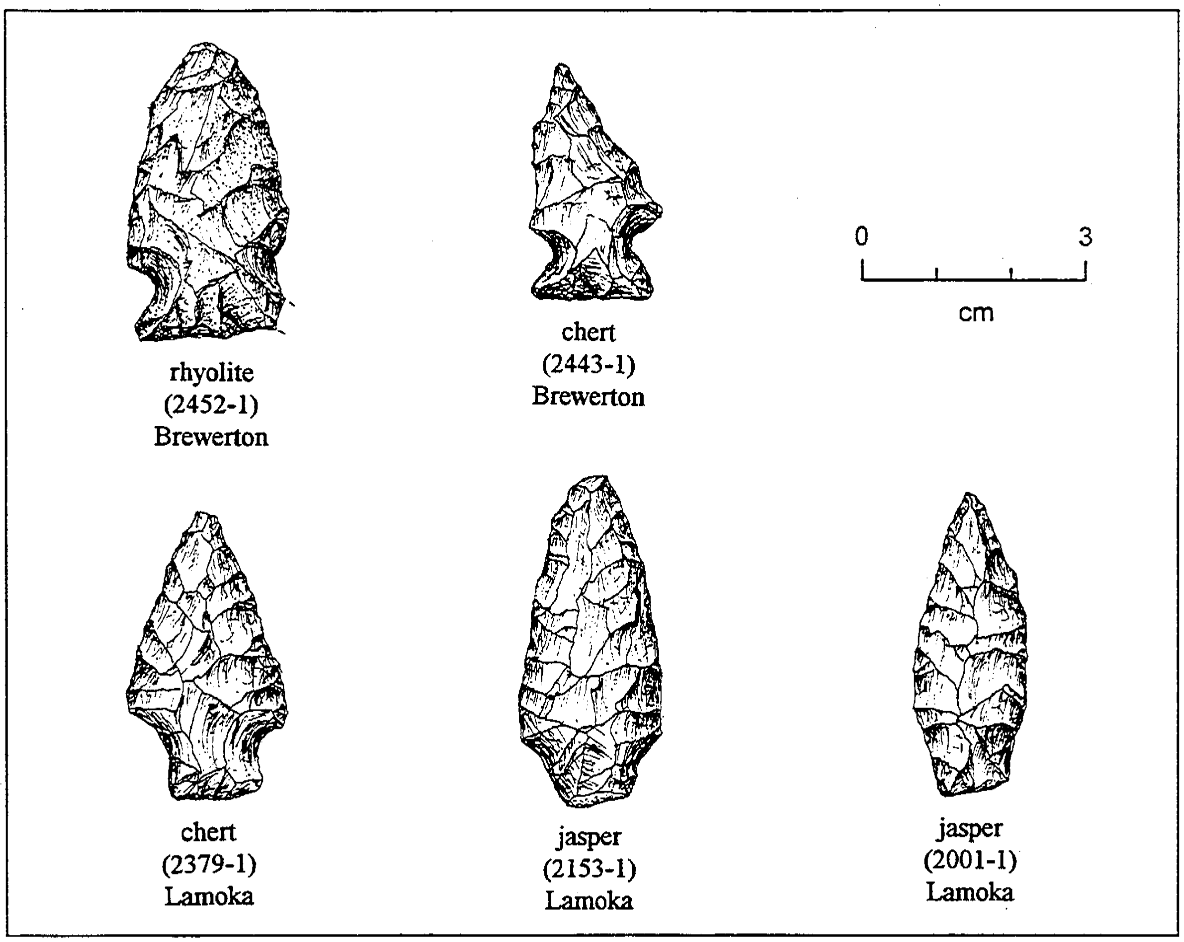

Figure 21. Notched and Stemmed Points from Area 2

Raw material frequencies among the points differed from those of the flaking debris across Area 2, the main variation coming in the proportions of the majority lithic types, quartz and Iron Hill jasper (Table 11). Quartz comprised the highest proportion of the debitage but a smaller proportion of the points, while the reverse was true for Iron Hill jasper. These data reflect area-wide frequencies, and do not take account of the various temporal components represented. Nonetheless, they demonstrate a technological pattern cross-cutting chronology in which a particular stone type, the locally obtained outcrop jasper, was used more frequently for projectile point production that crystalline quartz. The remainder of the material types were minority raw materials and were present in roughly the same ratio of points-to-debitage.

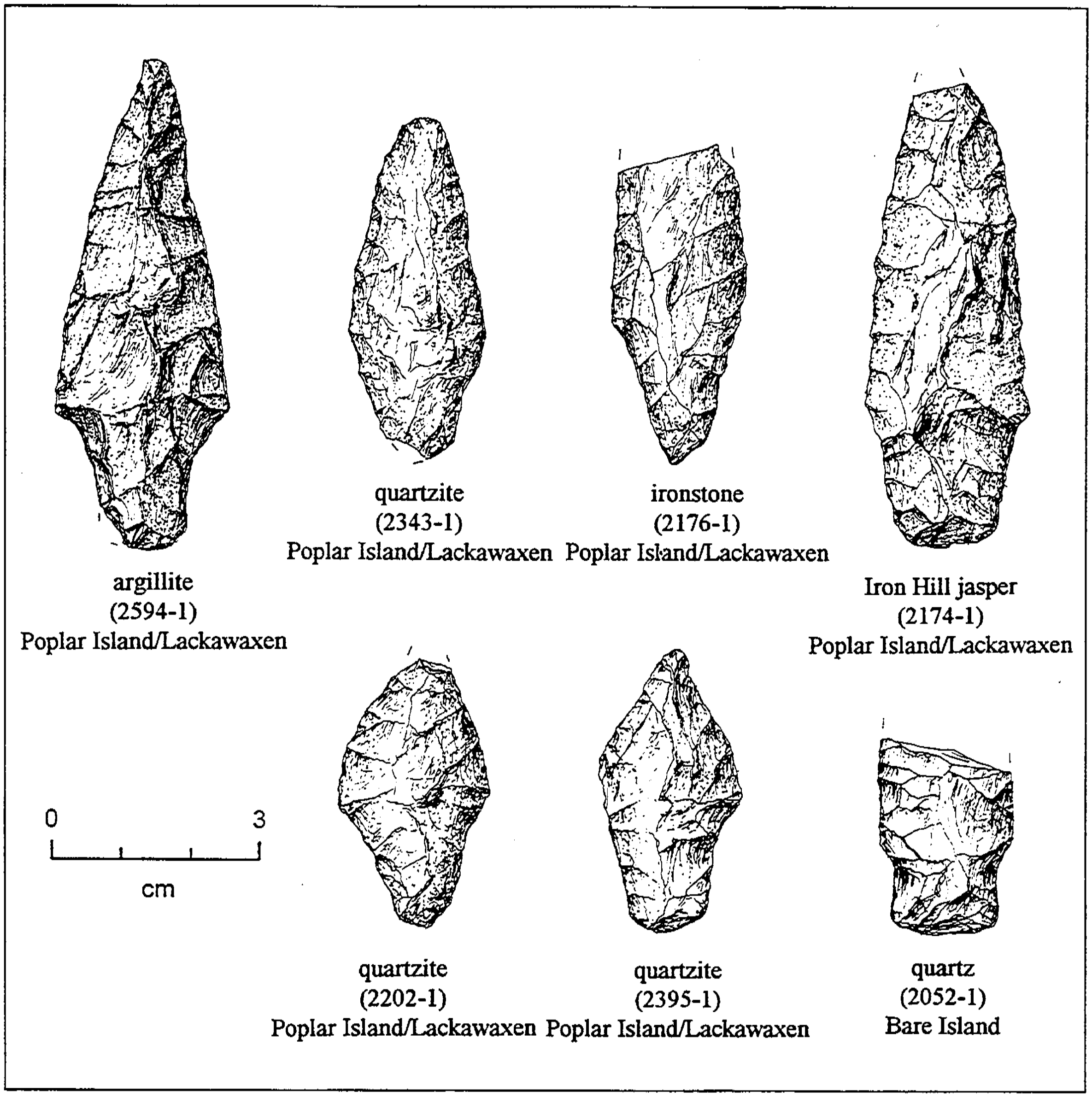

Figure 22. Narrow-Bladed, Stemmed Points from Area 2

Discarded and rejected bifaces showed no pattern in terms of raw material choice. Quartz and Iron Hill jasper were equally represented among early stage bifaces, and all bore characteristics of manufacturing rejects. Late stage bifaces were of various materials, and also were rejects—only one, a late stage rhyolite specimen, appeared to have been used. A relatively large number of unifaces were recovered. Most were similar in shape and manufacture, occurring as endscrapers made on thick chert flakes (Figure 24). The working edges or bits were similar in shape and undercutting on a number of examples suggested that some had been used against hard materials (although some undercutting may have resulted from crushing during edge trimming). Only one example bore a well-rounded edge, characteristic of extensive use against a smoothly abrading surface such as hide. There was also a relatively large number of cores, mostly of pebble material. Evidence of bipolar percussion was visible on just over one-third of these specimens. Two anvil stones, a hammerstone with bipolar wear (Plate 21), and a hammerstone with minor wear typical of use as an anvil were also recovered, indicating that reduction of pebbles was an important part of the tool manufacturing and maintenance economies.

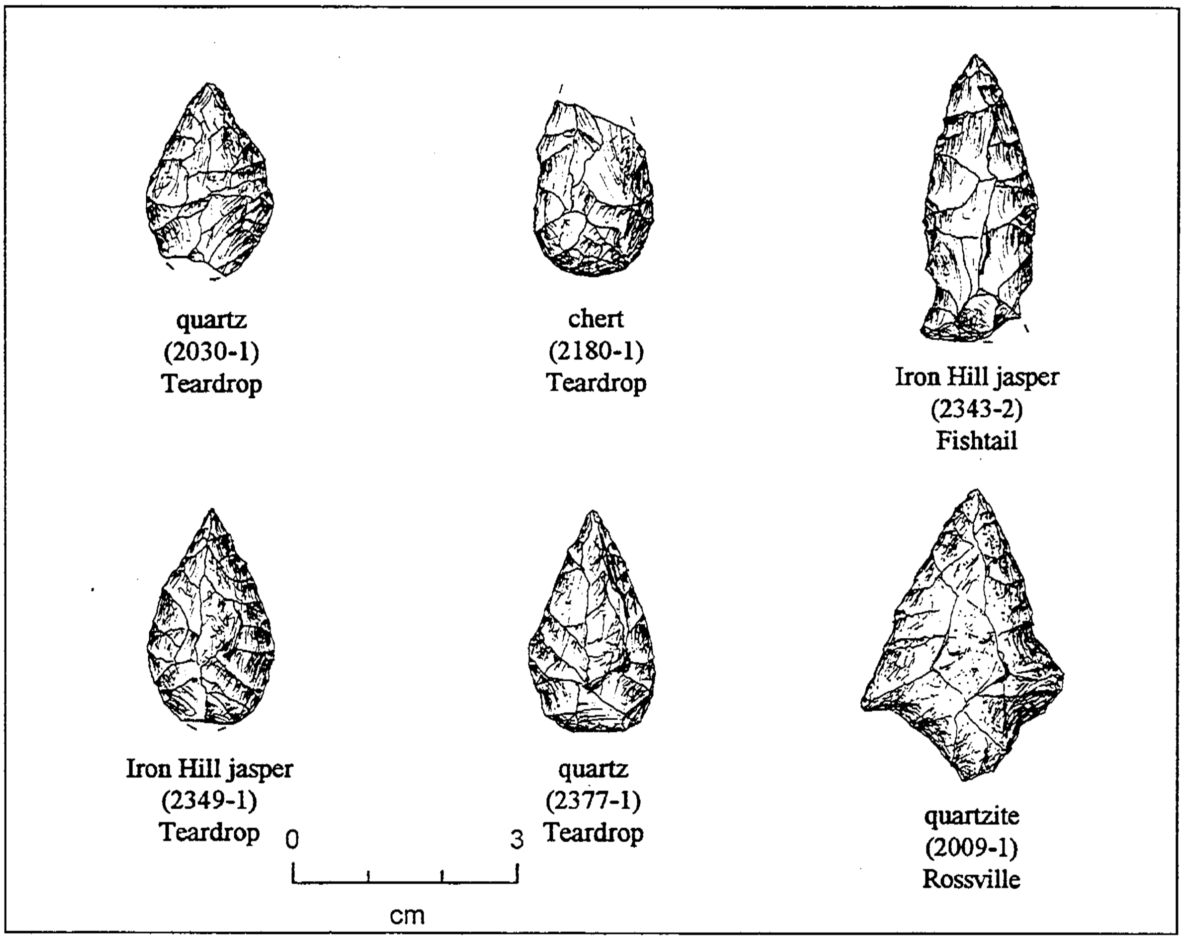

Figure 23. Teardrop and Other Points from Area 2

	Debitage	Projectile Points
Quartz	40%	24%
IH jasper	19%	32%

Table 11. Comparison of Majority Lithic Raw Material Frequencies within Artifact Categories from Area 2. Data Are Displayed as Percentages of Raw Material within Each Artifact Type

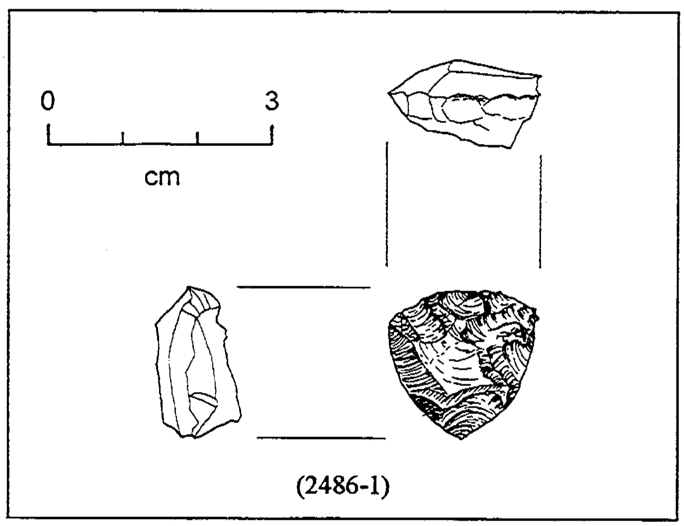

Figure 24. Chert Uniface From Area 2

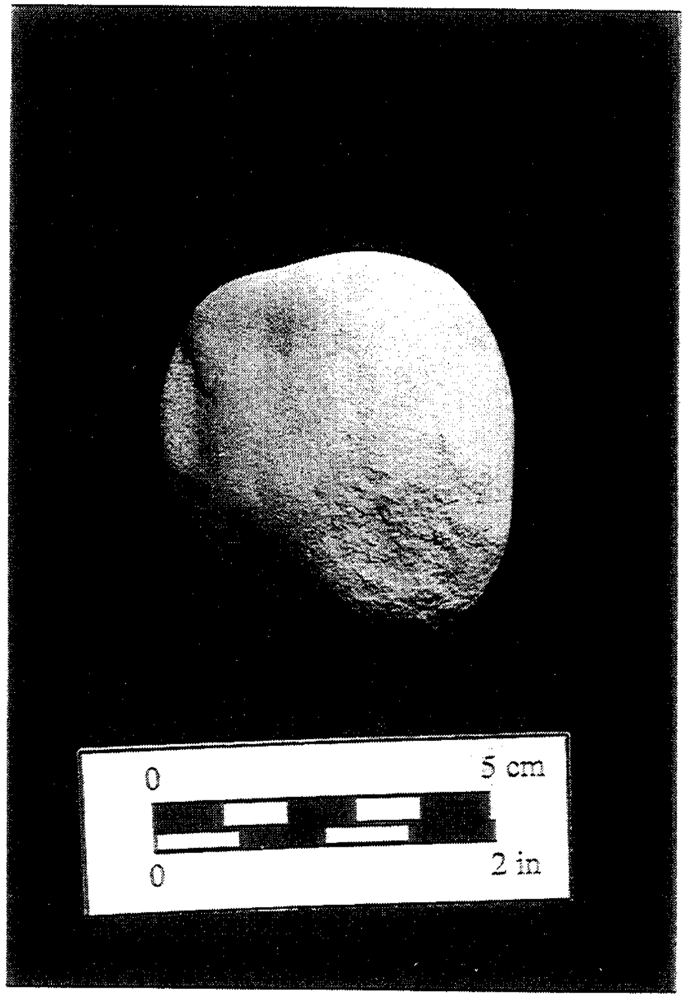

Plate 21. Hammerstone From Area 2 Showing Battering on Edge

Block D

Block D was excavated along the north edge of Area 2, in a relatively confined zone in which artifacts were recovered beneath the plow zone disturbance (see Plate 3 for location). In total, 1150 artifacts were recovered from the block excavation: 831 from the plow zone and 319 from sub-plow zone contexts. The artifacts from the sub-plow zone levels of the block were considered a discrete assemblage, and detailed attribute analysis of flaking debris from that deposit was conducted. Tables 12 and 13 compare artifact type and lithic raw material frequencies between the plow zone and sub-plow zone deposits in the block.

