6.1 Feature Analysis and Description

6.1.1 Methodology of Field Classification

Soil anomalies that were identified during the excavation of individual test units and examination of the mechanically stripped trenches were categorized into the types described below. This typology was based primarily on characteristics that were observable at the surface, when features were cleaned off and mapped, supplemented with information from the excavation of features. The typology included characteristics of shape, soil matrix, and artifacts as identified in the field, before the laboratory analysis of artifacts was conducted.

The classification included five types relating to the prehistoric occupation of the site, one type relating to the historic occupation, and four types not relating to the cultural occupation of the site.

Area of Intense Activity (AIA): These features had several defining characteristics which differentiated them from other feature types found within Site 7K-F-11/169. AIA features were found to be rather large (generally >2-3 m in diameter) and had diffuse boundaries with the surrounding soil matrix. These features were generally shallow but contained relatively high counts of lithic debitage and tools. They may be representative of activity areas, such as lithic reduction. Alternatively, because they were preserved below the plowzone but were shallow, it was possible that AIAs were living floors of semi-subterranean structures.

Fire Cracked Rock (FCR): These features were defined by the presence of moderate to high counts of FCR at the surface. FCR features were generally shallow and contained moderate to high counts of FCR and lithics. Some FCR features may have been remnant hearth areas which were disturbed by plowing.

Pit: Pits describe a large range of features with several defining characteristics. Pit features were generally large ovoid shaped stains with slight color variation from surrounding soil matrix. Pit features were generally deeper than other feature types and contained little stratigraphy (usually one stratum of fill). Artifact density varied greatly from one pit to another, with the highest densities found in their upper levels.

Shallow Basin: Shallow basins were shallow features with rounded-bottoms and little variation in stratigraphy of fill. Shallow basin features varied in overall size, but were generally ovoid in plan view. Artifact densities within shallow basins were low compared with other cultural feature types.

Cylindrical: Cylindrical pits contained a greater degree of stratigraphic separation than other cultural feature types found within the project area. The stratigraphy of feature fill was generally characterized by alternating strata of dark and light soils. Cylindrical pits were generally ovoid in plan view with dark soils compared to the surrounding soil matrix. Artifact densities varied within the strata of cylindrical pits, but were generally low.

Post Hole/Mold: Post hole/mold features were characterized by deep feature matrix with little or no stratigraphic separation of soils. These features were generally small and contained few artifacts. Three of the post hole/mold features were identified as historic in origin. The others were problematic, but were assumed to also be of historic origin, based on similarity of form. These were therefore considered cultural features associated with the historic component of the site, but were not associated with the prehistoric occupation.

Possible Tree Throws: These features shared certain characteristics which defined them as possible tree-throws. Most features of this type consisted of a primary stain of dark soil which was generally ovoid or T-shaped. Adjacent to the area of darkened soil there often was a sequence of E horizon, B horizon and C horizon soils which were tilted vertically, perpendicular to the surrounding soil matrix. Adjacent to this area of displaced soil column was another area of dark soil which was generally ovoid in plan view. Not all of the features included in this type had the second dark area of soil. These features also had a consistent profile, consisting of a dark wedge shaped area of soil (the first ovoid or T-shaped stain) adjacent to displaced soil column with strata ranged perpendicular to surrounding soils. Artifact density varied within features of this type, with some having extremely high counts while others contained little cultural material.

Non-Cultural: These were determined to be soil anomalies of non-cultural origin. They represented a wide array of shapes that were amorphous to ovoid in plan view. These anomalies were mostly related to episodes of bioturbation and root action.

Shallow Basin with Taproot: Shallow basin with taproot features were characterized by a shallow basin of ovoid shape and a deep ovoid area of darker soil which was the taproot. These features contained little stratigraphic separation within either the basin or the taproot. They were generally thought to be small tree or shrub disturbances. Artifact densities within these kinds of features were very low.

Modern Trench: This type of feature was characterized by a linear area of disturbed soil. Stratigraphy was mixed and non-discernable. Modern artifacts were prevalent within them.

6.1.2 Results of Field Classification

A total of 437 soil anomalies were identified below the plowzone, either in hand excavated test units and blocks or in the trenches that were mechanically stripped of topsoil. A total of 245 anomalies (56%) were partially or completely excavated. An additional 65 anomalies (15%) were closely examined in plan view or probed sufficiently to determine with a high degree of certainty that they were of natural origin. In all, 310 of 437 anomalies (71%) were examined during the Phase III excavations. The frequency of each feature type, based on the typology developed during excavation, is shown in Table 6.1.

Table 6.1 Field Classification of Features

Probable Cultural/Prehistoric	
Area of Intense Activity (AIA)	8
Fire Cracked Rock (FCR)	15
Pit	31
Shallow Basin	40
Cylindrical Pits	3
Total Cultural/Prehistoric	97

Non-Cultural or Historic/Modern	
Post Hole/Mold	7
Possible Tree Fall	62
Non-cultural (other)	134
Shallow Basin w/ Taproot	9
Modern Trench	1
Total Non-Cultural/Modern	213

6.1.3 Refinement of Typology for Cultural Features

Methodology

All soil anomalies that were tentatively identified as cultural features were included in the post-excavation analysis of feature types. The category of shallow basin with taproot was also included, to determine whether these were cultural features with intrusive roots, or non-cultural soil anomalies. Parameters of feature form, stratigraphy of feature fill, and associated artifact contents were examined. The aim was to determine whether the categories reflected separate and distinct types, as well as whether any individual features needed to be reclassified.

Morphological characteristics that were examined included feature diameter, feature depth, and feature shape. The area and volume of the feature were calculated from these measurements, using different geometric formulas depending on the general shape of the feature. The average of the feature length and width was taken, to provide a single measure of feature diameter for the calculation of feature area and the ratio of width to depth.

The feature fill was characterized in terms of the number of soil strata, the overall frequency of charcoal, and soil color. The artifact contents of features were tabulated, including weights and/or numerical counts of FCR, ceramics, steatite, ground stone tools, flaked stone tools, other lithics, bone, shell, and historic artifacts. These detailed feature characteristics are listed in Section 10.5.

The volume of the excavated portion of each feature was used to calculate the density in number per m^3 of the most common artifact types, to facilitate comparison between features. This was found to be useful for examining the frequency of FCR and lithics. Other categories of artifacts

occurred in such low frequencies or were present is so few features, that they were not useful for numerical comparisons.

Analysis of Features

Volume: The feature volume was calculated, using a variety of formulas appropriate to the calculation of different geometric shapes, such as sphere, cylinder, cone, or ellipse. For features that were only partially excavated, the volume was extrapolated from the recorded dimensions.

The distribution of volume for each feature type is shown in Figure 6.1. Features with the smallest volumes were separated in the first row at the left (volume < 0.1 m^3), while the other rows were grouped in increments of 0.5 m^3. As anticipated, both posts and FCR features had low volumes. Basins also had low volumes, since these features were generally smaller and shallower than pits. Pits varied widely in volume, encompassing a range of sizes. However, the continuous distribution did not support the division of the category into two subtypes. There were only three cylindrical pits in the initial fieldwork classification, and they had moderate

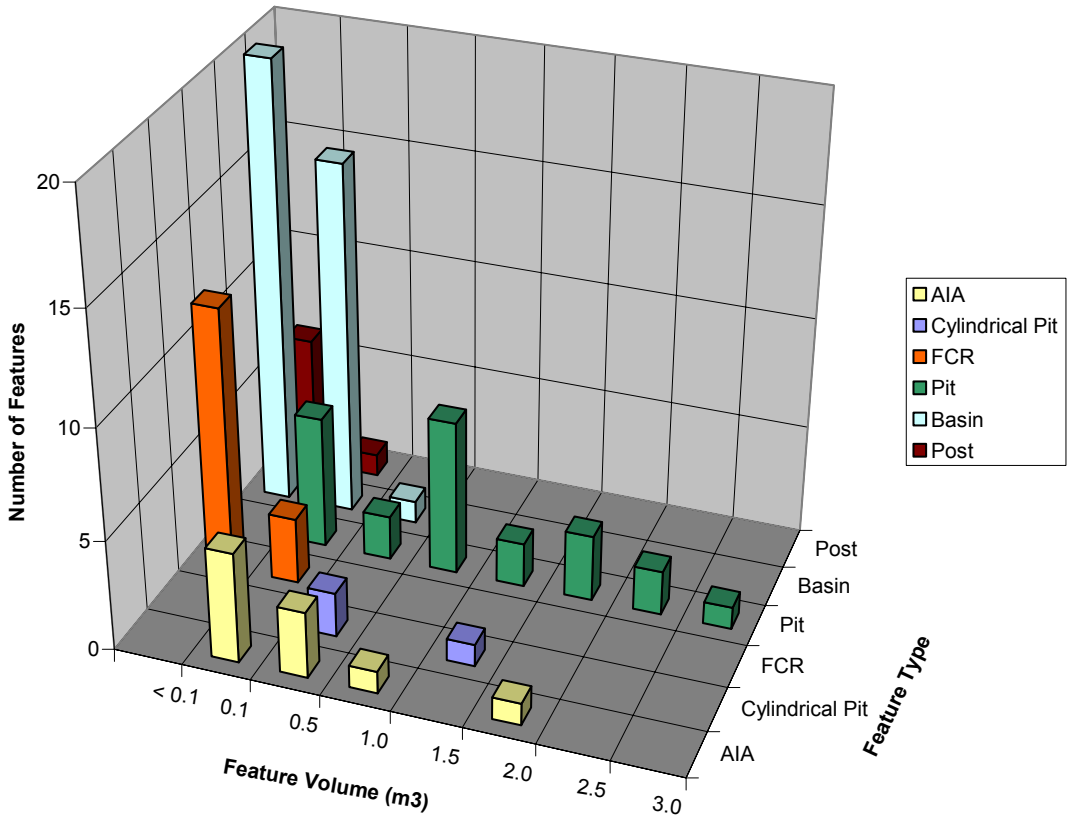


Figure 6.1 Distribution of Feature Types by Volume of Feature

volumes. The AIA features generally had low volumes. Most AIAs were shallow, but two with large surface areas and greater depth had higher volumes.

Feature 6 was classified as a pit. It had been partially excavated in Test Unit 13, but not sufficiently to allow calculation of volume or other measures. Since it contained no cultural material, it was eliminated from the analysis of features.

Width/Depth Ratio: Features were compared in terms of their physical dimensions, which provided a better measure of feature shape than total volume. Most features were round or ovoid in shape, making it easy to compute the average of the length and width to generate a single measure, the average width. The ratio of average width to depth was then calculated. Features with a limited surface area and great depth, such as post molds, would be expected to have a low ratio of width to depth. At the opposite end of the scale, features with a large surface area and relatively little depth, such as AIAs, would be expected to have a high ratio.

A chart of the distribution of width/depth ratios by feature type (Figure 6.2) showed the results in increments of 5, with all the largest values grouped in the last row at the right (> 35). Posts,

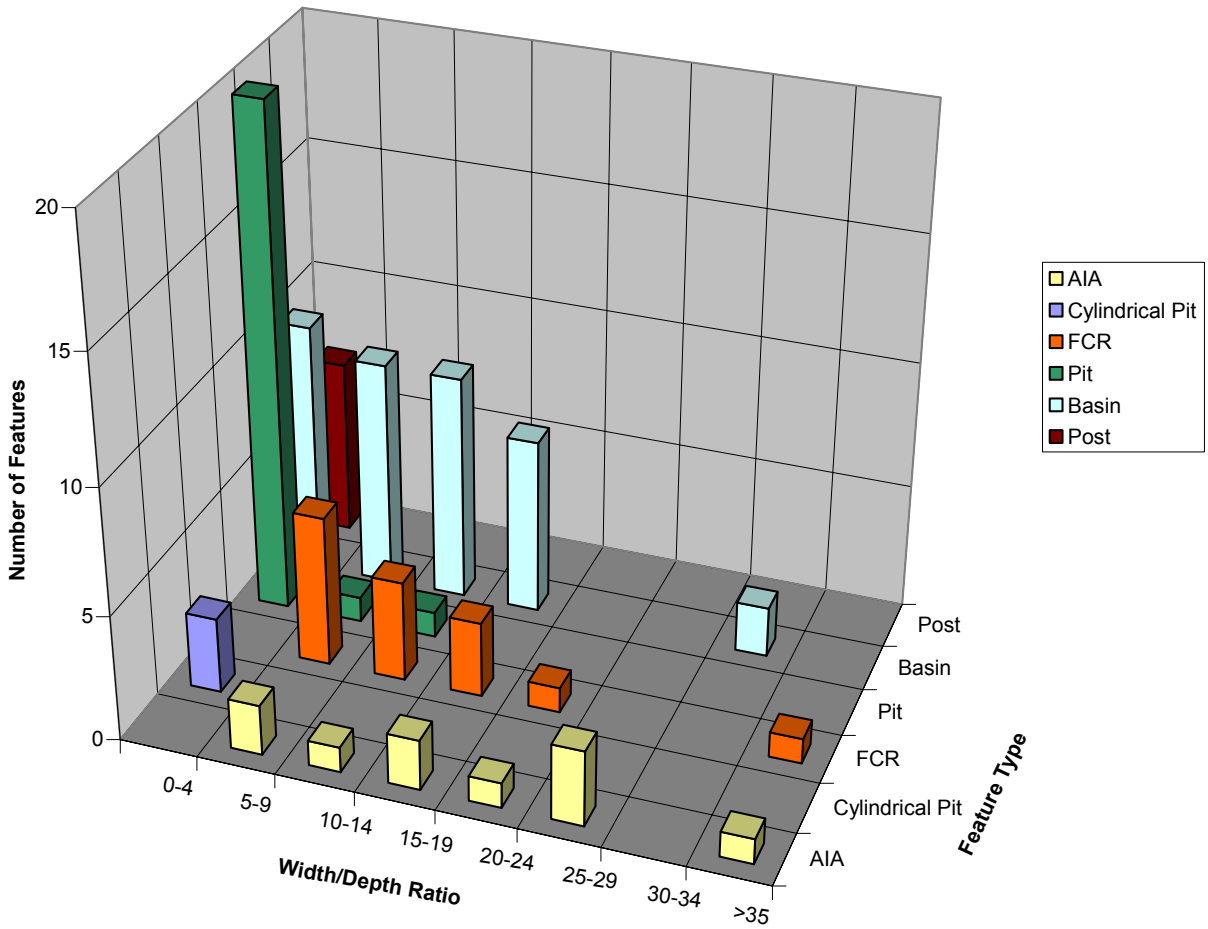


Figure 6.2 Distribution of Feature Types by Width/Depth Ratio

which have a small surface area and moderate depth, had a low ratio as expected. Posts were identified as historic features, and were therefore eliminated from further analysis, which focused on the prehistoric feature types. Pits and cylindrical pits had low ratios, resulting from the greater depth of these feature types. The AIA category displayed a range of values. AIAs were generally shallow, but varied in area. Feature 38, which had an extremely high value of 77, had the largest surface area.

Basins and FCR features both had generally low values. The outlying features with high values in these two categories were examined in greater detail. In the FCR category, Feature 119 stood out as having a high value of 36. It was only 5 cm deep, suggesting that it was the truncated remnant of a feature. In the basin category, Features 30 and 254 had high values of 31 and 32, respectively. Both features were very shallow, with depths of 2 cm. Feature 254 was retained in the basin category despite its shallow depth, because it contained cultural materials. A new category, stain, was developed to include features with surface area but almost no depth (depth of 1-4 cm). Three basin features were reclassified as stains, Features 30, 37 and 50. Stains contained no cultural material, and were therefore not included in the analysis of FCR and lithic artifact frequencies in prehistoric features.

Density of Fire-Cracked Rock: The weight of FCR recovered from each feature was recorded. The volume of the feature excavated was used to calculate a standardized density of FCR per cubic meter of feature fill (FCR/m^3). It was anticipated that FCR features would have high densities, while features that were not associated with fire-related activities would have lower densities.

Features with very low volumes produced disproportionately high values for density (Figure 6.3). In the basin category, most features had low to moderate densities of FCR. Features 80, 254, and 290, which had anomalously high densities of FCR, all had extremely small excavated volumes. All three of these features had depths of 5 cm or less.

In the pit category, most features also had low frequencies of FCR. This suggested that most pits had functions not related to fire and cooking, such as storage. Three pits had higher densities (Features 341, 371, and 376). These reflected true variation in FCR content and were not an artificial product of very low feature volume. These features may have been associated with fire-related activities.

In the FCR category, Feature 27 was found to contain no FCR. Review of the excavation data showed that this feature was associated with a large tree fall, and was therefore reclassified as non-cultural. Feature 210, which had a very low density of FCR, was reclassified as a basin as a result of this analysis. The other features in the FCR category all contained moderate to high densities of FCR.

The three cylindrical pits all had very low densities of FCR. The AIA category included a range of features with low to moderate densities of FCR.

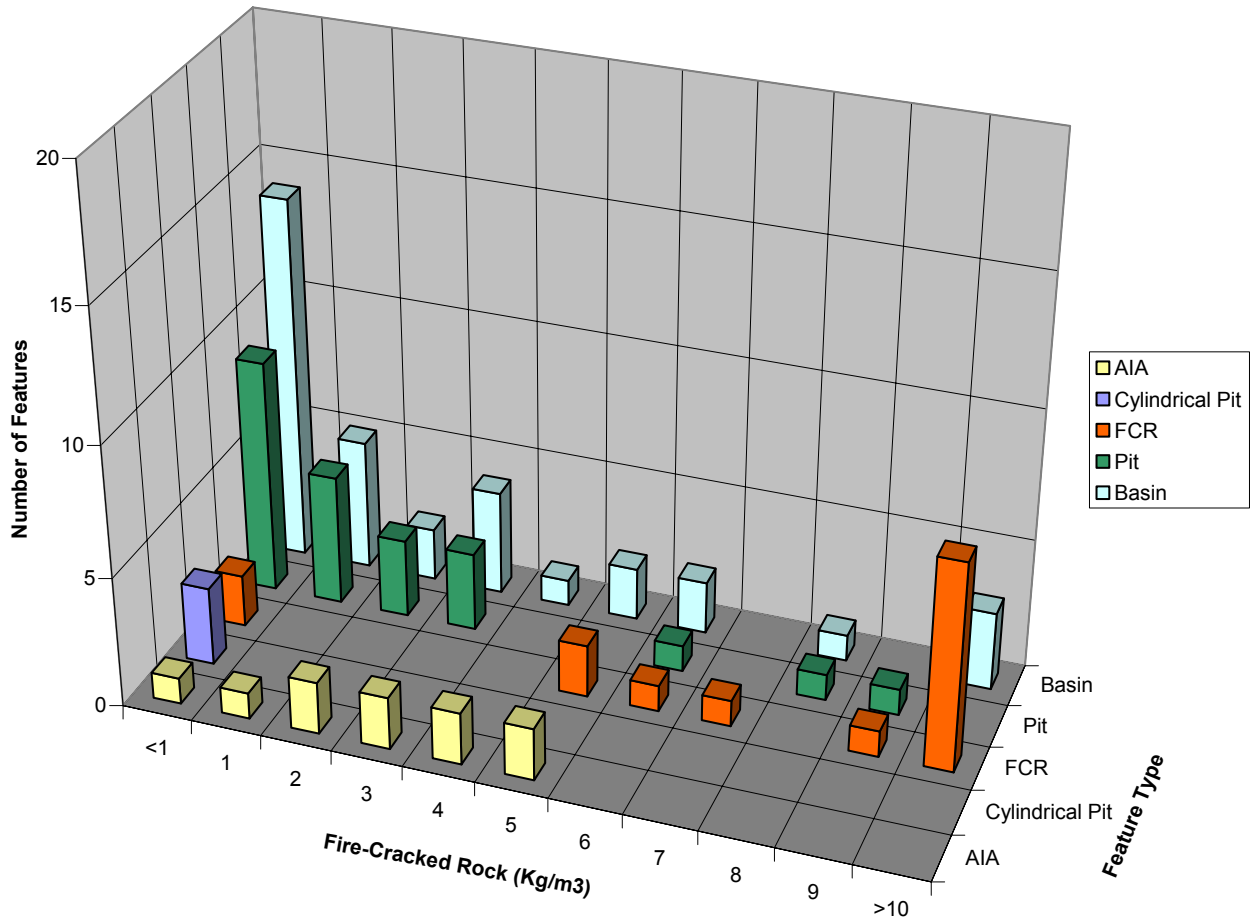


Figure 6.3 Distribution of Feature Types by Density of FCR

Density of Lithic Debitage: The number of lithic artifacts, excluding ground stone, was calculated for each feature. To standardize across the variation in feature volume, the density of lithics per cubic meter of feature fill (lithics/m^3) was calculated.

The results for lithics were similar to the results for FCR, in that features with very low volumes produced disproportionately high values for density of lithic artifacts (Figure 6.4). In the basin category, the three features with values over 1,000/m^3 (Features 41, 254, and 329) all had very low volumes. Most basin features had very low densities of lithic artifacts, with fewer having moderate values. The pit features showed a similar distribution, with most pits having low to moderate values for lithic density. Feature 371, the pit with the highest density of lithics, was a large feature that was also notable for other characteristics. Its artifacts included numerous grooved abraders and microtools (see below Section 6.4), as well as a high frequency of FCR.

The FCR category included three features with no lithics, and others with low to moderate densities. The single feature with a very high value (Feature 229) contained only two lithic

artifacts, the density being a product of its very low volume. The cylindrical pits all had low densities of lithics.

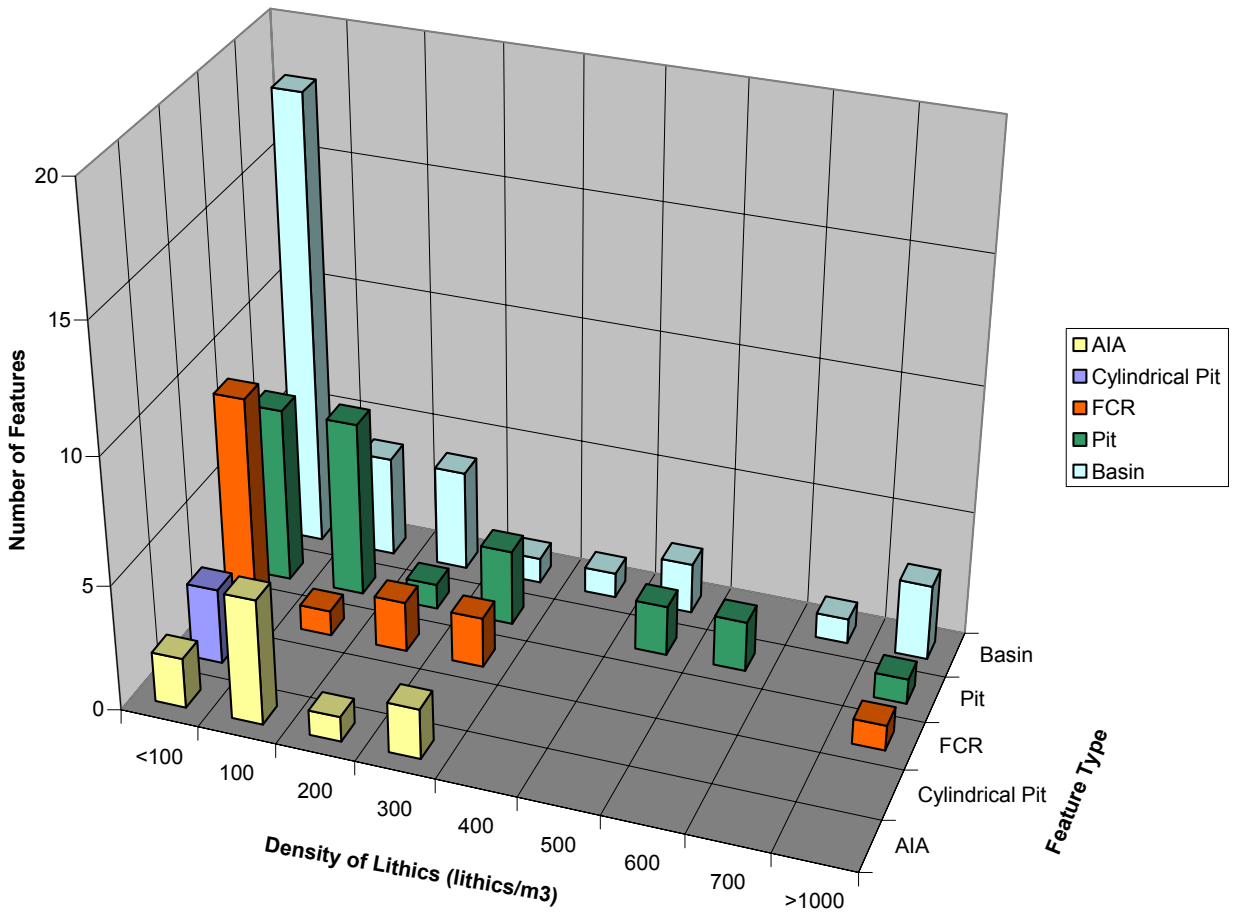


Figure 6.4 Distribution of Feature Types by Density of Lithic Artifacts

It was anticipated that AIA features would have moderate to high values for lithic density, because these features were defined in part by the increased presence of artifacts, compared to the surrounding soil. However, the distribution showed low to moderate values. AIAs had large surface areas and were generally shallow, resulting in generally moderate volumes. The frequency of lithics recovered from these features varied. This variability suggested that the AIA category may represent more than one type of function or activity, but no clear difference could be identified, as a basis for subdividing the type.

6.1.4 Revision of Feature Classification

The results of the first stage of feature analysis showed that the categories defined in the field were generally valid in terms of identifying different types of features. However, several areas

of overlap were also identified. Feature definitions were modified and several features re-assigned to different types to clarify the distinctions between types.

The difference between basins and pits was not apparent in the distribution of FCR or lithic artifacts. The separation between these two categories was based more on form than content. Both basins and pits were characterized by sloping walls and rounded bases, with shallower features classified as basins and deeper features classified as pits. Therefore, an arbitrary depth of 30 cm was used to separate the two categories. As a result, one shallow pit (Feature 341) was reclassified as a basin and eight deep basins (Features 31, 41, 43, 48, 110, 203, 273, and 291) were reclassified as pits. As mentioned above, three of the shallowest basins were reclassified as stains (Features 30, 37, and 50). Review of excavation data showed that Feature 371 should be reclassified as two overlapping but distinct features (Features 371 and 122), both of which were classified as pits.

The category of cylindrical pits was also redefined. The type was originally based on the cylindrical shape of the features, plus the presence of multiple strata in their fill. Review of the excavation data showed that one of these features did not properly fit the profile. Feature 350, which had a hemispherical rather than cylindrical shape and only two strata of fill was therefore reclassified as a pit. Of the three originally identified cylindrical pits, Features 10 and 178 were retained as cylindrical pit subtype A. Examination of field data indicated that three pit features had similar cylindrical shapes but lacked the multiple strata of fill. Features 330, 376, and 418 were therefore classified as cylindrical pit subtype B, which was characterized by a homogeneous single stratum of fill. Thus redefined, the cylindrical pit category included five features.

The FCR feature category was also reviewed. Because it was defined on the basis of the presence of FCR, this category included a variety of forms. These ranged from surface scatters with very little depth or volume to deeper basin-like features. Feature 27 had been classified as FCR but contained no FCR. It was reclassified as non-cultural in a review of tree throws. Feature 210 had a low density of FCR and was reclassified as a basin. Feature 46 was a surface cluster of FCR that overlaid a larger pit, Feature 48. The two were therefore merged into a single feature, classified as a pit.

Soil anomalies resulting from tree throws were among the non-cultural features identified at the site. A review of field data for tree throw features showed that seven of the cultural features should be reclassified as parts of large, complex tree throws. This included two pits (Features 83 and 180), two FCR features (Features 27 and 32), one basin (Feature 325), one basin that had been reclassified as a stain (Feature 30), and one AIA (Feature 201).

To further explore variation in the artifact content of features of different types, correlations between the two artifact density variables with sufficient sample sizes to generate reliable frequency distributions – lithic density and FCR density – were examined by feature type. The results are shown in Figure 6.5 and revealed distinct differences among the various feature types in the co-occurrence of these two variables. They are discussed more fully below by individual feature type.

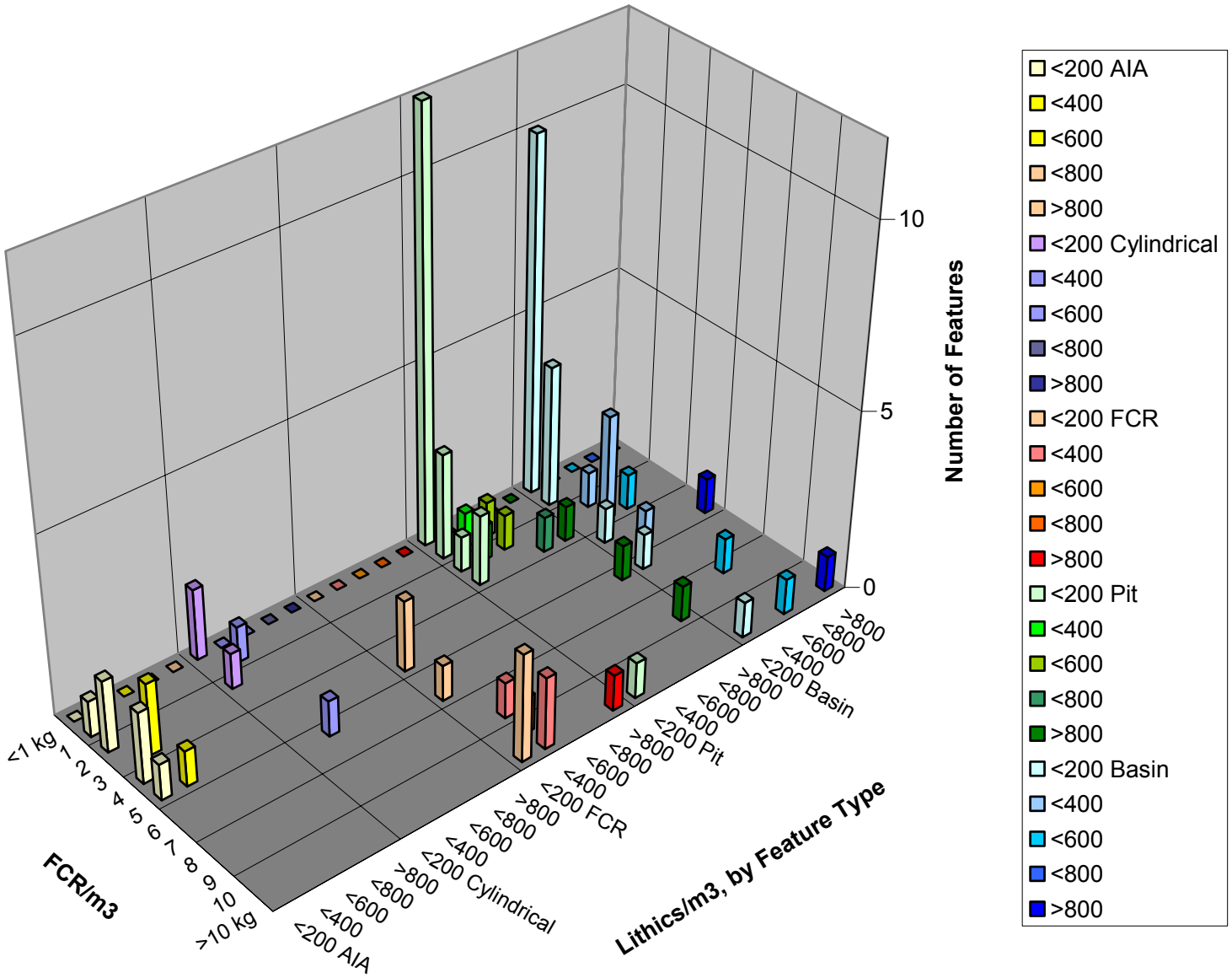


Figure 6.5 Distribution of Feature Types by Density of Lithics and FCR

The above described revisions of the feature typology resulted in a reduction of the total number of cultural features identified at the site from 97 to 81. The distribution of feature types is shown in Table 6.2. A summary of the cultural features, with radiocarbon dates and diagnostic artifacts is presented in Table 6.3.

Table 6.2 Revised Classification of Features

Cultural/Prehistoric	
Area of Intense Activity (AIA)	9
Basin	27
Cylindrical Pit	5
Fire-Cracked Rock (FCR)	11
Pit	27
Stain	2
Total Cultural/Prehistoric	81

Non-Cultural or Historic/Modern	
Post Mold	7
Tree Throw	58
Other Non-cultural	163
Modern Trench	1
Total Non-Cultural/Historic	229

6.1.5 Detailed Description of Revised Feature Types

Area of Intense Activity (AIA; n=9): These features were characterized as faint stains. Most examples had a large surface area, being more than 2 m in diameter, but had little depth, usually less than 10 cm. They were distinguished from the surrounding E or B horizon soils by increased soil mottling from the admixture of organic materials and an associated increase in artifacts. However, AIAs were not characterized by a high frequency of artifacts. As shown in Figure 6.5, AIAs were characterized by low densities of lithics and low to moderate densities of FCR compared to other feature types.