	Plow Zone		Sub-Plow Zone	
Artifact Type	**Count**	**Frequency(%)**	**Count**	**Frequency(%)**
Flakes	563	67.7	260	81.5
Chips (Potlids)	59	7.1	43	13.5
Fire-Cracked Rock	189	22.7	8	2.5
Unifaces	6	0.7	1	0.3
Points	5	0.6	0	0
Early Stage Bifaces	4	0.5	5	1.6
Cores	3	0.4	0	0
Late Stage Bifaces	2	0.2	0	0
Hammerstones	0	0	2	0.6
Total	831		319	

Table 12. Artifact Frequencies, Block D

	Plow Zone		Sub-Plow Zone	
Raw Material	**Count**	**Frequency(%)**	**Count**	**Frequency(%)**
Iron Hill Jasper	253	39.4	51	16.4
Quartz	202	31.5	112	36.0
Chert	59	9.2	16	5.1
Quartzite	52	8.0	19	6.1
Jasper	29	4.5	36	11.6
Ironstone	24	3.7	55	17.7
Argillite	12	1.9	1	0.3
Chalcedony	8	1.2	17	5.5
Andesite	2	0.3	0	0
Rhyolite	1	0.2	4	1.3
Total	642		311	

Table 13. Chipped Stone Raw Material Frequencies, Block D

Flakes

Flakes comprised the majority of the lithic artifacts from the block. Four principal raw material types were recognized: quartz, which accounted for 30 percent of the flake assemblage (n=87); ironstone, 20 percent (n=51); Iron Hill jasper, 20 percent (n=51); and cryptocrystalline pebble material including chert, jasper, and chalcedony, together accounting for 19 percent (n=50). Quartz and the chert-jasper-chalcedony group were assumed to be pebble in origin, ironstone to have originated from tabular blanks, and Iron Hill jasper from quarry blanks or cores.

A graph of the size distribution of flakes as measured by weight from the excavation block is shown in Figure 25. The chart indicates that the greatest variation between the raw material types occurred among the smallest flakes. That is, more than 75 percent of the Iron Hill jasper flakes in the assemblage weighed less than 0.5gm, while in contrast only about 50 percent of the ironstone flakes occurred in the same weight category. At the opposite end of the range, there were few large flakes of any material.

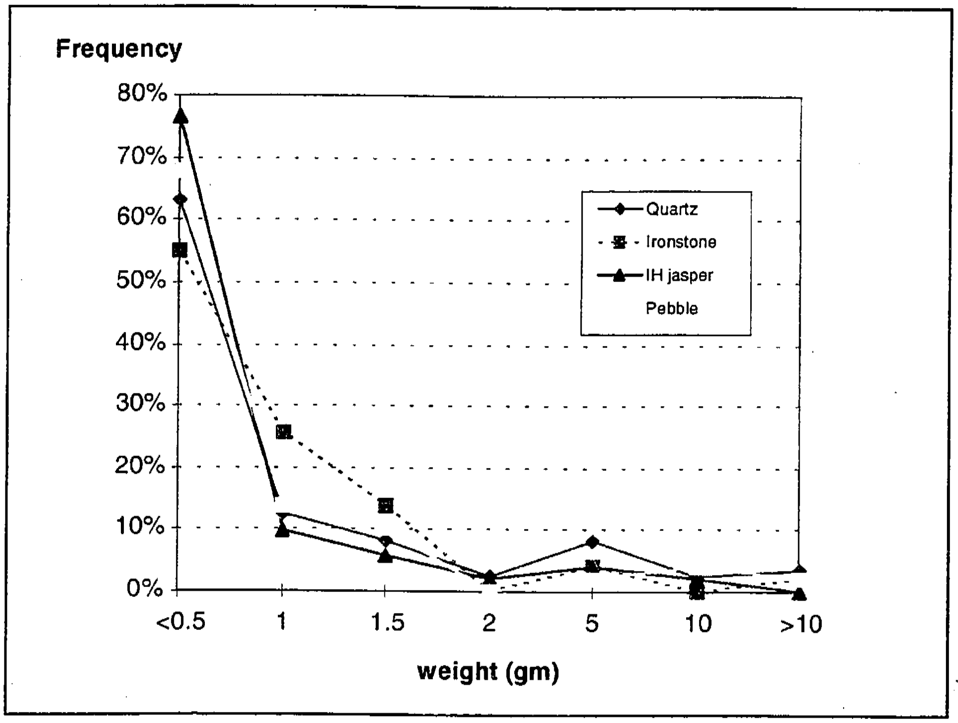

Figure 25. Flake Size Distributions Measured by Weight, Area 2, Block D

Tabulation of the presence of remnant cortex (Table 14) confirmed notions about raw material form. The lowest frequency occurred among Iron Hill jasper flakes, which were presumed to have been knapped from bifaces or cores derived from outcrop material. The frequency of cortex was higher for quartz and other pebble material, and highest, by a large factor, for ironstone. In the latter case, the tabular blanks from which the raw material was derived are typically thin and tend to retain bedding cortex. Analysis of platform attributes provided additional information. Platforms with remnant bifacial edges were frequent on Iron Hill jasper flakes, but not on other material types, suggesting the importance of jasper biface production. The highest frequency of crushed platforms occurred among quartz, chert, and ironstone, implying the use of hard-hammer percussion. In the case of ironstone flakes, this may have been a reflection of the hardness of the material, whereas for quartz and chert flakes it implied the common use of bipolar percussion.

Cortex	**IH jasper**	**Ironstone**	**Quartz**	**Pebble**
Absent	96	61	90	82
Present	4	39	10	18
Platform Type	**IH jasper**	**Ironstone**	**Quartz**	**Pebble**
Simple / 2 Facet	28	6	46	58
Bifacial	41	17	9	5
Cortical	7	0	2	3
Crushed	24	78	43	34

Table 14. Flake Attributes: Remnant Cortex and Platform Type, Area 2, Block D, Listed as Percentages

In summary, the small size of Iron Hill jasper flakes and frequency of remnant biface platforms among them implied that they resulted from the finishing and perhaps maintenance of bifaces. Ironstone also appeared to be associated with biface manufacture, while bipolar reduction was important among pebble materials—quartz, chert, chalcedony.

Area 3

Descriptive statistics and in-depth analyses of the artifactual material from Area 3 conducted in three separate sections: Stage 1 excavations; Block A data; and Block B data. Due to the amount of material recovered from intact stratigraphic contexts in the two excavation blocks, less importance, and thus less analytical effort, was directed toward the poorer contexts represented by the area-wide and plow zone databases. In contrast, Blocks A and B contained relatively undisturbed stratigraphic sequences, and the main strata identified within the blocks appeared to be linked chronologically. Yet, there was sufficient variation in the artifacts, as well as a great enough horizontal distance between the blocks, to suggest that the artifacts be analyzed separately.

Random stratified sampling of Area 3 resulted in the recovery of 2544 prehistoric artifacts. Of those, 57 percent were chipped stone, the remainder consisting of fire-cracked rock, hammerstones, or fragments of prehistoric ceramic. Artifact type frequencies are listed in Table 15, lithic raw material frequencies in Table 16.

Descriptive analysis of the projectile points from the Stage 1 units was undertaken and the results described below. Due to the mixed nature of the deposit, analysis of additional artifact types from the units was not carried out.

Artifact Type	Count	Frequency(%)
Flakes	1267	49.8
Fire-Cracked Rock	1074	42.2
Chips (Potlids)	112	4.4
Early Stage Bifaces	11	0.4
Late Stage Bifaces	8	0.3
Points	32	1.3
Cores	16	0.6
Unifaces	6	0.2
Vessel	12	0.5
Anvil	3	0.1
Hammerstone	3	0.1
Total	2544	

Table 15. Artifact Frequencies, Area 3, Stage 1

Raw Material	Count	Frequency(%)
Iron Hill Jasper	134	9.2
Quartz	334	22.9
Jasper	458	31.4
Chert	336	23.0
Quartzite	103	7.1
Argillite	11	0.8
Andesite	25	1.7
Ironstone	19	1.3
Chalcedony	31	2.1
Rhyolite	7	0.5
Total	1458	

Table 16. Chipped Stone Raw Material Frequencies, Area 3, Stage 1

Projectile Points

Thirty-three projectile points or point fragments were recovered from sampling and testing in Area 3. Twenty-one points were typologically identifiable, attributable to portions of the Archaic, Woodland I, and Woodland II periods. Figure 26 represents the frequency of each identified type arranged in rough chronological order. Woodland II period Levanna points were the most frequent (n=8) followed by Teardrop points (n=5). Lithic raw material selection followed patterns documented elsewhere in the Middle Atlantic, with Teardrops typically made of quartz, long-bladed points such as Poplar Island and Bare Island made of coarse-grained material or quartz, and the remainder, including the bifurcate, Fishtail, Rossville, Adena, and Levanna types, made of cryptocrystalline material. Selected points are illustrated in Figures 27 and 28.

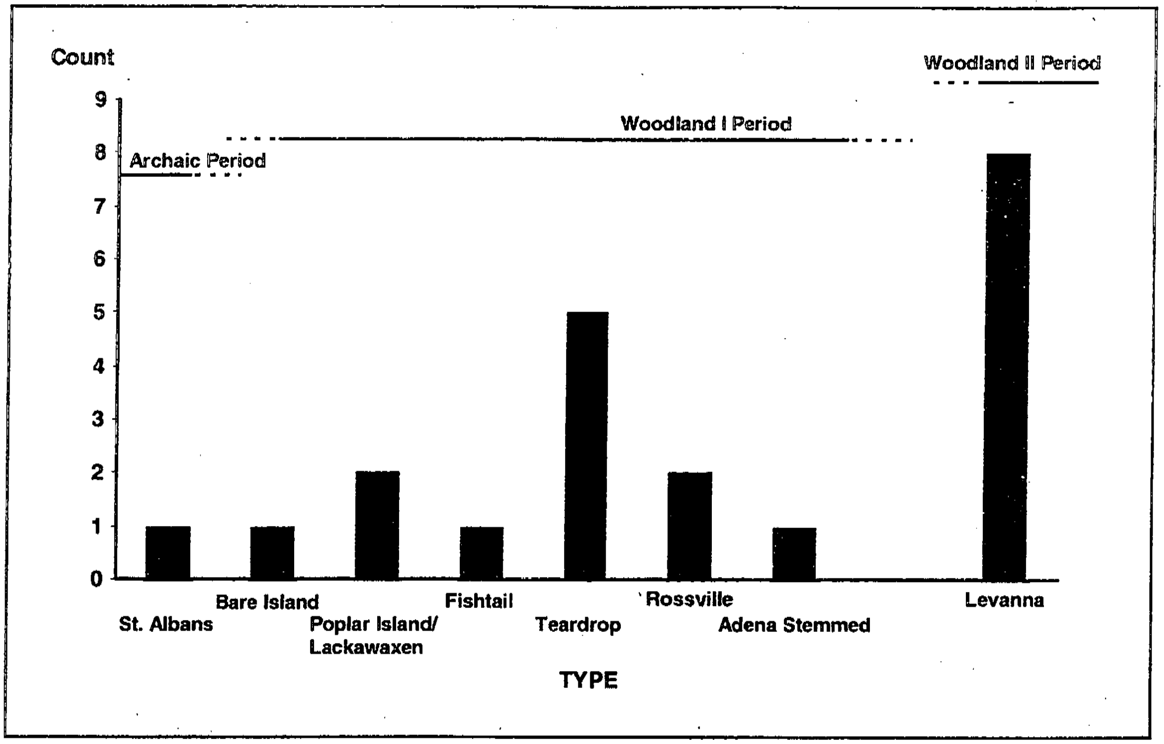

Figure 26. Counts of Chronologically Diagnostic Projectile Points from Area 3 Sampling

Breakage and use patterns suggested that the points had been used as both projectiles and cutting implements. Several points recovered from Area 3, including the Fishtail, both of the Rossville points, and one of the Teardrops, bore asymmetrically reworked blades typical of the repeated sharpening of the single edge of a cutting tool or knife. In contrast, a distal impact fracture was observed on one of the long-bladed points, a Poplar Island/Lackawaxen manufactured of andesite. Basal damage on several other specimens, including the Adena, Fishtail, St. Albans, one of the Teardrops, and several Levanna, may also have been impact related. A recurring pattern was noted among the Levanna specimens: five of seven of the triangles bore distal snap breaks along with damage to one basal tang. Such damage could have been associated with a twisting and cutting motion that snagged one of the protruding tangs, yet there were no indications of bending snap breaks. As likely, the damage resulted from impact. That the points were recovered at an apparent occupation site suggests that they were either returned to the site still embedded in the prey or, more probably, had been brought back for repair. In addition to the diagnostic points, two of the larger non-diagnostic distal fragments (252-1, 883-2) bore distal impact fractures and snap breaks at the neck. Several experimental studies have indicated that damage to the hafting element of a projectile point is a common result of impact. There was indication, then, that many of the Woodland II period points from Area 3 had been used as projectile tips, and that hunting may have been an important economic activity at the site during that period. Hunting may also have

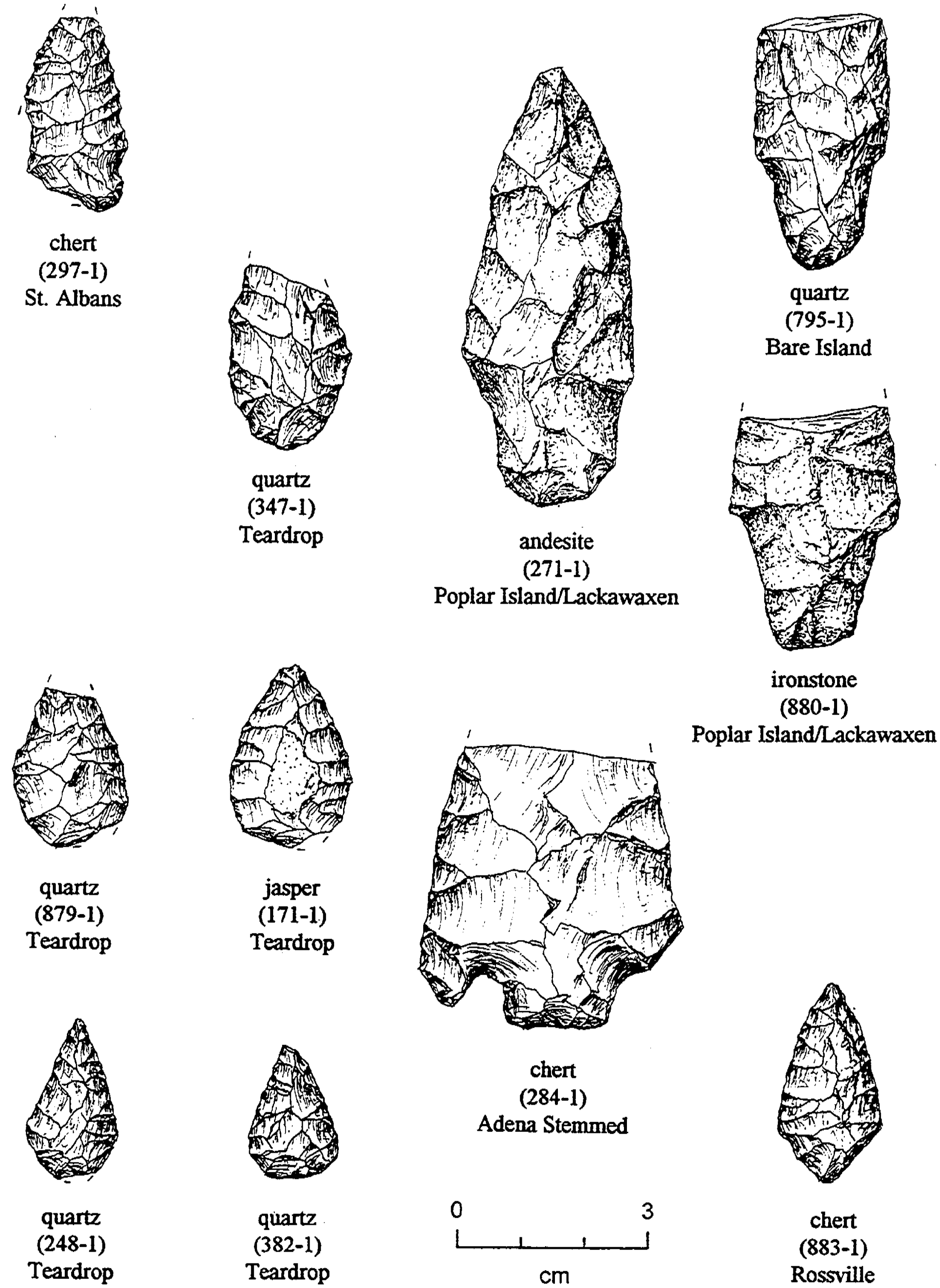

Figure 27. Projectile Points from Area 3 Sampling

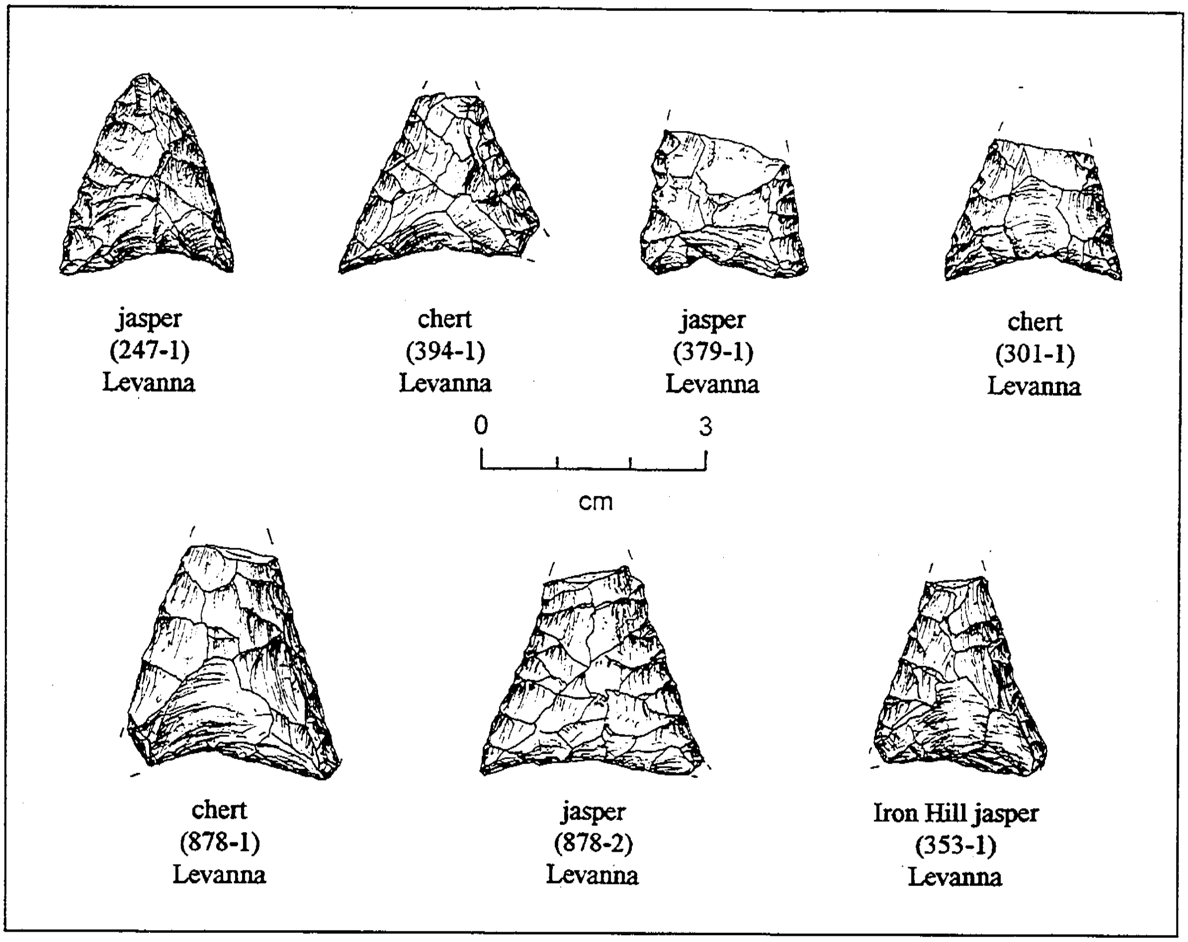

Figure 28. Triangular Points from Area 3 Sampling

been significant during earlier periods of site use, although evidence of impact related damage on stemmed and notched points was less widespread and systematic.