AIAs generally had diffuse boundaries, tapering out at the edges rather than having a distinct upward curving edge. For example, Features 287, 288, and 289 were defined as three overlapping AIA features based on their surface form (Figure 6.6; Photograph 6.1). A bisect profile across all three features revealed a consistent depth of 6 cm and showed no divisions between them. They may have represented one larger activity area, rather than three smaller features.

AIAs were characterized by low densities of lithic artifacts and low to moderate densities of FCR. As shown in Figure 6.5, this feature type formed a consistent cluster at the low end of both scales. Functionally, AIAs were most likely sunken living floors, such as the floors

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
9	Basin	1260-1000 BC	Townsend; Killens?		3/4 grooved ax	1307	9	5 hematite	Middle Woodland I Occupation. Radiocarbon date conflicts with ceramics. Cut into by Feature 48.
10	Cylind. Pit -A	AD 1460-1650	Townsend; Killens			438	25	2 historic ceramics, 4 brick, 2 nails; 51 shell, 3 bone	Woodland II Occupation. Cuts through Feature 38.
19	Basin					0	0		Dimensions approximate; in Trench 1.
23	Pit	2290-2140 BC		Rossville	9 microtool, 1 scraper	877	169	1 coal; 29 hematite	Early Woodland I Activity Area. In Trench 2.
31	Pit					0	3	7 hematite, 1 siltstone	In Trench 2.
37	Stain					0	0		With Features 38, 47, 50.
38	AIA				1 hammerstone, 1 uniface, 1 biface	1267	11	1 historic ceramic	Cut into by Feature 10. With Features 37, 47, 50.
41	Pit					98	41		Low feature volume.
43	Pit					45	12		Excavated one half.
47	FCR					2224	0		With Features 37, 38, 50.
48	Pit					42	0		Cuts into Feature 9.
50	Stain					0	0		With Features 37, 38, 47.
77	Basin				1 microtool	104	1		In Trench 1.
80	Basin					165	2		In Trench 1. Low volume.
81	Post					13	0		Historical; In Trench 1.
110	Pit				1 microtool	139	28	1 hematite	In Trench 3.
115	Pit				2 microtool, 2 biface	200	59	9 siltstone	In Trench 3.
119	FCR					384	7	3 mica	In Trench 3.
122	Pit			Untyped point	7 microtool, 2 biface, 1 knife, 1 hammerstone	2225	480	1 historic ceramic; 10 hematite; 13 siltstone	Overlaps with Feature 371.
145	Post					0	0		Historic; in Trench 4.

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
159	Basin					204	4	1 historic ceramic	In Trench 4.
165	FCR					887	3	1 hematite	In Trench 4.
178	Cylind. Pit -A	AD 1520-1950+				20	13	2 historic ceramic, 3 iron	Historical, based on radiocarbon date. In Trench 4.
181	FCR					505	16	1 historic ceramic, 1 coal; 3 hematite	
183	Basin				1 steatite bowl fragment	444	6	1 historic ceramic; 2 bone	
185	Pit	2870-2570 BC; 910-810 BC	Selden Island; Townsend		1 ground stone	826	11	1 historic ceramic, 2 brick; 6 hematite, 1 shell	Middle Woodland I Occupation. Charcoal date conflicts, bulk sherd date is good. Cuts into Feature 418.
190	FCR		Selden Island			391	16		Middle Woodland I Occupation.
195	Basin	1020-840 BC; 1190-1000 BC	Wolfe Neck; Selden Island; Coulbourn			847	79	1 historicl ceramic; 5 hematite, 1 siltstone	Middle Woodland I Occupation. Radiocarbon date good for Selden Island; Coulbourn may be intrusive?
197	Basin	350-110 BC	Selden Island; Wolfe Neck			143	7		Middle Woodland I Occupation.
200	Pit		Marcey Creek; Wolfe Neck		abundant rhyolite flakes	1078	271	2 historic ceramic	Middle Woodland I Occupation.
202	Basin					282	8		Overlaps with Feature 203.
203	Pit					643	26	1 hematite	Overlaps with Feature 202.
210	Basin		2 uniden-tifable		1 microtool	111	11		
227	FCR	1010-850 BC	1 uniden-tifiable	Untyped stemmed	1 biface	3160	28	4 hematite	Middle Woodland I Occupation.

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
229	FCR					453	2	5 hematite	Low feature volume.
233	AIA	1620-1460 BC	Killens	Rossville	2 abraders, 1 drill, 1 biface	2217	149	3 historic ceramic; 1 flat glass	Early Woodland I Occupation. Radiocarbon date matches point, not ceramics.
244	Pit					848	9	1 bottle	
248	Basin					27	4	2 brick	
253	Basin		Townsend			160	19	1 historic ceramic, 1 glass; 1 hematite	Woodland II Occupation.
254	Basin					599	11		Low feature volume.
255	Basin					621	23		
260	FCR					916	12	5 hematite	Low feature volume.
265	Basin					0	1		
268	FCR					2144	2		
269	FCR					1961	7		
273	Pit		Townsend		1 hammerstone	0	0	1 hematite	Woodland II Occupation. Overlaps with Feature 418.
274	Basin					48	0		
277	Basin				1 end scraper	108	9	1 glass	
279	Pit	AD 780-960	1 uniden-tifiable		9 steatite bowl, 2 ground stone, argillite flake cache, 1 biface, 1 uniface	979	445	2 coal; 2 hematite, 11 siltstone	Early Woodland I Occupation. Radiocarbon date conflicts with steatite.
280	Basin				2 microtool	248	7	1 flat glass	
283	Basin					65	34	1 historic ceramic; 2 hematite	
287	AIA					12	32	1 mica	With Features 288 and 289
288	AIA					397	41	1 historic ceramic	With Features 287 and 289.
289	AIA			Rossville		1155	38	4 historic ceramic; 1 hematite	Early Woodland I Occupation. With Features 287 and 288.

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
290	Basin					465	5		Low feature volume.
291	Pit				1 biface	330	32	2 hematite	
292	FCR					1025	21		
295	AIA	AD 780-960	Hell Island-like	Rossville	1 stone ax, 2 biface, 1 chopper, 1 microtool	4298	397	6 historic ceramic, 2 glass, 1 brick; 4 hematite, 1 mica	With Feature 298. Radiocarbon date good for ceramics, not point?
298	AIA				1 scraper, 1 biface	495	19	1 hematite	With Feature 295.
308	Basin		Selden Island	Bare Island		49	3	1 historic ceramic	Middle Woodland I Occupation.
323	AIA			Bare Island; Untyped stemmed	3 microtool	1401	137	6 hematite	Early Woodland I Occupation.
326	Pit			Rossville; Untyped point	2 abrader, 18 microtool, 1 steatite, 2 hammerstone, 1 teshoa, 7 biface	6958	1341	2 historic ceramic, 1 glass, 1 nail; 2 bone, 14 charcoal, 72 hematite, 62 siltstone, 1 wood	Early Woodland I Occupation. With Features 327 and 328. Water table prevented full excvation.
327	Basin				1 abrader	5	47	1 hematite	Within Feature 326.
328	Basin				1 microtool	214	23		Within Feature 326.
329	Basin				1 hammerstone	58	16		Low feature volume.
330	Cylind. Pit -B	2200-2030 BC		Savannah River Stemmed; Utyped point	1 abrader, 7 microtool, 1 drill, 2 hammer stone, 3 ground stone, 3 biface, 1 polished stone	6871	632	7 historic ceramic, 5 brick, 8 coal, 5 charcoal; 30 hematite, 49 siltstone, 1 mica; 22 nut hull, 2 bark	Early Woodland I Occupation. With Features 333 and 341.
331	Pit	2140-1950 BC		Bare Island	1 abrader, 4 microtool	2246	404	1 historic ceramic; 6 hematite, 1 siltstone, 1 nut	Early Woodland I Occupation. With Feature 332.

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
332	Pit			Untyped point	2 abrader, 3 microtool, 1 stone ax, 2 biface	2544	441	4 historic ceramic, 1 brick, 1 bone; 16 hematite, 3 siltstone	With Features 331 and 333.
333	Pit				2 microtool, 1 biface	231	50	1 glass, 1 flat glass, 1 brick, 2 coal; 6 siltstone, 1 hematite, 3 shell	Cut into by Features 330 and 332.
338	Pit		Townsend	Untyped point	3 abrader, 4 microtool, 1 biface	2461	265	2 historic ceramic; 2 shell, 7 hematite, 2 siltstone	Cut into by Feature 437.
340	Pit			Untyped broadspear	4 abrader, 12 microtool, 2 scraper, 1 hammer stone	2209	489	5 hematite, 7 siltstone	With Features 341 and 437.
341	Basin	2280-2020 BC		Rossville	1 abrader, 4 microtool, 3 polished siltstone	3326	200	1 glass; 7 hematite, 24 siltstone, 9 nut hull	Early Woodland I Occupation. With Features 330 and 340.
350	Pit					418	18		With Feature 352.
352	AIA					1038	69		With Features 350 and 434.
366	Basin		Selden Island			254	14	1 historic ceramic	Middle Woodland I Activity Area 1. In Trench 4.
371	Pit	2260-2040 BC		Rossville	5 abrader, 30 microtool, 1 uniface, 1 hammerstone, 1 grinding stone, 6 biface	14519	1675	8 historic ceramic, 1 flat glass, 1 nail; 2 shell, 2 bone; 118 siltstone, 50 hematite	Early Woodland I Occupation. Overlaps Feature 122.
372	Post					33	5	1 hematite	Historical. With Feature 375, 381, 384.
375	Post				1 microtool	10	15		Historical. With Features 372, 381, 384.

Table 6.3
Site 7K-F-11/169 Cultural Features

Feature Number	Feature Type	Radiocarbon Dates	Prehistoric Ceramics	Projectile Points	Tools	FCR (gr)	Lithic Debitage	Historic & Other Materials	Comments
376	Cylind. Pit -B	1860-1610 BC	1 uniden-tifiable	Rossville; mini Rossville/ Poplar Is.	15 microtool, 1 chopper, 1 scraper, 1 hammer stone	13582	671	7 historic ceramic, 1 glass, 1 brick, 1 coal; 3 shell, 14 hematite, 6 siltstone, 1 mica, 1 steatite	Early Woodland I Occupation. With Feature 419. Radiocarbon date for shell was modern. Ceramic intrusive?
381	Post					0	13		Historical. With Features 372, 375, 384.
384	Post					0	12		Historical. With Features 372, 375, 381.
387	Basin					42	5	1 historic ceramic	
388	Pit		Dames Quarter		1 microtool	1095	86	1 hematite	
418	Pit		2 uniden-tifiable	Rossville	1 hammerstone	548	4	1 coal; 1 hematite, 1 shell	Cut into by Feature 185, with Feature 273.
419	Cylind. Pit -B	1770-1630 BC		Rossville	13 microtool, 1 end scraper	3833	711	2 coal; 8 hematite, 12 siltstone	Early Woodland I Occupation. With Feature 376.
422	Post					29	1		May bee root associated with tree throw. Historical?
434	Pit					64	11		With Feature 352.
437	Pit				2 abrader, 9 microtool, 1 biface	1172	127	4 hematite, 3 siltstone	Cuts into Feature 338, with Feature 340.

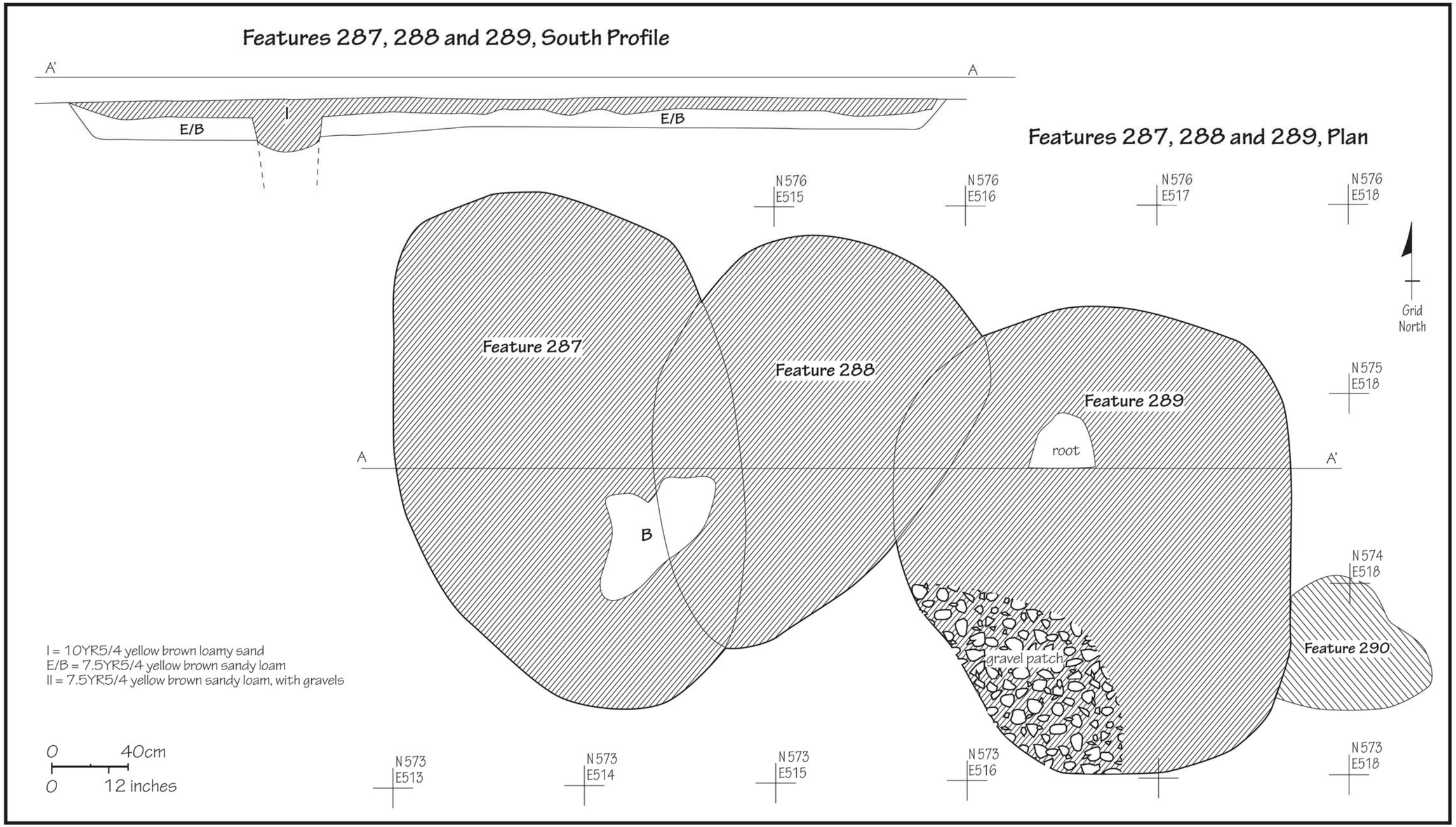


Figure 6.6 Area of Intense Activity, Features 287, 288, and 289 Plan and Profile, with Feature 290

Photograph 6.1 Areas of intense activity formed by overlapping Features 287, 288, and 289, with tree root, profile looking south.

semi-subterranean residential structures. Since there has been little soil accretion on the site, any surface activity areas would have been destroyed by plowing. Presumably, the AIAs that were found were just deep enough to have been preserved below the plowzone. Some AIA boundaries had clearly up-curving edges, defining the possible outer walls of a semi-subterranean structure such as a pit house. But in other cases, the edges tapered out at the plowzone interface, suggesting shallower structures where the walls have been destroyed by plowing. None of the AIAs were associated with patterns of post molds, which could have confirmed the presence of a superstructure. In sandy soils such as those at the site, however, post molds tend not to be preserved. So the absence of post molds associated with the AIAs was inconclusive.

All of the AIAs were found in Trench 5, in the southwestern part of the APE. Feature 38, which measured approximately 3 m x 5 m, was large enough to have been a living floor in a pit house. Features 295 and 298 may have formed a single pit house floor, together measuring more than 5 m in length. Similarly, Features 287, 288, and 289 may have been a single pit house floor, together measuring 4.7 m in length. Feature 323 had a smaller preserved area with a length of 2.5 m, suggesting that it was too small to have been a pit house floor. However, it was bordered by tree throws to the west and southeast, suggesting that the original feature may have been larger.

Feature 233 was the only AIA directly associated with a hearth. It was smaller than the other AIAs, measuring 3.5 m x 2.4 m. Across most of its width, it was 16 cm thick, with a diffuse lower boundary. A lower stratum of fill occurred in a deeper central area, associated with FCR,

reddened earth, and charcoal flecking. Two larger FCR features were identified west of Feature 233, in the vicinity of the Feature 295-298 and Feature 287-288-289 AIAs. Four small FCR features were identified in the area around the Feature 38 AIA. Lacking direct evidence, however, it could not be ascertained whether the FCR features were associated with the occupation of AIAs. Feature 10, a cylindrical pit, cut through the Feature 38 AIA, suggesting that it was later in date (Figure 6.7).

Large shallow depressions associated with a deeper D-shaped or oval area were initially identified as pit houses (Custe et al. 1994). These have since been identified as tree throws, with or without human modification (Petraglia et al. 2002, LeDecker et al. 2005). At the Black Diamond Site (7NC-J-225) however, possible evidence of pit houses or semi-subterranean structures was found. Here, three large flat rectilinear basin features were identified (Boen et al. 2011b). Initially identified as shelter locations or living floors, subsequent soil chemistry and artifact analyses did not support this interpretation, with the result that they could not be functionally distinguished from non-cultural features (Bowen et al. 2011b). The interpretation of large shallow basin features at the Black Diamond site as semi-subterranean residential structures was therefore inconclusive.

Cylindrical Pit (n=5): Based on the field data, three cultural features were identified as cylindrical pits, having a cylindrical shape with nearly vertical sides, a flat base, and multiple strata of fill. Review of the excavation data showed that two of the features fit this description and were retained as cylindrical pits (Features 10 and 178), while the third (Feature 350) had a hemispherical shape and lacked the multiple strata of fill. It was therefore moved to the pit category. Three features that had been classified in the field as pits (Features 330, 376, and 419) had morphological characteristics similar to cylindrical pits. Each had a circular shape and nearly vertical sides, but lacked the multiple strata of fill that characterized Features 10 and 178. These three features were therefore classified as a distinct subtype of cylindrical pit, subtype B (with a single stratum of fill), while those with multiple strata of fill were termed subtype A. Feature 10 was representative of subtype A. It was circular in plan, measuring 100 cm in diameter, and had vertical walls extending to a depth of 113 cm below the Ap horizon. (Figure 6.7; Photograph 6.2). The feature fill consisted of eleven strata of soil. Most of the artifacts, including prehistoric Townsend and Killens ceramics, were found in the three uppermost strata of fill. This indicated that the artifacts were deposited during the later stages of filling, and were not associated with the original function of the feature. Only a few scattered lithic artifacts were found in the lower strata, providing no evidence of the use of the feature. Feature 178 was classified as being similar to Feature 10 in morphology and very low frequency of FCR and artifacts (Photograph 6.3). However, dating results suggested that this feature was historic in origin (see below, Section 6.2).

Features 376 and 419 were representative of cylindrical pit subtype B. These two features were nearly identical. Each was circular in plan, measuring 175 to 180 cm in diameter, and had nearly vertical walls (Figure 6.8; Photograph 6.4). They extended to a depth of approximately 110 cm below the Ap horizon. However, excavation of the base of these features was impeded by a high water table. All of the feature fill was excavated to subsoil, but the shape of the base of the feature could not be accurately determined and may have been more rounded than depicted in the profile. Feature 330 was a similar cylindrical pit, located among a series of overlapping features

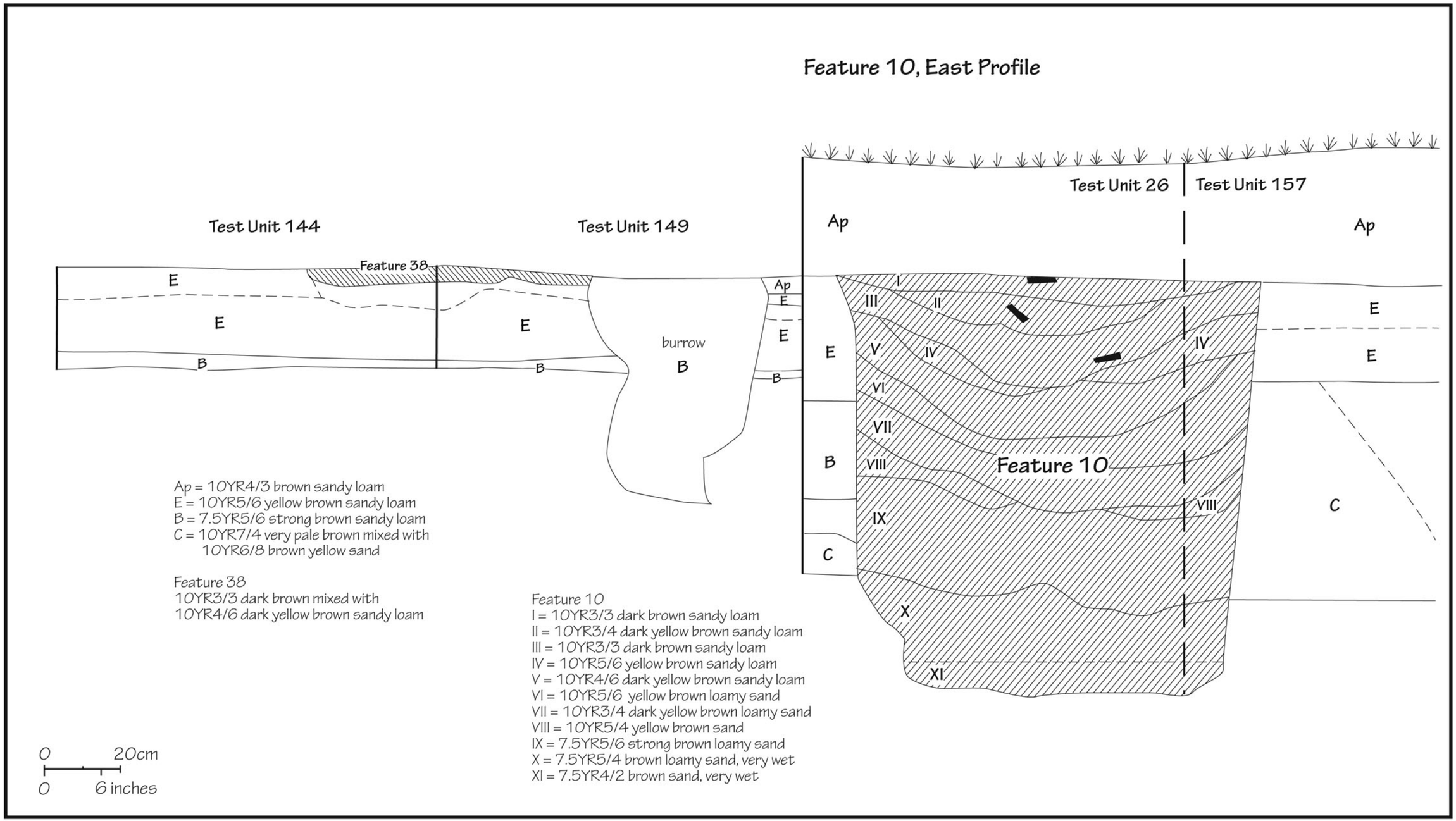


Figure 6.7 Cylindrical Pit Subtype A, Feature 10 Profile with Feature 38

Photograph 6.2 Cylindrical pit, Feature 10 during excavation of the third quadrant, looking northeast.

Photograph 6.3 Cylindrical pit, Feature 178 profile, looking southwest. Note the charcoal-rich lens near the base of the feature fill.

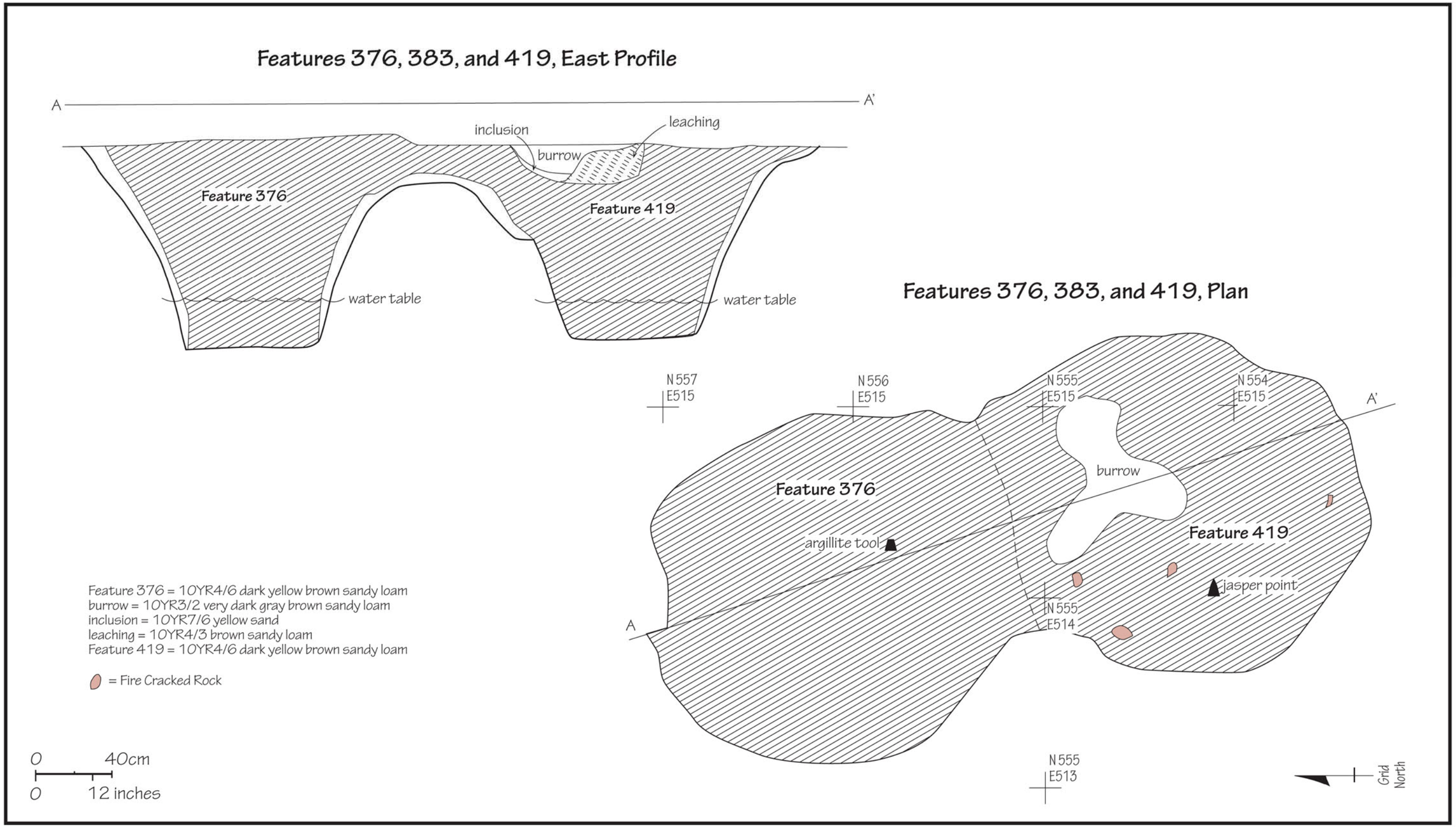


Figure 6.8 Cylindrical Pit Subtype B, Features 376 and 419 Profile

Photograph 6.4 Cylindrical pits, Features 376 and 419 during excavation, looking north.

6 m north of Features 376 and 419. These subtype B cylindrical pits each had a single stratum of fill, indicating that they had been filled in rapidly after use.

Like the cylindrical pit subtype A features, the cylindrical pit subtype B features contained low frequencies of FCR and low to moderate densities of lithic artifacts (Figure 6.5). Other artifacts they contained were similar to those found in other features in this portion of the site, including microtools, a Rossville projectile point, a Savannah River projectile point, and two untyped stemmed projectile points.

Cylindrical pits are distinguished by their shape, especially the vertical side walls. In sandy soils, such walls would have been unstable unless they were supported. The pits may have been lined with bark or basketry to maintain their shape during use. They must have been filled shortly after use. Subtype A cylindrical pits, with vertical sides and multiple layers of fill, likely retained their support lining while the pit gradually filled. Subtype B pits had side walls that were vertical at the bottom but flared towards the top, suggesting that the support lining may have been removed before the pit was filled. A study of the degradation of open pit features over time showed that features with distinctive shapes eroded over the three-year span of the study into amorphous pits lacking distinctive shape (Petraglia et al. 2002). What began as a steep-sided, flat bottomed pit had an irregular conical or rounded pit profile at the end of the study. This reinforced the likelihood that cylindrical pits were filled rapidly after use.

Cylindrical pits, also called silo features, have been found at numerous sites. They were generally assumed to have served a storage function. Analysis of the Puncheon Run Site included a review of the ethnohistoric literature on storage pits, with references to pits lined with mats or bark, and their use to store food in baskets or bags, covered with soil (LeeDecker et al. 2005). The analysis also included a summary of such pits found singly or in clusters at previously excavated sites. At the Delaware Park site (7NC-E-41), 31 large silo features, identified as Feature Type A, were associated with an Early to Middle Woodland occupation (Thomas 1981). Smaller silo features at the Lums Pond Site (7NC-F-18) were associated with a Woodland I Clyde Farm Complex occupation (Petraglia et al. 1998). At the Carey Farm Site (7K-D-13), silo pits were associated with "house-related" features, dating to the Middle Woodland period (Custer et al. 1996b). At the Puncheon Run site (7K-C-51), 11 silo pits were identified in the main pit cluster, dating to the Middle Woodland (LeeDecker et al. 2005).

At the Blackbird Creek Site (7NC-J-195D), 11 steep-sided or slightly bell-shaped flat bottomed cylindrical pits were found, situated at regular intervals in a linear pattern (Bowen et al. 2012). The researchers developed five hypotheses as to the likely function of these cylindrical pits, which based on their organized distribution appeared to have functioned within the context of some sort of resource processing facility. Hypothesized functions included storage, cooking, hide tanning, nut processing, and fish oil processing. Collectively, the available evidence suggested that the last hypothesis was the most likely, based in part on the near impermeability of the soils into which the pits had been excavated. They also speculated that large cylindrical or silo pits at other sites such as Lums Pond and Delaware Park with coarse, sandy, highly permeable soils were probably used for storage, since good drainage would be beneficial in the preservation of feature contents.

The soils at Site 7K-F-11/169 were relatively coarse and permeable, like those at Lums Pond and Delaware Park. Subtype A and B cylindrical pits at the site thus would have been unsuitable for holding liquids, and thus would not have been used for processing nut oils or milk (see below, Section 6.5), or fish oil. Absent evidence for cooking, a storage function thus seemed most probably. Although the Site 7K-F-11/163 cylindrical pits contained high densities of charred hickory nut hull fragments, they did not provide other evidence of the foodstuffs or other materials stored. While it is conceivable that the meats of hickory nuts, either whole or ground, were stored in these features, the high densities of charred nut hull fragments were likely incorporated into these features because they were prominent in the generalized domestic waste scattered across the site surface at the time the features were filled in. This reinforced the suggestion from ethnographic evidence that such pits were often used for the temporary storage of provisions, perhaps in baskets or bags, which were later retrieved. It would not be unlikely that hickory nut meats or nut meat meal were among the items so stored, and that hickory nut processing was a prominent activity in the vicinity when the features were created, and thus also a prominent form of general site waste when they were filled in.

Fire Cracked Rock (FCR; n=11): These features were defined by the presence of clusters of FCR. They were generally shallow, with the deepest extending only 11 cm below the base of the plowzone (Photograph 6.5). The shallow depth produced low volumes for these features, which tended to generate high densities for FCR (Figure 6.5). Although most FCR features had low to

Photograph 6.5 FCR, Feature 47 in Excavation Block 6, plan looking west.

Photograph 6.6 FCR Feature 190, plan looking north.

moderate densities of lithics, the low volume also tended to inflate the frequency of lithics, resulting in a notably high lithic density for one FCR feature (Feature 229). The FCR features were not characterized by the presence of charcoal or fire-reddened earth. The lack of charcoal, in both FCR features and other contexts across the site, was likely the result of the leaching and transportation of material in sandy soils.

Feature 190 was representative of FCR features. It consisted of FCR scattered over an area associated with a slight color change, which measured 80 x 86 cm and extended to a depth of 5 to 9 cm below the base of the plowzone (Figure 6.9; Photograph 6.6). The feature contained very few artifacts and only one diagnostic artifact, a Selden Island ceramic sherd. Since the sherd was found at the surface of the feature during initial clearing, it is unclear whether it relates to the feature contents, or was derived from the overlying plowzone soils.

Analysis of the formation of features at the Hickory Bluff Site demonstrated the types of evidence left by different fire-related activities (Petraglia et al. 2002). Experimental results showed that a roasting pit was characterized by the presence of large thermally altered stones (FCR) and charcoal, while stone boiling left small and fractured FCR that was not associated with charcoal or burning. A cooking hearth and a ceremonial fire, both located outside structures, left reddened areas associated with scattered FCR, while the pit inside a lodge was characterized by a high concentration of FCR.

Based on these characteristics, the FCR features at Site 7K-F-11 could potentially be identified as stone boiling areas. But since the low frequency of charcoal characterized the site as a whole, they may also have represented other activities, such as cooking or ceremonial hearths.

Pit (n=27): Pit features varied widely in overall size, but quantitative analysis revealed no clear basis on which to subdivide the category. Pits were generally ovoid in shape, with rounded, bowl-like bases. They ranged in diameter from 57 to 380 cm and in depth from 30 to 110 cm. Pits displayed little, if any, internal stratigraphy, suggesting that they had filled rapidly after use. Most of the Pits had low frequencies of both FCR and lithic artifacts (Figure 6.5). However, diversity was reflected in the presence of one pit with a high frequency of FCR (Feature 48) and five pits with high frequencies of lithics (Features 41, 122, 279, 326, and 371).

Feature 48 was an example of a relatively small pit. It had an oval shape and measured 77 cm in length, extending 34 cm below the base of the Ap horizon (Figure 6.10; Photograph 6.7). It included a cluster of FCR at the surface, but contained no other artifacts. Feature 371 was an example of a large Pit (Photograph 6.8). It had an irregular elongated shape measuring 100 x 90 cm, and extended 90 cm below the Ap horizon. There was no stratigraphic variation in the feature fill, which yielded high densities of both FCR and lithics, together with a Rossville projectile point.

Two other pit features were especially notable for their contents. Feature 200 was a moderately-sized pit that produced 269 pieces of lithic debitage, of which 258 (95%) were rhyolite. Elsewhere in the site, this lithic raw material was rare to absent; only in Feature 200 was such a notable concentration found. The feature also produced both Marcey Creek and Wolfe Neck sherds, suggesting that some mixing of feature contents had occurred.

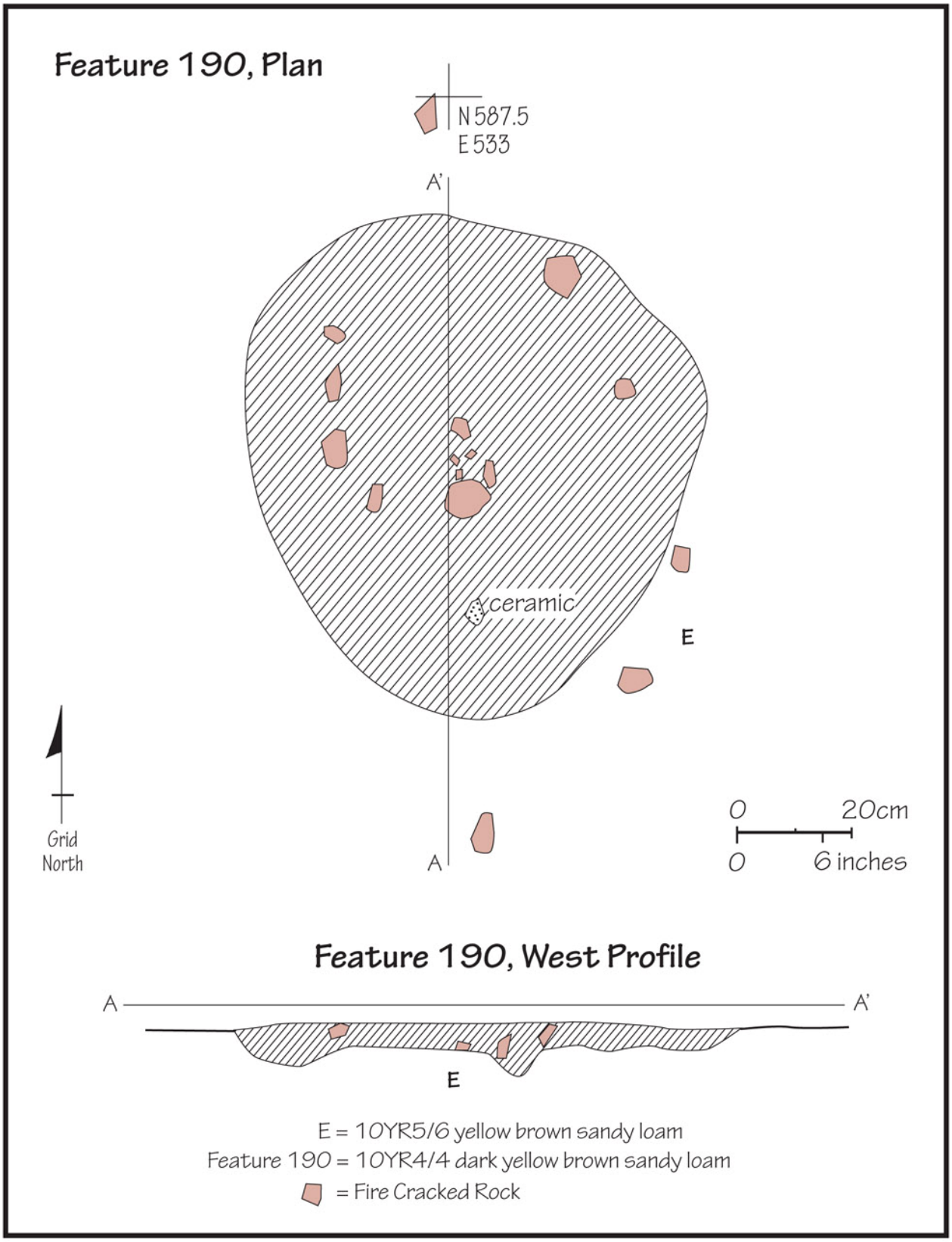


Figure 6.9 FCR Feature 190 Plan and Profile

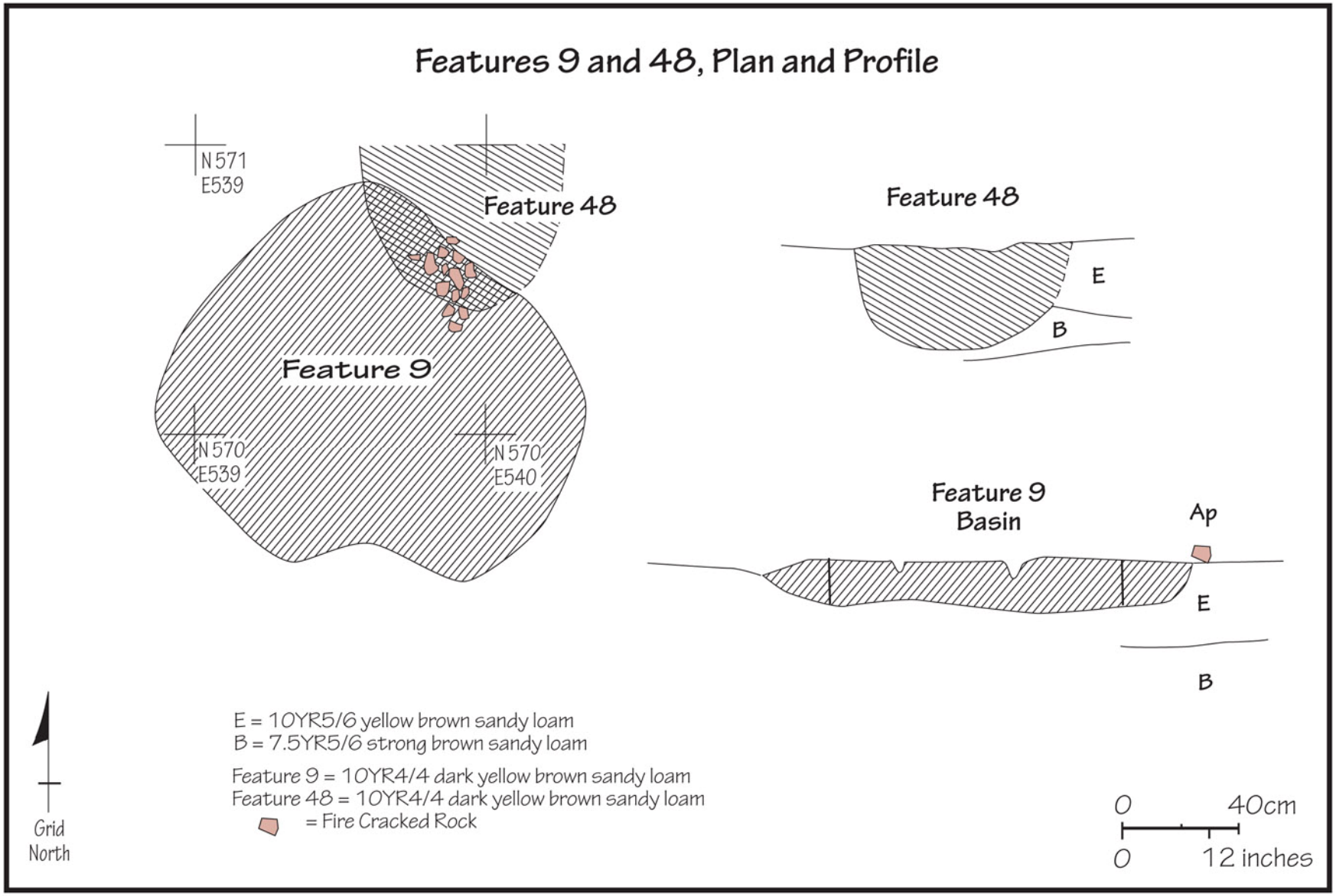


Figure 6.10 Basin and Pit, Features 9 and 48 Plan and Profiles

Photograph 6.7 Pit, Feature 48 in Excavation Block 7, profile looking north.

Photograph 6.8 Pit, Feature 371 during excavation, looking southwest.

Even more notable was pit 279, which produced some of the most dramatic archaeological discoveries during the data recovery excavations. Prior to excavation, a cluster of steatite sherds was exposed at the surface and in the upper levels of the feature fill. Below the steatite was a pestle/grinding stone with an associated mortar stone directly below it. At the base of the feature in a deep pocket of feature fill was a cache of highly decayed argillite blade-like flakes. Later analysis indicated that the steatite sherds comprised a portion of a single steatite vessel.

Collation of field data after completion of fieldwork indicated that Feature 229 had been partially disturbed by Feature 3, an adjacent tree throw. Excavation of Featurae 3 produced a second cluster of steatite sherds that comprised a portion of a second steatite vessel (Photograph 6.16 in Section 6.2), which had probably also been within Feature 279 prior to its partial disturbance.

Feature 279 returned a radiocarbon date of AD 78-960, which was not compatible with the steatite sherds and confirmed that feature contents had been to some degree disturbed and mixed by the Feature 3 tree throw.

Pits have been used in archaeological analysis as a catch-all category for features that could not be associated with a specific activity. Given the range of sizes included, the category likely represented evidence of a variety of activities, such as roasting pits, other food processing, storage, or burials.

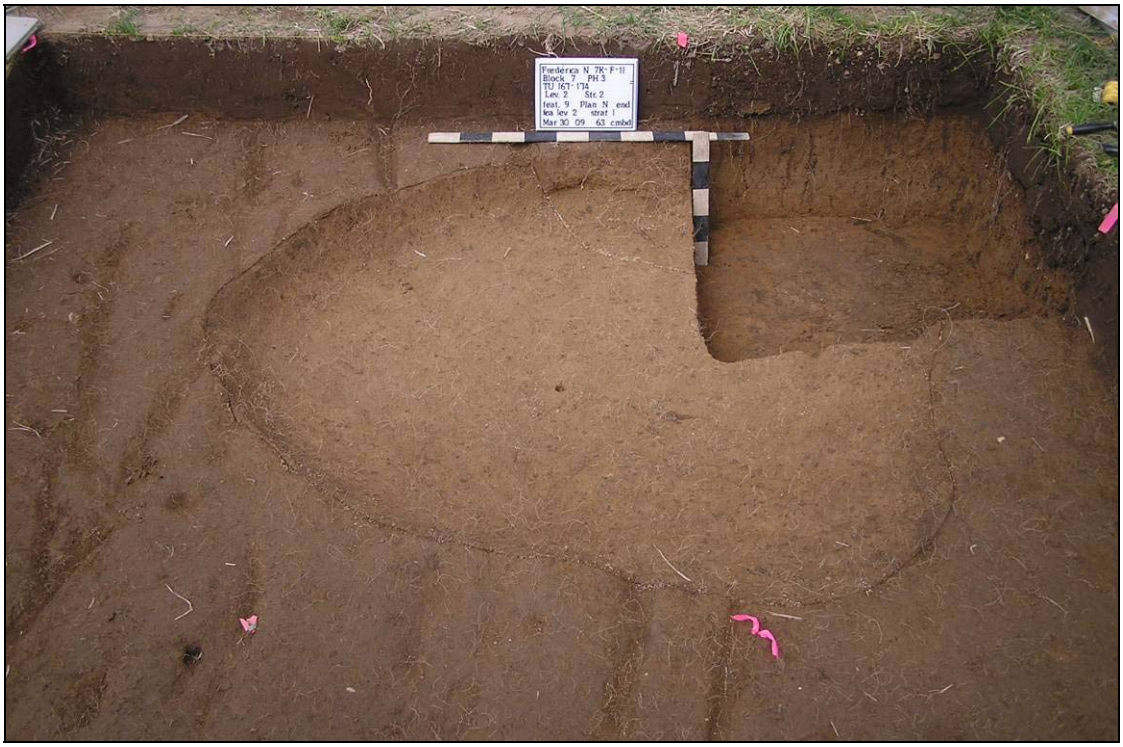
Basin (n=27): These features were distinguished from pits on the basis of their shallower depth, with an arbitrary maximum depth of 30 cm. Like pits, basins were generally ovoid in shape with rounded bases, and had little or no variation in internal stratigraphy. Most basins were characterized by low frequencies of both FCR and lithic artifacts (Figure 6.5). However, basins were a diverse feature category. One basin (Feature 80) had a high density of FCR and four had moderate to high densities of lithics (Features 327, 328, 329, and 341).

Feature 9 was representative of basins. It was an irregular oval measuring 130 x 150 cm, and extended 15 cm below the base of the Ap horizon (Figure 6.10; Photograph 6.9). The fill yielded a moderate density of FCR and a low frequency of other artifacts, which included Woodland II ceramics and a ground stone ax.

Basins represent the truncated remains of relatively shallow features. Unlike features that penetrated deeper below the base of the Ap Horizon, relatively little remains of basins from which to interpret their function. These shallow features could have been used as hearths, roasting pits, food storage facilities, or other functions.

Stain (n=2): Stains were horizontal areas of discoloration with almost no depth. They were characterized by a maximum depth of 4 cm and a complete absence of artifacts. Like basins, stains may represent the truncated bases of features that were used for a variety of activities. But they have been too extensively disturbed by plowing to provide additional information.

None of the cultural feature types found at the site contained artifacts indicative of their original function, with the exception of FCR features and possibly cylindrical pits. No masses of corn



Photograph 6.9 Basin, Feature 9 plan looking north in Excavation Block 7. Note Feature 48 pit intruding into north edge of basin (where the scale bar lies).

cobs, foodstuffs other than charred hickory nut hull fragments, or other cached materials were found to provide direct evidence of storage activities. Instead, features were filled (either gradually or intentionally) with surrounding soils. This process generally resulted in the inclusion of artifacts from activities that took place nearby, thus incorporating artifacts and other waste from the surrounding living surface. Features are therefore like time capsules, holding a collection of artifacts from a particular period.

Historical and Non-Cultural Soil Anomalies

Post Mold (n=7): Post features were small deep features, either circular or rectangular in plan. No evidence of preserved wood was found in the seven post molds identified at the site. They contained a low frequency of mixed historic and prehistoric artifacts. Four post molds formed a rectangle in the southwestern part of the site, associated with an early historic occupation. The other post molds were found in isolation. Based on the similarities of their profiles, they were all assumed to be historic in origin.

Tree Throws (n=62): Many of the large non-cultural soil anomalies were identified as tree throws, the soil disturbances resulting from fallen trees. In their classic form, these irregular pits had inverted stratigraphy, consisting of A/E/B/C horizon soils that had been rotated roughly 90 degrees, having been held together and pushed down by the root mass on the leeward side of a falling tree, while soils on the windward side were pulled up into the air, leaving a large pit. The

pit was filled both by soils held in the elevated root mass eroding back into the pit, and by adjacent soils washing in (see below, Section 10.1.2). Some tree throws had a long tapering impression made by the fallen tree trunk, additional evidence of the direction in which a tree had fallen. In cases where the stratigraphy had not been as well preserved, tree throws were still characterized by an oval or D-shaped pit with a distinctive profile of a steep wall on one long side and a more gently sloping wall on the opposite side.

Gradual drying of the surface in mechanically stripped trenches facilitated the identification of additional tree throws. The sandy B horizon and gravelly C horizon soils that had been pulled up by tree throws tended to dry out faster than adjacent soils. Examination showed that areas of such dry or gravelly soils paired with a darker stain, or located between two darker stains, were also traces of tree throws. Thus, soil anomalies that had been tentatively identified initially as separate features could later be identified as a single tree throw.

The artifacts found in tree throws included those that were in the soils disturbed by the falling tree, and any that washed in as the tree throw pit gradually filled. The density of artifact varied, with high densities in areas where human activity had left many artifacts in the surrounding soils and low densities in less heavily occupied portions of the site. Tree throws were common throughout the site. They may have disturbed or obscured cultural features associated with the prehistoric occupation.

Other Non-Cultural Anomalies (n=163): Soil anomalies were investigated to the extent needed to identify them as cultural or non-cultural in origin. Non-cultural anomalies were not investigated further, and included tree roots, rodent burrows, etc.

6.2 Site Chronology

6.2.1 Radiocarbon Dating

Thirty radiocarbon dates of various types and from several different contexts were obtained from samples collected at Site 7K-F-11/169 (Table 6.4). Of these, 17 dates were obtained from charred organic material recovered from cultural features, seven were from charred organic material from what were interpreted to be non-cultural tree throw features, two were from samples of shell recovered from cultural features, and four were bulk ceramic sherd samples containing charred organic residues that were found adhering directly to the sherd from which the sample was derived.

The two shell dates were paired with charred organic sample dates from the same features to enable calculation of a marine reservoir correction for shell dates from the Delaware Bay to the near shore Atlantic coast of Delaware, a region for which such a correction was not available. One pair of charcoal and shell samples returned dates of AD 1460-1650 and AD 1470-1560, respectively, both from Feature 10. This feature also produced diagnostic Townsend and Killens ceramics, providing corroboration of the accuracy of the paired dates. The desired marine reservoir correction was subsequently calculated (see Section 10.2). The other pair of samples returned dates of 1860-1850 BC and post-AD 1950. This feature (Feature 376) also produced Rossville and Poplar Island projectile points, and only a single non-diagnostic prehistoric ceramic sherd. The Early Woodland I date from carbonized organic material appeared to be accurate for the feature, while the ceramic sherd and the shell sample, which were both from the feature's uppermost level, were likely intrusive.

The four bulk sherd samples were selected primarily to provide additional radiometric dates for ceramic types of special interest. Marcey Creek, Dames Quarter, and Selden Island sherds were dated. The Marcey Creek sherd sample returned a date with two intercepts, 1620-1490 BC and 1480-1450 BC. Both intercepts were generally consistent with but among the earliest of previously accepted dates for this type. The Dames Quarter sample also returned a two intercept result, with dates of 1260-1230 BC and 1220-1020 BC. Again, both intercepts were consistent with expectations for the type. One of the Selden Island sherds produced a three intercept result, with ranges of 1190-1180 BC, 1160-1140 BC, and 1130-1000 BC. All three intercepts were close to but slightly earlier than previous results for the type. The other Selden Island sherd returned a single intercept date of 910-810 BC, which was consistent with expectations.

The tree throw radiocarbon samples all consisted of charred organic material. They were selected to address several key issues concerning this feature type. First was an assessment of whether these features were of natural (tree throw) origin or were cultural (e.g. pit houses). If the former, associated dates might include some that were earlier or later than the period of known site occupation. Alternatively, the dates might indicate that all or most of the features of this type were more or less contemporaneous, suggesting that they were the result of a single catastrophic storm. From oldest to youngest, the tree throw samples returned single or multiple intercept dates with inclusive ranges of 2280-2050 BC, 1430-1310 BC, 1260-1030 BC, AD 780-960, AD 780-980, AD 1160-1260, and AD 1670-1950. In general, the results were not entirely

Table 6.4
Site 7K-F-11 AMS Dating Results

Feature	Provenience	Feature Type	Sample Material	Conventional Radiocarbon Age	Calibrated Results (2 Sigma)	Laboratory Sample	Diagnostic Artifacts
TU 38	Stratum 1, Level 2	none	bulk sherd	3260 +/- 30 BP	BC 1610 to 1490 BC 1480 to 1450	Beta-307658	Marcey Creek Vessel 2
3	Stratum 1, Level 4	Tree Throw	charcoal	1140 +/- 30 BP	AD 780 to 790 AD 810 to 850 AD 850 to 980	Beta-309416	Coulbourn Vessels 2 & 3, Mockley, Townsend ceramics; untyped point
5	Stratum 1, Level 1	Tree Throw	charcoal	3760 +/- 30 BP	BC 2280 to 2250 BC 2230 to 2220 BC 2210 to 2130 BC 2090 to 2050	Beta-309417	Dames Quarter, Selden Island, Killens ceramics; Fox Creek point
9	Stratum 1, Level 1	Basin	charcoal	2910 +/- 40 BP	BC 1260 to 1000	Beta-304996	Townsend Vessel 1
10	Stratum 2, Level 2	Cylinder	charcoal	330 +/- 30 BP	AD 1460 to 1650	Beta-307300	Townsend Vessels 2 thru 11; Killens Vessel 1
	Stratum 2, Level 2		shell	790 +/- 30 BP	AD 1470 to 1560	Beta-307301	
12	Stratum 6, Level 8	Tree Throw	bulk sherd	2930 +/- 30 BP	BC 1260 to 1230 BC 1220 to 1020	Beta-307655	Dames Quarter Cord Marked Vessel 1
23	Stratum 1, Level 3	Pit	charcoal	3790 +/- 30 BP	BC 2290 to 2140	Beta-307302	Rossville point
178	Stratum 8	Cylinder	charcoal	270 +/- 30 BP	AD 1520 to 1570 AD 1590 to 1590 AD 1630 to 1670 AD 1780 to 1800 AD 1950 to 1950	Beta-307307	none
180	Stratum 1, Level 1	Tree Throw	charcoal	3100 +/- 30 BP	BC 1430 to 1310	Beta-304997	Marcey Creek
184	Stratum 1, Level 2	Tree Throw	charcoal	820 +/- 30 BP	AD 1160 to 1270	Beta-309418	unidentifiable ceramic; untyped point
185	Stratum 1, Level 3	Pit	charcoal	4120 +/- 40 BP	BC 2870 to 2570	Beta-304998	Selden Island Vessel 1; Townsend; unidentified
	Stratum 1, Levels 1 & 2		bulk sherd	2710 +/- 30 BP	BC 910 to 810	Beta-307656	
195	Stratum 1, Level 1	Basin	charcoal	2790 +/- 40 BP	BC 1020 to 840	Beta-304999	Selden Island Vessel 3, Wolfe Neck, Coulbourn ceramics
	Stratum 1, Levels 1 & 2		bulk sherd	2890 +/- 30 BP	BC 1190 to 1180 BC 1160 to 1140 BC 1130 to 1000	Beta-307657	
197	Stratum 1, Level 1	Basin	charcoal	2160 +/- 30 BP	BC 350 to 290 BC 230 to 160 BC 130 to 110	Beta-309419	Selden Island Vessel 5; Wolfe Neck Vessel 2

Table 6.4
Site 7K-F-11 AMS Dating Results

Feature	Provenience	Feature Type	Sample Material	Conventional Radiocarbon Age	Calibrated Results (2 Sigma)	Laboratory Sample	Diagnostic Artifacts
227	Stratum 1, Level 2	TAS	charcoal	2790 +/- 30 BP	BC 1010 to 890 BC 880 to 850	Beta-307303	untyped stemmed point
233	Stratum 1, Level 2	AIA	charcoal	3270 +/- 30 BP	BC 1620 to 1490 BC 1470 to 1460	Beta-307304	Killens Vessel 2; Rossville point
236	Stratum 1, Level 2	Tree Throw	charcoal	850 +/- 30 BP	AD 1160 to 1260	Beta-309420	Townsend & Killens ceramics; Levanna point; Poplar Island point
279	Stratum 1, Level 3	Pit	charcoal	1170 +/- 30 BP	AD 780 to 900 AD 920 to 960	Beta-305000	steatite bowl; unidentifiable ceramic
295	Stratum 1, Level 1	AIA	charcoal	1170 +/- 30 BP	AD 780 to 900 AD 920 to 960	Beta-305001	Hell Island-like ceramic; Rossville point
305	Stratum 1, Level 1	Tree Throw	charcoal	870 +/- 30 BP	AD 1050 to 1090 AD 1120 to 1140 AD 1150 to 1220	Beta-309421	teardrop point
330	Stratum 1, Levels 5 & 6	Cylinder	charcoal	3730 +/- 30 BP	BC 2200 to 2030	Beta-305002	Savannah River point, untyped point
331	Stratum 1, Level 5	Pit	charcoal	3670 +/- 30 BP	BC 2140 to 1950	Beta-307308	Bare Island point
341	Stratum 1, Levels 2 & 3	Basin	charcoal	3730 +/- 40 BP	BC 2280 to 2250 BC 2220 to 2020	Beta-305003	Rossville point
348	Stratum 1, Level 3	Tree Throw	charcoal	140 +/- 30 BP	AD 1670 to 1780 AD 1800 to 1890 AD 1900 to 1950 Post AD 1950	Beta-309422	Townsend ceramic
371	Stratum 1, Level 9	Pit	charcoal	3740 +/- 30 BP	BC 2260 to 2260 BC 2210 to 2110 BC 2100 to 2040	Beta-305004	Rossville point
376	Stratum 1, Levels 5 & 6	Cylinder	charcoal	3400 +/- 40 BP	BC 1860 to 1850 BC 1770-1610	Beta-305005	Rossville point; mini Roosville/Poplar Island point
	Stratum 1, Level 1		shell	350 +/- 30 BP	Post AD 1950	Beta-307305	
419	Stratum 1, Level 3	Cylinder	charcoal	3410 +/- 30 BP	BC 1770 to 1630	Beta-307306	Rossville point

conclusive with respect to the origin of the tree throw features at the site, except to suggest that they were certainly not contemporaneous. One feature clearly postdated the prehistoric site occupation, indicating that it, at least, was not a prehistoric pit house.

Of the 17 dates obtained from charred organic material recovered from cultural features, nine returned early Woodland I (traditional Late Archaic) single and multiple intercept dates ranging in age from 2870-1460 BC. Specific ranges for these dates included 2870-2570 BC, 2290-2140 BC, 2280-2020 BC, 2260-2040 BC, 2250-2020 BC, 2200-2030 BC, 1860-1850 BC, 1770-1630 BC, and 1620-1460 BC. Of the nine features that returned these dates, only three contained ceramics in the feature fill. Of these latter features, one (Feature 376) contained a single non-diagnostic sherd in its uppermost disturbed level, a context that also returned the modern date for shell. The underlying levels of the feature thus appeared to be early Woodland I in age, consistent with the radiocarbon date of 1860-1850 BC. Another feature (Feature 233) produced a single Killens sherd, also from its uppermost level. The third feature that produced an early Woodland I date as well as ceramics was Feature 185, which also produced a middle Woodland I (traditional Early Woodland) date of 910-810 BC. Associated diagnostics included Selden Island and Townsend ceramics. The contents of this feature suggested some mixing of earlier materials into a later feature. Therefore, the early Woodland I date of 2870-2570 BC (the earliest date from the site) was considered questionable.

The nine features that returned early Woodland I dates also produced a total of seven narrow-bladed stemmed projectile points (here considered an early Woodland I diagnostic, see below, this section) and a Savanna River point, providing additional corroboration of the reliability of these dates. Collectively, eight of the nine early Woodland I dates came from contexts and had artifact associations that suggested they were reliable indicators of the age of the features from which they derived.

Four middle Woodland I (traditional Early Woodland) dates were returned from charred organic samples from four features. Collectively, the single and multiple intercept dates spanned a period of 1260-110 BC. Specific ranges included 1260-1000 BC, 1020-840 BC, 1010-850 BC, and 350-110 BC. All four of these features contained ceramics. Feature 195, which returned a middle Woodland I date of 1020-840 BC, produced Selden Island, Wolfe Neck, and Coulbourn diagnostic ceramics. Feature 197 (350-110 BC) produced Selden Island and Wolf Neck diagnostics, Feature 9 (1260-1000 BC) produced fragments of a Townsend vessel, and Feature 227 (1010-850 BC) produced a single non-diagnostic sherd.

In addition to dates from charred organic samples, two of the above-described bulk sherd samples came from cultural features, and both produced early Woodland I dates. Feature 185 produced the Selden Island bulk sherd date of 910-810 BC in association with a Townsend sherd and an early Woodland I date of 2870-2570 BC. As discussed above, the results from this feature suggested considerable mixing of materials from widely differing time periods.

In addition to its charred organic sample date of 1020-840 BC, Feature 195 produced the Selden Island bulk sherd date of 1190-1000 BC, as well as Wolf Neck and Coulbourn ceramics.

Although the features that produced middle Woodland I dates were generally consistent in documenting an association between the dates and diagnostic artifacts of the same general period, there was little correspondence between specific dates and the presumed ages of the ceramic types in question. However, the results were sufficiently consistent internally to allow assignment of three of these features (Features 195, 197, and 227) to the middle Woodland I period with confidence. Features 9 and 185 were more problematical. Feature 9 contained a substantial quantity of Woodland II Townsend ceramics in association with its middle Woodland I date of 1260-1000 BC. As discussed above, Feature 185 produced mixed results and its early Woodland I charred organic sample date could be considered reliable.

Charred organic samples from two features returned late Woodland I (traditional Middle Woodland) radiocarbon dates. The two-intercept date from Feature 279 had an inclusive range of AD 780-960. However, the feature also produced a fragmentary steatite bowl, a cache of argillite flakes, and a single unidentifiable ceramic sherd. The results suggested some mixing of later materials in an early Woodland I feature. The radiocarbon date was not considered a reliable indicator of the feature's age. The two-intercept sample from Feature 295 also dated to AD 780-960. Diagnostics in the feature included a Hell Island-like sherd and a Rossville projectile point. The date was consistent with the presumed age of the sherd but was late for the Rossville point. Considering the overall prevalence of narrow bladed stemmed projectile points at the site, it would not be surprising if some became incorporated by chance into features that post-dated the points. The Feature 295 date was thus considered to be potentially reliable.

One Woodland II (traditional Late Woodland) date was returned from a charred organic sample. A sample from Feature 10 produced a single intercept date of AD 1460-1650. A shell sample from the same feature (see above) returned a single intercept date of AD 1470-1560. The feature also produced a large sample of Townsend and Killens ceramics, but no other diagnostic artifacts. The results were highly consistent internally, and the dates were both considered to be reliable. A second charred organic sample produced a possible Woodland II date. The sample was from Feature 178, and returned a multiple intercept date with an inclusive range of AD 1520-1950. The feature produced no diagnostic artifacts, and the reliability of the date could not be independently evaluated.

Discussion: With the exception of the tree throw dates which due to their contexts could not be evaluated independently, the majority of the radiocarbon dates from Site 7K-F-11/169 were consistent with chronologically diagnostic artifacts recovered from the same contexts. Of the 23 radiocarbon dates from cultural contexts, including those returned from charred organic, bulk sherd, and shell samples, 18 dates (78%) were considered to be reliable indicators of the age of the contexts from which they were derived, three (13%) were considered unreliable because of conflicting chronological evidence, and two (10%) could not be independently evaluated due to the lack of associated chronologically diagnostic artifacts. These results compared favorably with other recent data recovery excavations in Delaware, some of which encountered various degrees of difficulty with radiocarbon dating attempts (e.g. Custer et al. 1996; Bowen et al. 2011a; LeeDecker et al. 2005).

Of the 17 charred organic material samples from cultural features that were dated, 15 were bulk samples recovered as such in the field and two were samples that were extracted from feature

flotation samples. All three of the radiocarbon dates that were considered unreliable were returned by bulk charred material samples. Both of the flotation samples returned dates considered reliable, including a Woodland II date of AD 1460-1650 that was corroborated by association with a similar date returned by a shell sample and substantial amounts of Woodland II ceramics. The other flotation sample returned a date of 1010-850 BC that was directly associated with an unidentified ceramic sherd and indirectly with a recognizable concentration of other features of similar age (see Section 6.3). Although bulk charred organic material samples were available from most of the features that were dated, the samples were uniformly small and all required the AMS (accelerator mass spectrometry) counting technique.