Block A

A total of 1952 prehistoric artifacts were recovered from the sub-plow zone levels of Block A. Stratigraphic and vertical artifact distribution analyses indicated that at least two distinct depositional episodes were present, represented by archaeological Stratum C and archaeological Strata D and E (referred to here as D/E, as shown in Figure 8). The deposits appeared relatively intact as well as chronologically discrete. Radiocarbon dates placed Stratum C in the Woodland II period, and Stratum D/E in the Woodland I period. Thus the artifact assemblages from the deposits were analyzed separately.

Stratum C — Woodland II

One-hundred-fifty-five artifacts were recovered from Stratum C of Block A, 81 percent of which consisted of chipped stone debris. The remainder consisted of fire-cracked rock fragments and a prehistoric ceramic sherd. Artifact type frequencies are listed in Table 17, and lithic raw material frequencies are detailed in Table 18.

Artifact Type	Count	Frequency(%)
Flakes	109	70.3
Fire-Cracked Rock	28	18.1
Chips (Potlids)	14	9.0
Points	1	0.6
Cores	1	0.6
Unifaces	1	0.6
Ceramic	1	0.6
Total	155	

Table 17. Artifact Frequencies, Woodland II Deposits, Block A

Raw Material	Count	Frequency(%)
Quartz	49	38.9
Iron Hill Jasper	22	17.5
Chert	24	19.0
Jasper	18	14.3
Quartzite	8	6.3
Ironstone	2	1.6
Rhyolite	2	1.6
Chalcedony	1	0.8
Total	126	

Table 18. Chipped Stone Raw Material Frequencies, Woodland II Deposits, Block A

Non-Flaking Debris

Two tool forms were recovered from Stratum C, a projectile point fragment and a uniface. The point fragment (303-4) consisted of the distal end of a small chert point, truncated at a bending snap break. The uniface (390-9) was made from a small, bipolar quartz core fragment.

Flakes

Three principal raw material types were recognized among the flakes: quartz, 39 percent of the flake assemblage (n=42); Iron Hill jasper, 18 percent (n=20); and cryptocrystalline pebble material (chert, jasper, and chalcedony), 33 percent (n=36). Analysis of the size distributions showed that most of the flakes of each material type (approximately 65 percent) occurred near the small end of the scale, in size-grade 3. Notably, there were no flakes of any material type in the largest group (size-grade 1), and only a small percentage of quartz flakes in the next largest (size-grade 1.5). This finding suggested either little evidence of early stage reduction or the exclusive use of small cores or biface blanks.

Little of the quartz debris was cortical, as indicated in Table 19. Given the assumption that the quartz utilized at the site originated in pebble form in local gravel bars, this lack of cortical flakes was surprising. It seemed to support the notion that relatively little early stage reduction was represented in the flake assemblage.

	IH jasper	Quartz	Pebble
Non-Cortical	95.0	92.9	69.4
Cortical	5.0	7.1	30.6
	n=20	n=42	n=36

Table 19. Cortex Frequency, Woodland II Deposits, Block A

Stratum D/E — Woodland I

In total, 1747 artifacts were recovered from Stratum D/E of Block A. Eighty-seven percent consisted of chipped stone debris, the remainder comprised of fire-cracked rock fragments, hammerstones, anvil stones, a celt, and several cobbles. Artifact type frequencies are listed in Table 20, and lithic raw material frequencies are detailed in Table 21. Due to the intact nature of the deposit and the relatively large number of artifact types, descriptions of all of the major artifact types have been included.

Artifact Type	**Count**	**Frequency(%)**
Flakes	1183	68.3
Fire-Cracked Rock	208	12.0
Chips (Potlids)	270	15.6
Cores	30	1.7
Unifaces	13	0.8
Early Stage Bifaces	14	0.8
Hammerstones	5	0.3
Late Stage Bifaces	4	0.2
Points	3	0.2
Anvils	2	0.1
Celt	1	0.1
Total	1733	

Table 20. Artifact Frequencies, Woodland I Deposits, Block A

Raw Material	**Count**	**Frequency(%)**
Quartz	642	41.7
Iron Hill Jasper	254	16.5
Chert	213	13.8
Quartzite	162	10.5
Jasper	137	8.9
Ironstone	63	4.1
Argillite	22	1.4
Andesite	19	1.2
Rhyolite	16	1.0
Sandstone	6	0.4
Chalcedony	5	0.3
Schist	1	0.1
Total	1540	

Table 21. Chipped Stone Raw Material Frequencies, Woodland I Deposits, Block A

Projectile Points

Three projectile points or point fragments were recovered from Stratum D/E of Block A. Both of the typologically identifiable points were attributable to the early portions of the Woodland I period (Figure 29). The long-bladed, Poplar Island point was manufactured from coarse-grained material, the smaller, Lamoka point from local cryptocrystalline material.

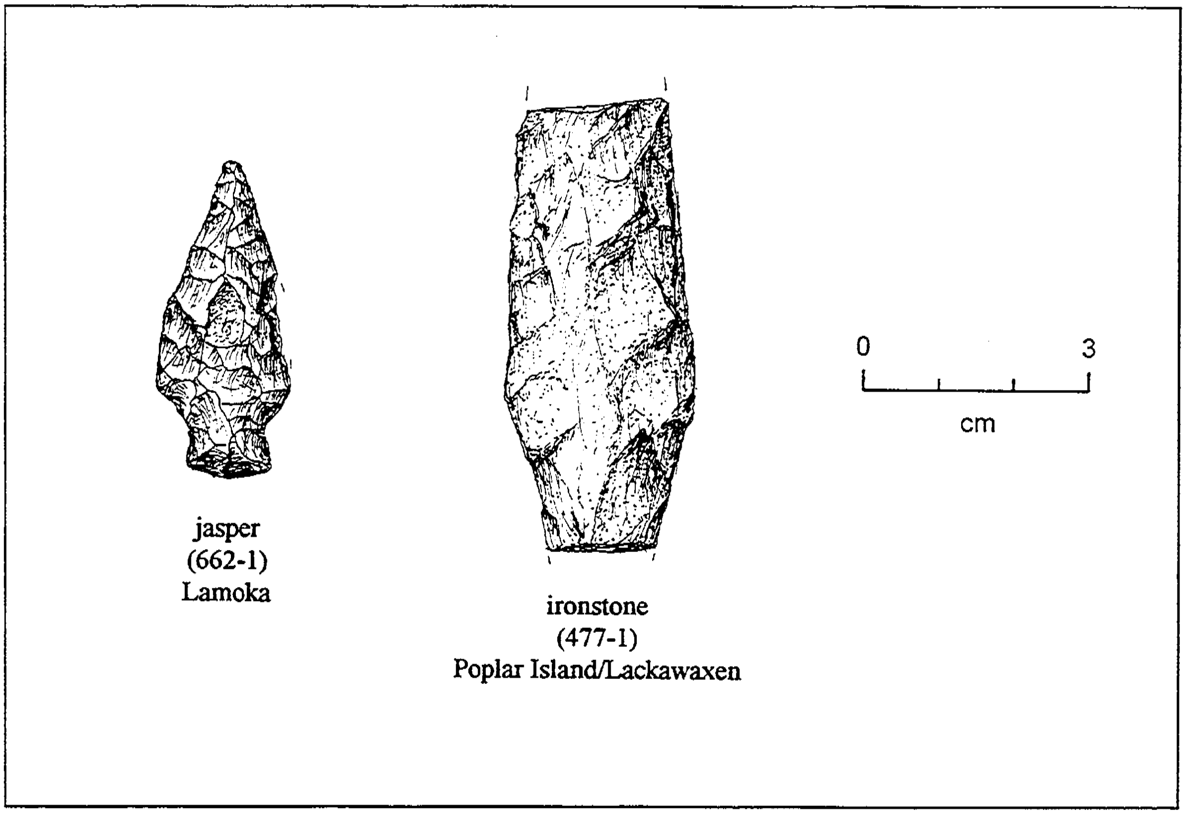

Figure 29. Projectile Points from Woodland I Deposits, Block A

Bifaces

Fourteen of the 18 bifaces in the assemblage were classed as early stage (Plate 22). Six were of quartz and two of pebble chert. The remainder consisted of coarse-grained material: ironstone, argillite, and quartzite. A large proportion of the bifaces in the sample, nearly 60 percent, were complete. All but one bore evidence of rejection during manufacture, due to material flaws or small size. The four late stage bifaces consisted of quartz, argillite, ironstone, and Iron Hill jasper, the last being the only biface of Iron Hill jasper in the assemblage.

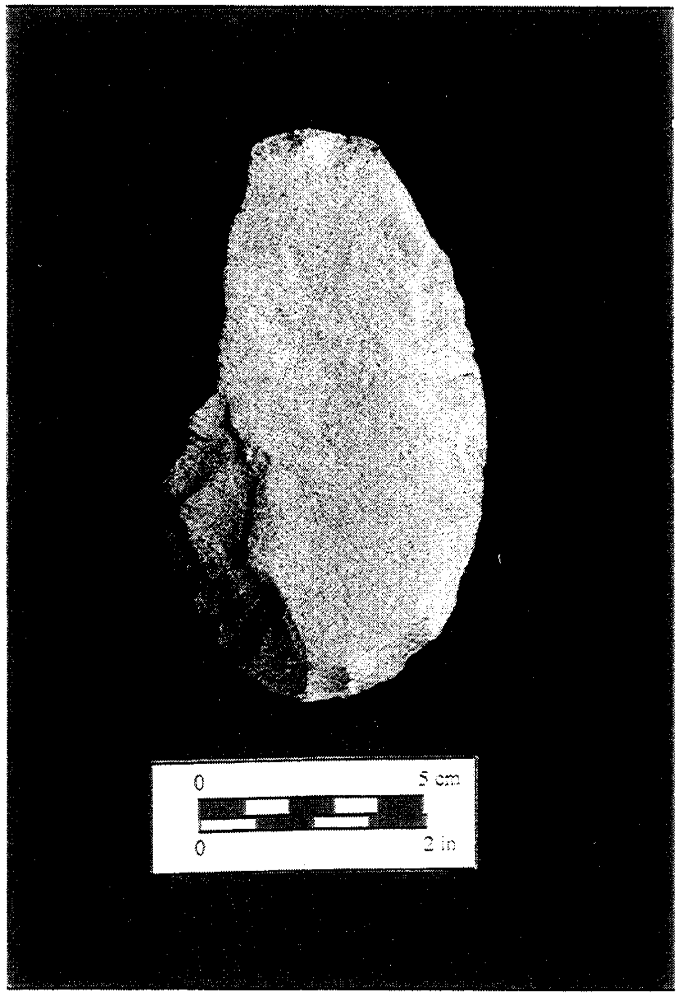

Plate 22. Early Stage Biface from Woodland I Deposits, Block A

Unifaces

Of the 13 unifaces in the assemblage, 10 were manufactured on chert, Iron Hill jasper, or jasper flakes. Most were endscrapers. The chert examples were made on bipolar flakes or cores and retained pebble cortex. Visible wear on the tool edges occurred as minor flaking, while few exhibited undercut edges such as would be expected from use against a hard surface. Rounding of the bit edge, typical of use against a soft material such as hide, was noted in one-third of the specimens.

Cores

The 30 cores recovered from Stratum D/E ranged in size from small pebbles to relatively large cobbles. Many bore evidence of bipolar percussion, and the proportion was especially high among some raw material types: 80 percent for pebble chert and jasper; 90 percent for quartz. In contrast, none of the quartzite cores were bipolar. There was evidence throughout the assemblage of the testing and rejection of poor quality material both among pebbles and cobbles.

Table 22 displays the relative distributions of raw materials among flakes and cores. The greatest differences were among the coarse-grained materials, where there was a higher proportion of quartzite cores than flakes and an absence of cores of materials such as andesite, argillite, sandstone, and rhyolite. Most of the quartzite cores were large tested cobbles, and thus contributed little to the quartzite debitage frequency, suggesting that quartzite was not a major part of the flaking industry at the site. The figures for the other coarse-grained lithic materials were among the most direct indications of reduction strategy in the data. They implied that most of the coarse-grained material was brought to the site in finished form, and that the flaking debris generally represented tool resharpening, not manufacture.

	Flakes	Cores	Flake:Core
Iron Hill jasper	18.5	23.3	50.0
quartz	42.9	33.3	50.7
pebble material	17.2	16.7	40.8
quartzite	11.9	26.7	17.6
other	9.5	0.0	—

Table 22. Raw Material Frequencies Among Cores and Flakes, Listed as Percentages, Woodland I Deposits, Block A

Hammerstones and Anvil Stones

There were 5 hammerstones and 2 anvil stones among the material recovered from Stratum D/E (Plate 23). The hammerstones consisted of dense quartzite cobbles, the anvils of sandstone. Both anvils had been heavily utilized as hammerstones. One hammerstone bore pecking across one relatively flat face, indicating that it had been used in bipolar percussion. Two refitted fragments were from a relatively large tabular cobble. Judging from the shape of the cobble and the location of the fracture, the piece may have been broken in use as an anvil.

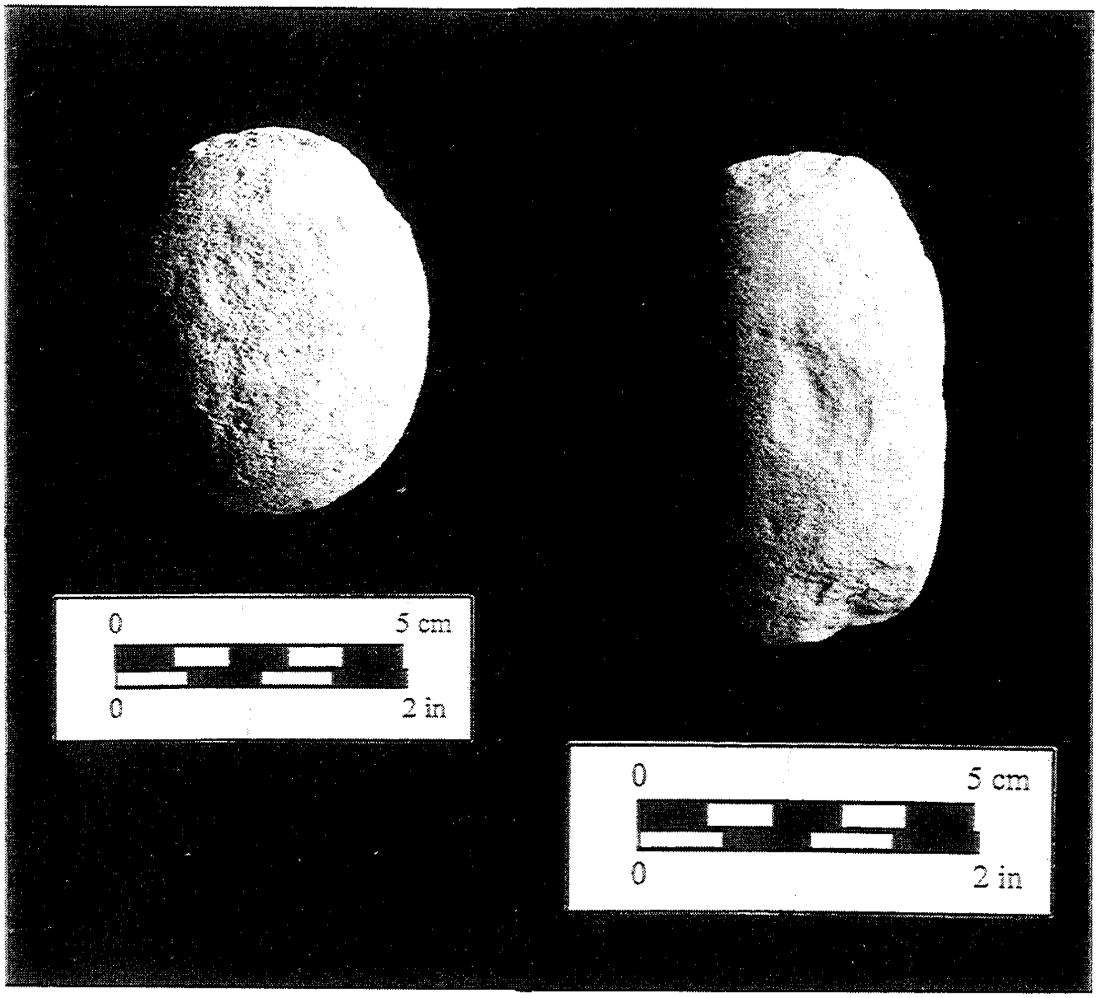

Plate 23. Hammerstone and Anvil, Woodland I of Block A

Celt

One celt fragment was recovered from Stratum D/E (Plate 24). It was made on a tabular fragment of dark gray hornblende schist, a metamorphic rock originating in the piedmont. One end had been battered, while the other had been unifacially flaked. Bedding planes in the material caused the flaking to be uneven and appear crude. The edge produced was only slightly dulled in one isolated area, suggesting that the artifact had not been heavily used and may have been unfinished.