All four bulk sherd samples returned dates that were corroborated by the ceramic types of the sherds used, although one sherd from a Seldom Island vessel was found in the mixed context of Feature 185. Although the sample was small, the results of this approach suggested that it is reliable and can contribute chronological information relevant to ceramic typology as well as to the resolution of more general site dating issues.

The single radiocarbon date for shell that was returned by a prehistoric sample was consistent with a charred organic sample date and with associated prehistoric ceramic types. The other shell sample returned a modern date, indicating that the sample was intrusive in the prehistoric feature from which it derived.

6.2.2 OSL Dating Results

As indicated above (see Section 2.0), samples of soil for OSL (Optically Stimulated Luminescence) dating were collected in the field from various contexts. Because the technique has only recently been perfected and the application of currently accepted procedures to archaeological situations is relatively new, the OSL dating research performed here focused primarily on evaluating the reliability of the technique within the specific constraints of archaeological contexts at Site 7K-F-11/169. For this purpose, nine OSL soil samples, all from cultural features, were selected as a preliminary test of the method. The analysis focused exclusively on cultural features because these were the only contexts at the site that could reasonably be expected to contain deposits that were chronologically homogeneous. To allow comparisons between radiocarbon dates and OSL dates, five of the nine OSL samples were from features (Features 330, 341, 371, 376, and 419) that returned radiocarbon dates that were considered reliable based on associated chronologically diagnostic artifacts. These features included three cylindrical pits, a basin, and a pit. One additional OSL sample was from a feature (Feature 178) that based on its morphology appeared to be a prehistoric cylindrical pit, but which produced a multiple intercept radiocarbon date of AD 1550-1950, suggesting that the feature might be of historic age. This OSL sample was selected to further assess the age of this feature. The remaining three OSL samples were from pits (Features 332, 338, and 388) for which no radiocarbon dates were available but were of interest for other reasons. Specifically, the Feature 332 sample was selected because although the feature lacked a radiocarbon date and produced no diagnostic artifacts, it contained a distinctive complex of chronologically non-diagnostic artifacts, including microtools and grooved abraders, that suggested it was of early Woodland I age (see below, Section 6.5). Similarly, no radiocarbon date was available for Feature 338, which contained the same presumably early Woodland I complex of tools but also produced

Woodland II period ceramics. Feature 388 also lacked a radiocarbon date but did contain middle Woodland I Dames Quarter ceramics, a ceramic type of special interest (see below, this Section). These latter three samples were thus selected to clarify various chronological issues.

Methods: In the field, OSL samples were collected from feature contexts by driving OSL sample tubes into the exposed walls of feature fills in half-excavated features. The filled sample tube was then removed and its ends were capped. Since OSL dates measure the time that has elapsed since the soil in the sample was last exposed to sunlight (referred to as "bleaching"), every attempt was made during the sample collection process and later during sample storage to protect the samples from exposure to light.

The Institute for Integrated Research in Materials Environments and Society (IIRMES) of the California State University at Long Beach performed the OSL dating analysis. Their results are presented in detail below in Section 10.1.8. To summarize, the specific OSL dating procedure that was used to process the Site 7K-F-11/169 samples is termed single aliquot regeneration optically stimulated luminescence (SAR-OSL), which has significantly enhanced the accuracy and precision of the technique (Timor et al. 2011). The procedure involves extracting a small sample of soil from the center of each sample tube and then preparing multiple aliquots of treated sediment consisting of samples of coarse (sand-sized) grains of quartz. Each aliquot is then irradiated to generate a luminescent signal, the strength of which is measured. OSL dates are generated mathematically based on the strength of the resulting luminescent signal. As applied to the Site 7K-F-11/169 OSL feature samples, the procedure involved preparing and measuring either five or six aliquots per soil sample, thus resulting in the calculation of five or six separate OSL dates for each of the nine originally submitted samples of feature fill.

Results: The variability exhibited by the individual OSL readings for each core sample was large, with individual aliquot dates for each that spanned ranges of from 1000 years to as much as 7000 years (Table 6.5). This suggested that the soils in the sampled features had been last exposed to sunlight, or bleached, at widely different times in the past, which in turn had implications concerning the manner in which the features in question had filled in. For example, if a feature excavated by the prehistoric occupants of the site was simply abandoned and left open to fill in through natural processes such as gradual side wall slumping and slope wash, one would expect that all or nearly all the soil introduced into the feature would be bleached during the process. Since filling in features in this manner would likely take no more than several decades at most, a soil sample from within the feature fill would be expected to generate OSL dates that were internally consistent with one another, clustering close to but perhaps slightly later than the date the feature was abandoned. Clearly, this expectation was not met by the Site 7K-F-11/169 OSL dates, since individual aliquots from each feature sample produced widely ranging dates.

Alternatively, if a feature was filled intentionally by the prehistoric site occupants when it was no longer needed or upon reoccupation of the site on a subsequent visit, one might expect that earth would be introduced into the feature in clumps of varying sizes, as site occupants intentionally pushed side walls into the feature pit and/or filled it with earth from intentional excavations nearby, perhaps in the creation of a new feature. Thus, filling features intentionally might introduce earth some but not all of which had been protected from exposure to sunlight and thus

Table 6.5
Evaluation of OSL Dates

Feature	Age Assignment	Type	Diagnostics	Radiocarbon Dates	OSL Date Range	Comments
330	EWI	Cylinder	Savannah River Point	2200 - 2030 BC	12,349 ± 839 – 4887 ± 384 BC	All OSLs too early
419	EWI	Cylinder	Rossville Point	1770 - 1630 BC	997 ± 392 BC-AD 34 ± 258	All OSLs too late
376	EWI	Cylinder	Rossville Point Unidentified Ceramic	1860 – 1610 BC	3215 ± 275 – 1910 ± 275 BC	Latest OSL OK?
371	EWI	Pit	Rossville Point	2260 – 2040 BC	3615 ± 288 – 2671 ± 246 BC	Latest OSL OK?
341	EWI	Basin	Rossville Point	2280 – 2020 BC	7799 ± 577 – 3430 ± 324 BC	All OSLs too early
332	EWI	Pit	None	None	4236 ± 421 – 2191 ± 282 BC	Latest OSL OK?
178	WII/Hist?	Cylinder	None	AD 1550 – 1950	2636 ± 323 – 79 ± 144 BC	All OSLs too early
338	WII or EWI?	Pit	Townsend Ceramic	None	8136 ± 537 – 1091 ± 162 BC	Latest OSL OK?
388	MWI?	Pit	Dames Quarter Ceramic	None	4311 ± 361 – 2639 ± 258 BC	All OSLs too early?

remained unbleached, with the result that the feature fill might produce a wide range of OSL dates. This was the pattern exhibited by the Site 7K-F-11/169 OSL dating results. Given the likely "contamination" of the Site 7K-F-11/189 feature fill OSL samples with "older" unbleached quartz grains, it followed that the most recent OSL date from a given aliquot from a given sample of feature fill could be taken to indicate that the feature could not have been filled in any earlier than that date, but could not rule out the possibility that the feature could have been filled in later than that date. Individual aliquot OSL dates that predated the latest date from a feature sample presumably included quartz grains that had not been bleached, or not fully bleached, during the process of feature filling, and thus would need to be disregarded as clearly unrepresentative of the actual time of feature use/infilling.

Comparison of the OSL dating results with radiocarbon dates was generally consistent with the above interpretation, in that most of the OSL dates were earlier than the corresponding radiocarbon dates from the same features (Table 6.5). Of the five OSL samples from features with reliable radiocarbon dates, two (from Features 330 and 341) returned latest OSL dates that were approximately 2500 years and 1000 years earlier than the radiocarbon dates from the same feature, respectively, while two others (from Features 371 and 376) produced latest OSL dates that were earlier than the corresponding radiocarbon dates by somewhat narrower margins of approximately 500 years and 200 years, respectively. Presumably, the aliquots from all four of these samples included quartz grains that were not bleached at the time of feature infilling, thus producing an average reading that was earlier than the actual event of feature infilling. The fifth OSL sample from a feature that returned a reliable radiocarbon date (from Feature 419) yielded an anomalously late OSL date, with an *oldest* OSL reading that was 700 years *later than* the radiocarbon date. How such an anomalous result could have occurred was unclear, unless perhaps the sample was inadvertently exposed to sunlight during sample collection in the field or later during sample transport and storage.

The OSL sample from Feature 332, for which no radiocarbon date was available, produced a latest OSL reading of 2191 +/- 282 BC, which was generally consistent with the presumed age of the early Woodland I tools recovered from the feature, but was at the early end of the overall range of radiocarbon dates from the site as a whole. The OSL sample from Feature 178, the Woodland II/historic cylindrical pit, returned a latest OSL date of 79 BC+/-144, which was again earlier than any of the intercepts of the associated radiocarbon date. The OSL sample from Feature 338, which produced both early Woodland I tools and Woodland II Townsend ceramics, produced a latest OSL date of 1091+/-162 BC, which was consistent with the presumed age of the tools, but being a "couldn't be earlier than" type of date, could not independently rule out a Woodland II date for the event of feature infilling. Finally, the OSL sample from Feature 388, which produced Dames Quarter (middle Woodland I) ceramics, returned a latest OCL date of 2639+/-258 BC, which was significantly earlier than the generally accepted age of prehistoric ceramic manufacture and use in the region (see below, this Section).

Discussion: In general, the OCL dating results were of limited use in the chronological analysis of the features from the site. Because many of the dates were significantly earlier than the associated radiocarbon dates, the results were generally suspect for situations in which other chronological evidence was lacking or was internally inconsistent. In the event, only two of the nine OSL samples returned dates that were consistent with other chronological evidence. The

OSL dates from Features 332 and 338 suggested that both features, and the distinctive tool complex they contained, could date to the early Woodland I period of site occupation.

Clearly, the most notable result of the OSL dating analysis was the consistently early age of the OSL dates that the feature samples generated. Of the nine OSL samples submitted, all but two were either obviously too early or appeared to be somewhat too early, based on other chronological evidence. This outcome suggested that at least at this site, feature infilling occurred in a way that introduced soil into features without completely bleaching its constituent quartz grains in the process. Under these circumstances, OSL dates could not provide a reliable and independent way to assess the age of the features in question.

In this regard, it is perhaps pertinent that the natural sub-plowzone soils at Site 7K-F-11/169 were fluviomarine sediments of pre-Wisconsinan age, and if undisturbed would have last been bleached more than 100,000 years ago. If just a single unbleached quartz grain of these fluviomarine sediments was by chance included in a dated aliquot, the resulting OSL date would be differentially affected by the extreme age of the contaminating particle. Thus, incorporation of only a very minor amount of unbleached soil during the process of feature infilling could potentially have resulted in OSL dates that were substantially earlier than the actual age of feature infilling. Considering this, it is perhaps surprising that the Site 7K-F-11/169 OSL dates were as close to the corresponding radiocarbon dates as they were.

Presumably, the currently accepted SAR-OSL dating procedure would be more successfully applied in situations involving the gradual accumulation of soil materials through natural geological processes such as deposition in slow moving shallow water or through soil creep and slope wash, during which soil material would be fully bleached and then buried and protected from further exposure to sunlight. Clearly, such conditions did not prevail in the processes by which cultural features at Site 7K-F-11/169 were filled in, and the potential problem of contamination by unbleached older soil may have been exacerbated by the great age of the natural subsoil into which the features had been excavated by prehistoric site occupants. Within the general context of archaeological research, current SAR-OSL protocols may thus prove more useful for situations such as naturally stratified sites where the principal mechanism for stratification was the gradual particle by particle accumulation of soil material.

However, even when applied in seemingly more favorable depositional contexts, previous SAR-OSL dating attempts have encountered difficulties attributable to contamination by older unbleached grains of quartz. For example, to establish a chronological sequence for Mousterian occupations in the eastern Sahara Desert, Bubenzer et al. (2007) attempted to supplement radiocarbon dates with SAR-OSL dates from samples taken from naturally deposited fluviomarine sediments. They found significant discrepancies between the radiocarbon dates and the OSL dates that they attributed to the "differences in heterogeneous sediments of degree of bleaching."

Although a comprehensive review of recent OSL dating research in archaeology is beyond the scope of this study, it is notable that attempts to overcome the problem of unbleached sample contamination in the SAR-OSL procedure have recently achieved some success. For example, Jacobs et al. (2011) developed a refinement of the procedure that they refer to as single-grain

OSL dating, in which the individual grains of quartz isolated by the SAR process are screened to eliminate unbleached older grains as well as younger recently bleached grains, prior to irradiation and measurement of the luminescent signal. As applied to soil samples from Middle Paleolithic stratified cave sediments in Morocco, the procedure successfully removed unbleached "older" quartz grains that originated as roof fall from sand grains of aeolian origin presumably bleached at the time of site occupation. The resulting dates were considered reliable based on other chronological evidence. If it proves to be more generally applicable, the single-grain OSL method would thus appear to have considerable potential to improve the accuracy and reliability of OSL dating when applied to archaeological contexts.

6.2.3 Projectile Point Typology

In all, 67 items recognizable as hafted bifaces, generally referred to as projectile points or projectile point/knives, were recovered during the Phase II and III excavations reported herein (Table 6.6). Of these, 45 could be assigned to recognized types with known or suspected ages. Fifteen additional points were recovered from areas within Site 7K-F-11/169 during the Phase I and II excavations performed previously by ADM, of which nine were assigned to recognized types. The 54 typeable points produced by the various stages of excavation at Site 7K-F-11/169 were identifiable as belonging to 15 previously recognized types, listed below with brief descriptions of the specimens recovered from Site 7K-F-11/169.

The general literature on projectile point typology in the eastern North America generally and the mid-Atlantic region specifically (including Custer 2001) uses the traditional prehistoric chronology exclusively rather than the Custer (1989) chronology currently used in Delaware. To be consistent with the site specific analyses and interpretations presented elsewhere in this report, in the discussion that follows traditional period designations are converted to the Delaware scheme.

Kirk/Palmer (n=1): These corner notched points have prominent shoulders and straight to slightly concave bases. They are distinctively well-made with well-controlled flaking and ground bases and notches. Some have serrated edges. They generally were made from notably high-quality lithic raw materials. Many smaller specimens exhibit prominent alternate edge beveling. These characteristics all suggest considerable care in manufacture and curation during the use life of the point. Kirk/Palmer points have consistently been assigned to the Early Archaic Period. Examples include date ranges of 8000-7000 BC (Custer 2001), 7500-6900 BC (Justice 1987), and 7500-6000 BC (Fogelman 1988). The single specimen from Site 7K-F-11/169 was recovered during Phase III excavation of test units on grid. It was made from a fine grained black chert and has small ground notches and a ground base (Photograph 6.10).

Lamoka (n=1): Lamoka points have narrow, thick blades, expanding to straight stems and sloping shoulders. They are generally expediently made and often exhibit remnants of cortex, especially on their bases. They are assigned early Woodland I ages of 3500-2500 BC in New York State and 2570-1800 BC in Pennsylvania (Ritchie 1961, Kinsey 1972, Justice 1987). However, Funk (1993) reports dates for Lamoka points from the upper Susquehanna River valley of New York that range from ca. 2500 BC to c.1700 BC, closely approximating Kinsey's

Table 6.6
Projectile Point Typology Site 7K-F-11/169

Test Unit	Feature	Strat	Lev	Type	Chronology	Complete	Lithic Material	Comments	Length (mm)	Width (mm)	Thick. (mm)
GP				Bare Island	3000 BC - AD 500 (Custer 2001)	Base	Rhyolite	tip broken, L=43.15mm		18.28	8.29
157		2	2	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Argillite	eroded, weak shoulders	58.11	18.92	8.93
183		2	2	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Jasper		41.00	21.40	6.60
163		2	2	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Jasper	convex base	33.20	16.40	8.30
	308	1	1	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Argillite		47.20	21.30	5.20
	323	1	1	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Quartzite	cortex on base of stem	49.30	18.60	9.40
	331	1	4	Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Quartz	convex base	40.40	20.50	10.40
GP				Bare Island	3000 BC - AD 500 (Custer 2001)	Com	Quartz		45.32	19.49	9.94
161		1	1	Basal Notched	AD 0 - 1000 (http://history. delaware.gov/archaeology/point s/ques16.shtml)	Com	Jasper		24.35	20.80	4.50
11	5	2	4	Fox Creek Lanceolate	AD 400-900 (Custer 2001)	Com	Grey Chert	convex blade edges, straight base	51.80	31.70	11.80
90		1	1	Kirk/ Palmer Notched	8000-7000 BC (Custer 2001); 6900 - 6000 BC (Justice 1987; 82)	Base	Black Chert	very small notches, ground base; L=21.57mm		15.90	5.10
	225	1	4	Lehigh/Koens-Crispin Broadspear	2500-1700 BC (Custer 2001)	Base	Argillite	shallow shouders, wide concave base; L=31.52mm		50.10	7.50
	236	4	4	Levanna	AD 100-1600 (Custer 2001)	Com	Jasper	concave base	22.50	18.40	4.90
	376	1	6	Mini-Rossville/ Poplar Island		Com	Quartzite	broken at base; possibly Bradley Spike	35.60	5.30	5.60

Table 6.6
Projectile Point Typology Site 7K-F-11/169

Test Unit	Feature	Strat	Lev	Type	Chronology	Complete	Lithic Material	Comments	Length (mm)	Width (mm)	Thick. (mm)
157		2	2	Piney Island	3000 BC - AD 500 (Custer 2001)	Com	Black Chert		50.53	21.11	9.66
171		1	1	Piney Island	3000 BC - AD 500 (Custer 2001)	Com	Jasper		48.40	18.80	8.60
	199			Piney Island	3000 BC - AD 500 (Custer 2001)	Base	Grey Chert	broken; L=33.83		24.69	10.89
	339	surf		Piney Island	3000 BC - AD 500 (Custer 2001)	Com	Black Chert	wide stem; use wear as p.pt.	47.50	23.55	9.25
30		1	1	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Rhyolite	flat base	72.10	23.30	7.10
71		2	2	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Black Chert	pentagonal shape w/ straight sides contracting to base, strainght basal edge; use wear as p.pt.	41.60	23.90	9.80
120		1	1	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Black Chert		59.60	23.30	12.20
169		2	2	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Quartz	round base	44.20	16.70	10.80
	344	4	1	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Argillite	reddened	58.85	27.90	8.55
	293	1	1	Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Quartzite	black, round base	53.00	22.30	9.20
	236	5	1	Poplar Island	2500 BC - AD1000 (Custer 2001)	Base	Quartzite	broken; L=37.35mm		28.57	11.35
GP				Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Quartz	tip fractured	49.50	19.50	9.65
GP				Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Quartz		40.25	18.40	7.60
PP				Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Jasper	use wear as knife	40.50	21.20	8.00

Table 6.6
Projectile Point Typology Site 7K-F-11/169

Test Unit	Feature	Strat	Lev	Type	Chronology	Complete	Lithic Material	Comments	Length (mm)	Width (mm)	Thick. (mm)
PP				Poplar Island	2500 BC - AD1000 (Custer 2001)	Com	Jasper	angular shoulders; use wear, possibly used	56.00	24.80	9.70
54		1	1	Rossville	2700 - 2000 BP (www.nativetech.org/stone/pointtypes/stem-rossville.html)	Com	Jasper	tip fractured; use wear as p.pt.	40.21	31.73	9.79
62		1	1	Rossville	2700 - 2000 BP	Com	Grey Chert	tip & base broken, fractured lengthwise; L=38.39, Th=7.57		22.50	
126	23	1	2	Rossville	2700 - 2000 BP	Com	Argillite		39.80	26.60	6.70
183		1	1	Rossville	2700 - 2000 BP	Com	Quartz	tip fractured	35.50	28.10	10.80
	295	1	1	Rossville	2700 - 2000 BP	Com	Grey Chert	cortex on blade; use wear as drill?	44.03	25.36	9.00
	371	1	2	Rossville	2700 - 2000 BP	Com	Jasper	use wear as p.pt.	49.20	28.20	7.20
	376	1	1	Rossville	2700 - 2000 BP	Com	Quartz	small	31.60	18.30	5.90
	289	1	1	Rossville	2700 - 2000 BP	Com	Quartzite		53.71	27.11	10.11
	233	1	1	Rossville	2700 - 2000 BP	Com	Jasper		34.10	22.40	9.20
	326	1	4	Rossville	2700 - 2000 BP	Com	Chalced-ony	formed on flake	40.90	20.80	7.60
	341	1	1	Rossville	2700 - 2000 BP	Com	Jasper	serration on blade; use wear as p.pt.	33.00	22.10	8.10
GP				Rossville	2700 - 2000 BP	Com	Quartzite		49.10	31.70	11.70
GP				Rossville	2700 - 2000 BP	Com	Jasper	narrow blade	40.40	19.60	10.40
	419	1	2	Rossville	2700 - 2000 BP	Com	Chert	crude	43.40	18.50	8.80
	330	1		Savannah River Stemmed	3000 - 1000 BC (Justice 1987; 163)	Com	Quartzite	large blade, arcing shoulders, slightly concave base	120.20	41.35	17.15
GP2 PH II				Susquehanna Broadspear		Base	Argillite	N793E677			

Table 6.6
Projectile Point Typology Site 7K-F-11/169

Test Unit	Feature	Strat	Lev	Type	Chronology	Complete	Lithic Material	Comments	Length (mm)	Width (mm)	Thick. (mm)
	339	3	4	Untyped Broadspear		Com	Black Chert	unequal shoulders, edge of base may be broken	43.00	27.40	7.40
	340	1	1	Untyped Broadspear		Distal	Argillite	break above shoulders; L=46.66, W=41.72			6.43
17.1 PH II		1	1	Untyped Pt		Distal	Black Chert	N720E660			
GP5 PH II				Untyped Pt		Distal	Argillite				
18		1	1	Untyped Pt		Base	Argillite	very eroded, possible broadspear; L=39.06, W=34.36			6.82
41		2	1	Untyped Pt		Com	Argillite	very eroded; L=53.30		31.20	5.90
97		2	2	Untyped Pt		Com	Quartz	contracting stem	30.09	15.73	7.37
120		1	1	Untyped Pt		Distal	Grey Chert	contracting stem? Base broken, L=32.80		12.40	8.50
126		1	1	Untyped Pt		Base	Quartz	contracting stem, medial break, L=26.60, W=16.00			7.45
127		1	1	Untyped Pt		Base	Quartz	contracting stem, tip broken, L=41.05mm	41.05	19.30	10.20
90	3	2	2	Untyped Pt		Com	Jasper	contracting stem	34.70	19.00	8.85
90	3	2	2	Untyped Pt		Com	Jasper	asymmetrical shoulders	31.60	22.50	9.40
	418			Untyped Pt		Com	Quartz	tip fractured; contracting stem	44.10	21.40	11.80
	122	1	4	Untyped Pt		Base	Quartz	medial break, contracting stem; L=32.08, W=19.87			9.36

Table 6.6
Projectile Point Typology Site 7K-F-11/169

Test Unit	Feature	Strat	Lev	Type	Chronology	Complete	Lithic Material	Comments	Length (mm)	Width (mm)	Thick. (mm)
	323	1	1	Untyped Pt		Com	Argillite	very degraded; contracting stem, rounded base	52.30	19.50	7.90
	330	1	1	Untyped Pt		Base	Argillite	very degraded, contracting stem, tip broken; L=40.30		24.20	7.60
	338	1	1	Untyped Pt		Distal	Jasper	stem missing; L=36.70		21.20	5.60
PP	184			Untyped Pt		Com	Grey	serrated edges, base broken; L=41.17		13.62	4.93
	227	1	2	Untyped Stemmed		Base	Jasper	tip broken, straight stem; L=41.11		18.10	9.00
101		1	2	Untyped Stemmed		Com	Heat Treated Jasper	straight stem	41.40	24.60	7.90
163		1	1	Untyped Stemmed		Com	Quartz	tip fractured	31.65	16.80	8.65
	326	3	8	Untyped Stemmed		Com	Heat Treated Jasper	use wear as p.pt.	36.60	17.60	6.50

Photograph 6.10 Various projectile point types. *Left to right:* Fox Creek, chert (Lot 58.A), Kirk/Palmer, chert (289.A), Levanna, jasper (1244.A), Basal Notched, jasper (679.1.E).

Photograph 6.11 Broadspear projectile points. *Left to right:* Savannah River, quartzite (Lot 1448), two untyped broadspears, chert and argillite (1555.A, 1572.A), Lehigh/Coens Krispin, argillite (1160.B)

findings from the upper Delaware River valley in Pennsylvania. In contrast, Custer (2001) attributes these points a long span of use from the early Woodland I through the late Woodland I. The single specimen from Site 7K-F-11/169 was recovered during ADM's Phase I survey of the portion of the site within Phase I APE.

Savannah River (n=1): These large broad-bladed points have slightly contracting stems and convex blades. They exhibit relatively expedient manufacture, usually from relatively poor quality raw materials. They have been assigned to the early Woodland I, with ranges for example of 2500-1700 BC (Custer 2001), 3000-1000 BC (Justice 1987), and 2000-1000 BC (Fogelman 1988). The single specimen from Site 7K-F-11/169 was found during Phase III feature excavations, and was made from quartzite (Photograph 6.11). It was recovered from a feature that produced a radiocarbon date of 2200-2030 BC, which was well within the established range for this type.

Teardrop (n=1): These small ovate points have rounded bases, and lack either notches or stems. Custer (2001) attributes them to the middle Woodland I. The one point from Site 7K-F-11/169 was recovered during ADMs Phase I survey, and assigned an age of 3000 BC-AD 1000.

Goose Creek Spike (n=1): Like Teardrop points, Goose Creek Spike points are small and ovate Custer (2001) identifies them as a variant of the Teardrop type that is found principally in Virginia. The Goose Creek Spike point from Site 7K-F-11/169 was found during ADM's Phase I survey.

MacPherson (n=1): MacPherson points are side notched, with rounded shoulders and an expanding stem. The base is rounded and the side notches are broad and shallow. Fogelman (1988) assigns dates of 2500-1700 BC to these points. Justice (1987) places them within her Lamoka cluster, with a matching date range of 3500-2500 BC. The one MacPherson point recovered from Site 7K-F-11/169 was found during ADM's Phase I survey.

Lehigh/Coens Krispin (n=1): One of the classic broadspear types, Lehigh/Coens Krispin points have wide blades, short straight-sided to contracting stems, and prominent sharp shoulders. Originally defined as two separate types (Cross 1941, Kraft 1970), they have more recently been treated as a single type (e.g. Custer 2001). Like other classic broadspear types, most have thin cross sections and some are distinctly asymmetrical. They are associated with distinct changes in lithic technology that occurred at the end of the early Woodland I, during what has traditionally been referred to as the Terminal Archaic or Transitional period. Lehigh/Coens Krispin points are generally assigned to the earliest part of the classic broadspear period, from 2500-1700 BC (e.g. Custer 1996, 2001). A single example from Site 7K-F-11/169 was recovered during Phase III feature excavations (Photograph 6.11). It was fashioned from argillite.

Untyped Broadspear (n=2): Two point fragments recovered from 7K-F-11/169 exhibited the broad blades and thin cross sections of classic broadspears, but were insufficiently complete to assign them to a specific broadspear type. In general, broadspears date to the end of the early Woodland I. Custer assigns the group as a whole to 2500-1500 BC (Custer 1996, 2001). However, many other researchers propose a slightly later and narrower age range, from c.1800-1100 BC (Kinsey 1972, Funk 1993, Kraft 1970). Both of the broadspear fragments from Site

7K-F-11/169 were found during Phase III feature excavations. One is of black chert, the other is of argillite (Photograph 6.11).

Rossville (n=15): The majority of the points recovered at Site 7K-F-11/169 were relatively narrow bladed and stemmed. They belonged to a cluster of similar types including Rossville, Bare Island, Poplar Island, and Piney Island. These various types are distinguished by minor variations in blade and stem morphology. The Rossville type was formally defined by Ritchie (1961), who described them as varying from lozenge-shaped points to narrow bladed points with weak shoulders, contracting stems, and rounded bases. They were generally expediently made, and are often described as thick and rough. Ritchie (1961) assigned an age range extending from the end of the early Woodland I through the middle Woodland I. In the upper Delaware River valley, Rossville points were the predominant point type in the middle Woodland I Bushkill Complex contexts, dated to c. 480 BC (Kinsey 1972). There, the type was rare to absent in earlier and later contexts. More recently, Justice (1987) places the Rossville type within the Dickson Cluster, with a generalized age range of early to middle Woodland I, and Custer (2001) identifies the type as a regional variant of Poplar Island, with an even longer age range extending from the Middle Archaic through the late Woodland I.

In regional archaeological literature, the Rossville type is sometimes treated as an alternative name for Piscataway points. However, the Piscataway type as originally defined by Stevenson and Ferguson (1963) is distinctive in lacking a distinguishable stem; instead, the base is short and trianguloid and the overall shape of the point is that of a radically asymmetrical lozenge. It is unlike either the near lozenge-shaped Rossville variant and entirely unlike the more common contracting stemmed, rounded base Rossville variant. For these reasons, Rossville points are not considered identical to or a variant of Piscataway points herein. No Piscataway points were identified in the Site 7K-F-11/169 projectile point assemblage.

Two of the Rossville points from Site 7K-F-11/169 were recovered during ADM's previous Phase II survey. The remaining 13 points were recovered during Phase III test unit and feature excavations (Photograph 6.12). Lithic raw materials included jasper (n=5), quartz (n=2), quartzite (n=2), gray chert (n=2), argillite (n=1), and chalcedony (n=1). Seven Rossville points were found in features that produced radiocarbon dates. From oldest to youngest, these dates were 2290-2140 BC, 2280-2020 BC, 2160-2040 BC, 1860-1610 BC, 1770-1630 BC, 1620-1460 BC, and AD 780-960.

Bare Island (n=8): Bare Island points are narrow bladed stemmed points that have straight to slightly expanding stems with generally straight bases. They were described by Ritchie (1961), based largely on excavations at the Kent-Halley Site on Bare Island in the lower Susquehanna River valley of Pennsylvania. They show more care in manufacture than Rossville points. In Ritchie (1961) they are simply attributed to the early Woodland I. Custer (2001), however, argues that like Rossvilles and other contracting stemmed points, they could date to an extended time period from 5000 BC to AD 1000, but that they most commonly date to between 3000 BC and AD 500. Justice (1987) includes them as a morphological variant in the Lamoka cluster, with dates of 3500-2500 BC in New York and 2570-1800 BC in Pennsylvania. Like Rossville, dating this type is somewhat problematical.

Photograph 6.12 Rossville projectile points. *Top row, left to right:* chert (Lot 184.B, 1340.F), argillite (550.A); *Middle row, left to right:* jasper (171.A, 1625.A, 1216.A, 1582.A, 1839.A); *Bottom row, left to right:* quartzite (1323.A, 1842.A), quartz (1866.A, 1655.A) chalcedony (1404.L).

The eight Bare Island points from Site 7K-F-11/169 were all found during Phase III test unit and feature excavations (Photograph 6.13). Lithic raw materials included jasper (n=2), quartz (n=2), argillite (n=2), rhyolite (n=1), and quartzite (n=1). One Bare Island point was found in a feature that produced a radiocarbon date of 2140-2030 BC, which falls within all the presumed age ranges for the type.

Piney Island (n=4): Another narrow bladed stemmed variant, Piney Island points are distinguished by being exceptionally long and thin. They have straight, rectangular stems and straight bases. Custer (2001) attributes them to an extended date range, from 3000 BC to AD 1000. Presumably based on Kent (1996), Fogelman (1988) assigns them to the period 4000-2000 BC. This was a minor stemmed variant at Site 7K-F-11/169. The specimens recovered were all found during Phase III test unit and feature excavations. Two were of black chert, one was gray chert, and one was jasper (Photograph 6.14).

Poplar Island (n=11): The second most prevalent narrow bladed stemmed point type from Site 7K-F-11/169 after Rossville, Poplar Island points are distinguished from other similar types by their long tapering stems, which are sometimes pointed. The type is formally described by Ritchie (1961), based largely on excavations at the Kent-Halley Site on Bare Island in the lower Susquehanna River valley. Like Bare Island points, Ritchie (1961) assigned this type a general early Woodland I age. Custer (2001) argues that Poplar Island points can date to any time period between 5000 BC and AD 1000, but that the vast majority post-date 2500 BC, with larger examples being generally earlier than smaller ones. Like the Rossville type, Justice (1987) includes this type as a morphological correlate of the Dickson Cluster, with a date range of early through middle Woodland I.

The eleven Poplar Island points from Site 7K-F-11/169 were all found during Phase III test unit and feature excavations (Photograph 6.15). They were made from quartz (n=3), black chert (n=2), quartzite (n=2), jasper (n=2), argillite (n=1), and rhyolite (n=1).

Miniature Rossville/Poplar Island (n=1): This unusually small quartz point had morphological characteristics of both the lozenge shaped Rossville variant and a weak shouldered Poplar Island point. It presumably shares an age range with the general narrow bladed stemmed family of point types. The point was recovered during Phase III feature excavations at Site 7K-F-11/169. It was recovered from a feature that produced a radiocarbon date of 1860-1610 BC.