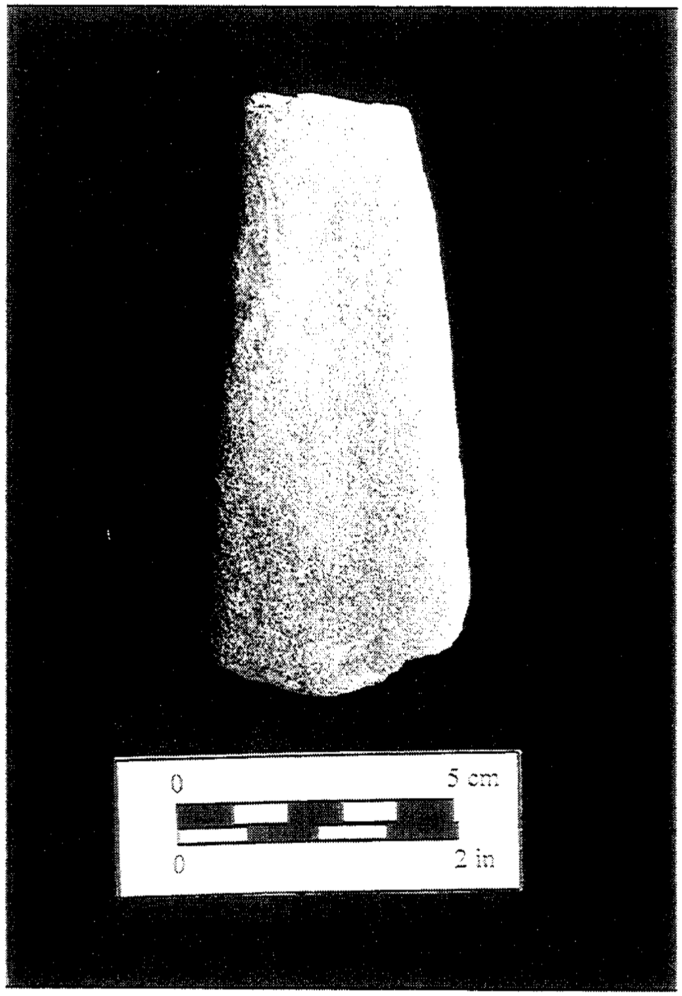

Plate 24. Celt from Woodland I Deposits, Block A

Flakes

The raw material breakdown among flakes mirrored the overall material distribution in the assemblage: quartz, 43 percent (n=507); Iron Hill jasper, 19 percent (n=219); pebble chert and jasper, 18 percent (n=208); and coarse grained stone, including quartzite, 12 percent (n=141), and andesite, argillite, ironstone, and rhyolite at 1 to 4 percent each. Due to the relative size of the quartzite sample, it has been analyzed as one of the major raw material types.

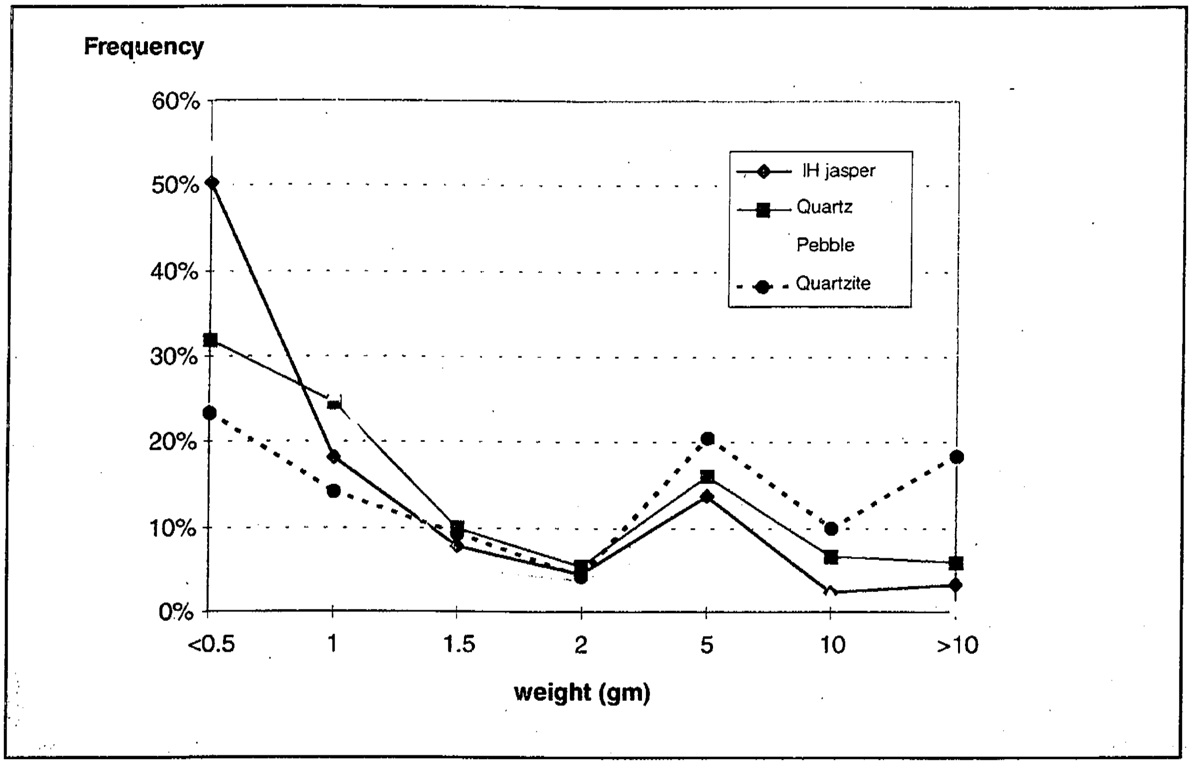

Figure 30. Flake Size Distribution by Weight, Woodland I Deposits, Block A

An analysis of size grade data indicated that there were slightly more large quartz and quartzite flakes in comparison with Iron Hill jasper or pebble chert and jasper (Figure 30). Weight distributions indicated a similar pattern but with some additional variation evident. Quartz displayed a similar distribution to quartzite at the small end of the scale, indicating considerably fewer small flakes in comparison to both pebble chert and Iron Hill jasper. Notably, the remainder of the quartz graph paralleled the cryptocrystalline materials. The low incidence of small quartz flakes suggested little thinning or finishing of quartz, and implied that knapping was more often aimed at the production of larger flakes, suitable for use as tools, rather than the reduction of a core into a bifacial tool. The parallel portions of the three graphs, at the high end of the scale, may reflect the size of the raw material pieces brought to the site—small pebbles for quartz and pebble cryptocrystalline and relatively small bifaces for Iron Hill jasper, in contrast to larger, cobble forms for quartzite. Some confirmation of this notion is seen in the size distribution of cores: all eight quartzite cores were in the form of relatively large cobbles; of the quartz cores with identifiable original forms, one-half were pebble and one-half cobble, the latter noted in each case as "small cobble;" and four of five cryptocrystalline cores were pebble.

The calculation of mean flake weights generally supported the implications drawn from the size distribution data (Table 23). The largest flakes of quartz and quartzite (size grade 1) were considerably heavier than those of other materials. In addition the means for the remaining grades were consistently higher, implying thicker flakes across the size range. The overall means, calculated over the four grades 1-3, indicated that quartz flakes were typically twice as heavy as Iron Hill jasper flakes, and quartzite several times heavier still. Iron Hill jasper flakes appeared to be consistently the thinnest flakes among the materials.

Size Grade	IH jasper	Quartz	Pebble	Quartzite
1	23.3	59.0	17.0	52.4
1.5	10.6	14.8	4.2	15.2
2	3.5	4.7	3.5	4.7
3	0.7	1.1	0.6	1.1
4	0.1	0.2	0.1	0.3
grade 1-3	1.8	3.6	1.1	7.9

Table 23. Mean Flake Weight per Size Grade, Woodland I Deposits, Block A

The frequency of remnant cortex was analyzed by size grade (Table 24), and provided a clear indication of the difference in raw material form. The table highlights the near absence of cortical flakes among the Iron Hill jasper debris and the greater frequencies among the materials that were initially cobbles or pebbles. The proportional reduction of cortex frequency can be distinctly seen moving down the columns, as flaking debris becomes smaller.

sgrade	IH jasper	Quartz	Pebble	Quartzite
1	0	66.7	100.0	90.9
1.5	80.0	37.5	0	94.4
2	6.5	30.3	66.7	72.7
3	5.8	13.0	25.0	56.6
4	0	1.7	17.8	50.0

Table 24. Cortex Frequency by Size Grade, Woodland I Deposits, Block A

In summary, the flake analyses indicated that different manufacturing techniques were used for different stone types in the assemblage from Stratum D/E of Block A. The quartz and quartzite flakes from the deposit were larger and thicker than the Iron Hill jasper flakes, indicating different flaking procedures and possibly different end-products. The bifaces in the assemblage were mostly early stage forms made of quartz or coarse-grained materials. The relative absence of Iron Hill jasper bifaces suggested that few of those tools were manufactured at the site, and that those that were had been finished and removed from the site area. Yet a substantial amount of Iron Hill jasper was recovered among the flaking debris, implying that the flakes were largely maintenance related and not associated with the full range of reduction. Size distribution data, and in particular, weight distributions, lent some support to this conclusion.

Stratum D/E Artifact Clusters

Based on the results of spatial analyses conducted on artifact distributions in Stratum D/E, two main clusters of lithic debitage were isolated as discrete activity areas (see spatial study discussed later in this chapter). The artifacts from each group were analyzed separately to determine whether patterns were present that were not brought out by the general stratum analysis. One cluster covered eight excavation units in the northeast part of the block and contained a total of 712 artifacts. The second cluster covered five units in the southwest part of the block and contained 282 artifacts.

Comparison of artifact types showed that neither group contained a especially large amount of fire-cracked rock, suggesting that fire-related activities were not the main focus of the occupations in either location. Other artifact types occurred in roughly the same frequencies in both groups, with the exception of chips, which were more frequent in the northeast cluster. Quartz was the majority raw material type among flakes in both clusters, suggesting that it was the most important component of the lithic reduction process in both areas.

Analysis of specific artifact attributes suggested that the northeast cluster represented the remains of lithic reduction focused mainly on quartz. Little initial reduction of the material was conducted, and the main goal may have been producing a particular tool form, such as a biface or flake tool. Ironstone bifaces were also manufactured in the northeast part of the block. A hearth may have been present in the area, but the use of fire appeared to have been incidental to the main lithic reduction activity (see spatial study discussed later in this chapter). Quartz reduction was the main stone tool activity in the southwest part of the block as well. In addition, chert and jasper pebbles were flaked in that area, and quartzite cobbles were used to produce flake tools. As in the area to the north, a hearth may have been present in the southwest area, but it did not appear critical to the main focus of activity.

Block B

A total of 491 prehistoric artifacts were recovered from the sub-plow zone levels of Block B. Stratigraphic analysis indicated that the same general depositional episodes seen in Block A were present in Block B: Stratum C, dated to the Woodland II period, and Stratum D/E, dated to the Woodland I period. The artifact assemblages from the deposits were analyzed separately.

Stratum C — Woodland II

Of the 162 prehistoric artifacts recovered from Stratum C, approximately 72 percent consisted of chipped stone debris, the remainder consisting of fire-cracked rock and a fragment of prehistoric ceramic. Artifact type frequencies are listed in Table 25, and lithic raw material frequencies are detailed in Table 26.

Artifact Type	Count	Frequency(%)
Flakes	53	32.7
Fire-Cracked Rock	82	50.6
Chips (Potlids)	21	13.0
Points	2	1.2
Cores	2	1.2
Early Stage Bifaces	1	0.6
Non-diagnostic Ceramic	1	0.6
Total	162	

Table 25. Artifact Frequencies, Woodland II Deposits, Block B

Raw Material	Count	Frequency(%)
Quartz	42	53.2
Chert	11	13.9
Iron Hill Jasper	9	11.4
Jasper	7	8.9
Andesite	5	6.3
Quartzite	4	5.1
Chalcedony	1	1.3
Total	79	

Table 26. Chipped Stone Material Frequencies, Woodland II Deposits, Block B

Projectile Points

Two projectile points or point fragments were recovered (Figure 31). Both points were attributable to portions of the Archaic period. The side-notched quartz point (502-1) was classified typologically as Brewerton. The serrated fragment (476-1) was of chert. While the base of the latter artifact was missing, the general shape of the blade was consistent with one of several varieties of bifurcate-based points from the Archaic. Considering evidence from radiocarbon dating and stratigraphic analyses detailed elsewhere in the report, both artifacts appeared to have been out of place stratigraphically. They probably represented the scavenging of earlier artifacts by later inhabitants of the site.

Non-Flaking Debris

One early stage biface was recovered from Stratum C. It consisted of relatively coarse-grained Iron Hill jasper. Two cores were also in the assemblage. Both were small cores of Iron Hill jasper and both had been heated. One was burned after discard, judging by the scarring on its surfaces, while the other may have been heated intentionally as part of the knapping process.

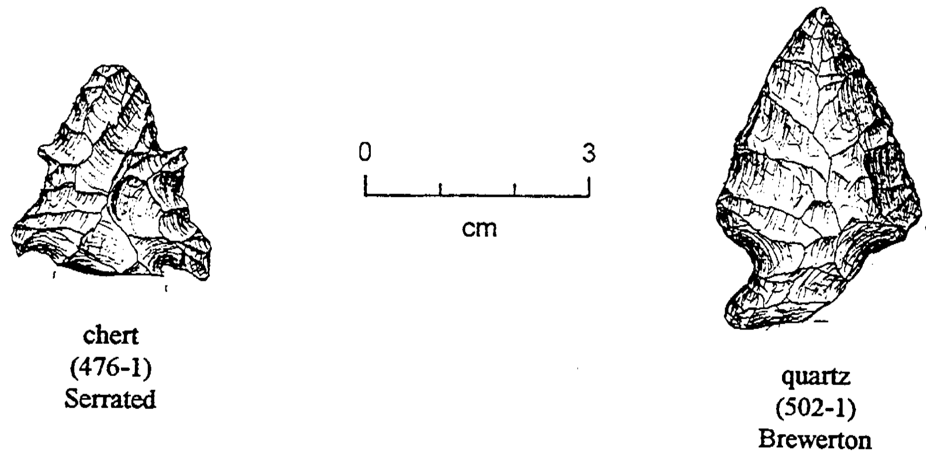

Figure 31. Projectile Points from Woodland II Deposits, Block B

Flakes

The most of the flakes from Stratum C were quartz (51 percent, n=27). The size distribution of quartz flakes alone was analyzed, due to the small and potentially unrepresentative samples present for the remaining material types. Twenty-five of the quartz flakes (93 percent) were non-cortical. Since quartz was presumed to have been obtained from local gravel bars in pebble or cobble form, the lack of cortex suggested that the debris was from a relatively late portion of a reduction sequence.

Stratum D/E — Woodland I

Of the 329 prehistoric artifacts recovered from Stratum D/E of Block B, approximately 83 percent consisted of chipped stone debris, the remainder consisting of fire-cracked rock, hammerstones and anvil-stones, a celt fragment, and a fragment of prehistoric ceramic. Artifact type frequencies are listed in Table 27, and lithic raw material frequencies are detailed in Table 28.

Artifact Type	Count	Frequency(%)
Flakes	202	61.4
Fire-Cracked Rock	51	15.5
Chips (Potlids)	54	16.4
Points	4	1.2
Cores	4	1.2
Early Stage Bifaces	3	0.9
Late Stage Bifaces	3	0.9
Unifaces	3	0.9
Anvil	2	0.6
Hammerstone	1	0.3
Celt	1	0.3
Ceramic	1	0.3
Total	329	

Table 27. Artifact Frequencies, Woodland I Deposits, Block B

Raw Material	Count	Frequency(%)
Quartz	140	51.3
Iron Hill Jasper	73	26.7
Jasper	21	7.7
Quartzite	22	8.1
Rhyolite	5	1.8
Chert	4	1.5
Andesite	4	1.5
Argillite	2	0.7
Ironstone	2	0.7
Total	273	

Table 28. Chipped Stone Raw Material Frequencies, Woodland I Deposits, Block B

Projectile Points

Four projectile points or point fragments were recovered from Stratum D/E (Figure 32). Typologically identifiable points were attributable to portions of the Archaic and Woodland I periods. Radiocarbon dating and stratigraphic analyses, reported elsewhere, indicated that the early Woodland I stemmed points, classified as Poplar Island (616-1) and Bare Island (787-1) were in place stratigraphically. The remaining two points, classified as Jack's Reef (621-1) from the late Woodland I and LeCroy (877-1) from the Archaic period, appeared to occur in the deposit as a result of scavenging or postdepositional disturbance to the soil profile.

Bifaces

There were 6 bifaces recovered from the deposit, 3 early stage and 3 late stage. Of the early stage bifaces, 2 were of quartz and one of ironstone. All were fragments and appeared to have been manufacturing rejects. All of the late stage bifaces were of quartz; two were complete and one a fragment. Like the early stage bifaces, each appeared to have been a manufacturing reject.

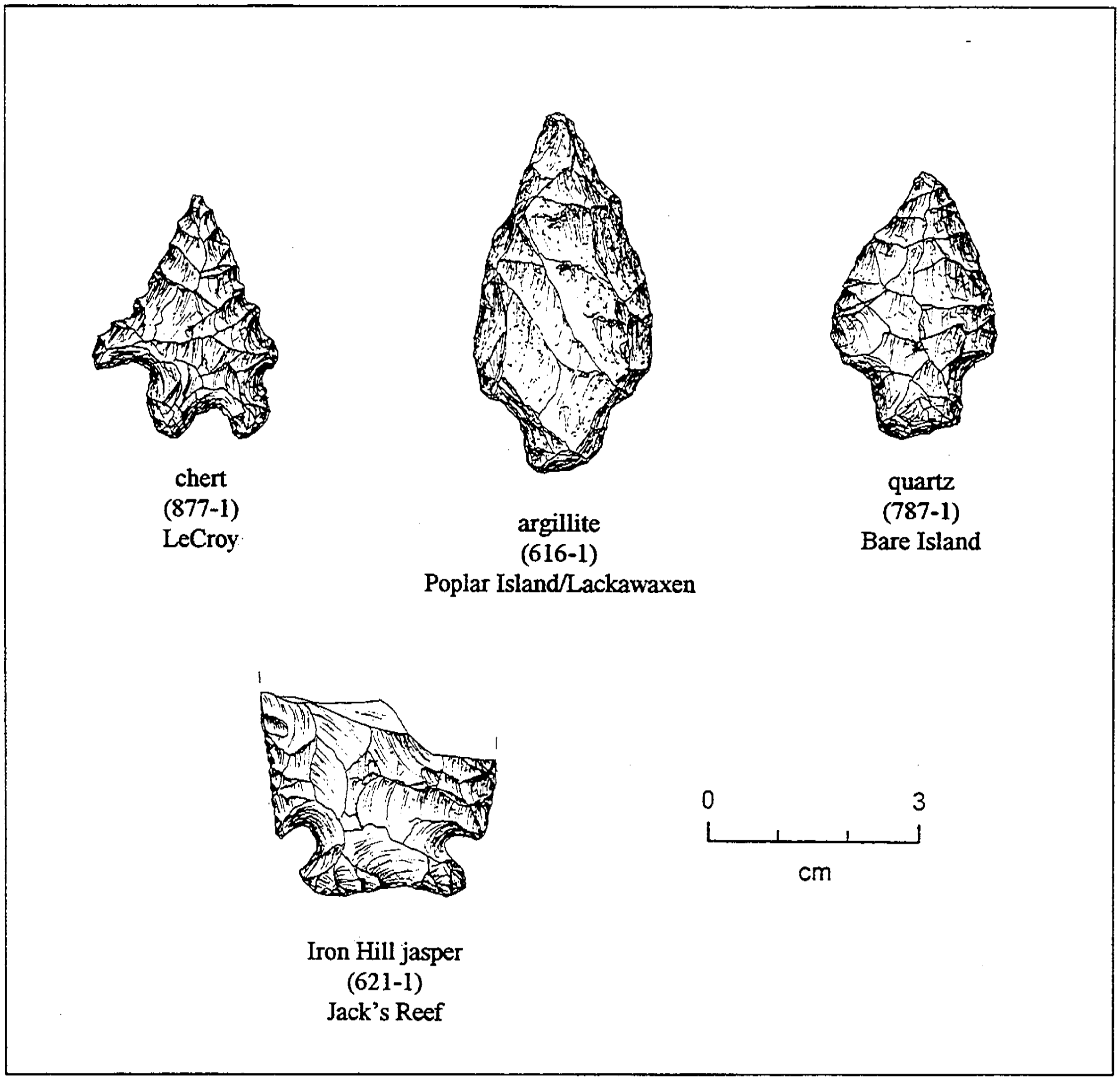

Figure 32. Projectile Points from Woodland I Deposit, Block B

Unifaces

Three unifaces were recovered from Stratum D/E (Figure 33). All were scrapers made on quartz flakes. The ends or thick edges of the flakes had been trimmed into rounded working edges, or bits. Wear from use occurred as flaking on the upper or dorsal edges of the specimens.

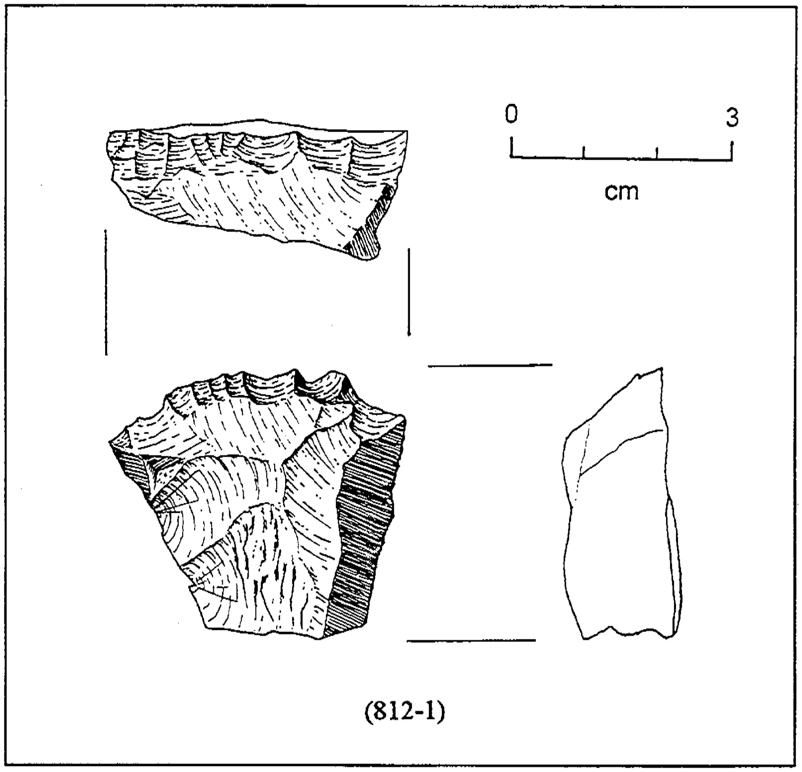

Figure 33. Uniface from Woodland I Deposits, Block B

Cores

Four cores were recovered from the deposit. Two Iron Hill jasper specimens consisted of several refitted fragments making up a large irregular cobble that had been tested and discarded. A quartz core had no remnant cortex and exhibited direct evidence of bipolar percussion. A small chert core was also present.

Hammerstones

There were 2 fragments of an anvil stone and 1 hammerstone among the material recovered from Stratum D/E. The anvil fragments refitted to form part of a flat, disk-like cobble of coarse sandstone (Plate 25). The edges of the stone were battered, indicating additional use as a hammerstone. One of the fragments was reddened along one edge, as evidence of burning. The fragment that refit was recovered from a point more than a meter distant, suggesting that the burning was postdepositional. This evidence, together with other artifactual and spatial data, suggests cultural re-use of surfaces.

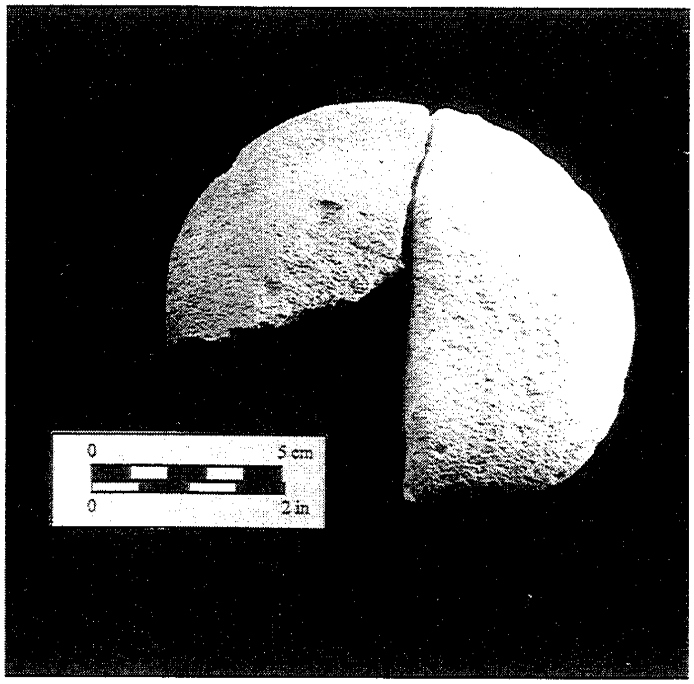

Plate 25. Anvil from Woodland I Deposits, Block B

Celt

The celt recovered from Stratum D/E was made on a waterworn cobble of dense, indurated argillite (Plate 26). It was extensively battered at one end and appeared to have been used as a chopping tool. The artifact may have been scavenged for potential reuse at a later date, since several flakes were removed unifacially from the opposite end as well as from along one lateral edge, apparently to test the raw material.

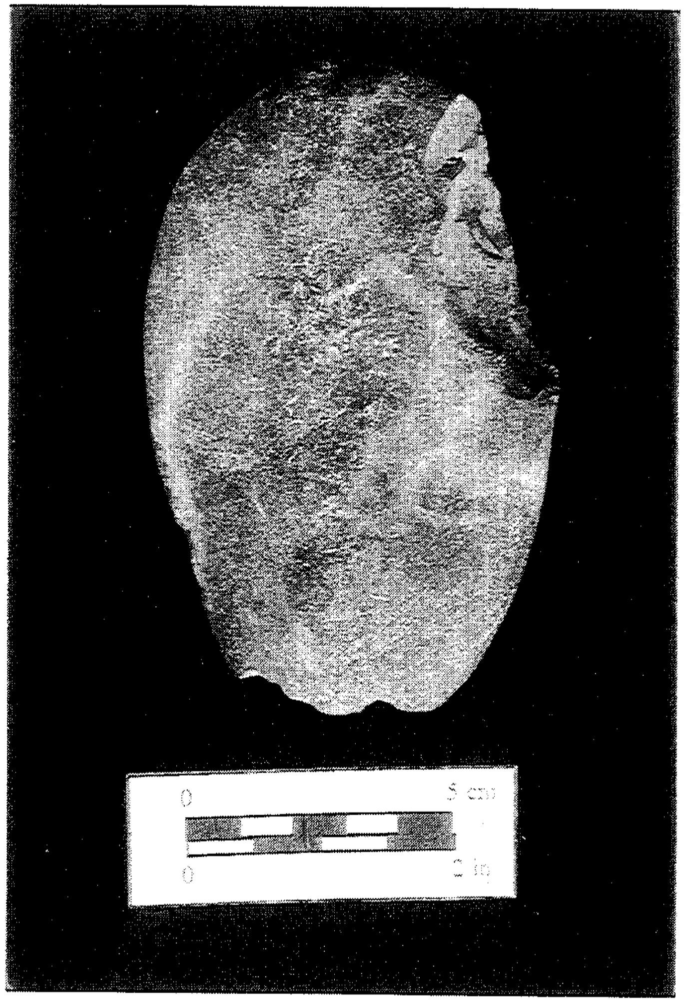

Plate 26. Celt from Woodland I Deposits, Block B

Flakes

Quartz accounted for approximately 51 percent (n=102) of the flake assemblage from the deposit; Iron Hill jasper, 27 percent (n=55); quartzite, 11 percent (n=22); and cryptocrystalline pebble material, 6 percent (n=12). Other coarse grained stone, including andesite, argillite, ironstone, and rhyolite, comprised less than 3 percent each. Due to the relative size of the quartzite sample, it was included in several of the attribute analyses. Conversely, the sample size of the pebble cryptocrystalline materials was small and possibly unrepresentative. Data for this material type has been included in the various tables, but not in the general interpretation.

Analysis of the size distributions of flakes by size grade indicated that there were more large quartz flakes present than Iron Hill jasper flakes, suggesting the possibility that different reduction strategies were represented in the two materials. The quartzite distribution showed an even higher proportion of large flakes, and stood out as distinct from the either of the first two material types.

Size distributions by weight (Figure 34) showed the same clear variation in the size of quartzite flakes. Well over one-half weighed 10 gm or more, implying that a large proportion of the material was the result of early stage reduction, or possibly a reduction strategy aimed at producing relatively large flakes suitable for tool use. In comparison, similar proportions of Iron Hill jasper and quartz flakes weighed less than .5 gm.

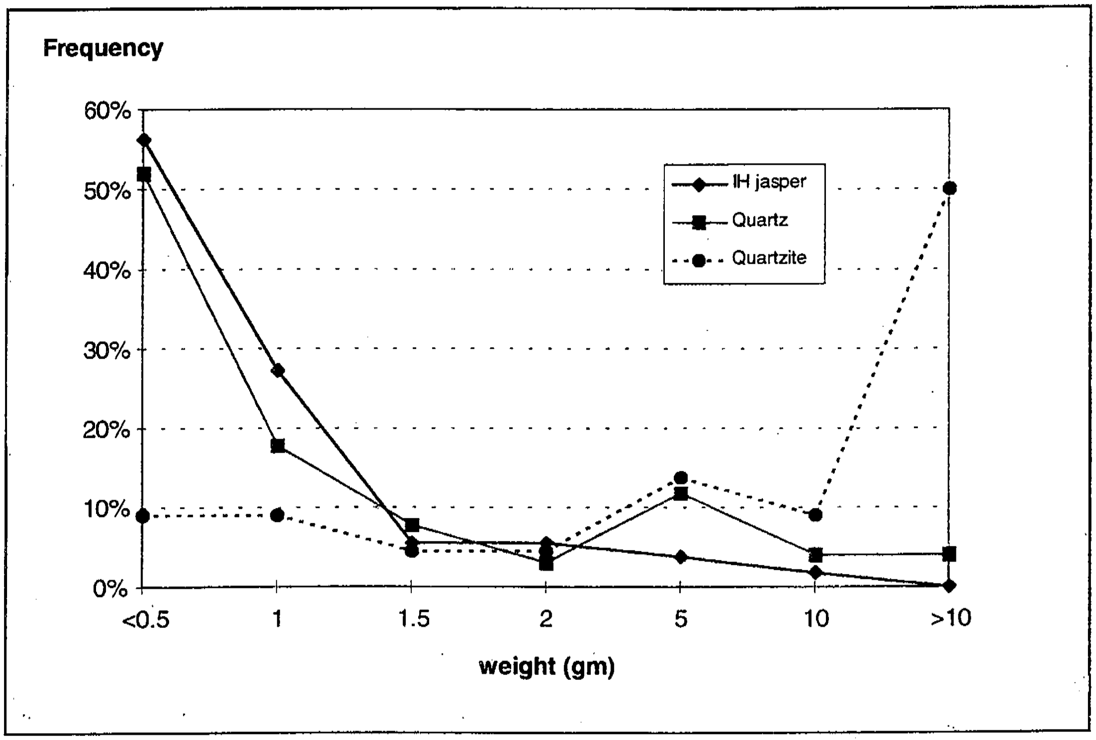

Figure 34. Flake Size Distribution by Weight, Woodland I Deposit, Block B

Variation between the jasper and quartz flake weight distributions was not marked, although the mean weight calculated for each size-grade indicated some difference between the two materials (Table 29). That is, quartz flakes were consistently heavier for each grade, implying that they were thicker than the Iron Hill jasper flakes. This finding may have resulted from a combination of differences in the knapping quality of the materials and in the reduction strategies or forms of percussion used. Yet several lines of evidence appeared to imply that there was little difference in the technological treatment of Iron Hill jasper and quartz. Not only were size distributions similar, the relative frequency of cortical flakes was nearly identical (Table 30), in a variation from the pattern seen in other parts of the site in which a large portion of the quartz flakes were cortical.

Size Grade	IH jasper	Quartz	Pebble	Quartzite
1	0	128.2	18.9	63.3
1.5	0	11.9	0	19.8
2	3.0	4.0	3.6	4.5
3	0.6	0.9	1.2	1.0
4	0.1	0.2	0.1	0
grades 1-3	0.8	6.5	3.7	26.6

Table 29. Mean Flake Weight per Size Grade, Woodland I Deposit, Block B

The results of the flake analyses were compared with biface frequency data. The comparison implied that there may in fact have been a difference in quartz and jasper reduction strategies. All but one of the bifaces, both early and late stage, were quartz—none were manufactured from Iron Hill jasper. This suggested that Iron Hill jasper was of secondary importance in the lithic reduction activities. One final analysis shed further light on the issue. The incidence of various platform types showed a low frequency of bifacial platforms among quartz flakes, but a high frequency among Iron Hill jasper flakes (Table 30). Coupled with the absence of jasper biface rejects, this finding implied that the Iron Hill jasper flakes in the deposit did not result from on-site tool manufacture, but from the sharpening or retooling of artifacts brought already made to the site. In contrast, a main focus of quartz reduction was biface manufacture. Quartz flakes also displayed a relatively high frequency of simple platforms, characteristic of earlier stages of reduction, as well as a high frequency of crushed platforms, such as often result from bipolar percussion used to initiate fractures on pebbles or small cobbles. While the platform attribute data seem contradictory, they may merely indicate that there was no single trajectory followed for quartz reduction.