Fox Creek Lanceolate (n=1): Fox Creek Lanceolate points are large and broad with parallel to converging convex sides and straight to concave bases. They sometimes exhibit weak shoulders and slightly contracting basal sections. They also occasionally exhibit basal grinding. Most are made of rhyolite or argillite (Custer 2001).

Fox Creek points have differing age ranges that apparently vary regionally. In eastern New York they have been dated to 400-300 BC (Ritchie 1961), in the upper Delaware valley to AD 360-450 (Kinsey 1972), and in the Chesapeake Bay area to AD 400-900, where they are often found in association with Mockley ceramics (Custer 2001). The single example from Site 7K-F-11/169 was found during Phase III test unit excavations and was fashioned from chert (Photograph 6.10).

Photograph 6.13 Bare Island projectile points. *Top row, left to right:* argillite (Lot 1370.A; Site 7K-F-169 Lot 121), rhyolite (1867.A), jasper (669.B); *Bottom row, left to right:* quartzite (1375.A), quartz (1826, 1455.A), jasper (686.A).

Photograph 6.14 Piney Island projectile points. *Left to right:* jasper (Lot 736.C), chert (1567, 669.A, 1083).

Photograph 6.15 Poplar Island projectile points. *Top row, left to right:* jasper (Lots 1849.B, 1848.A), argillite (1590.A), rhyolite (118.B); *Middle row, left to right:* chert (214.A, 429.A), quartzite (1335.A); *Bottom row, left to right:* quartz (728.A), quartzite (1245.A), quartz (839.B, 1819).

Basal Notched (n=1): These distinctive points have trianguloid blades and two usually prominent notches in their bases. Custer (2001) assigns them to the Middle Woodland with a date range of AD 0-1000. The single example from Site 7K-F-11/169 was found during Phase III test unit excavations and was fashioned from jasper (Photograph 6.10).

Wharton Corner Notched (n=1): Wharton Corner Notched points are small with trianguloid blades and small notches in their corners. Fogelman (1988) assigns them to the late Woodland I; they are not discussed in Custer (2001) or Justice (1987) and the type appears to be rare in the mid-Atlantic region. The one specimen from Site 7K-F-11/169 was found during ADM's Phase I survey.

Levanna (n=3): This well known type is small, thin, and triangular with roughly equilateral sides and straight to slightly concave bases. It is widely recognized throughout eastern North America as a hallmark of the Woodland II period. Three examples were recovered from Site 7K-F-11/169, one during ADM's Phase I survey, a second during ADM's Phase II survey, and a third (made of jasper) during Phase III feature excavations.

Untyped Stemmed (n=4): Four stemmed points and point bases were found during Phase III excavations which were morphologically unlike, or insufficiently complete to permit assignment to any recognized type. In all likelihood these examples were closely related to, or were fragments of points belonging to, one or another of the narrow bladed stemmed types described above. Three of these points were of jasper and one was quartz. One example was recovered from a feature that produced a date of 1010-850 BC.

Untyped Points (n=25): These points exhibited morphologies that could not be matched to currently recognized types. As expected, they exhibited the full range of lithic raw material variability found at Site 7K-F-11/169. Six untyped points were found during ADM's Phase I and II surveys, and 19 were found during the Phase III excavations.

Discussion: By far the most prevalent projectile point types found at Site 7K-F-11/169 were the different varieties of narrow bladed stemmed points, including Rossville, Poplar Island, Piney Island, and Bare Island. Collectively, these types accounted for 42 (76%) of the 55 typeable points recovered from the site. These point types were distinguished from one another based on relatively subtle morphological variations, and the assignment of points to one or another type probably represented a largely arbitrary categorization of a continuous range of variability that in reality lacked "natural" breaks. If so, it was reasonable to analyze these points as a general family of point types sharing a range of morphological variability, and perhaps common periods of use and/or functions.

Radiocarbon dates were obtained for a total of nine specimens belonging to this general family of point types, including seven Rossville points, one Bare Island point, and one point classified as a miniature Rossville/Poplar Island point. These points were not specifically chosen for dating, but were for the most part the points that were found in features and thus were within dateable contexts. This circumstance likely does not indicate that Rossville points in particular were chronologically or functionally distinctive vis-à-vis the other narrow stemmed point types,

but was instead due to two factors relating exclusively to sampling issues. First, points assigned to the Rossville type turned out to be the most common type to occur at the site, and thus were more likely to occur in features. Second, Rossville points were probably included more often in features simply by chance, considering that overall sample sizes per point type were low.

Based on these considerations, it was reasonable to extrapolate the Rossville/Bare Island/miniature Rossville/Poplar Island dates to the larger family of narrow bladed stemmed points, at least for the collection from Site 7K-F-11/169. To summarize from the foregoing, eight of the nine (89%) dates for points belonging the narrow bladed stemmed family fell within a period of 2290-1460 BC, within the early Woodland I period. The one point that did not fall within this range was a Rossville point with an associated date of AD 780-960, which was technically within the late Woodland I, but was so far removed in time from all the other dates associated with these point types as to suggest that the point had become incorporated into a feature of more recent age, or that the dated sample was intrusive to the feature.

The dating results from Site 7K-F-11/169 for the narrow bladed stemmed family of projectile points had implications regarding several typological and chronological issues. As indicated above, this point family has generally been assigned a wide date range that includes the early Woodland I through late Woodland I periods. At Site 7K-F-11/169, the absence of associated middle Woodland I dates and the near absence of associated late Woodland I dates would suggest that at least at this site, the use of these points was chronologically more restricted, being largely confined to the early Woodland I. Further consideration, however, suggests that this interpretation may be an oversimplification. The lack of associated late Woodland I dates might simply reflect the near absence of a site occupation or occupations dating to this time period. Very few late Woodland I diagnostic ceramics were found during survey and excavation, and only two radiocarbon samples returned late Woodland I dates. However, the same could not be argued regarding middle Woodland I occupations at the site, since diagnostic ceramics from the period were relatively prevalent, and seven features could be reliably dated to it. These dated features produced only two stemmed points; one was classified as Bare Island, the other was an untyped stemmed point. In contrast, eight reliably dated early Woodland I features produced eight narrow bladed stemmed projectile points, including six Rossville points, one Bare Island, and one miniature Rossville/Popular Island. Although the sample sizes were low, the results suggested that at Site 7K-F-11/169, use of narrow bladed stemmed points was relatively intensive during the early Woodland I, declined markedly during the subsequent middle Woodland I despite continued site occupation, and ceased or nearly ceased during the late Woodland I, possibly due to site abandonment or near abandonment.

Comparative information from other recently excavated sites in Delaware concerning the age and use of narrow bladed stemmed points is mixed. Generally, following Custer (1996, 2001; Custer et al. 1996a, 1996b) most Delaware researchers assign these points a wide span of use from c. 5000 BC to AD 500. They also generally assume that the majority date to the early through middle Woodland I periods. Specific information from reliably dated contexts, however, is not abundant. At Sandom Branch (Bowen et al. 2011a), for example, radiocarbon dates could not be reliably associated with artifact assemblages, and as a result, dating of the site was based on artifact types thought to be chronologically diagnostic. Thus, the researchers assigned Brewerton, Lamoka, and Lackawaxen to the early Woodland I, while straight/contracting

stemmed points and points typed as Rossville/Piscataway, as well as Marcy Creek, Coulbourn, and Mockley ceramics, were considered to be of middle to late Woodland I age. However, the assemblage in question was not recovered from separable feature or stratigraphic contexts, and the presumed artifact ages and associations could not be independently evaluated.

Excavations at Frederic Lodge (Egghart et al. 2003) produced a substantial assemblage of narrow bladed stemmed points, identified as Piscataway (n=4) and Woodland I Stemmed (n=17). Again, however, the assemblage was recovered from the surface or from the plowzone and shallow, mixed subsoil contexts. Where deeper subsoil deposits were found, what were considered to be Middle Archaic, early Woodland I, and middle-late Woodland I site components could be spatially and/or stratigraphically separated. Of interest here, the early Woodland I component that could be physically isolated produced a single diagnostic artifact, a fishtail projectile point, in association with a FCR feature, but could not be directly dated. In age, the closest date from the site as a whole was from the early portion of the early Woodland I, considerably earlier than dates associated with fishtail points elsewhere. Also of interest, the middle-late Woodland I component that could be physically isolated contained points classified as Woodland I Stemmed, along with FCR features and a large pit. Again, no radiocarbon dates were directly associated, and the three middle-late Woodland I dates from elsewhere at the site were all from bulk soil samples and all returned dates from the very end of the period, post-dating even the latest dates reported for narrow bladed stemmed types in the general literature.

In the extensive projectile point assemblage recovered at Hickory Bluff (Petraglia et al. 2002), stemmed points were the most prevalent point family. Included were points identified as Woodland I Stemmed (n=47), as well as Poplar Island (n=4), Lackawaxen Contracting Stemmed (n=7), Rossville (n=8), and untyped contracting stemmed (n=6). However, isolating different chronological components at the site was problematic. The site was contained within a deposit 30 cm thick, representing occupations spanning 4000 years of prehistory. The analysis focused on the spatial associations among artifact types and features in an attempt to identify chronologically homogeneous concentrations. The results suggested that stemmed points were generally associated with middle-late Woodland I ceramic types. A problem for possible comparison of the results with the Site 7K-F-11/169 point assemblage was the inclusion of both wide bladed and narrow bladed varieties within the numerically dominant Woodland I Stemmed type, since the two variants might vary substantially in period of use and/or function.

The extensive excavations at Carey and Island Farm (Custer et al. 1996b) also produced surprisingly little data relevant to the age and use of narrow bladed stemmed points, here generally identified by the researchers as Type B Stemmed points. Many of the numerous features excavated produced points of this type, and some also produced middle-late Woodland I and/or Woodland II ceramics. However, the mixture in many features of ceramic and projectile points of different ages made such associations suspect. Radiocarbon samples were submitted for two features that contained Type B Stemmed points. One returned a date of AD 990-1040, the other a date of AD 240-340. Only the latter date fell within the accepted range for the type reported in the literature.

Puncheon Run (LeeDecker et al. 2005) produced results that are perhaps the most informative for the interpretation of the Site 7K-F-11/169 projectile point assemblage. Here, two of the four major Phase III excavation blocks – the Buried Plowzone Area and the Cobble Bar Area – produced small assemblages of diagnostic artifacts, including three points identified as narrow bladed stemmed varieties from the Buried Plowzone Block and one narrow bladed stemmed/Rossville point from the Cobble Bar Area Block. However, both areas were attributed a long period of use, from at least c.1000 BC to AD 1000, and thus did not provide reliable dates for the diagnostic artifacts found there. In contrast, a third block excavation – the Metate Area Block – produced a substantial projectile point assemblage consisting of 32 typeable specimens, of which 27 (84%) belonged to narrow bladed stemmed forms. These included Poplar Island, Piney Island (Types A and B Stemmed), Bare Island, and (tentatively) Lamoka. Additionally, the assemblage was recovered from sub-plowzone contexts that were radiocarbon dated to what the researchers refer to as early Woodland I (3000-2000 BC) to middle Woodland I (1500-1000 BC. Ceramic artifacts found in the block were from the upper levels of the soil column, and were interpreted as not associated with the primary occupation represented by the projectile points. In type composition and age, the Puncheon Run Metate Block projectile point assemblage is directly comparable to the narrow bladed stemmed projectile point assemblage from Site 7K-F-11/169. Protein residue analysis indicated that local animals, including fish, had been taken by the site inhabitants, and that the distinctive point assemblage might relate to specialized spear fishing.

The fourth excavation block - the Feature 30 Block - at Puncheon Run also produced findings relevant to the interpretation of the Site 7K-F-11/169 projectile point assemblage. This block contained three distinctive features, two large storage pits and a shallow flat-bottomed pit. Associated artifacts included seven typeable projectile points - a Fox Creek point, a Jacks Reef point, two relatively wide-bladed contracting stemmed points, a corner notched point, and a possible triangular point base. Based on one radiocarbon date, the ceramic assemblage, and the diagnostic Fox Creek and Jacks Reef projectile points, the researchers suggest that the cultural deposits in the Feature 30 Block were of late Woodland I age, likely dating to AD 500-900.

Although the size of the sample of points from the Feature 30 Block was small, its composition appeared to differ dramatically from those of the Metate Block at Puncheon and Site 7K-F-11/169. Specifically, there were no narrow-bladed stemmed points of the types that were so clearly dominant in the latter two assemblages. Additionally, the Fox Creek and Jacks Reef types from the Feature 30 Block were absent or nearly absent from the very sizeable point samples from the Puncheon Run Metate Block and Site 7K-F-11/169.

Several tentative conclusions can be drawn from the foregoing comparisons. First, the relatively reliable dating results for the Puncheon Run and Site 7K-F-11/169 assemblages suggest that at least regionally, the use of narrow bladed stemmed projectile points may be chronologically more restricted than previously thought, perhaps limited largely to the early (pre-ceramic) portion of the Woodland I period. Second, the Puncheon Run Metate Block data may indicate that the type was functionally distinctive as well, perhaps related to procuring and processing fish.

The remaining point types identified in the Site 7K-F-11/169 assemblage were represented by one or only a few examples each. In general, these points would seem to reflect a low level of intermittent site use throughout prehistory, ranging from the Early Archaic through the Woodland II, and there was little else to be concluded from them. However, two of these lower frequency point types warrant brief further discussion. In association with steatite fragments and the remains of a single steatite vessel, the three broadspear points and point fragments document a notable occupational episode relating to later phases of the early Woodland I, a period that has traditionally been referred to as the Transitional or Terminal Archaic. This widespread association of distinctive traits represents distinct changes in technology, patterns of exchange, and presumably other less tangible aspects of life as compared with what preceded and succeeded it. The broadspear component at Site 7K-F-11/169 indicated that the site was occupied during this distinctive period in mid-Atlantic prehistory, and that the site occupants at the time participated in the societal changes that then occurred. Also of interest were the three Woodland II projectile points, which were associated with substantial amounts of Woodland II ceramics and which collectively were more prevalent than middle Woodland I ceramics. Several features and feature clusters were also attributable to the Woodland II, indicating that in addition to the early Woodland I and middle Woodland I, the Woodland II was a third period of relatively intensive site occupation. This is explored in more detail below.

6.2.4 Ceramic Typology and Chronology

In all, 429 prehistoric ceramic sherds were recovered during additional Phase II testing and Phase III data recovery excavations at Site 7K-F-11/169. An additional 103 ceramic sherds were recovered during ADM's previous Phase II survey of the site area. Ceramic specialist Daniel Griffith analyzed A&HC's additional Phase II and Phase III collections, and re-examined ADM's previous Phase II collection to insure consistency of typological designations and to integrate all the ceramics from the site into the analysis (see Section 10.1.1). His findings as they relate to the chronology of the site are summarized here.

Of the 532 total ceramic sherds recovered from the site, 294 sherds could be identified as belonging to one of the eight principal ceramic series that occurred at the site. Sixteen sherds were classified as "unidentified" because they exhibited interior and exterior surfaces and clearly visible paste, but did not match defined types and did not occur in sufficient numbers to suggest that they represented previously undefined series, or examples of series defined elsewhere. The remaining sherds were too small or eroded to be assigned to a defined ceramic series. The eight principal series represented in the collection spanned the period of prehistoric ceramics manufacture and use on the Delmarva Peninsula. Included were Marcey Creek, Dames Quarter, Selden Island, Wolfe Neck, Coulbourn, Hell Island, Killens, and Townsend. They are listed below with brief descriptions of the specimens recovered from Site 7K-F-11/169.

In addition to the principal ceramic series listed above, sherds belonging to several other series were recovered in minor amounts, including Mockley(n=1), Minguannan (n=16), possibly Nassawango (n=1), and possibly Potomac Creek (n=2).

The sherds of steatite bowls recovered from the site, although obviously not ceramic, are discussed in this section because as vessels, they presumably played a functional role similar to

that of ceramic vessels. Their use preceded and overlapped with the use of ceramic vessels, and they presumably initiated the development of ceramic vessel technology.

Steatite (n=33): Steatite vessels are bowls carved of soft stone, which commonly have flat bottoms and exterior lugs on opposite sides of the vessel. In eastern North America, their generally accepted temporal range is from about 1800 BC to 800 BC (Truncer 2004), but regionally, temporal ranges may be more restricted. In the Delmarva Peninsula, steatite use is thought to date to approximately 1700-1200 BC (Custer 1989).

The 33 steatite sherds recovered during excavations at Site 7K-F-11/169, 18 were from two reconstructable vessels found in Features 3 and 279 (Photograph 6.16). These features were a tree throw and a pit located within the area identified as the early Woodland I occupational component of the site (see Section 6.3). Charred organic material from Feature 279 returned a date of AD 790-960, which was long after the accepted temporal range for the manufacture and use of steatite vessels. Feature 279 also contained a cache of argillite blade-like flakes. As indicated below (Section 6.5), use of argillite lithic raw material appeared to be characteristic primarily of the early Woodland I occupation at the site. This, in conjunction with its location within the boundaries of the early Woodland I occupational component, suggested that Feature 279 dated to the early Woodland I, and that the reconstructed steatite vessel did so as well. Of the remaining steatite sherds recovered from the site, only two were recovered from feature contexts. One was found in Feature 326, a basin that was also within the early Woodland I occupational component area but was otherwise undated; the other was in Feature 183, a basin that contained no other diagnostic artifacts and was not within any of the identified site components. The remaining steatite sherds were recovered from undateable plowzone and non-cultural feature contexts.

Marcey Creek (n=14): Marcey Creek ceramics are steatite-tempered and are frequently flat bottomed and slab constructed. They have smooth, plain interior and exterior surfaces, and are thought to be imitations of steatite vessels. They are found in the upper Delaware valley in New Jersey and extend from there into southeastern Pennsylvania, eastern Maryland, Delaware, eastern Virginia, and northeastern North Carolina. In Delaware, they were contemporaneous with steatite vessels late in the period of steatite vessel use, with dates (including those from Site 7K-F-11/169) that range from about 1610 to 700 BC (see Section 10.2) for a compilation of dates for prehistoric Delaware ceramics).

Thirteen Marcey Creek sherds found at Site 7K-F-11/169 could be identified as representing two vessels. Two radiocarbon dates were associated, one with a sherd or sherds from each vessel. The date for Marcey Creek Vessel 1 was from charred organic material in a non-cultural feature and returned a date of 1430-1310 BC; the one for Marcey Creek Vessel 2 was a bulk sherd sample which returned a date of 1610-1450 BC. The former date was consistent with the range of other dates for Marcey Creek in Delaware and the region, but the latter date was slightly earlier than the traditionally accepted temporal range for Marcey Creek. As such, it may indicate that ceramic use began in Delaware and the region somewhat earlier than previously thought, and Vessel 2 may thus date to the beginning of the period of overlap between the use of steatite vessels and ceramics.

Photograph 6.16 Steatite bowl fragments from Feature 279 (Lot 306). Together, the fragments fored a partial bowl 22 cm long, excluding the lug handle.

Dames Quarter (n=25): Dames Quarter ceramics have black hornblende/gneiss temper with plain or occasionally cord marked exteriors and may be formed by either molding or coiling. However, no plain sherds with hornblende/gneiss temper were present in the Site 7K-F-11/169 collection. Instead, all black stone tempered sherds found were exterior cord marked.

Dames Quarter ceramics occur in Delaware and in the eastern shore of Maryland, and date to approximately 1420-970 BC. Ten Dames Quarter sherds found at the site could be assigned to three vessels. A single bulk sherd radiocarbon date of 1260-1020 BC was returned for a Dames Quarter sherd. This was within but at the more recent end of the temporal range for the series.

That only cord marked Dames Quarter sherds were found at the site suggested the possibility that there were two distinct Dames Quarter types – Dames Quarter Plain and Dames Quarter Cord Marked. Whether these two types might actually represent two distinct ceramic types, or even two separate and distinct ceramic series, would require additional research on the temporal spans and technological characteristics of these two varieties of Dames Quarter ceramics.

Selden Island (n=33): Selden Island ceramics are steatite tempered and exhibit S-twist cord marking. They date to approximately 1195-810 BC, and are found in the middle Delaware Valley in New Jersey, southeastern Pennsylvania, all of Delaware, and eastern Maryland and Virginia.

Nineteen Selden Island sherds found at Site 7K-F-11/169 could be assigned to seven separate vessels. Two bulk sherd samples from Selden Island sherds returned dates of 910-810 BC and 1190-1000 BC. Both dates were within the accepted temporal range for the type.

Wolfe Neck (n=14): Wolfe Neck ceramics are similar in form, construction, and surface treatment to Selden Island ceramics, but have crushed rock temper. They exhibit a temporal range of approximately 780 BC - AD 75, and are found in southern New Jersey, all of Delaware, and the eastern shore of Maryland.

Five Wolfe Neck sherds found at the site comprised portions of three vessels. One associated date was returned for the series; a charred organic sample from a cultural feature returned a date of 350-110 BC, within the latter half of the accepted range for the type.

Coulbourn (n=11): These grog and clay nodule tempered ceramics are either cord marked or net impressed. They exhibit cordage impressions with an S-twist. They occur in Delaware except in its extreme northern tip, in the southeastern-most portion of New Jersey, and in the Maryland eastern shore. Their accepted temporal range is 55 BC - AD 350. Five sherds from Site 7K-F-11/169 came from three vessels. None of the dates from the site were associated with Coulbourn sherds.

Hell Island (n=8): Hell Island ceramics have finely crushed quartz and mica temper, and are cord marked and fabric impressed. Cordage impressions exhibit a Z-twist. They are found in the southern half of New Jersey, the southeastern corner of Pennsylvania, and in Delaware and the adjacent parts of Maryland. They are assigned a temporal range of approximately AD 525-1230. A single Hell Island sherd from the site was recovered from a feature that returned a charred organic material date of AD 780-960, which was within the range for the type. One Hell Island sherd could be identidied as belonging to a vessel.

Townsend and Killens (n=203): Townsend and Killens ceramics are shell tempered and manufactured by coiling. Vessels are conoidal and have fabric impressed or smooth exteriors. Killens ceramics are distinguished by their finer shell temper and grittier paste. Townsend ceramics are found in central and southern Delaware and in tidewater Maryland, Virginia, and North Carolina. In contrast, Killens ceramics are restricted to central Delaware. The accepted temporal range for Townsend ceramics is approximately AD 940-1705. The temporal range for Killens ceramic is more restricted, from AD 1285 to 1705.

Twenty-six Townsend sherds were identifieable as belonging to 13 separate vessels. There were three associated dates from Site 7K-F-11/169. Two of the dates came from one cultural feature. A charred organic sample from Feature 10 returned a date of AD 1470-1650, and sample of marine shell from the same feature returned a date of AD 1470-1560. The third date was from charred material in a non-cultural tree throw feature, which also contained Townsend ceramics. The sample returned a date of AD 1160-1260.

Four Killens sherds represented two vessels. Killens sherds were found in the same features that produced the dates associated with the Townsend sherds.

The two dates from the cultural feature were within the accepted ranges for both Townsend and Killens ceramics, and the presence of both ceramic series in this feature reinforced the presumed close relationship between these two series. The date from the non-cultural tree throw feature was within the range for Townsend, but was earlier than the range for Killens. However, cultural materials from different periods could easily become mixed during the formation of tree throw features (see below, Section 10.1.2), and the association between the radiocarbon sample and the ceramics was uncertain.

If the Townsend date from the tree throw feature is accepted as reliable, it could suggest that there were two principal Townsend occupations at the site, one dating to c. AD 1150-1250, the other to c. AD 1450-1650.

Discussion: The chronology of site occupation was further investigated based on radiocarbon dating of ceramic artifact types. The method employed can be described as gap analysis, which involves comparing the 2-sigma date ranges for the dates associated with the various ceramic series identified in the collection. Assuming continuous site occupation from the earliest Marcey Creek ceramics to the latest Townsend and Killens ceramics, the 2-sigma date ranges for the various series recovered should overlap. Alternatively, if there were significant periods during which the site was not used, one might expect a corresponding gap to appear between the 2-sigma date ranges of one series and the series that succeeded it in time.

The methods and results of gap analysis for the Site 7K-F-11/169 ceramics are presented in detail in Section 10.1.1. To summarize, there was a small gap of 39 years between the 2-sigma date ranges for the Marcey Creek and Dames Quarter series. Between Dames Quarter and Selden Island there was no gap. Between Selden Island and Wolfe Neck there was a large gap of 477 years, and between Wolfe Neck and Coulbourn the gap was 52 years. Between Coulbourn and Hell Island was another large gap of 460 years. Between Hells Island and Townsend the gap was 86 years.

Overall, the analysis suggested that during the period of ceramic use, site occupation was intermittent, and that the site was one of several or perhaps many alternative locations on the landscape for prehistoric settlement.

6.3 Spatial Analysis and Interpretation

6.3.1 Spatial Distribution of Artifacts

Methodology

The initial stage of Phase III testing, in which test units were excavated at regular intervals across the site, provided evidence of the distribution of artifacts in the plowzone. Subsequent excavation of the test unit blocks and stripped trenches provided additional information on distribution of subsurface features. Surfer® software was used to examine the spatial distribution of artifacts from the grid unit excavations. Patterning observed in the Ap horizon was then compared with the patterns of occupation at the site, which were identified primarily on the basis of the features.

Distribution of Artifacts in the Plowzone

A total of 1,698 prehistoric artifacts and 4,525 historic artifacts were recovered from the Ap horizon in the grid test units. Historic artifacts were found in the highest concentrations in the northern end of the project area. The Soulie Gray Farmstead (7K-F-169) had been located in this vicinity. The farmstead, which dated to the nineteenth and twentieth centuries, has been demolished. A second concentration of historic artifacts was found at the southwest end of the project area. This concentration was associated with an early historic occupation, which is described in greater detail in Section 7.0.

Prehistoric artifacts were found in relatively high frequencies in the Ap horizon throughout the project area on the southwest side of SR 1, and were found in much lower frequencies on the northeast side of the highway (Figure 6.11). The area on the northeast side of the highway formed the periphery of the prehistoric site. No cultural features and few diagnostic artifacts were found in this part of the site, with the exception of a cluster of middle Woodland I Marcey Creek ceramics.

On the southwest side of the road, there was a zone with higher frequencies of prehistoric artifacts in test units located along the North 630 transect, especially Test Units 62 and 71. Excavation Block 5 was later placed in this area, revealing the presence of an outlying early Woodland I site component. There was also a broad zone of higher artifact frequencies covering the southwestern end of the project area, west of the East 550 transect. Later excavation of Blocks 1, 2, 3, 6, and 7, and the clearing of Trench 5 confirmed that numerous features associated with three separate occupations were concentrated in this portion of the site.

Prehistoric ceramics occurred in low frequencies in the grid test units. Therefore, all the middle Woodland I ceramics were grouped together in one distribution map (Figure 6.12), including the Marcey Creek, Dames Quarter, Selden Island, and Wolfe Neck types. Woodland II ceramics were grouped in a second map (Figure 6.13), including the Townsend and Killens types. Ceramics of the late Woodland I period, including the Coulbourn and Hell Island types, were not present in the A horizon in sufficient quantities for mapping. The Surfer® maps showed that