Cortex	IH jasper	Quartz	Pebble	Quartzite
Absent	92.7	92.2	58.3	22.7
Present	7.3	7.8	41.7	77.3
Platform Type	**IH jasper**	**Quartz**	**Pebble**	**Quartzite**
Simple / 2 Facet	12.5	50.0	11.1	41.2
Bifacial	75.0	12.1	44.4	0.0
Cortical	0.0	4.5	44.4	23.5
Crushed	12.5	33.3	0.0	35.3

Table 30. Additional Flake Attribute Data, Woodland I Deposit, Block B

Ceramic Artifacts

A relatively small number of ceramic sherds were recovered from deposits across the Lums Pond site. All were small, heavily weathered fragments, most of which were difficult to classify in terms of known ceramic types. They were categorized mainly by tempering agent, material such as sand or ground shell that was added to the clay to make it easier to work and fire.

Area 2

Seventeen identifiable fragments were recovered in Area 2: 15 from pit features and 2 from the plow zone deposit. Two of the sherds were tempered with fine-to-medium grain sand. The sand tempered sherds were similar to ceramics from the region associated with the early portions of the Woodland I period. The remaining thirteen were tempered with crushed schist. Similar ceramics have been referred to in Delaware as "experimental" wares (Cara Blume, personal communication, 1996). Experimental wares represent an early period in the development and use of ceramics in the region, when there were few established manufacturing traditions, and various tempers, vessel shapes, manufacturing methods, and surface treatments were being tested for effectiveness (Wise 1975; Custer 1989). Radiocarbon dates from the pit features containing the sherds indicated that both the sand- and schist-tempered types were in use at the Lums Pond site during the early part of the Woodland I period, around 2800 BP.

Area 3

Twelve identifiable ceramic fragments were recovered from Area 3. All were excavated from plow zone proveniences. Four sherds were sand tempered, 7 were shell tempered, and 1 was tempered with crushed quartz. The latter was identified as a type referred to as Wolfe Neck ware, a relatively thick ceramic ware that was typically quartz tempered and had an exterior roughened with cord markings or net impressions. The ware gives rise to the name for an associated cultural complex in the Piedmont/Fall Line, the Wolfe Neck Complex, dated to the middle portion of the Woodland I period.

The shell tempered sherds were generally characteristic of the so-called Townsend series wares, most commonly associated with the Woodland II period Slaughter Creek Complex on the Lower Coastal Plain. Townsend wares were a thin-walled, more highly fired type of pottery, often decorated with designs formed by incised lines. While most of the examples from Area 3 at Lums Pond were poorly preserved, several did bear parallel incised lines as evidence of decorated exteriors. Shell tempered Townsend wares were usually accompanied by triangular projectile points, such as were recovered from Area 3.

Spatial Study

Archaeology and Plow Zones

Like many prehistoric archaeological sites in northern Delaware, the Lums Pond site lay in an agricultural field. Much of the archaeological material comprising the site had been disturbed by repeated plowing over a number of years. Sites like this have often been ignored in archaeological research, dismissed out-of-hand as having little potential for providing useful information about prehistoric life in the region. Yet several studies in recent years have focused specifically on the question of whether artifacts recovered from plow zone deposits can in fact be informative and if so, what they may be able to reveal about the former inhabitants of the area. A common conclusion of these studies has been that within limits, important archaeological data do remain in sites that lie in plowed fields.

A plowshare moving through the soil will obviously disrupt the position of artifacts lying in its path. Yet plowing typically occurs in a back-and-forth pattern, and there is some evidence to indicate that over a long period of time, repetition of such a pattern may cancel out or equalize the amount of movement. While individual artifacts may be moved during plowing, groups of artifacts are not necessarily moved very far. Thus in some instances, certain distinctive clusters of artifacts, such as a group of potsherds and hearthstones from a cooking episode, or a mass of flaking debris from the manufacture of a tool, may remain essentially intact. Many factors, including the duration and direction of plowing, the sizes of the artifacts, and the characteristics of the soil, will determine how likely it may be for this effect to occur. Also important is the original configuration of the site. Many, closely spaced artifact clusters may become intermixed by plowing, whereas the best chance of identifying original areas of activity may be at a site containing relatively few, widely distributed clusters.

A related issue concerns the interpretation of plow zone artifact clusters at sites with deep deposits. It has been proposed that if the occupation layers at a site are relatively deep and only the upper portions have been plowed, it is possible that the distribution or location of artifacts in the plowed layer may serve as a guide to the discovery of artifact concentrations and features below. Studies have produced different conclusions as to how well this observation actually holds up in practice. Certainly the complexity of the site components and the stratigraphic relationships between the plowed and unplowed layers will be important factors in how comparable the artifact patterns may be.

Data Collection at Lums Pond

A major aim of the investigations at the Lums Pond site was assessing horizontal provenience data—where the artifacts lay within the site and how they related to prehistoric activity. This was undertaken in some detail using a computer modeling study. Artifact distributions were analyzed to identify distinct spatial elements that might indicate areas of specific activity or that might point to the locations of features preserved below the plow zone. The data used in this analysis were gathered during Stage 1 sampling of the three main site areas—Areas 1, 2, and 3. As described in Chapter VI, the samples consisted of the material recovered from a series of one-meter-square test units excavated as a 5 percent random stratified sampling of each area. Detailed study of each sample was conducted using commercially available computer software that performs a type of analysis known formally as cluster analysis. The results were displayed as topographic plans generated from grid-based data. Using the results of the analyses of random sampling, intensive investigation was carried out in the areas of greatest prehistoric activity in each location. Excavation blocks were placed in these areas to recover the concentrated artifact data remaining from the periods of site use represented. Additional cluster analyses was conducted for each occupation episode recognized in the blocks.

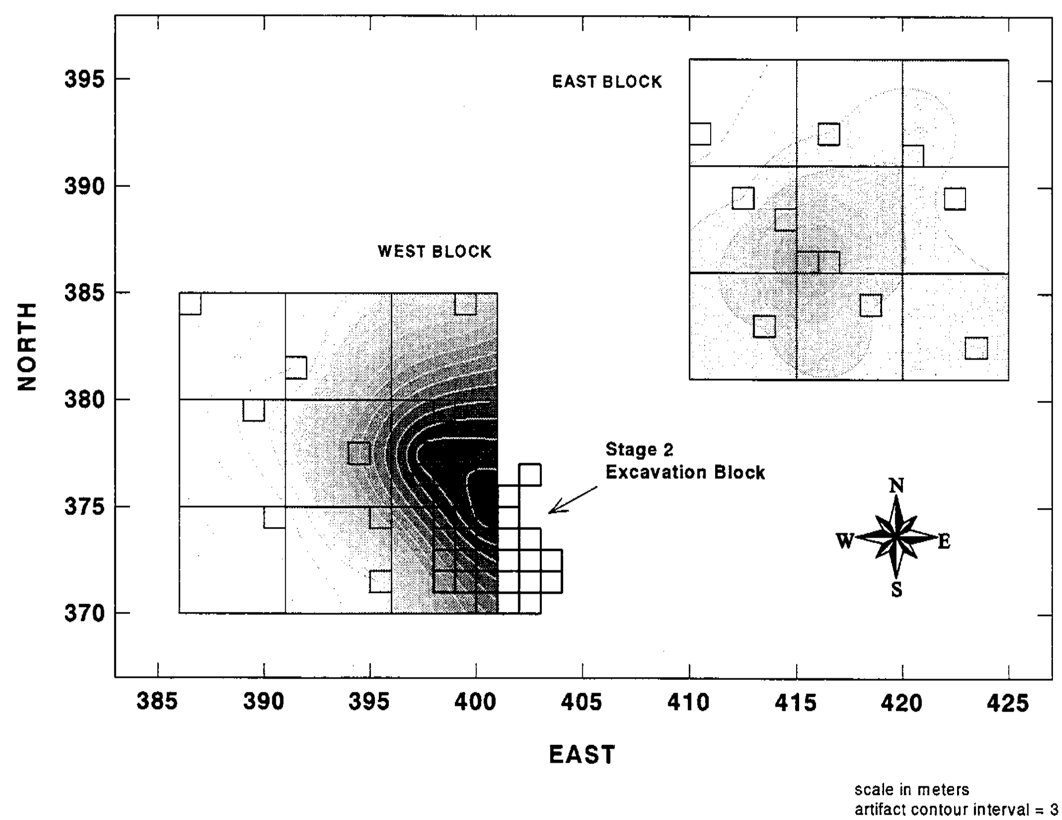

Figure 35. Results of Random Sampling, Area 1

Area 1

Two sampling blocks containing a total of 18 test units were used for the random sampling of artifact distributions in Area 1. The highest artifact frequencies, up to 48 artifacts per unit, occurred in the western block, and cluster analysis, depicted in Figure 35, suggested an area of concentrated activity there. Iron Hill jasper artifacts, including a stemmed projectile point dated to the early portion of the Woodland I period, were the most frequently occurring materials. Seven additional units were excavated to further investigate the artifact concentration. All of the artifacts were recovered from the plow zone, and there was no evidence of subsoil features.

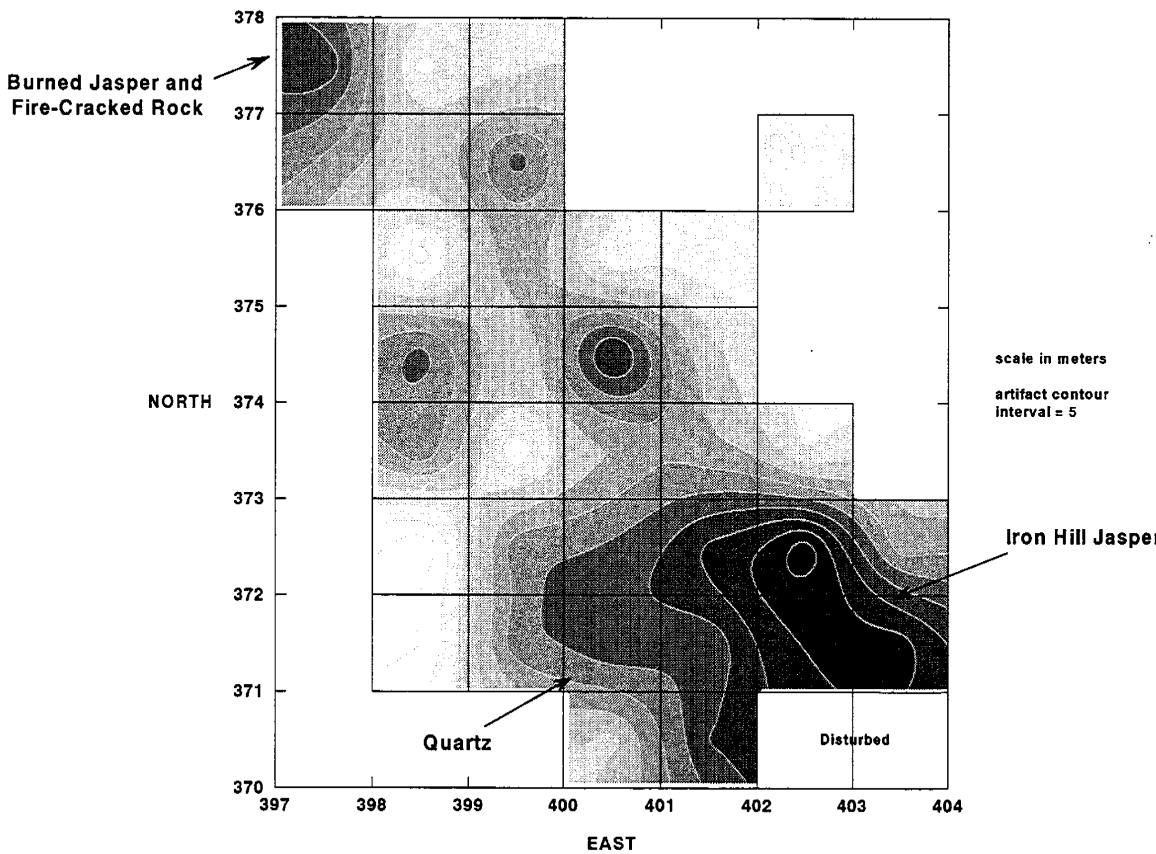

Figure 36. Artifact Distribution in Area 1 Excavation Block

A block excavation totaling 35 square meters was placed in the southeast corner of the western square focusing on the main artifact concentration. Cluster analysis of the artifact distribution, shown in Figure 36, resulted in a pattern that was reducible to two main features: a distinct concentration in the lower right half of the block, and a second, more scattered distribution in the upper left half. A limited number of artifact types were recovered from the block, which implied that the range of activities represented there was not great. The artifact patterning was interpreted in terms of repetitive knapping episodes, with one or more work areas occurring in the southern part of the block, separated from an additional area to the north

Quartz artifacts lay in different locations from Iron Hill jasper material throughout the block. There was little evidence of quartz to the northwest, while most was concentrated south and west of the main jasper cluster at the south end of the excavation. These findings suggested either separate work areas or different reduction episodes for the two raw material types. There was also evidence that some of the jasper had been heat treated. Small clusters of burned jasper flaking debris occurred in the north of the block near concentrations of fire-cracked rock that may have been the remains of a hearth used to bake the material. There was little indication of either fire-related artifact to the south, in contrast.

Area 2

Two sampling blocks measuring 30-meters-square were used in the Stage 1 investigation of Area 2. Seventy-two units were excavated in the random sampling of the area. The results of analyses of artifact distributions based on the sampling are depicted in Figure 37. The map depicted indicates that most of the activity in Area 2 lay to the east. Two of the most intensive artifact concentrations in the eastern sampling block lay near the center of the grid and along the western edge. There were variations in artifact types and raw materials in parts of the sampling block that suggested the potential for identifying different activity areas. Fire-cracked rock, for example, occurred in the main artifact clusters in the eastern sampling block but not along the northern edge of the block. In contrast, there was almost no Iron Hill jasper flaking debris or tools in the concentration at the center of the block.

There were fewer artifacts overall and less evidence of prehistoric activity in the west sampling block. Counts were generally higher near the western edge of the grid. Fire-cracked rock was present in each of the concentrations, but there was very little Iron Hill jasper in any part of the western block.

A large proportion of the projectile points from Area 2 were long-bladed, stemmed types classified as Poplar Island/Lackawaxen or Bare Island, both of which are diagnostic of the early portion of the Woodland I period. A second point type was also common, the Teardrop point, similarly dated to the early Woodland I. Both point forms were recovered from all parts of the sampling blocks, and the overlap of the types suggested that the deposits in Area 2 generally consisted of a single temporal component. Ceramic fragments and triangular points, the latter probably related to Woodland II use of the area, were also recovered, but in low numbers. They were widely scattered, suggesting considerably less intensive land use during later time periods.

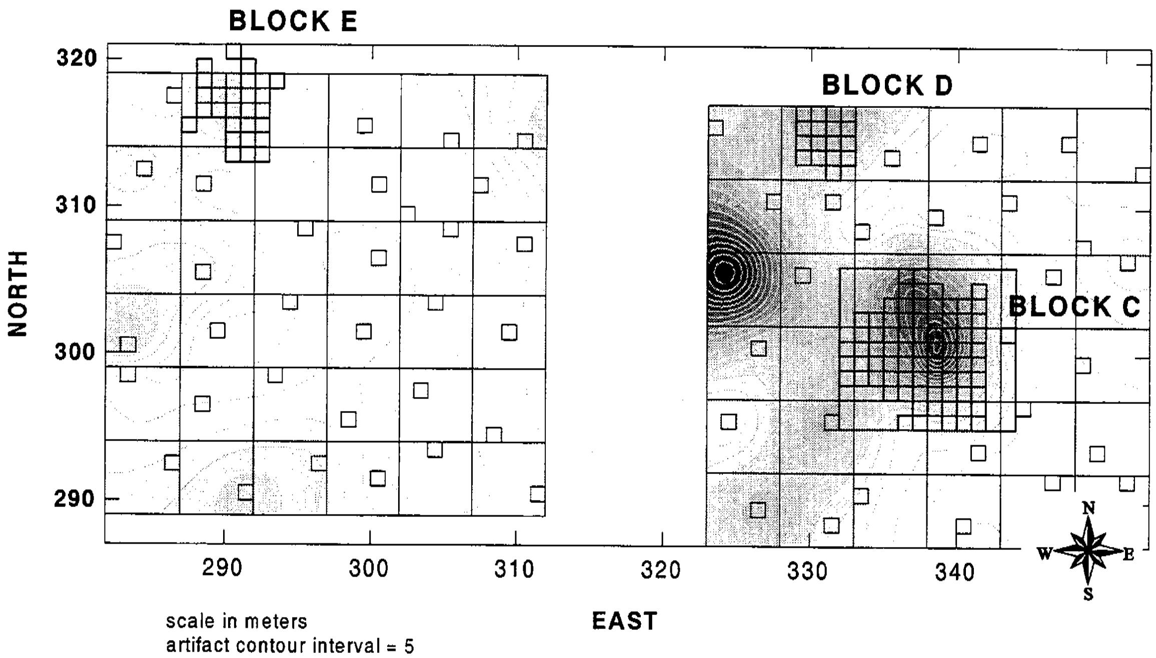

Figure 37. Results of Random Sampling, Area 2

Data recovery excavations focused on three parts of Area 2. The sampling excavations indicated that the deposits were not deep in most of the area and that almost all of the artifacts lay in the plow zone. Yet features were discovered below the plow zone in two sections of the site. One large pit feature lay along the north edge of the western sampling area, and a cluster of smaller pits lay near the center of the eastern area. A block of units was excavated in both areas to exposed the features and allow them to be excavated individually. One of the goals of the spatial study was to determine whether the distribution of artifacts in the plow zone bore any relationship to the location of features lying below. To do this, the distribution of artifacts, and in particular, of fire-cracked rock, was compared with the maps of feature locations. There were several possibilities as sources of the fire-cracked rock concentrations observed in the plow zone. These included material fed into the plow zone from the pit features themselves as the features were disturbed by plowing; hearths or cooking features associated with the features; or hearths from a later occupation unrelated to the underlying pits.

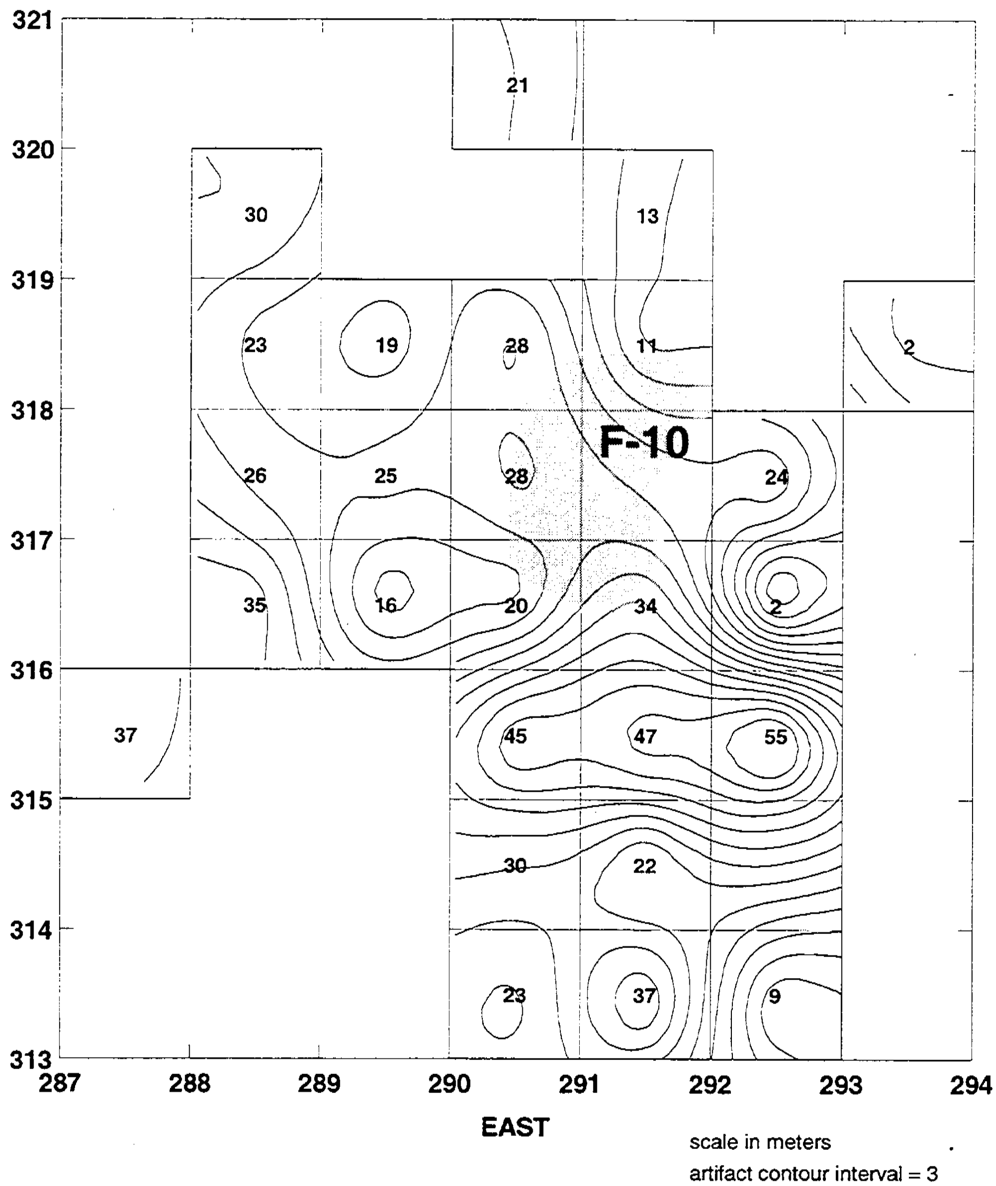

Figure 38. Comparison of Plow Zone Artifacts and Feature Location, Block E, Area 2

Figures 38 and 39 show maps of the two excavation blocks and the features revealed beneath the plow zone in each area. For clarity, artifact densities are shown with unfilled contour lines and artifact counts have been added for each excavation unit. Block E was excavated over the large pit feature, Feature 10. Analysis of the data from the block showed little correlation between the distribution of artifacts in the plow zone and the location of the pit. A similar situation was noted for Block C, excavated over the cluster of pit features in the eastern part of Area 2. Analysis of the random sample from the area had indicated a concentration of artifacts in the general region of the feature cluster. Examination at the higher resolution provided by the Block C showed little direct correlation. One reason for the lack of a one-to-one correspondence between the artifact clusters in the plow zone and the underlying features became apparent when the features were fully excavated: there were in fact few artifacts in the pits. The lone exception was Feature 19, on the north edge of the cluster, which contained a fairly large amount of fire-cracked rock. The unit directly over that feature yielded a relatively high artifact count (n=80), and much of the material was fire-cracked rock (n=53). In this case the pit may have been the source of some of the artifacts occurring in the plow zone above.

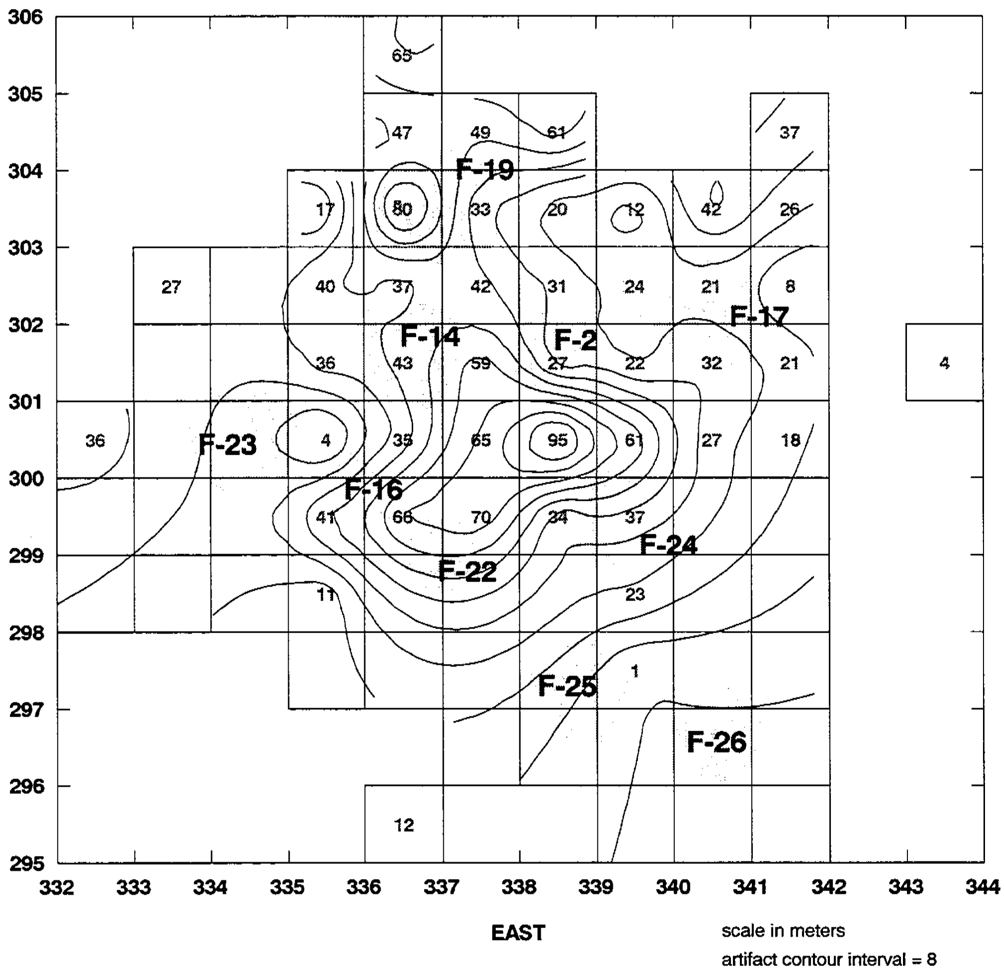

Figure 39. Comparison of Plow Zone Artifacts and Feature Location, Block C, Area 2

In spite of the fact that there was not a consistent correlation between the distribution of artifacts in the plow zone and the features below it, the features were located in areas with concentrated activity. This was evident in the general clustering of artifacts nearby. Significantly, these clusters were composed in large part of fire-cracked rock—from 33 to 55 percent of the artifact total in each case. This finding suggested that hearths for cooking or resource processing were located in immediate association with the pits. That the hearths were associated with the pits was presumed from temporal data, including radiocarbon dates and diagnostic artifacts, linking the plow zone and sub-plow zone deposits.

The third block excavation in Area 2, Block D, lay to the north, where random sampling located a small area in which artifacts occurred in quantity in the soil beneath the plow zone. Comparison was made between the horizontal distribution of artifacts in the plow zone and sub-plow zone levels, and several distinct differences were noted (Figure 40). There were various centers of concentration in the plow zone deposit, while below, artifacts were concentrated in only a single unit. Further examination of the sub-plow zone layer showed that Iron Hill jasper flaking debris was spread evenly across the block, while quartz, pebble chert, and ironstone were clustered to the east. Quartz and ironstone displayed the tightest clustering. Most of the flakes in this area were small in size. Several bifaces and unifaces of quartz and ironstone and a small hammerstone were recovered from nearby units as well. The distribution suggested that the artifacts were the remains of an isolated tool manufacturing area. Judging from the small sizes of the flaking debris, the work appeared to have been centered on the finishing or maintenance of tools.

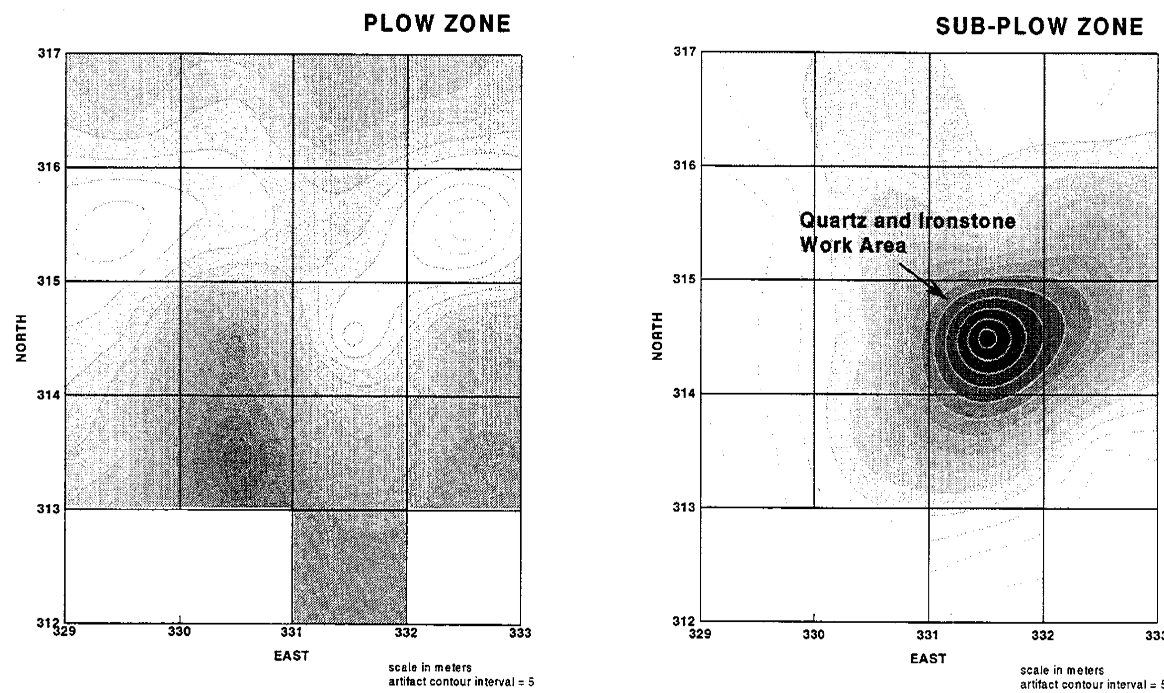

Figure 40. Comparison of Plow Zone and Sub-Plow Zone Artifact Locations, Block D, Area 2

Area 3

Area 3 lay in the southern portion of the site, bordering one of two streams that formed the edge of the site area. Deep floodplain deposits were found along the stream containing artifacts buried as deeply as 85cm below the current ground surface. The random sampling of Area 3 consisted of 41 test units excavated in an area measuring approximately 820 square-meters running along the stream (Figure 41). From these excavations, the extent of the buried floodplain and the terrace that formed its north edge were mapped along with artifact concentrations contained in the floodplain.

Two main of artifact clusters were evident. The heaviest concentration lay just southeast of the center of the grid. This area also saw the densest occurrence of fire-cracked rock, suggesting the potential for extensive fire-related activity in that location. A second concentration of artifacts lay to the northeast, with fire-cracked rock making up less of the total. In only one instance was there variation in the clustering of stone material types. Quartz occurred in conspicuously low counts in the central area but in higher counts to the northeast.

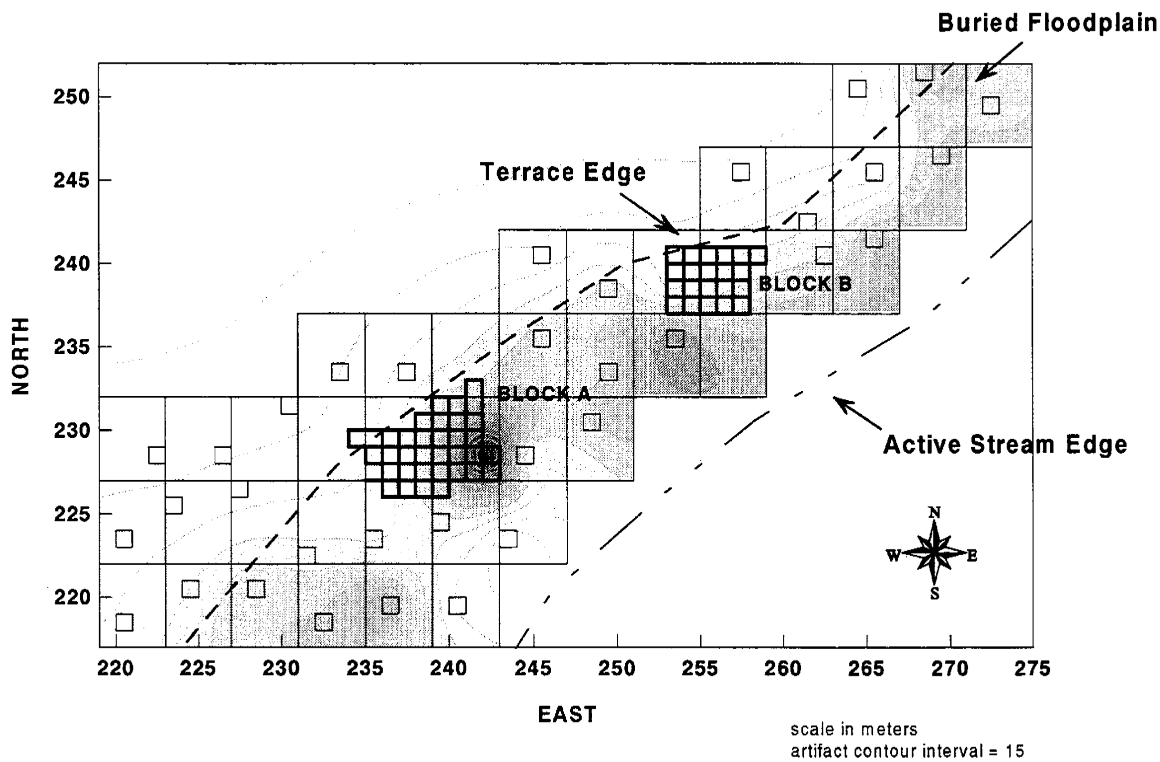

Figure 41. Results of Random Sampling, Area 3

Various projectile points and ceramic sherds were recovered from Area 3, representing several temporal periods. There was little chronological pattern to the artifacts other than a tendency for more late material than early. In addition, there was no evidence of clustering by period to suggest that different parts of the area had been occupied at different times. Levanna (Woodland II) and Teardrop points (Woodland I) were the most frequent types, and both were found in all parts of the area. Other Woodland I types included Rossville, Adena Stemmed, Fishtail, Bare Island, Poplar Island/Lackawaxen. Two serrated points from the Archaic period were also recovered. Ceramics, mostly ascribed to the Woodland II period, were scattered across the area as well.

Intensive data recovery investigations were conducted in two locations chosen on the basis of artifact distribution and stratigraphy. Both excavation blocks, Block A and Block B, are shown in Figure 41. They were placed in areas that contained deep sub-plow zone deposits as well as artifact concentrations below the plow zone. Note that the illustration shows artifact distributions from the plow zone and sub-plow zone combined, and thus the block locations do not correspond with the artifact concentrations shown on the map.