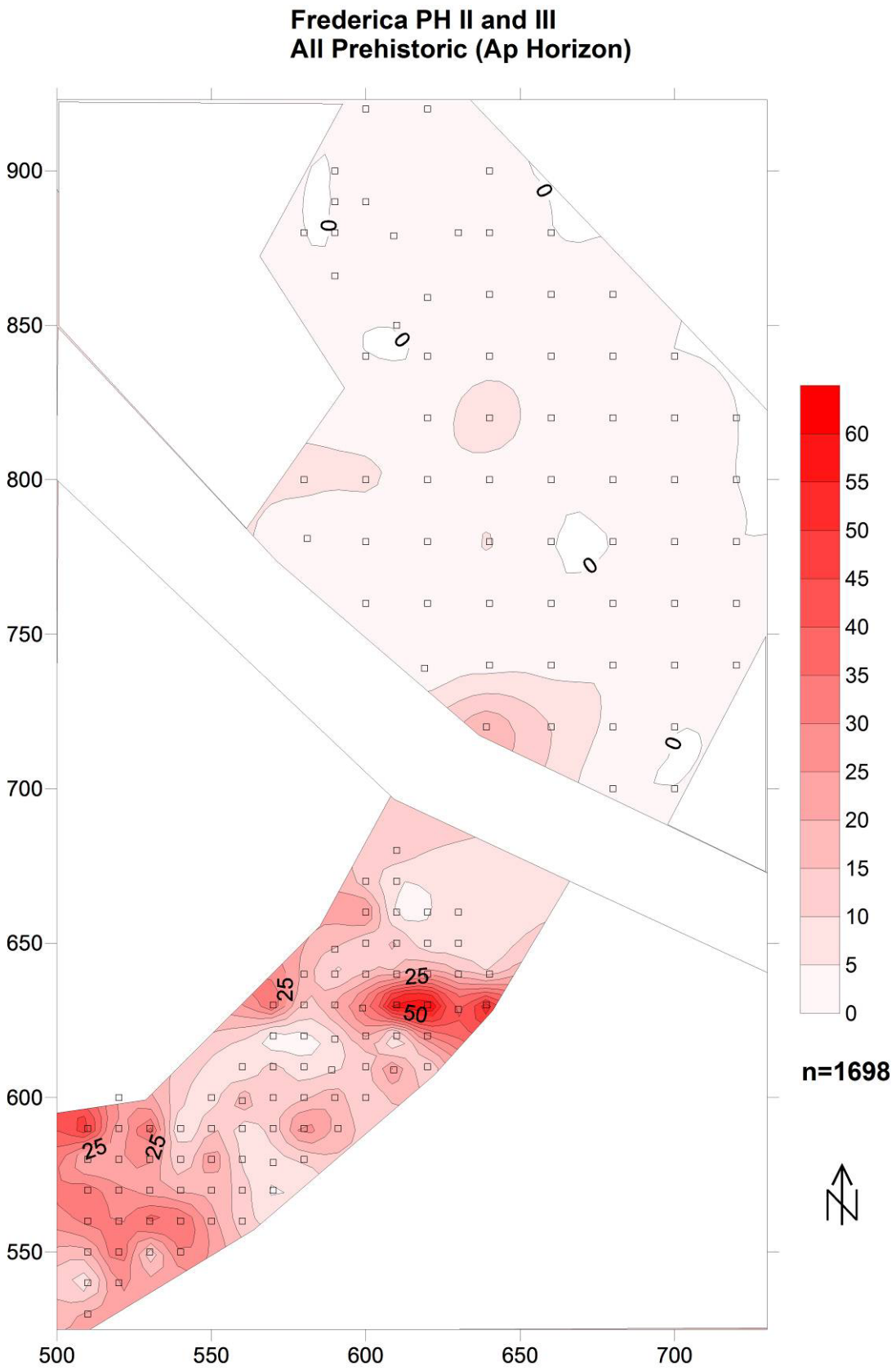


Figure 6.11 Spatial Distribution of Prehistoric Artifacts

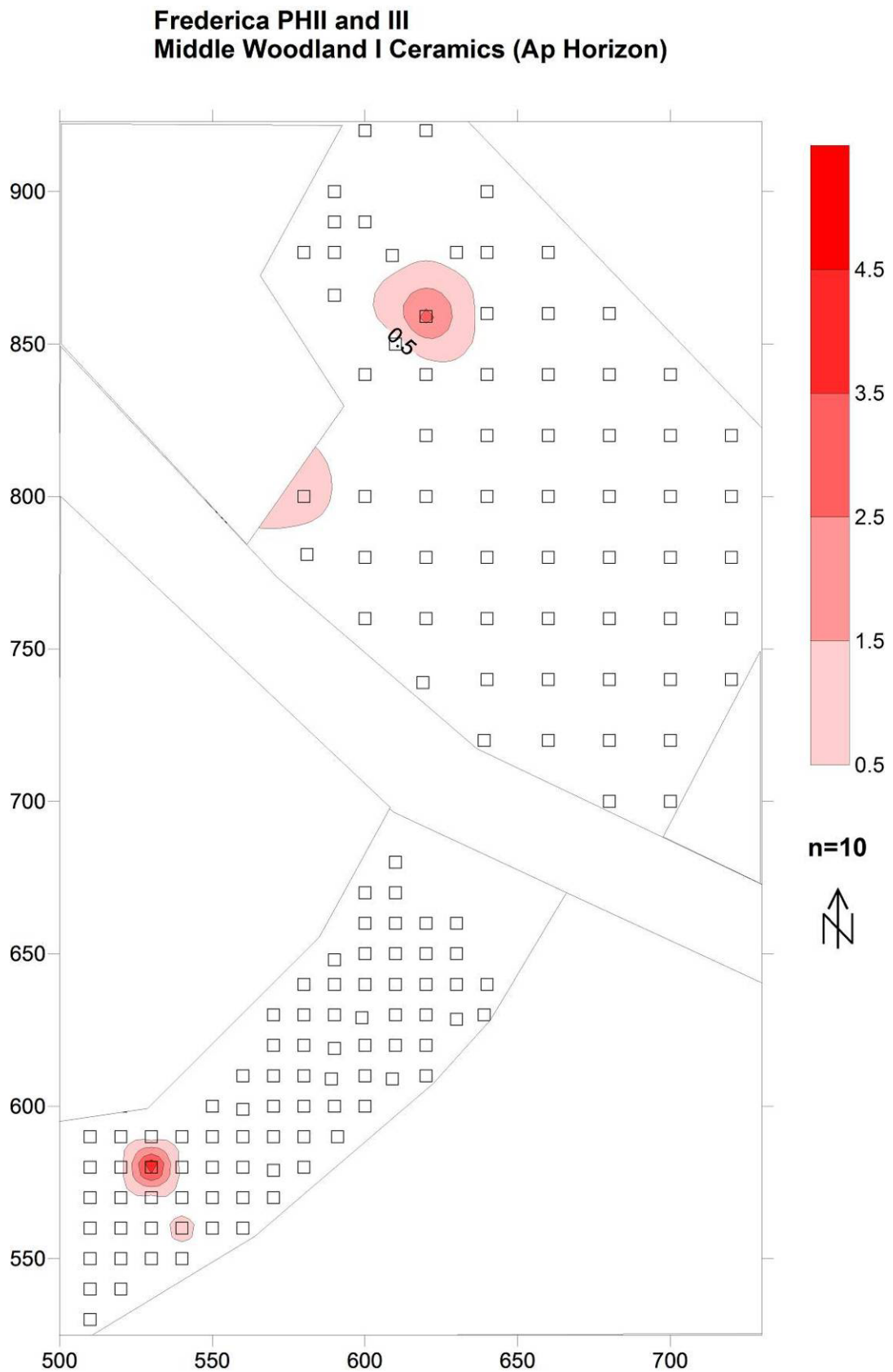


Figure 6.12 Spatial Distribution of Middle Woodland I Ceramics

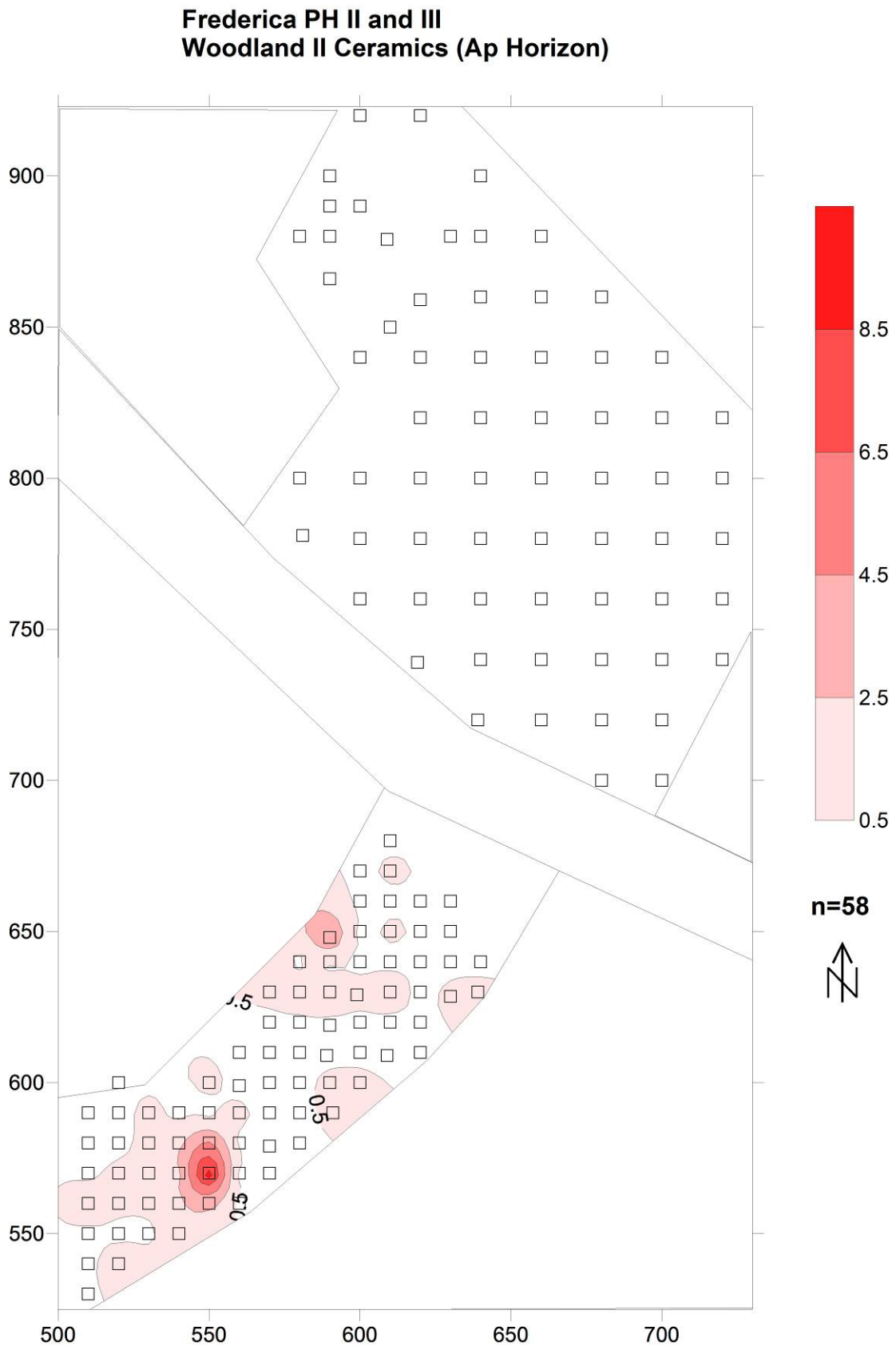


Figure 6.13 Spatial Distribution of Woodland II Ceramics

middle Woodland I ceramics were concentrated in one location, consisting of five sherds (Selden Island and Wolfe Neck found in the plowzone in Test Unit 18. Later excavation of features in Trench 5 confirmed the presence of a middle Woodland I occupation in this vicinity, including additional ceramics found in several nearby cultural features. A second cluster of middle Woodland I ceramics was found in excavation Block 4 (approximately 40 m to the northeast), in the context of the plowzone and a tree throw. This clustering was not reflected in the grid test units, although additional sherds were recovered in Feature 366, adjacent to Block 4 in Trench 4.

On the northeast side of the road, middle Woodland I ceramics included a single sherd of the Dames Quarter type found in Phase II Test Unit 52 and one sherd of Marcey Creek in Phase II Test Unit 38. The latter was associated with additional Marcey Creek ceramics found in a tree throw and in the adjacent test unit of excavation Block 8.

The Woodland II ceramics were found in the highest concentration in Test Units 26 and 27. These were associated with additional ceramics, mostly Townsend, recovered from Feature 10, a cylindrical pit in Test Unit 10 and adjacent units in Block 6. A secondary peak was mapped to the northeast at Test Unit 82, where five Killens sherds were recovered. The distribution of ceramics in both plowzone and feature contexts is described in greater detail in conjunction with the ceramic analysis (Section 10.1.1).

Jasper was the predominant lithic material utilized by prehistoric occupants at the site. Mapping the distribution of jasper in the plowzone thus showed the same patterns of distribution already described for prehistoric artifacts as a whole (Figure 6.14). Jasper was the basis of a concentration of artifacts in test units along the North 630 line, especially Test Units 62 and 71. This surface distribution reflected the presence of a concentration of jasper lithics in Feature 23, which was exposed in Test Unit 71 and excavation Block 5. Jasper also occurred in relatively high frequencies in the southwestern end of the site. Subsequent excavations in Trench 5 confirmed that this portion of the site had been the focus of the three principal occupations associated at the site.

Chert was the second most common type of lithic material utilized at the site. It was found in the highest frequencies along the western edge of the project area, especially in the vicinity of Test Units 5 through 8 (Figure 6.15). This area, exposed in Trench 5, was found to contain the highest concentration of cultural features in the site, and was associated primarily with the early Woodland I site component. A minor concentration of chert artifacts was found in Test Units 20 and 21 on the East 540 grid line. Other Surfer® maps showed that argillite and FCR were also concentrated in the vicinity of Test Unit 21. However, exposure of Trench 5 showed no associated concentration of features in this area. An isolated cluster of chert was shown in Test Unit 34, located on the North 600 line. This concentration appeared as a peak on the Surfer® map, but was based on 12 out of the 20 lithics from this unit being of chert material. This was a reminder that the overall frequency of lithics was not high across most of the project area.

Quartz and quartzite were both moderately utilized local materials and occurred in similar proportions in the artifact assemblage overall. However, the Surfer® distribution maps suggest

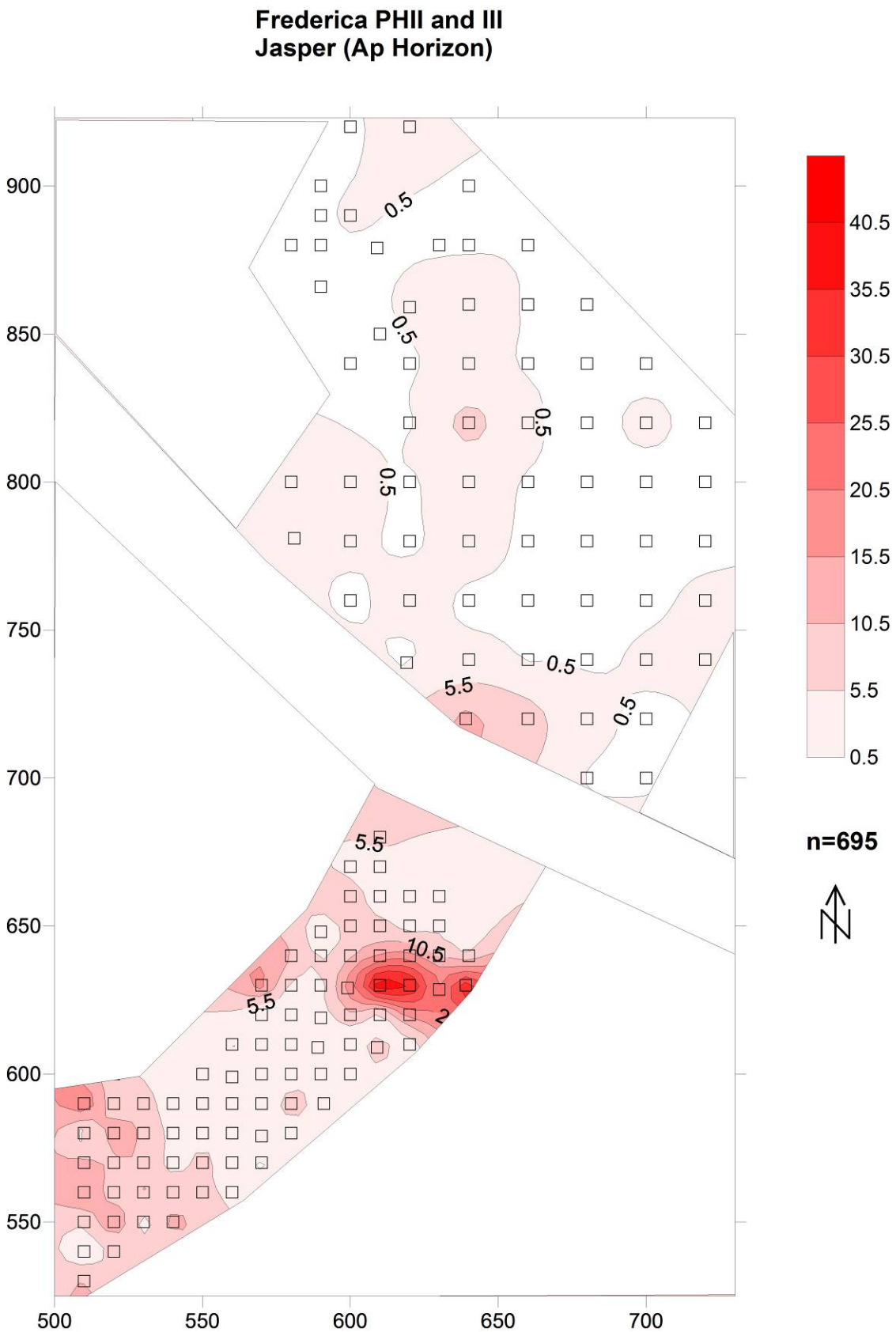


Figure 6.14 Spatial Distribution of Jasper Lithic Artifacts

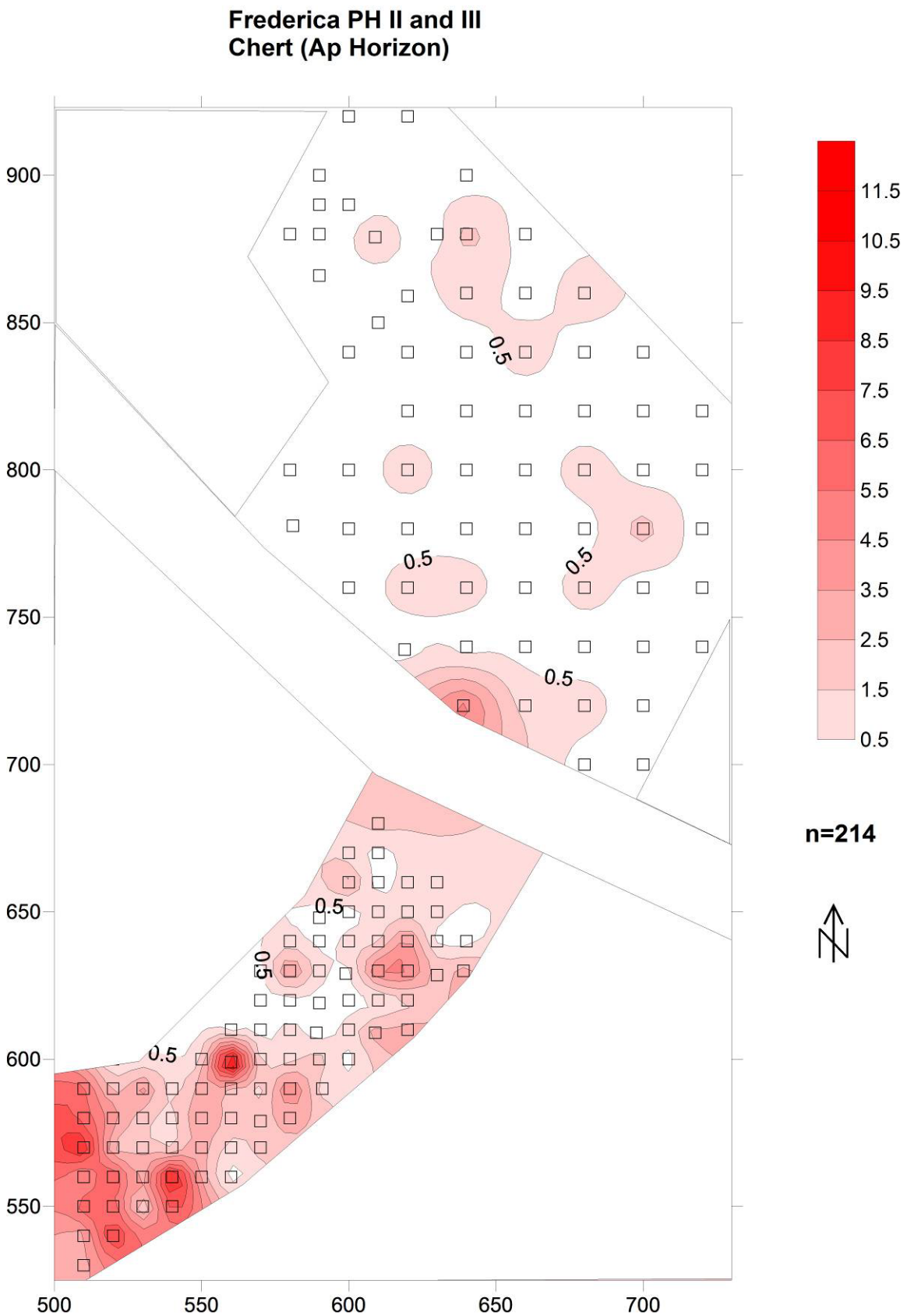


Figure 6.15 Spatial Distribution of Chert Lithic Artifacts

that the two materials were utilized differentially. Quartz was notable for its absence from the southwestern edge of the project area where most lithics were concentrated (Figure 6.16). Instead, its distribution included minor peaks spread along the southeastern portion of the project area. At the southern end of this range was Test Unit 25, adjacent to the concentrations of chert lithics and FCR in Test Unit 21. This area of the site, where both cultural features and chronologically diagnostic artifacts were scarce, was not associated with a specific occupational component at the site. Quartz materials were not concentrated in the same area where jasper was identified on the North 630 line, associated with the outlying early Woodland I site component. Instead, quartz was found in a wider ring of test units surrounding this component, including Test Unit 76 to the east, Test Unit 73 to the west, and Test Unit 60 to the north.

Quartzite did not show the same distribution as quartz, suggesting that it may have been preferred during different periods of occupation or may have been associated with different activities. The distribution of quartzite was similar to that of chert. The highest frequencies occurred at the western edge of the project area, with small peaks in Test Units 5 and 8 (Figure 6.17). Another small peak in quartzite was found in Test Unit 19. Exposure of this area in Trench 5 showed that it was within the area of a middle Woodland I site component, but no cultural features were found nearby.

Argillite represented a distinctly non-local material, found in low frequency at the site. The artifact distribution map showed a single peak at Test Unit 16 (Figure 6.18). This area was exposed in the southern part of Trench 5, but was not included with any of the three prehistoric components. The only soil anomalies in the vicinity of Test Unit 16 were tree throws. A cache of over 200 argillite flakes was found in Feature 279, which produced a late Woodland I date of AD 780-960. However, this large pit feature, which was located 12 m west of Test Unit 16, also produced fragments of a steatite bowl, which, along with the argillite cache, suggested an early Woodland I date.

Rhyolite was a minor material in the site assemblage, represented by only 13 artifacts in the Ap horizon of the grid test units (Figure 6.19). Half of the rhyolite was found in one location, representing 7 out of 38 lithic artifacts from Test Unit 7. They were not associated with any cultural features or diagnostic artifacts. Excavations yielded one notable concentration of rhyolite artifacts. Feature 200 was a Pit located 18 m to the east in Trench 5. It produced 269 lithics, of which 258 (96%) were of rhyolite. The feature also contained sherds of Marcey Creek and Wolfe Neck ceramics, and was included in the middle Woodland I site component.

In the case of relatively scarce materials such as argillite and rhyolite, the distribution of artifacts in the surface soils did not correspond to the distribution of artifacts in subsoil features. A similar disjunction was noted in the distribution of microtools. These small flake tools were found singly in the Ap horizon in several test units along the North 630 line. This corresponded well with the occurrence of microtools in Feature 23, in excavation Block 5. No microtools were found in the Ap horizon in the southwestern end of the project area. However, high frequencies of microtools were found in cultural features in this portion of the site, especially in the area associated with the early Woodland I site component.

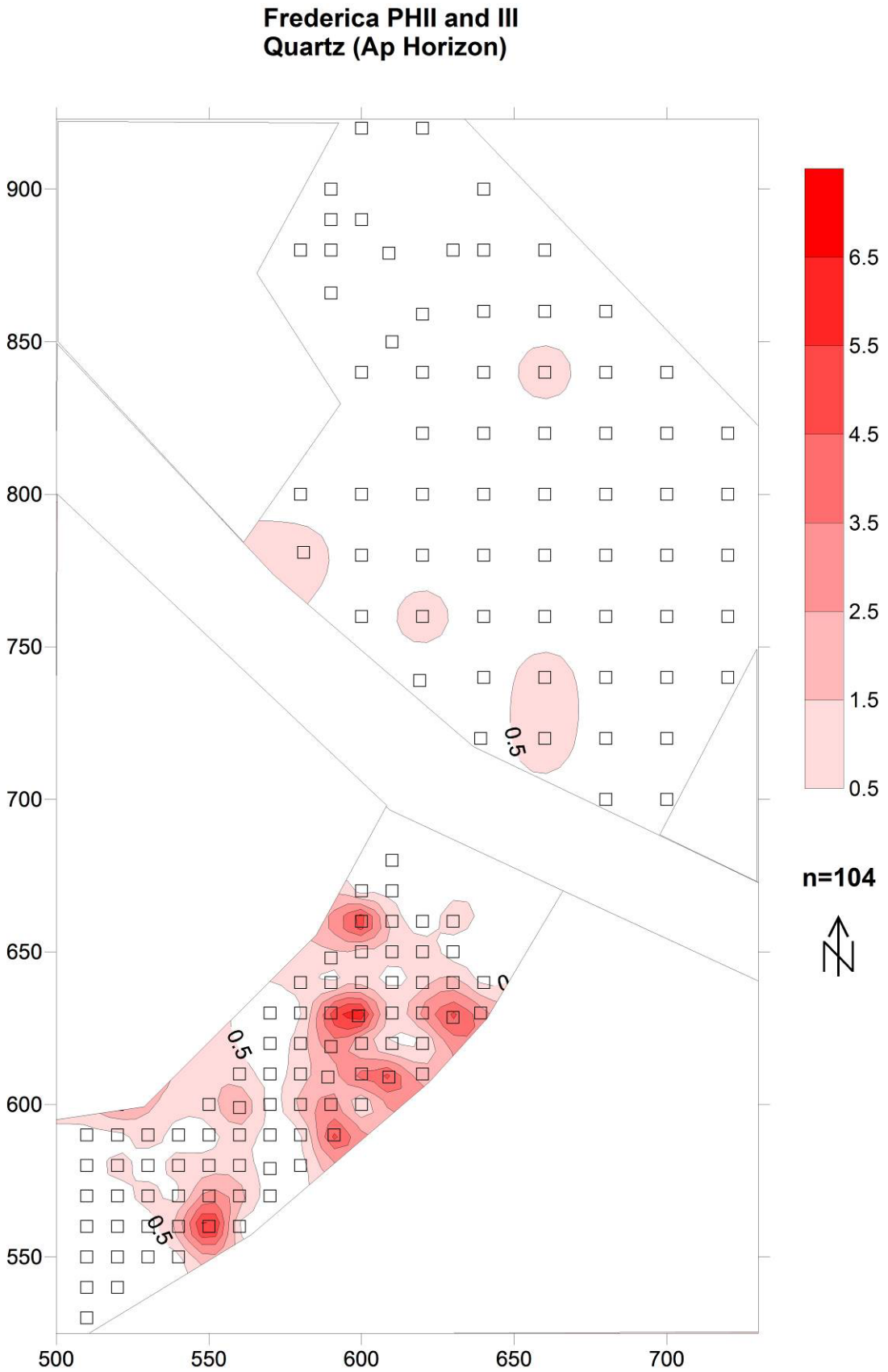


Figure 6.16 Spatial Distribution of Quartz Lithic Artifacts

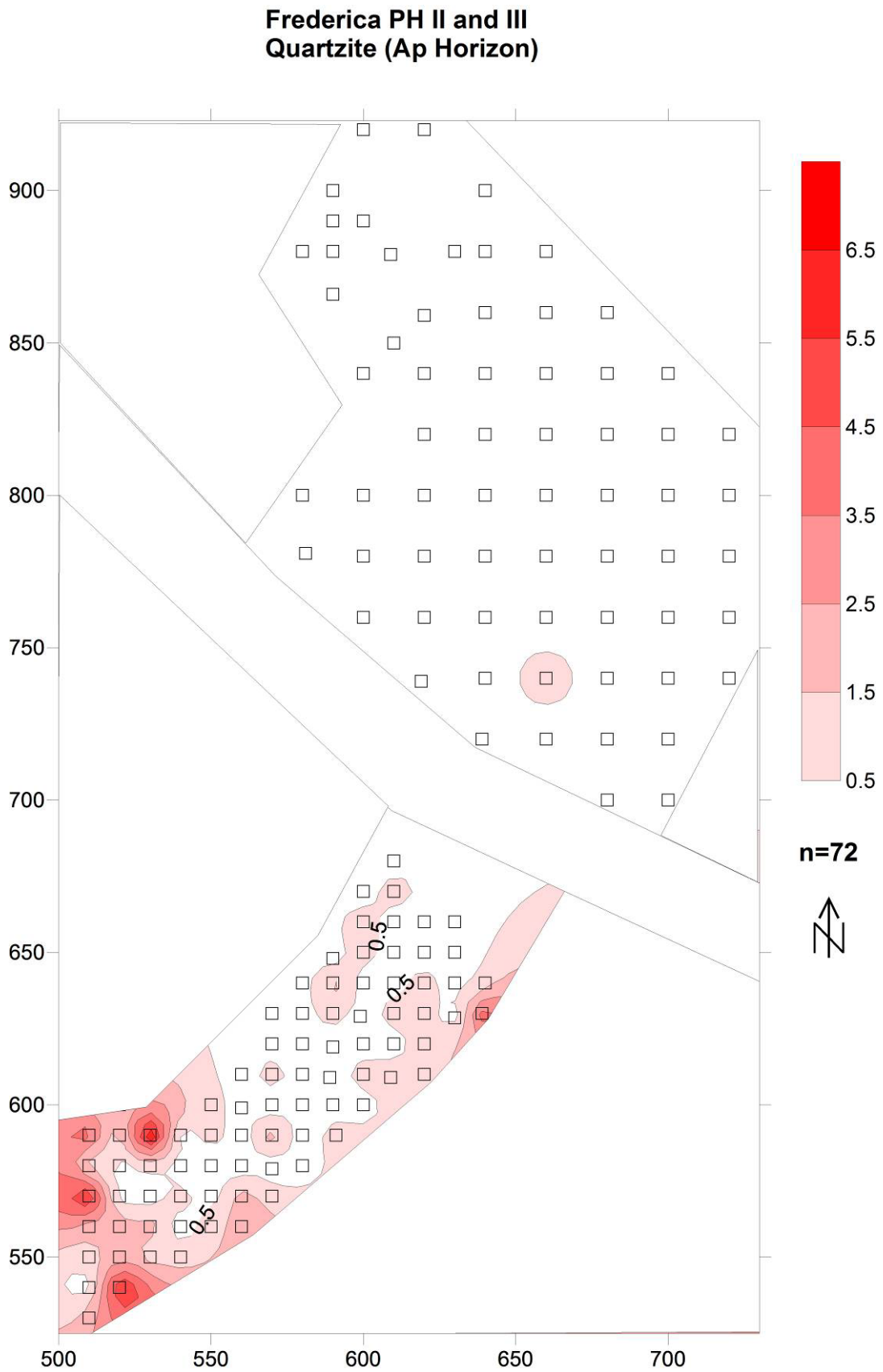


Figure 6.17 Spatial Distribution of Quartzite Lithic Artifacts

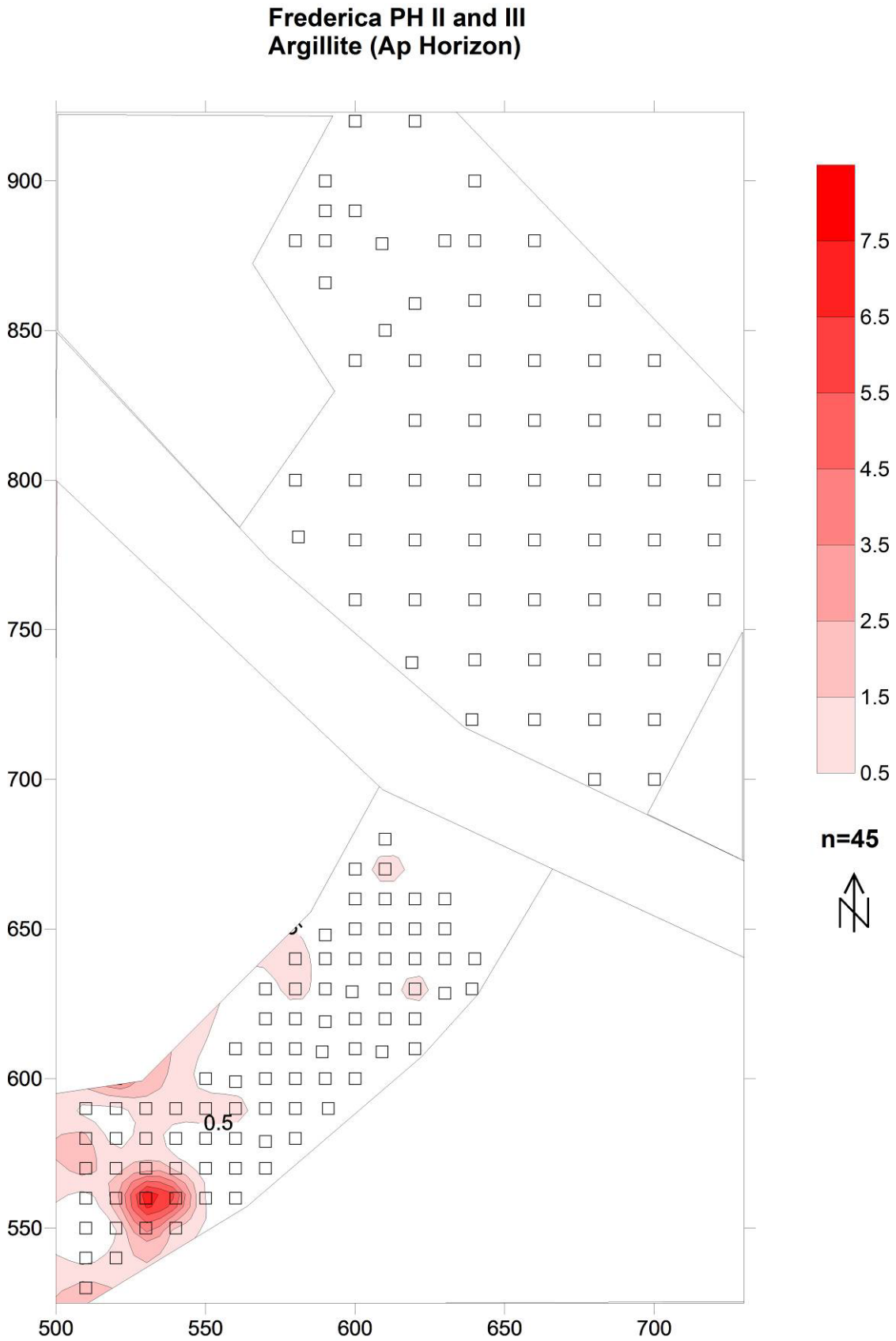


Figure 6.18 Spatial Distribution of Argillite Lithic Artifacts

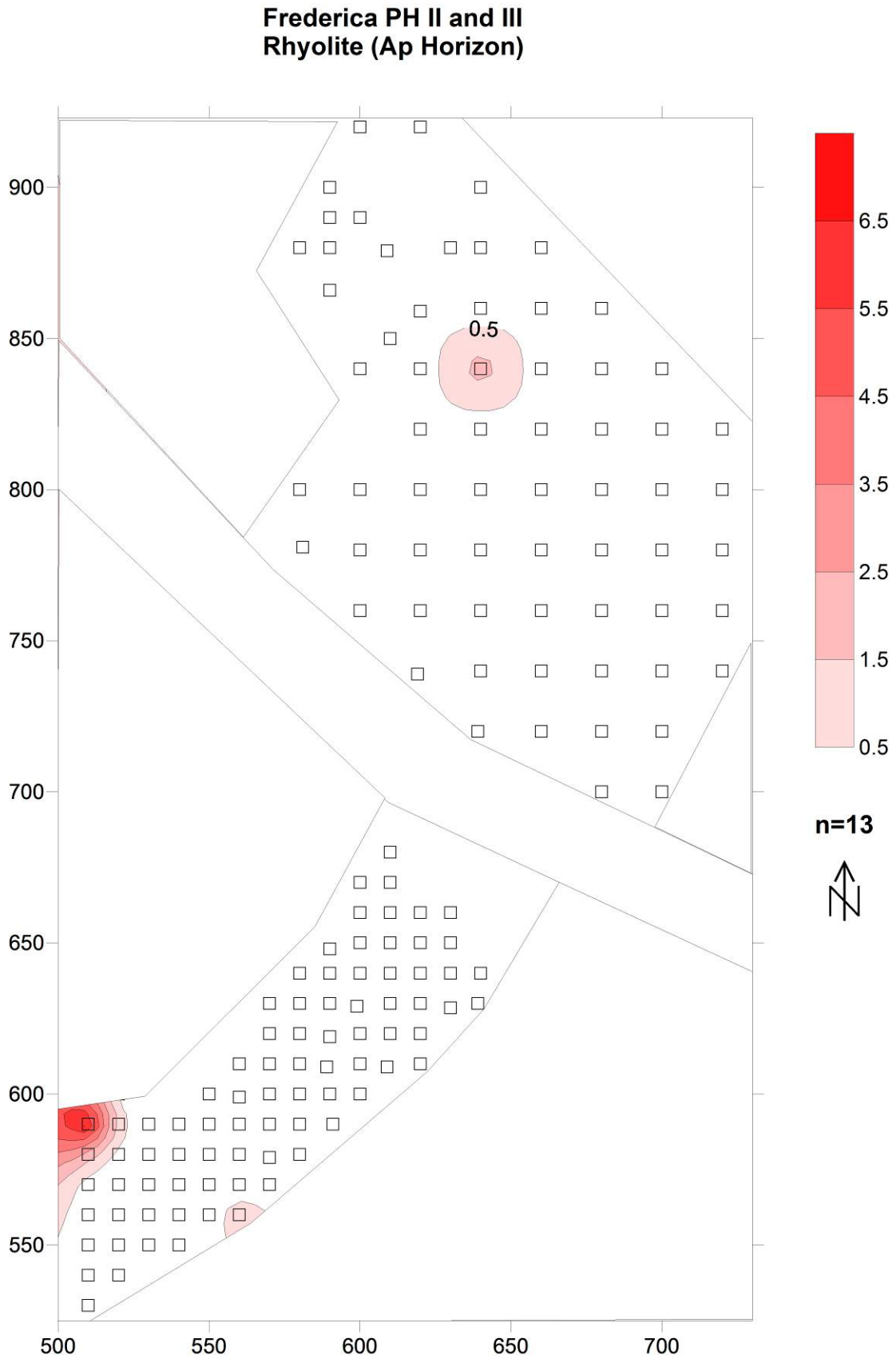


Figure 6.19 Spatial Distribution of Rhyolite Lithic Artifacts

FCR was relatively abundant in the Ap horizon. The excavation of features showed that many fire-related features were shallow, extending only a few centimeters below the AP horizon. Much of the FCR that would have been associated with such features was thus incorporated into the plowzone. The distribution of FCR from the grid test units showed that the density of FCR was generally greater in the southwestern end of the project area, the same region where most other artifact densities increased (Figure 6.20). The peak of FCR frequency was found in Test Unit 21, located along the southern edge of Trench 5. This area was not associated with an FCR feature or a cultural feature containing chronologically diagnostic artifacts. Shallow features may have existed and have been destroyed by plowing. Similarly, a minor peak in frequency of FCR was shown in Test Unit 43, a location in Trench 4 not associated with cultural features. A minor peak further to the northeast was shown in Test Unit 71. This location was identified as an early Woodland I site component, based on the artifacts from Feature 23 and Block 5.