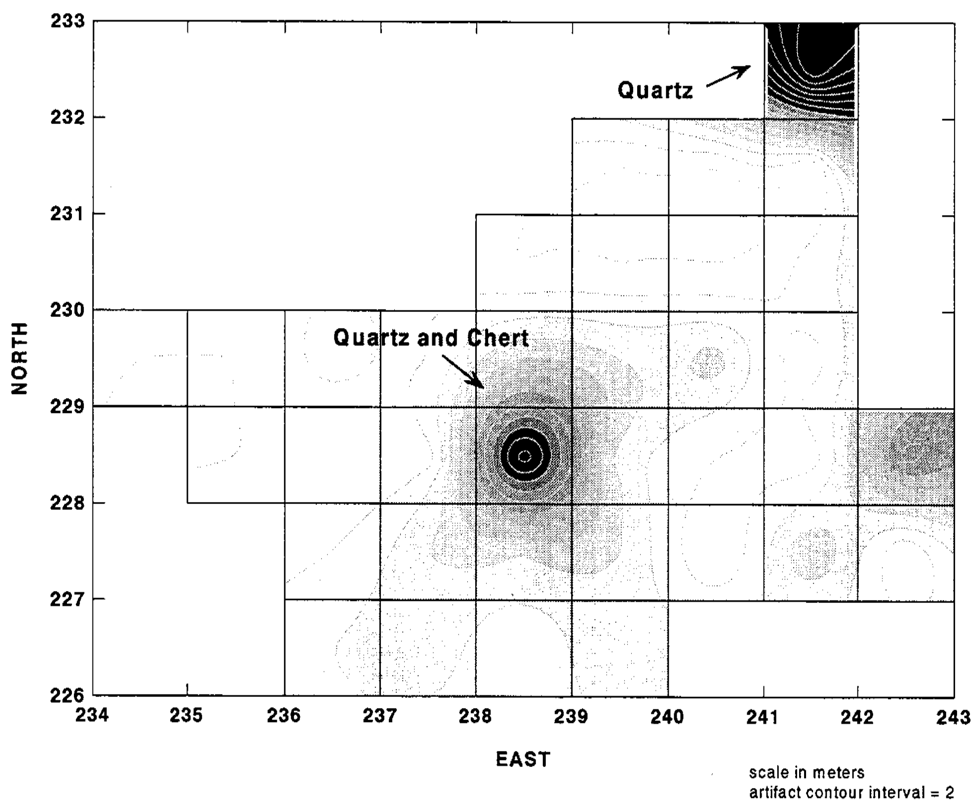

Figure 42. Artifact Concentrations in Woodland II Layer, Block A

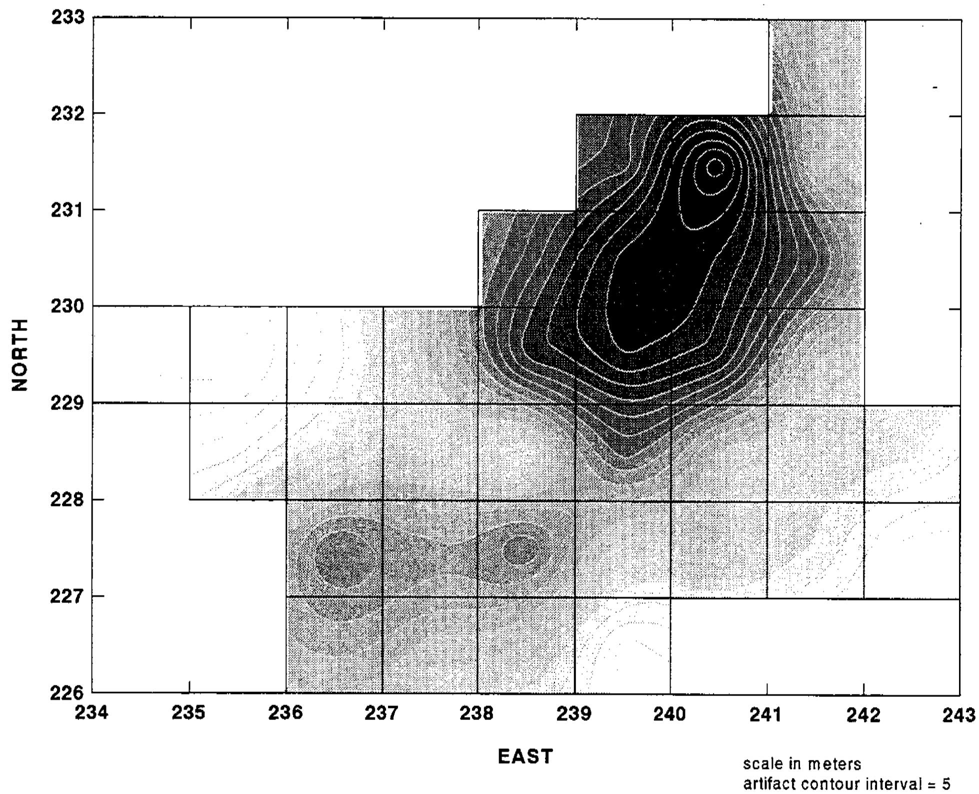

Figure 43. Artifact Concentrations in Woodland I Layer, Block A

Block A

There were two separate occupation layers below the plow zone in Block A. Radiocarbon dates from the upper layer, Stratum C, indicated that the occupation there occurred sometime around 430 years ago, corresponding to the Woodland II period. Two small artifact clusters were mapped (Figure 42). One lay near the center of the block made up of flakes and chips of quartz and pebble chert. The second lay to the north and consisted largely of quartz debris. Little fire-cracked rock was present. The artifacts appeared to represent portions of two stoneworking areas, one focused on quartz and chert reduction, the other on quartz alone.

The lower occupation zone was contained in Stratum D/E. Radiocarbon dates indicated that the layer was deposited around 3330 years ago, a time corresponding to the middle portion of the Woodland I period. Artifacts in the stratum were clustered in two areas, as shown in Figure 43. For the most part, the artifact and stone types were similar in both concentrations. Quartz flakes occurred in both areas along with quartz cores and bifaces, indicating that several tool forms may have been produced from that material.

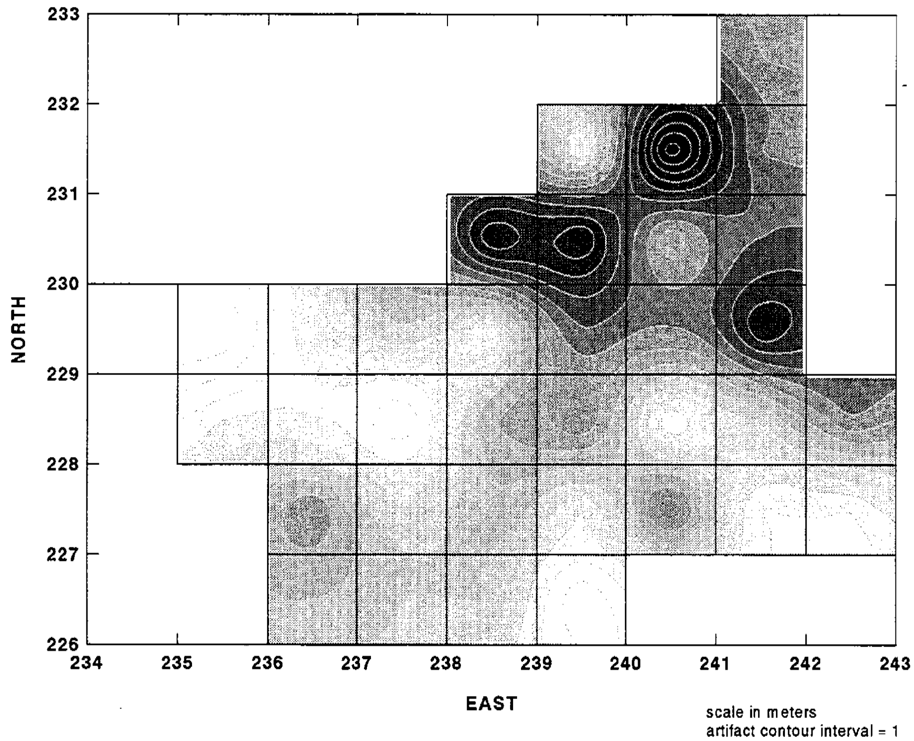

Figure 44. Concentrations of Heated Jasper and Chert in Woodland I Layer, Block A

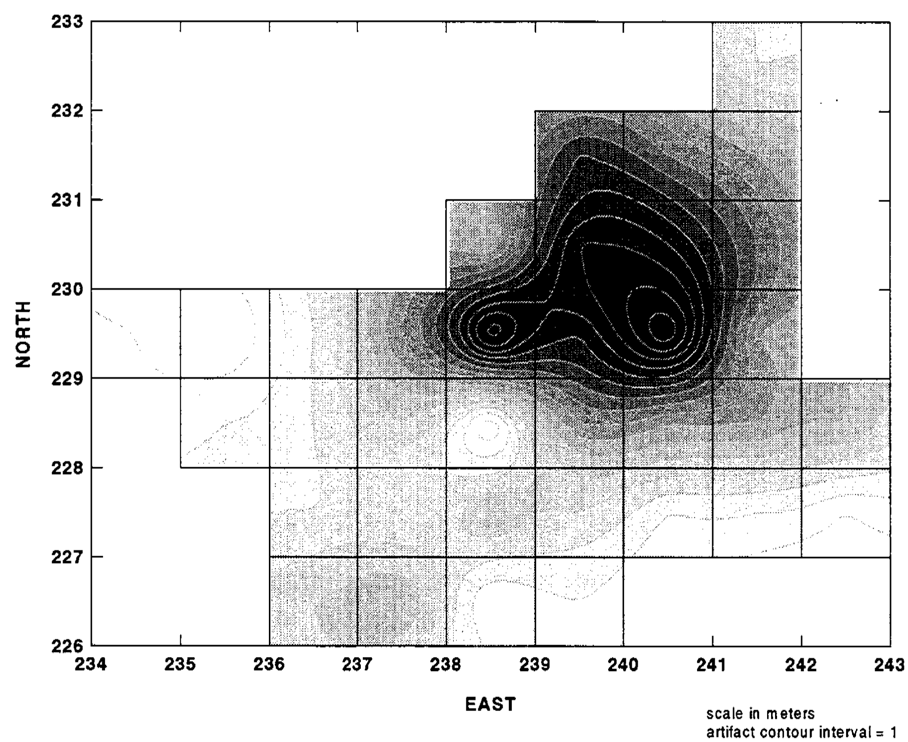

Figure 45. Concentration of Fire-Cracked Rock in Woodland I Layer, Block A

Chert flakes and unifaces were also found, suggesting that chert had been used to produce a specific type of scraping tool. Iron Hill jasper flakes occurred throughout both areas, while quartzite flakes were concentrated to the south. There was also evidence of the heating of some materials. Figures 44 and 45 show the clustering of heated or burned flakes of jasper and chert, and separate but associated fire-cracked rocks in the northern part of the block (Plate 27). There was relatively little fire-cracked rock elsewhere in the stratum suggesting that the material comprised the remains of one or more hearths, possibly disassembled by re-use of surfaces.

Plate 27. Fire-Cracked Rocks, Block A, Area 3, View East

Block B

As in Block A, there were two separate occupation layers below the plow zone in Block B. Both layers were associated with the occupation zones in Block A and dated to the same periods. Stratum C, a Woodland II deposit, contained artifacts clustered in the central and northern parts of the block, as shown in Figure 46. The artifacts consisted of

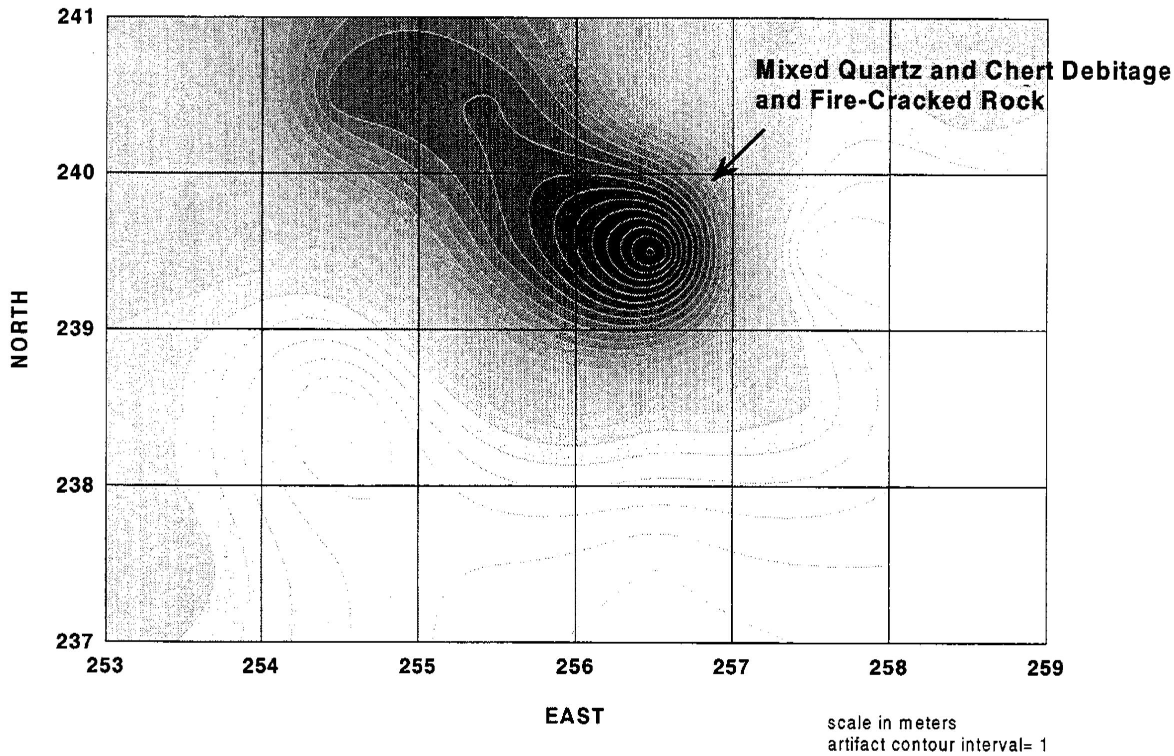

Figure 46. Artifact Concentrations in Woodland II Layer, Block B

fire-cracked rock, along with quartz and chert flaking debris. This material appeared to have been the remnants of a stoneworking area with a small hearth nearby.

The underlying layers in Block B were dated to the middle portion of the Woodland I period. There were two generalized artifact concentrations in the stratum (Figure 47), although analysis of artifact type frequencies showed that they may have been part of a single work area. Several discrete groups of debris were discerned within the overall clustering. Quartz and Iron Hill jasper flakes were found in separate areas in the southern part of the block. There was a relatively large number of quartz chips in the debris, which implied the use of bipolar percussion in that area. A second concentration of mixed quartz and jasper debris lay near the center of the block, along with fire-cracked rock. The burned rock appeared to be remnants of a small fire-related feature, probably a hearth, lying on the northern edge of the artifact concentration.

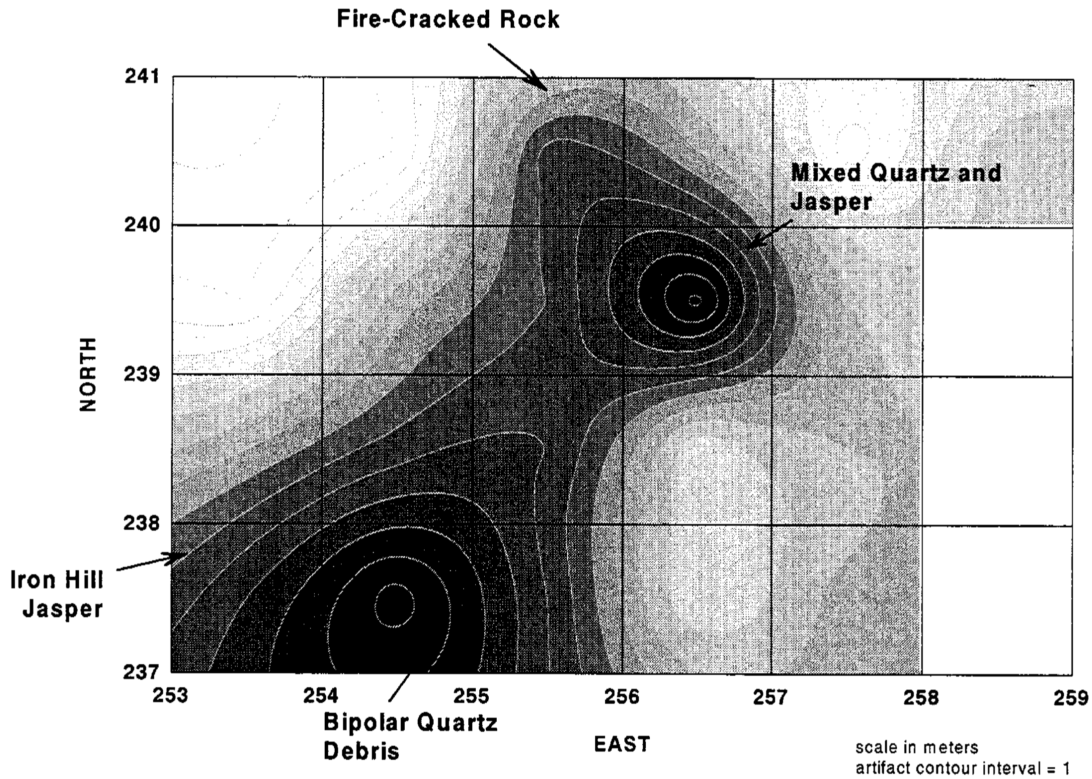

Figure 47. Artifact Concentrations in Woodland I Layer, Block B