6.3.2 Distribution of Features and Identification of Occupations

Data inspection indicated that features were distributed in distinct clusters within the overall site area. Analysis was therefore performed to determine whether these clusters represented chronologically or functionally distinct site subareas. To this end, radiocarbon dates and chronologically diagnostic artifacts recovered from features in conjunction with discernable spatial clustering of features and general artifact distributions in the plowzone were examined. As described in detail below, this resulted in the delineation of six spatially distinct subareas that contained artifact assemblages and associated features that appeared to date at least primarily if not exclusively to different periods of site occupation. Based on their aerial extent and the diversity of the features they contained, these subareas were tentatively identified as an early Woodland I occupational component, a middle Woodland I occupational component, a Woodland II component, and three smaller and less diverse peripheral components that appeared to represent more specialized activity areas. Two of these activity area components appeared to date to the middle Woodland I period of site occupation and one to the early Woodland I period of site occupation. The Woodland II component was intermediate in size and diversity between the other occupational components on the one hand and the activity area components on the other. Thus its functional designation was unclear and it was simply referred to as the Woodland II component. Corresponding to the low frequency of late Woodland I diagnostics, no spatial components dating to this period appeared to be present within the investigated area. Instead, surrounding the identified site components were areas where artifacts were recovered from the Ap horizon, but cultural features were widely scattered and not associated with artifact concentrations.

Because Site 7K-F-11/169 was a non-stratified site, some artifact and feature mixing among the spatially delineated components was expected, especially among those in close proximity to one another. However, based on the distribution of radiocarbon dates and diagnostic artifacts, the bulk (but not necessarily all) of the non-diagnostic artifacts and undated features within a component could confidently be assigned to it.

Based on the distribution of ceramic diagnostics only, subconsultant Daniel Griffith independently delineated what he termed occupational clusters corresponding to the principal

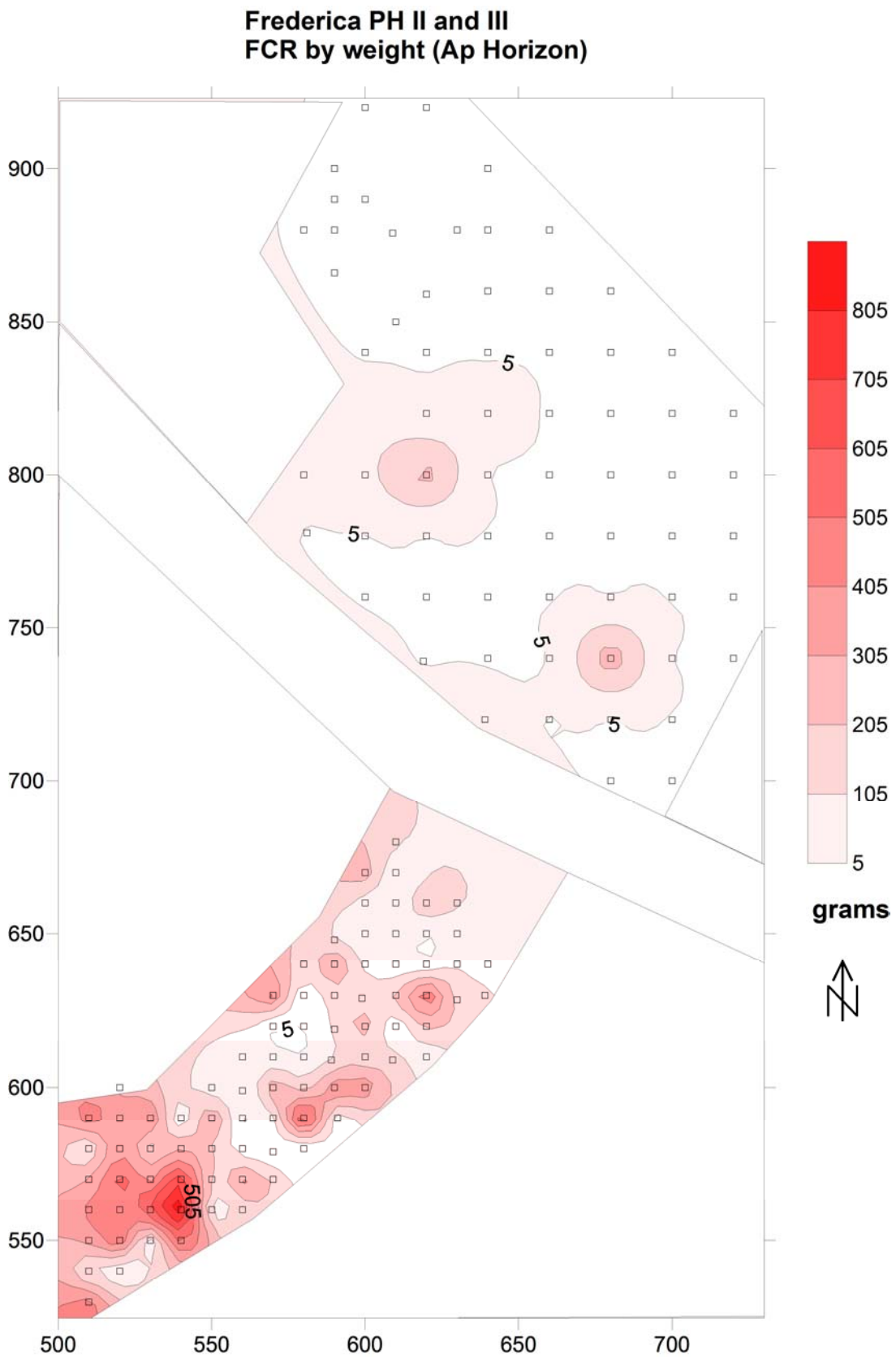


Figure 6.20 Spatial Distribution of FCR

ceramic series in the site assemblage. For the most part, these ceramic clusters corresponded to the site components defined for the full assemblage, and are discussed below as they relate to each defined site component.

Early Woodland I Occupational Component: The early Woodland I occupational site component was identified in the western third of Trench 5 (Figure 6.21). There were numerous features in this area, some of which overlapped, reflecting the repeated prehistoric occupation of this location. Seven features in this component produced projectile points associated with early Woodland I radiocarbon dates, which ranged from 2280-1460 BC. Five of these dated contexts were associated with Rossville projectile points (Features 233, 341, 371, and 376, and 419), one with a Bare Island projectile point (Feature 331) and one with a Savannah River Stemmed projectile point (Feature 330). These features were also notable for the absence of ceramic sherds, with the exception of sherds of Woodland II Killens ceramics in Feature 233 and one unidentifiable ceramic sherd in Feature 376. Four additional features were attributed to the early Woodland I occupation. Two were features with Rossville projectile points (Features 289 and 326), one contained a Bare Island projectile point (Feature 323), and one contained fragments of a steatite bowl and an argillite debitage cache (Feature 279). These additional features were also notable for the absence of ceramic sherds, with the exception of a single Woodland II Killens sherd in Feature 233 and one unidentifiable sherd each in Features 279 and 376. Collectively, the features attributed to this component included three AIA features, one basin, four pits, and three cylindrical pits. Artifacts from the excavation of grid Test Units 4, 5, and 11, as well as excavation Block 2 were also attributed to this early Woodland I component. Although partially within the boundaries delineated for this site component, artifacts from excavation Block 1 were not included in it because it was mostly disturbed by a single large tree throw feature.

The early Woodland I occupational component in Trench 5 encompassed a portion of the site with moderate to high overall artifact densities. In contrast and consistent with its presumed age, the component exhibited low to very low densities of ceramic artifacts of all periods. It had high densities of chert debitage, moderate to high densities of quartzite debitage, moderate densities of argillite and jasper debitage, and low to very low densities of quartz and rhyolite debitage. FCR densities were moderate.

In addition to being a distinct spatial cluster of features, the early Woodland I occupational site component appeared to exhibit internal feature clustering. In the northern portion of the component, there were six AIAs in close proximity, five of which were directly adjacent to or overlapped at least one of the other AIA features in this part of the site. Spatially associated with the six AIAs in this feature cluster were two FCR features, a pit, and a basin. A possible interpretation was that the AIAs represented several residential structures (see above Section 6.1), while the FCR features, the pit, and the basin were associated and had perhaps been used in food preparation or other domestic activities. To the south within the overall component was a second distinct cluster of features, in this case consisting mostly of pits, cylindrical pits, and basins. A single AIA was also present there. In contrast to the feature cluster to the north, this feature cluster appeared to consist primarily of processing and/or storage facilities. Thus, the patterning of features within the early Woodland I component suggested that the component as a whole was spatially organized, with an area for what might have been residential structures and associated facilities that was separate from a second area for resource processing and storage.

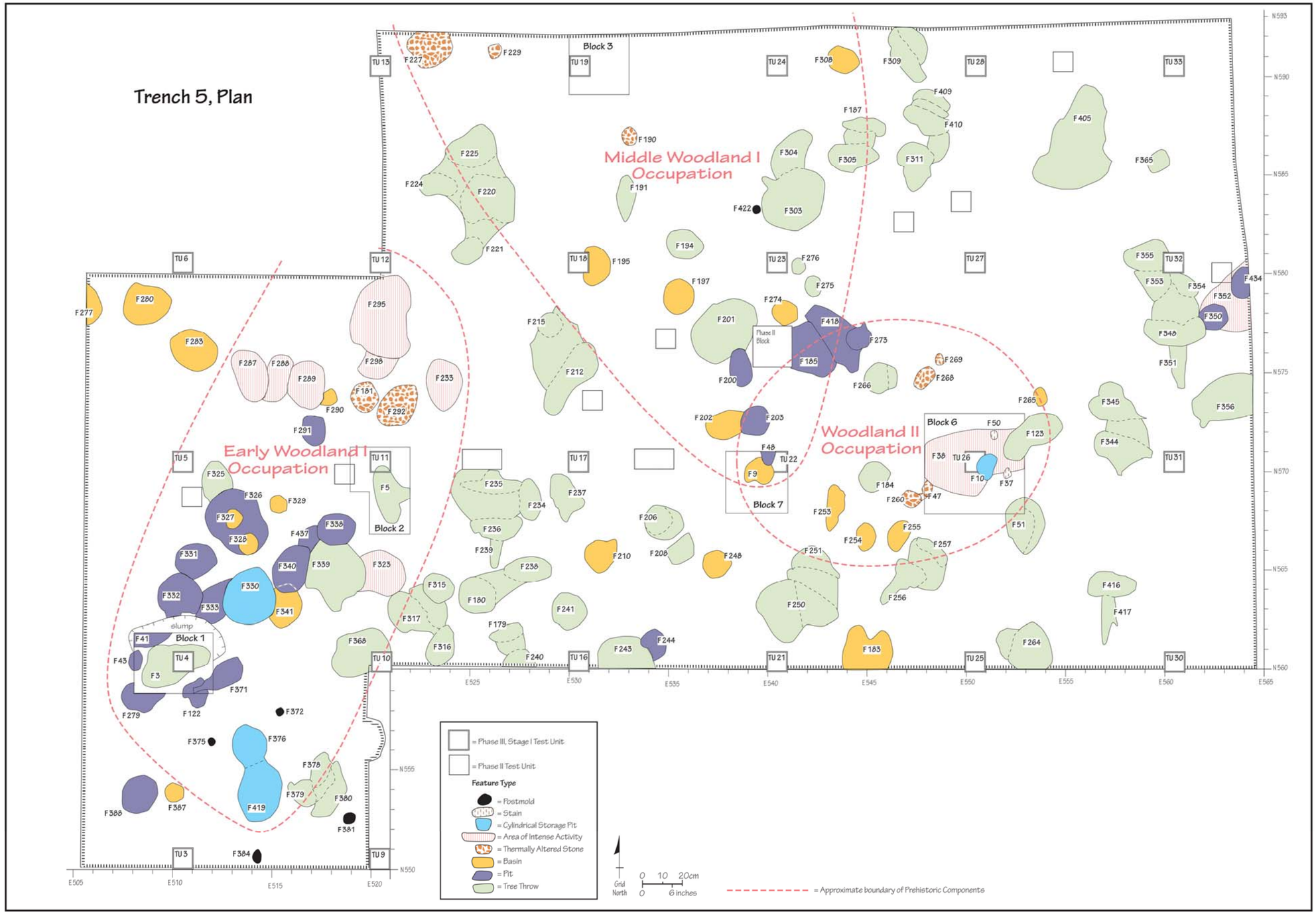


Figure 6.21 Prehistoric Occupation Areas in Trench 5

Three of the ceramic clusters defined by Griffith were located within portions of the early Woodland I occupational component as defined here, including his Coulbourn Cluster 2, Hell Island Cluster 1, and Townsend Cluster 1. While these clusters indicated that the area within the early Woodland I component as visited and perhaps used in some way during most of the period of overall site occupation, the sample sizes of the ceramic types recovered there were very small and represented a very minor constituent of the quite large early Woodland I occupational component assemblage. In this regard, it is perhaps pertinent that the early Woodland I occupational component was close to the tidal wetlands along Spring Creek, and site occupants of other portions of overall site area likely passed regularly through the area of this component on their way to and from the wetlands and the creek.

Middle Woodland I Occupational Component: The middle Woodland I occupational component was identified in the north-central part of Trench 5, where a lighter clustering of features was found. Five features in this area produced radiocarbon dates from the middle Woodland I period, ranging from 1260-110 BC. In Feature 227, the radiocarbon date was associated with an unidentifiable ceramic sherd and an untyped projectile point. In Features 195 and 197, the dates were associated with middle Woodland I Selden Island and Wolfe Neck ceramics. Feature 9 was located in an area of overlap between the southern end of the middle Woodland I occupational component and the western end of a Woodland II component (see below, this section). This was reflected in the association in the feature of a middle Woodland I radiocarbon date with Woodland II Townsend and Killens ceramics, indicating a mixing of contexts. Another mixed context was identified on the eastern side of the occupation area. Feature 185 produced an early Woodland I date from charcoal (2870-2570 BC) and a middle Woodland I bulk sherd date (910-810 BC) from a Selden Island sherd. The feature contained several Selden Island sherds, plus one Woodland II Townsend sherd. The overlap of Feature 185 with Features 418 and 273 was not clarified until excavation of these features was completed, as a result of which the Townsend sherd may have been associated with Townsend ceramics identified in Feature 273. Middle Woodland I ceramics were recovered from three additional features within this occupation area, including Selden Island sherds from Features 190 and 308, (the latter associated with a Bare Island projectile point) and Marcey Creek and Wolfe Neck sherds from Feature 200. Feature 200 was also notable because the lithics consisted almost exclusively of large rhyolite flakes. Collectively, the features attributed to the middle Woodland I occupational component included four Basins, two FCR features, and two pits. Grid Test Units 18, 19, 22 through 24, and excavation Block 3 were also included in the analysis of this occupation. The component encompassed a portion of the site with moderate overall prehistoric artifact densities, but had a higher concentration of middle Woodland I ceramics than anywhere else within the site area. It had low to moderate densities of debitage of all lithic raw materials except quartzite, which had relatively high densities. It exhibited moderate densities of FCR.

Two of Griffith's ceramic clusters occurred within portions of the middle Woodland I occupational component, Selden Island Cluster 1 and Coulbourn Cluster I. While the Selden Island ceramics dated to the earlier middle Woodland I, the Coulbourn ceramics dated to the terminal middle Woodland I and the early part of the subsequent late Woodland I period. This suggested that occupation of the area continued for a short time after the middle Woodland I/late Woodland I boundary, at least as defined here.

Woodland II Component: A Woodland II component was identified in the east central part of Trench 5, and as indicated, overlapped with the eastern edge of the middle Woodland I occupational component. The Woodland II component centered on Feature 10, a cylindrical pit that yielded a high frequency of Woodland II Townsend ceramics and radiocarbon dates of AD 1460-1650 (charcoal) and AD 1470-1560 (marine shell). Two additional features also yielded Townsend type Woodland II ceramics, including one basin (Feature 253) and one pit (Feature 273). As noted above, Woodland II ceramics were also found in Features 9 and 185, which were attributed to the middle Woodland I occupation. Artifacts from the excavation of Test Unit 26 and Block 6 were included in the analysis of the Woodland II component.

The Woodland II component encompassed an area with low to moderate overall artifact densities. Middle Woodland I ceramics were absent, but as expected Woodland II ceramics exhibited a high density. Quartz debitage exhibited medium to high densities, jasper and chert debitage had moderate densities, quartzite and argillite had low densities, and rhyolite was absent. FCR densities were moderate.

The four Woodland II component FCR features were in the immediate vicinity of its AIA feature. The pit and basin features were slightly further away. The cylindrical pit appeared to have been excavated through the AIA, suggesting at least two distinct episodes of occupation. Although perhaps indicative of fewer site visits by smaller groups, the Woodland II component exhibited organizational characteristics reminiscent of the early Woodland I occupational component, with a possible residential structure directly associated with what might have been food preparation or other domestic facilities, and with processing and storage facilities nearby but farther away.

One Woodland II ceramic cluster, Townsend Cluster 2, corresponded to the Woodland II component defined here. As indicated, a second Woodland II ceramic cluster, Townsend Cluster 1, was within the early Woodland I occupational component, and associated non-diagnostic artifacts could not be separated from the much larger early Woodland I assemblage. The third Woodland II ceramic cluster, Townsend Cluster 3, was situated just to the north of the Woodland II component in an area of dense tree throw features but no intact cultural features. This suggested that the Woodland II component as defined here may originally have extended into this tree throw area, but if so had been obliterated there by toppled trees.

Early Woodland I Activity Area Component: In Trench 2, located to the northeast closer to SR 1, Features 23 and 31 were first identified in Test Unit 71 and further excavated in Block 5. Feature 31 was a small pit that produced only three non-diagnostic lithic artifacts. Feature 23 was a large pit noted for the association of microtools with a Rossville projectile point. It produced a radiocarbon date of 2290-2140 BC. Additional microtools and a Poplar Island projectile point were recovered from the Ap horizon in Block 5. Feature 23 and Block 5 were identified as an activity area site component dating to the early Woodland I period (Figure 6.22). Excavation of the remainder of Trench 2 exposed only tree throws and other non-cultural anomalies.

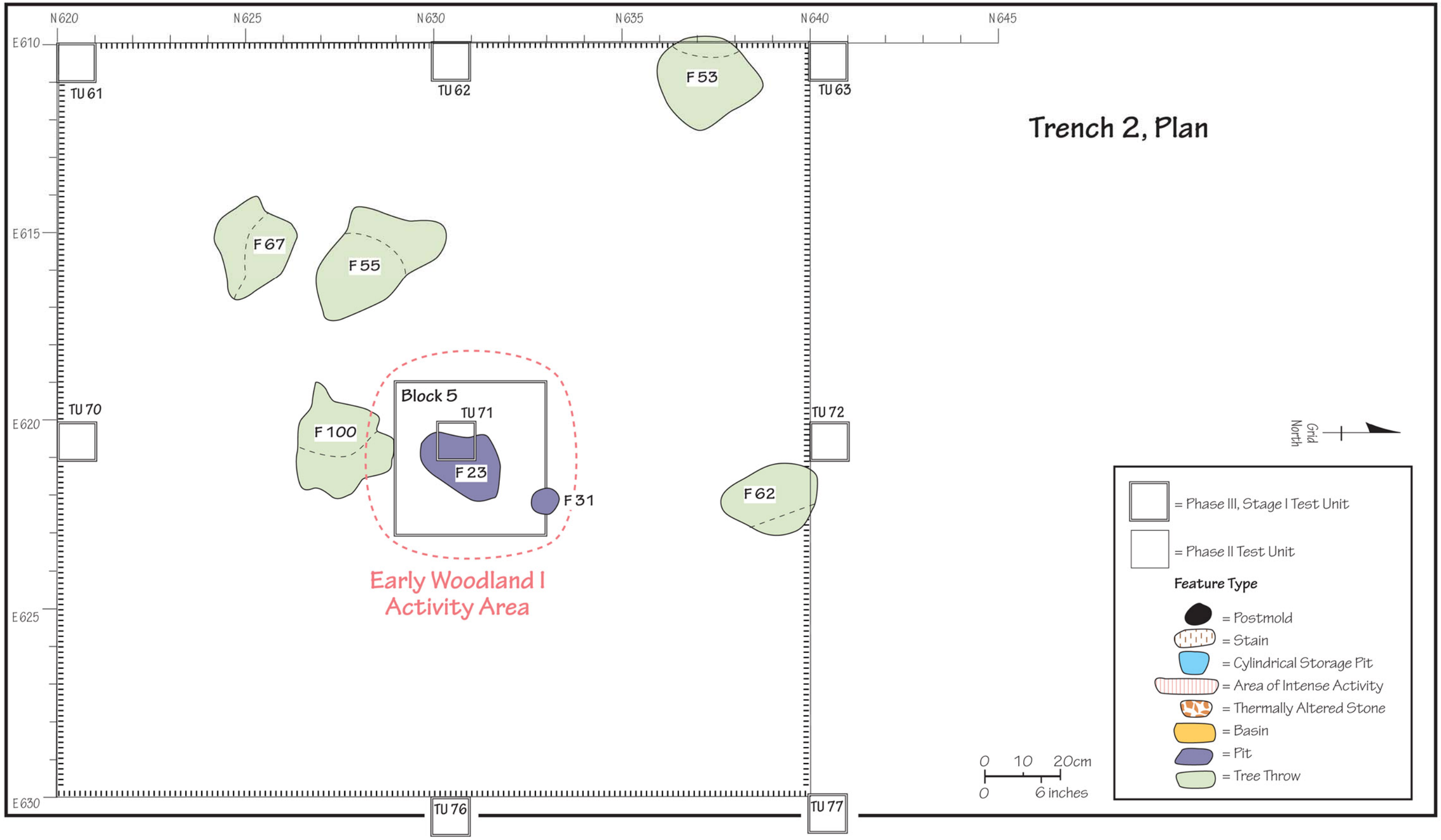


Figure 6.22 Prehistoric Activity Area in Trench 2

The early Woodland I activity area component was within a portion of the site with high overall prehistoric artifact densities and very high densities of jasper debitage. Chert and quartz debitage exhibited moderate densities, but debitage of all other lithic raw materials had low to very low densities. Ceramic densities were very low in this portion of the site, but FCR densities were relatively high.

One ceramic cluster, Dames Quarter Cluster 2, partially overlapped with the area encompassed by the early Woodland I activity area component. While this presumably reflects use of the area during the early portions of the middle Woodland I period, associated non-diagnostics could not be separated from the far more numerous early Woodland I assemblage in this part of the site.

Middle Woodland I Activity Area 1: One feature that contained middle Woodland I ceramics (Feature 366) was exposed in Trench 4, located to the southwest of Trench 2. The feature was adjacent to excavation Block 4, which also yielded a number of middle Woodland I period ceramics from the plowzone and from a tree throw. Together, Feature 366 and Block 4 were identified as an activity area site component dating to the middle Woodland I period (Figure 6.23). This site component was in a portion of the site with generally low artifact densities for debitage of all lithic raw materials as well as ceramics of all periods, but exhibited a moderate density of FCR.

Three ceramic clusters overlapped with this middle Woodland I activity area. Dames Quarter Cluster 1 and Wolf Neck Cluster 2 both incorporated Feature 366, but also extended a considerable distance to the to east to incorporate ceramics of these types in tree throw Feature 166, which due to its disturbed context and distance from Feature 366 and excavation Block 4, was not included in this activity area. In contrast, Selden Island Cluster 2 was essentially coterminous with the middle Woodland I activity area 1.

Other features uncovered in Trench 4 included a basin (Feature 159) and an FCR feature (Feature 165) that each had very few artifacts and no chronologically diagnostic artifacts. A cylindrical pit (Feature 178) yielded few artifacts and no chronologically diagnostic prehistoric artifacts. Radiocarbon dating of a charcoal lens in Feature 178 produced a late date of AD 1520-1950, suggesting that the feature could be of historic age. There was also an isolated post mold (Feature 145), which was also of historic age.

Middle Woodland I Activity Area 2: On the northeast side of SR 1, there was a notable concentration of Marcey Creek ceramics from the excavation of Test Unit 38 and Block 8. This locus was identified as a middle Woodland I period activity area component (Figure 6.24). A soil anomaly in Block 8 was identified as a tree throw, so no cultural features were associated with this component. It was within a portion of the site with very low overall prehistoric artifact densities. This was true for debitage of all lithic raw materials, FCR, and all ceramics with the exception of middle Woodland I types, which exhibited a moderate density.

No ceramic clusters were identified in the vicinity of this component.

Areas Lacking Components: Only two of the five mechanically excavated trenches that were excavated failed to produce evidence of concentrated archaeological remains that could be

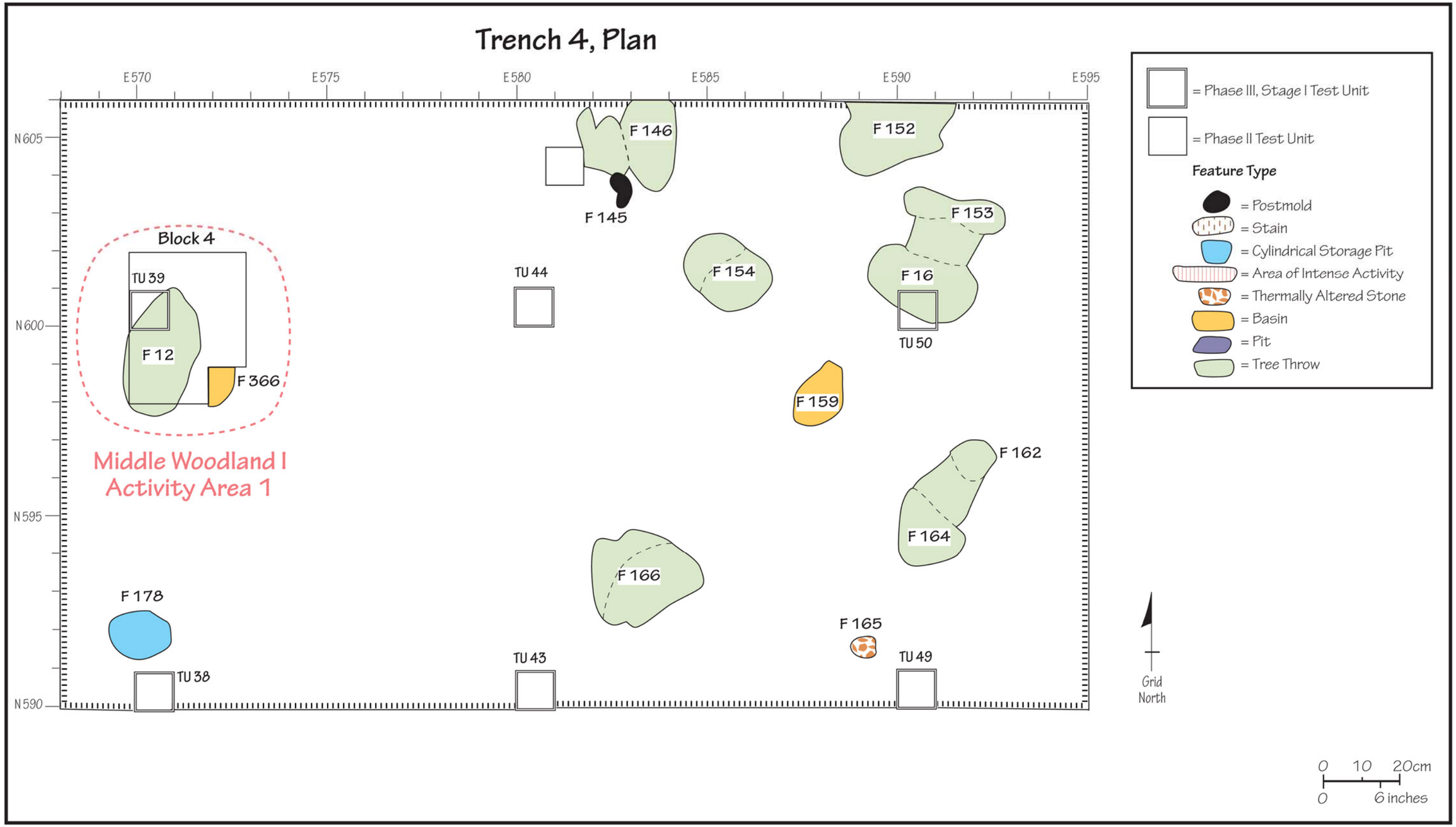


Figure 6.23 Prehistoric Activity Area in Trench 4

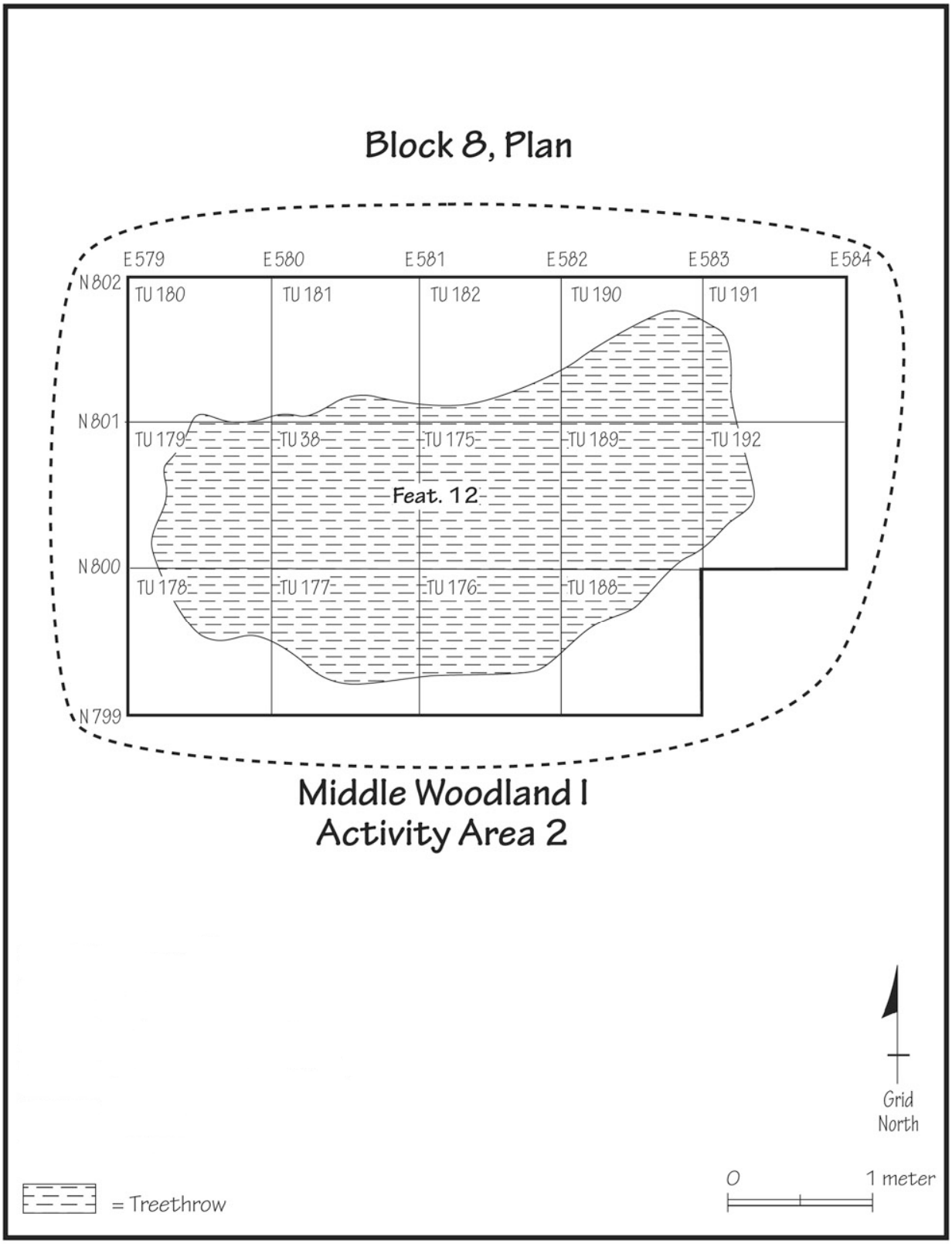


Figure 6.24 Prehistoric Activity Area in Block 8

identified as site components. On the southeast side of SR 1, two prehistoric features were exposed in Trench 1 and one in adjacent grid Test Unit 60 (Features 19, 77, and 80), plus one post mold of presumed historic date. The three prehistoric features were all basins, which yielded very few artifacts. There were no chronologically diagnostic artifacts and therefore no indication of the period of occupation in this area of the site.

Trench 3, located east of Trench 2, exposed three cultural features. Features 110 and 115 were pits and Feature 119 was an FCR feature, each of which yielded few artifacts and no diagnostics. A complex feature identified during the Phase II survey by ADM (ADM Features 5/5a and 7) was located along the southern edge of Trench 3. It contained a number of middle Woodland I ceramics, mostly of the Dames Quarter series. However, this feature was re-interpreted as a tree throw based on comparison with the Phase III excavation results.

Although no site components could be identified in Trench 3, one ceramic cluster, Dames Quarter Cluster 3, corresponded to its location, incorporating the Dames Quarter ceramics found in ADM Features 5/5a and 7.

A final ceramic cluster, Hell Island Cluster 2, was located to the south of Trench 4 and did not correspond to any of the identified site components.

Summary

Radiocarbon dates and chronologically diagnostic artifacts recovered from features in conjunction with discernable spatial clustering of features and general artifact distributions in the plowzone resulted in the delineation of six spatially distinct subareas that contained artifact assemblages and associated features that appeared to date primarily to different periods of site occupation. These subareas were tentatively identified as an early Woodland I occupational component, a middle Woodland I occupational component, a Woodland II component, and three smaller and less diverse peripheral components that appeared to represent more specialized activity areas. Two of these activity area components appeared to date to the middle Woodland I period of site occupation and one to the early Woodland I period of site occupation. Intermediate in size and diversity, the Woodland II component was simply referred to as the Woodland II component.

Thus the early Woodland I period at Site 7K-F-11/169 was represented by a large and dense occupational component in the southwest end of the project area and a smaller activity area component to the northeast in Block 5. The middle Woodland I period was represented by a large but less dense occupational component in Trench 5 and two smaller activity areas in Blocks 4 and 8, the latter being on the northeast side of SR 1. No discernable artifact and feature concentrations dating to the late Woodland I period were identified within the investigated portion of the site. The overall paucity of ceramics from this period confirmed that the site was lightly used during this period. The Woodland II period was represented by a single site component that was intermediate in size and density.

6.4 Lithic Technology

6.4.1 Chipped Stone Technology and Tools

Lithic Raw Materials

For the purposes of analysis, the chipped stone debitage from Site 7K-F-11/169 was categorized as belonging to six raw material types: jasper, chert, quartz, quartzite, argillite, and rhyolite (Table 6.7). Each is discussed briefly here.

Jasper (n=9,553, 54%): The most prevalent raw material found at the site, jasper debitage occurred in its natural brownish yellow form and in its reddish heat-treated form. The nearest known sources are collectively known as the Delaware Chalcedony Complex, a source area in extreme northwestern Delaware in the vicinity of Iron Hill and Chestnut Hill, and in the neighboring portions of southeastern Pennsylvania and northeastern Maryland. Lithic raw materials from these sources are variously referred to as Cecil County black flint and Broad Run chalcedony, but are more correctly identified as jaspers of varying lithology (Custer 1989). However, jasper pebbles are also a prevalent constituent of the gravel rich Bw horizon soils at and near the site. It is thus possible that the prehistoric site occupants acquired jasper lithic raw material locally, and the most readily available local sources for the material were probably gravel deposits in nearby streams, where larger pieces, perhaps derived ultimately from the Columbia Formation gravels in headwater areas, were concentrated by fluvial sorting (see below, Section 10.1.2). Other well-known but far more distant sources include the Reading Prong quarries of southeastern Pennsylvania, including Macungie and Vera Cruz, approximately 100 miles to the north. Considering its prevalence in the assemblage, it was likely that the jasper at Site 7K-F-11/169 came from local stream gravels or some as yet unknown source closer to the site.

Chert (n=3,691, 21%): The Site 7K-F-11/169 lithic assemblage included a wide variety of cherts, of varying textures from grainy to vitreous, and of varying colors from nearly white to light and dark grey, brown, and black. Since chert from a single source locality often varies widely in color and texture, descriptive categorizations based on these characteristics rarely correspond to specific sources or source areas, and are thus largely meaningless. For this reason the cherts in the Site 7K-F-11/169 assemblage were analyzed as a single raw material type that undoubtedly contained material from a variety of sources. Like jasper, chert is a prevalent constituent of the gravel rich Bw horizon soils at and near the site, and the most readily available local sources for the material would have been gravel deposits in streams.

Quartz (n=,1954, 11%): One of the most difficult of the common lithic raw material types to knap, quartz was nevertheless the third most prevalent raw material in the debitage assemblage. Like jasper and chert, it is a common local soil constituent, and was likely collected prehistorically from local stream gravels.

Quartzite (n=1,250, 7%): Quartzite is metamorphosed sandstone. It also is a prevalent constituent of the local Bw horizon gravel, and was likely procured prehistorically from streambed gravels.

Table 6.7

Lithic Debitage and Raw Materials

Artifact Description		Jasper		Chert		Quartz		Quartzite		Argillite		Rhyolite		Grand Total	
		Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Biface Preform	-Primary	63	0.7%	14	0.4%	18	0.9%	17	1.4%	2	0.2%	0	0.0%	114	0.6%
	-Secondary	16	0.2%	5	0.1%	3	0.2%	3	0.2%	5	0.6%	0	0.0%	32	0.2%
Decortication Flake		615	6.4%	165	4.5%	60	3.1%	55	4.4%	4	0.5%	0	0.0%	899	5.1%
Biface Thinning Flake	-Primary	710	7.4%	176	4.8%	63	3.3%	66	5.3%	12	1.4%	1	0.3%	1028	5.8%
	-Secondary	2684	28.1%	1177	31.9%	377	19.7%	400	32.0%	441	49.8%	113	33.1%	5194	29.4%
	-Tertiary	1443	15.1%	667	18.1%	264	13.8%	161	12.9%	59	6.7%	46	13.5%	2641	15.0%
Biface Reduction Subtotal		5531	57.9%	2204	59.7%	785	41.0%	702	56.2%	523	59.1%	160	46.9%	9908	56.1%
Flake Core		85	0.9%	27	0.7%	17	0.9%	12	1.0%	4	0.5%	0	0.0%	145	0.8%
Core Flake	-Primary	21	0.2%	12	0.3%	4	0.2%	5	0.4%	13	1.5%	0	0.0%	55	0.3%
	-Secondary	59	0.6%	19	0.5%	13	0.7%	2	0.2%	20	2.3%	0	0.0%	113	0.6%
Core Reduction Subtotal		165	1.7%	58	1.6%	34	1.8%	19	1.5%	37	4.2%	0	0.0%	313	1.8%
Shatter and Flake Fragments Total		3857	40.4%	1429	38.7%	1095	57.2%	529	42.3%	325	36.7%	181	53.1%	7436	42.1%
Grand Total		9553	54.1%	3691	20.9%	1914	10.8%	1250	7.1%	885	5.0%	341	1.9%	17657	100.0%

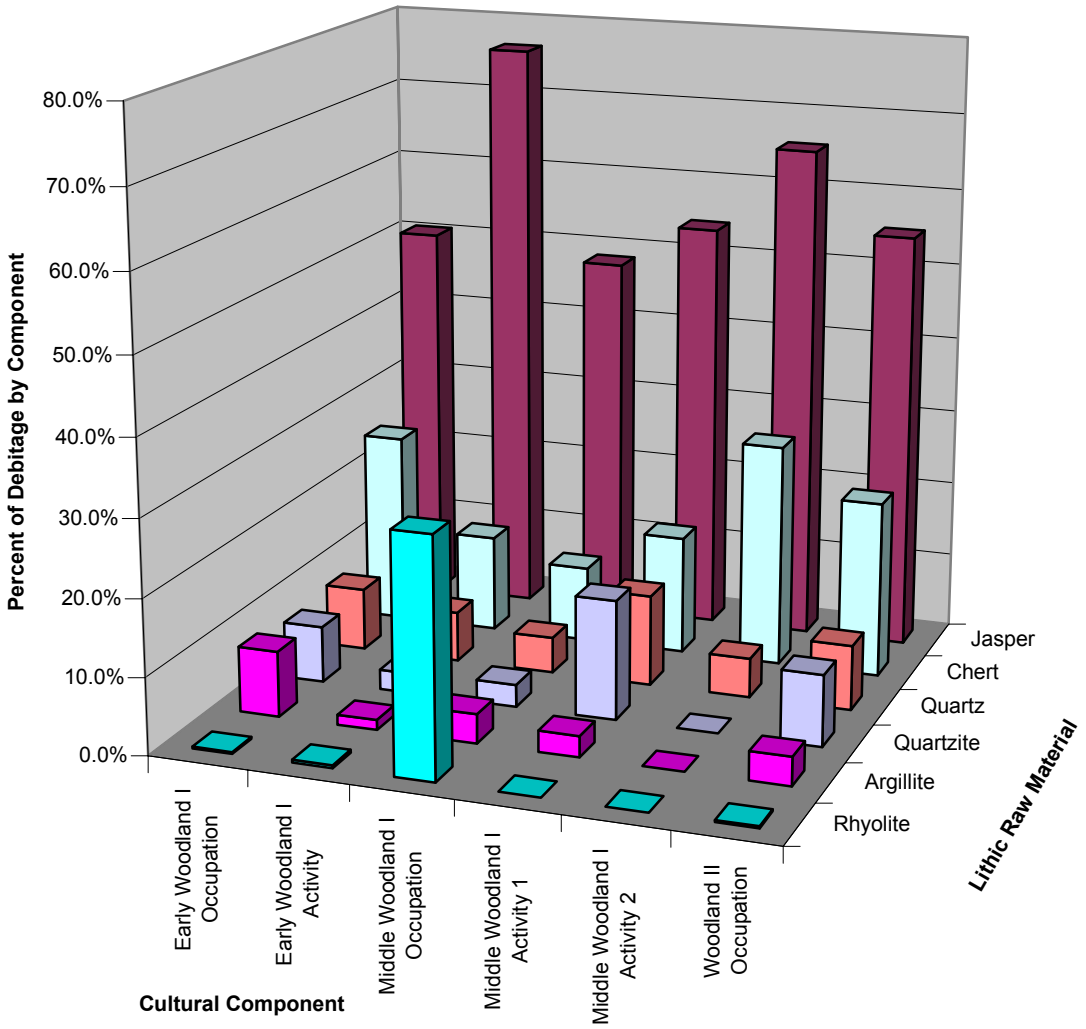
Argillite (n=885, 5%): An extrusive igneous rock, argillite debitage was less common in the Site 7K-F-11/168 assemblage than the preceding lithic materials. Known nearby sources are found in the Lockatong Formation in Bucks and Montgomery Counties, Pennsylvania, approximately 80 miles north of the site. Whether or not the argillite at Site 7K-F-11/169 was derived ultimately from these sources, as discussed below (this section), it was clearly an exotic lithic raw material at this site.

Rhyolite (n=341, 2%): Another extrusive igneous rock, rhyolite was the least prominent non-minor lithic raw material in the Site 7K-F-11/169 debitage assemblage. The South Mountain quarries in Adams and Cumberland Counties, Pennsylvania are one well known source for rhyolite. South Mountain is approximately 120 miles from Site 7K-F-11/169, although other source areas undoubtedly exist elsewhere. Like argillite, at Site 7K-F-11/169 rhyolite was clearly an exotic lithic raw material.

Other Raw Materials: Other lithic raw materials were identified in very small numbers in the debitage assemblage during laboratory processing and identification, primarily chalcedony and sandstone. In mineralogical parlance, chalcedony is a semi-precious gem stone, and is a cryptocrystalline intergrowth of quartz and moganite. As such, it is not strictly speaking a cryptocrystalline silicate. True chalcedony is relatively rare, and was almost certainly only rarely employed by prehistoric people as a lithic raw material. In archaeological parlance, chalcedony is generally identified as any very fine grained cryptocrystalline silicate which is translucent and has a waxy luster, unless it is black or brown in which case it may be called flint instead. Thus most of what archaeologists call chalcedonies are in all likelihood varieties of chert. For this reason and because sample sizes were too low to support separate numerical analysis, debitage identified as chalcedony was included here with chert for the purposes of numerical analysis. Considering that most of the FCR and groundstone tools found at the site were of sandstone, what appeared to be lithic debitage of this material was probably either waste from ground stone tool manufacture or (more likely) small pieces of FCR with debitage-like morphologies. Again, sample sizes were very small, and sandstone debitage was for these reasons not included in the analysis.

Lithic Raw Material by Component

Examination of the debitage composition of the six cultural components identified within the overall site area (see above, Section 6.3) revealed differences in lithic raw material composition (Figure 6.25). Interestingly, the early Woodland I occupational and activity area components were distinctively different. In the occupational component, argillite, an exotic lithic raw material, comprised a higher percentage of debitage than in any other component and jasper comprised a relatively low percentage compared to other components. In contrast, in the early Woodland I activity area, jasper was more prevalent that in any other component, and argillite was less prevalent than in any other component except the middle Woodland I activity area 2 component. The middle Woodland I occupational component was also distinctive, with a rhyolite percentage that far exceeded any other component and the lowest jasper percentage of any component. These characteristic were attributable in part to a single feature (Feature 200) within this component that produced exceptionally large amounts of rhyolite debitage. The middle Woodland I activity area 1 component was distinctive in having relatively large amounts



	Early Woodland I Occupation	Early Woodland I Activity	Middle Woodland I Occupation	Middle Woodland I Activity 1	Middle Woodland I Activity 2	Woodland II Occupation
Rhyolite	0.2%	0.4%	30.8%	0.0%	0.0%	0.3%
Argillite	8.6%	1.3%	3.8%	2.8%	0.0%	3.7%
Quartzite	7.4%	2.6%	2.9%	15.6%	0.0%	9.3%
Quartz	8.2%	6.6%	4.7%	11.9%	5.2%	8.5%
Chert	25.2%	12.7%	10.0%	15.6%	29.3%	23.1%
Jasper	50.5%	76.4%	48.4%	54.1%	65.5%	55.1%

Figure 6.25 Lithic Raw Materials and Site Components

of quartzite and less jasper. The middle Woodland I activity area 2 component contained quartz, chert, and jasper almost exclusively but was otherwise most similar to the early Woodland I activity area component, while the Woodland II component had what might be considered average amounts of all the different lithic raw material types. Except for the middle Woodland I occupational component, rhyolite was present as only a trace in all components.

The significance of this patterning was not entirely clear. The high percentage of argillite in the early Woodland I occupational component presumably reflects greater access to this exotic raw material during that period of occupation, and the contrast between it and the early Woodland I activity area component might indicate that although belonging to the same general time period, the two components were not contemporaneous. Throughout the mid-Atlantic region, high percentages of exotic lithic raw materials are characteristic of Terminal Archaic/Transitional sites, and it may thus be that the early Woodland I occupational area component dates to the terminal early Woodland I Period, while the early Woodland I activity area component was earlier, dating to what is traditionally called the Late Archaic. In this regard, it may be significant that the early Woodland I occupational component also contained almost all of the steatite recovered from the site, another Terminal Archaic/Transitional diagnostic.

It was also notable that the early Woodland I activity area component and the middle Woodland I activity area 2 components were in the northeastern portion of the APE. The other four components were all in close proximity in the southwestern portion of the APE, and the similarities among them may reflect some degree of component overlap and mixing of debitage from different occupations/activity areas. Finally, it may be that sampling variability affected the patterns displayed by the less prevalent lithic raw materials such as rhyolite, argillite and quartzite.

The generally very low frequency of rhyolite in the assemblage, in combination with the presence of large amounts of rhyolite in one feature, might indicate that rhyolite came into the possession of site occupants on only rare occasions, perhaps as individuals acquired the material opportunistically through trade/exchange networks.

Lithic Reduction Strategies, General

Lithic debitage recovered at the site was classified using two standard lithic reduction strategies, biface reduction and flake core reduction. As indicated above, biface reduction byproducts included primary and secondary biface preforms as well as primary, secondary, and tertiary biface thinning flakes. Flake core byproducts included flake cores as well as primary and secondary core flakes. Decortication flakes produced during the two basic strategies were not distinguishable, and were simply categorized as such. Because it could not be assigned to either reduction strategy, shatter was not included.

Analysis indicated that biface reduction activities were far more prevalent at Site 7K-F-11/169 than flake core reduction activities (Figure 6.26). This was true for all the major types of lithic raw material in the assemblage, but was especially true of rhyolite, arguably the most “exotic” of the raw materials present. This suggested that the rhyolite procured by site occupants was in the form of prepared biface preforms and perhaps finished bifacial tools. Considering the low

frequency of flake core reduction byproducts for all material types, it was also possible that those that were present were actually produced by chance during biface reduction activities, and that flake core reduction was rarely if ever intentionally practiced.

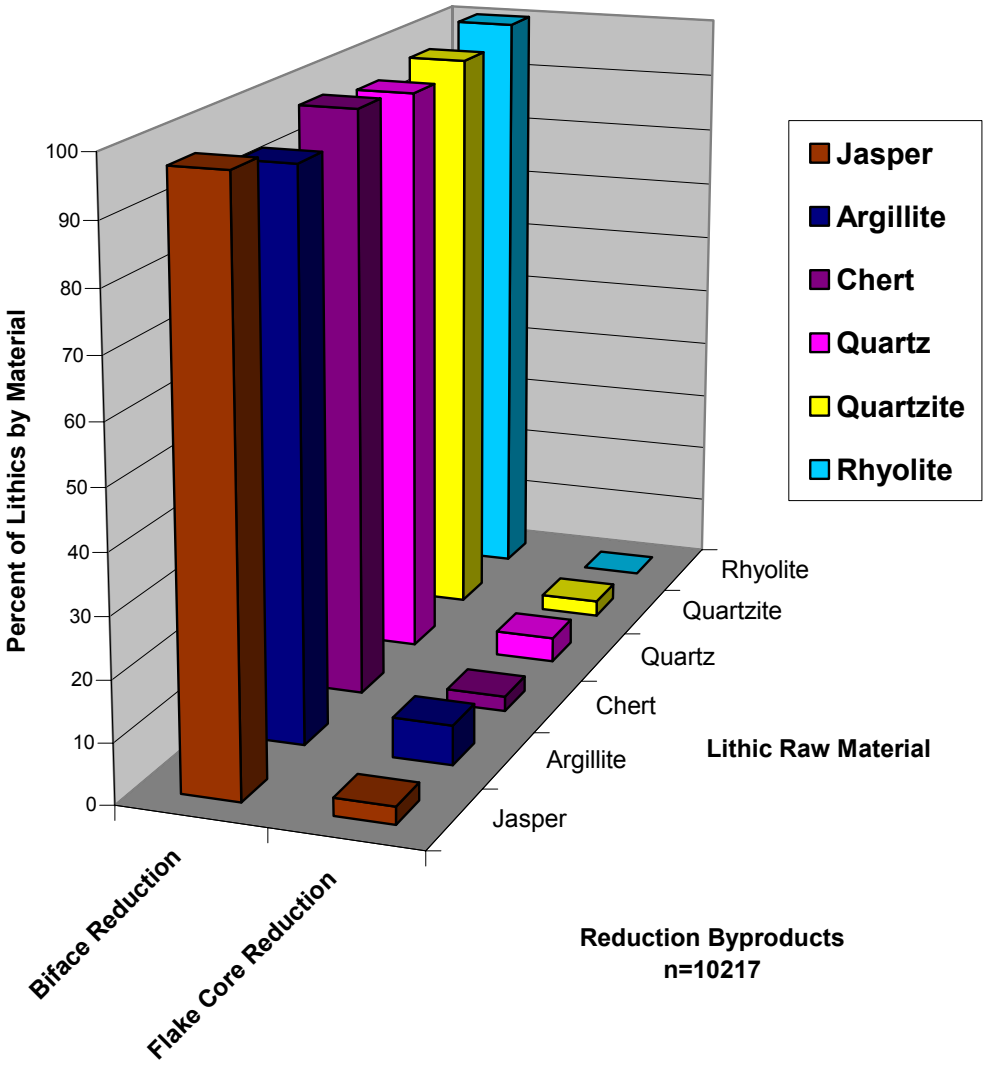


Figure 6.26: Biface vs. Flake Core Reduction Byproducts by Lithic Raw Material

Comparisons of biface and core reduction byproducts for the different lithic raw materials in the overall site assemblage revealed two distinctive patterns (Figure 6.27). One pattern was characteristic of chert, quartz and quartzite, which were presumably available in the immediate site vicinity. This pattern included relatively high percentages of primary biface thinning flakes, higher but moderate percentages of secondary biface thinning flakes, lower percentages of tertiary biface thinning flakes (probably lower due to ¼" screening), and relatively high percentages of decortication flakes. A clearly contrasting pattern was exhibited by the

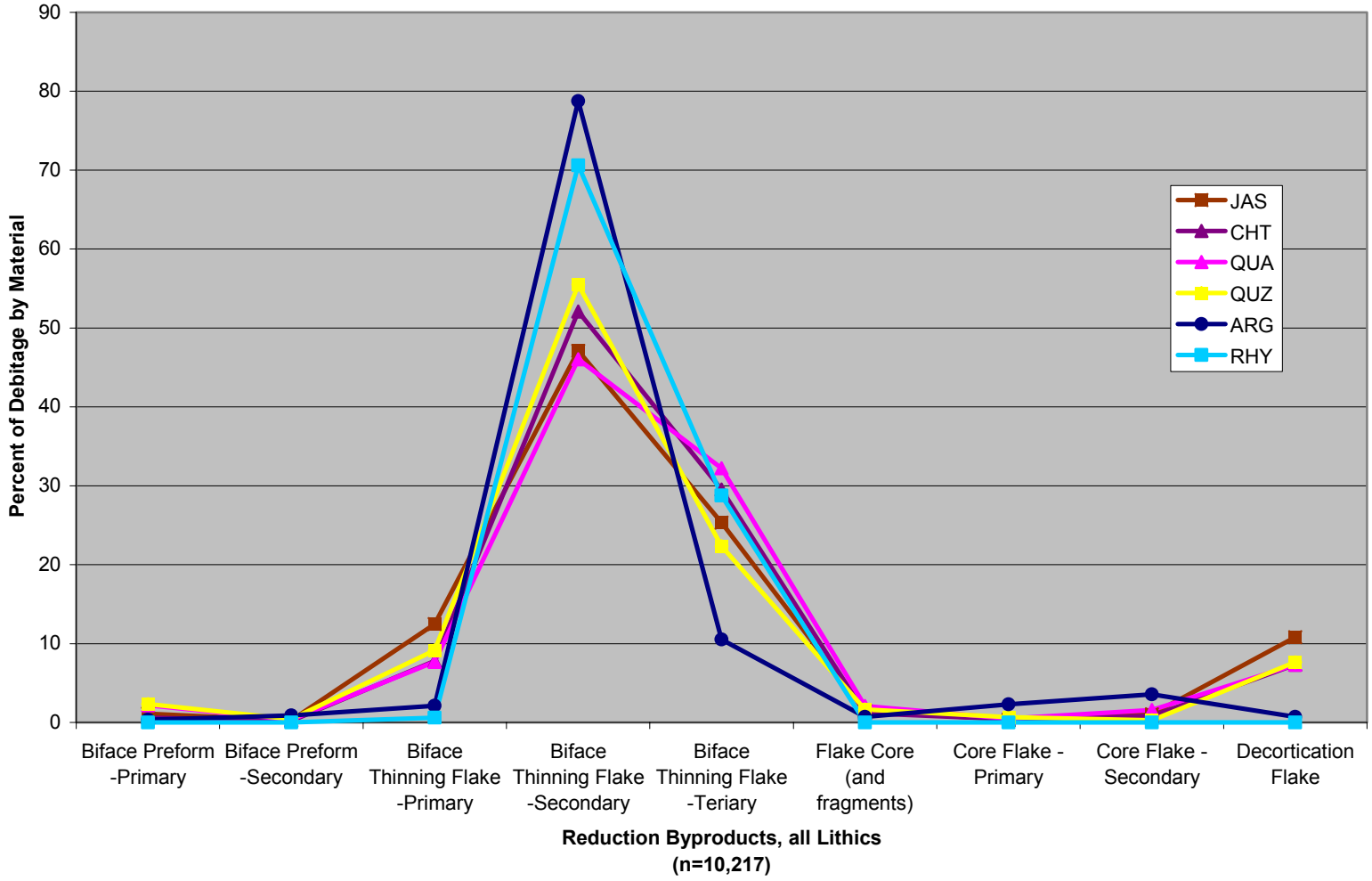


Figure 6.27 Biface and Core Reduction Debitage by Lithic Material

presumably exotic lithic raw materials argillite and rhyolite, which had distinctly lower percentages of primary biface thinning flakes, distinctly higher percentages of secondary biface thinning flakes, and almost no decortication flakes. Of interest was the pattern exhibited by jasper, which was virtually identical to that of the local lithic raw materials.

Collectively, the results indicated that chert, quartz, and quartzite were reduced at the site from unmodified pieces of lithic raw material to finished tools, thus producing the full range of lithic reduction byproducts from early stage biface preforms and decortication flakes to tertiary biface thinning flakes. This was the type of pattern that would be expected of lithic materials that were available in relatively close proximity to the site. In contrast, argillite and rhyolite debitage included almost no early stage biface reduction byproducts and significantly higher percentages of late stage biface reduction byproducts. This truncated reduction strategy was consistent with reduction at the site of biface preforms that had been prepared elsewhere and that were fashioned by site occupants into finished tools. The latter pattern was consistent with the reduction of exotic lithic raw materials, which could be transported much more efficiently as preforms than as much bulkier unmodified lithic raw material.

Jasper debitage from the site exhibited a nearly identical pattern to that of chert, quartz, and quartzite. This suggested that jasper was also readily available in the immediate site vicinity rather than having been procured from distant sources, such those of the Delmarva Chalcedony Complex.

Examination of flake core reduction byproducts also revealed distinct differences among lithic raw materials (Figure 6.28). Three distinct patterns were discernable. Jasper, chert, and quartz all exhibited high percentages of flake cores and fragments, low percentages of primary core flakes, and high percentages of secondary core flakes. Quartzite flake core debitage exhibited very low percentages of secondary core flakes, but was otherwise similar to jasper, chert, and quartz. Argillite was distinctive, with very low percentages of flake cores and fragments, higher percentages of primary core flakes, and very high percentages of secondary core flakes. Rhyolite flake core debitage was not present in the assemblage.

These results were again consistent with the presumed acquisition of argillite and rhyolite in the form of prepared preforms, which would produce debitage resembling flake core byproducts less frequently than more local materials subjected to the full range of biface reduction activities. The results also confirmed the similarity between jasper reduction byproducts and those of chert and quartz. The significance of the distinctive flake core reduction sequence exhibited by quartzite was not obvious.

Lithic Reduction Strategies by Component

The lithic reduction strategies displayed by debitage from each of the occupational and activity area components identified within the site area were also examined. However, the analysis was constrained to some degree by sample sizes. Only the early Woodland I and middle Woodland I occupational components produced sufficiently large samples to support reliable debitage analysis of all the principal types of lithic raw material in the site assemblage. The reduction patterns they exhibited were essentially the same as the overall pattern for the site as a whole

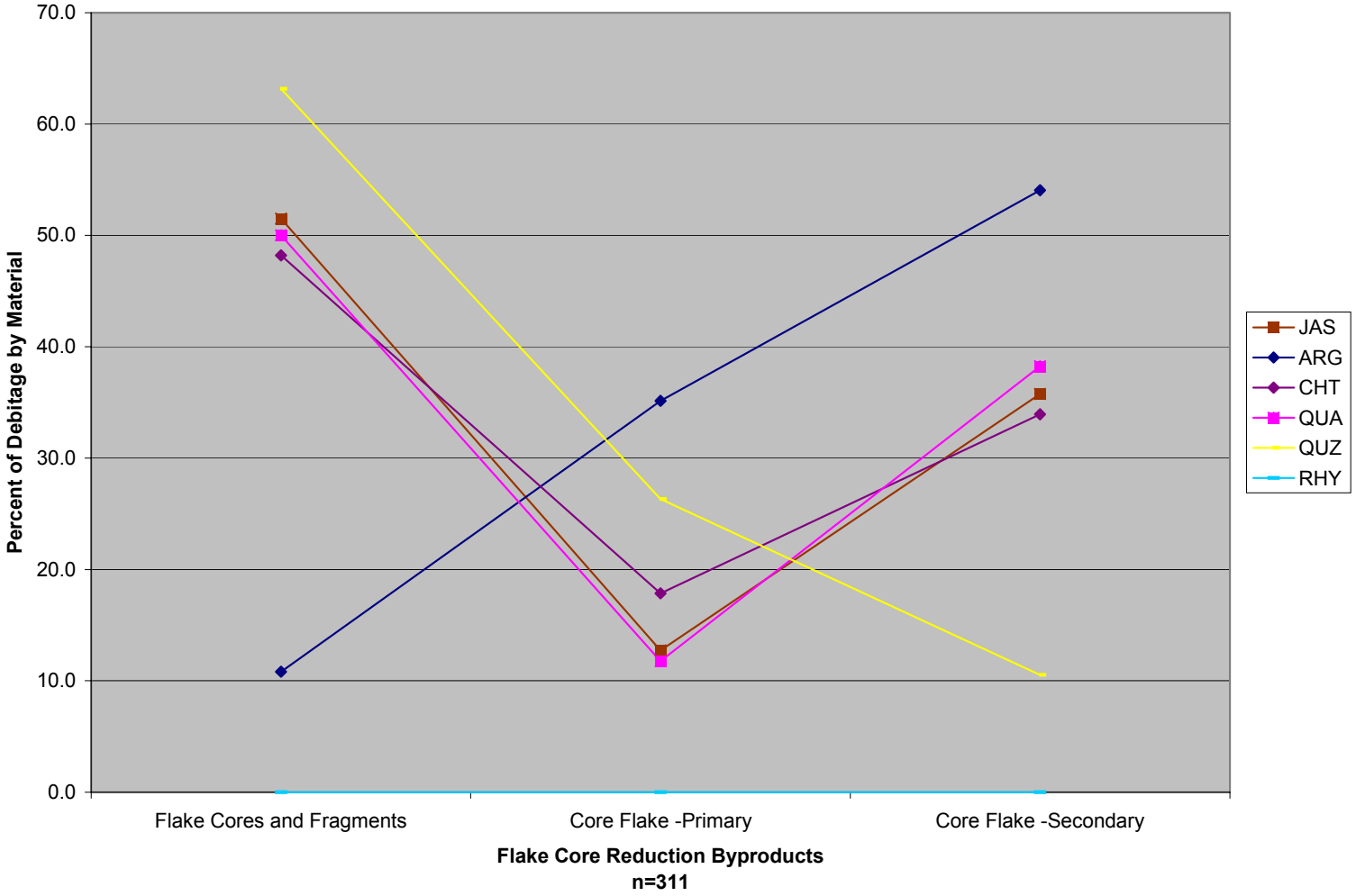


Figure 6.28 Flake Core Reduction Debitage by Lithic Material

(Figures 6.29 and 6.30), with jasper, chert, quartz, and quartzite showing relatively high percentages of early stage biface reduction byproducts, while argillite and rhyolite had higher percentages of late stage byproducts.

The remaining component-specific lithic debitage samples contained numerically insufficient amounts of argillite and rhyolite to reliably reflect reduction behavior. These lithic raw materials were therefore omitted from the analysis of these components. Amounts of argillite and rhyolite were so low in these component assemblages as to suggest that debitage of these materials was present primarily due to admixture from the nearby early Woodland I and middle Woodland I occupational components.

With this data modification, the pattern for the early Woodland I activity area component was similar to the overall assemblage and to the early Woodland I occupational component patterns.

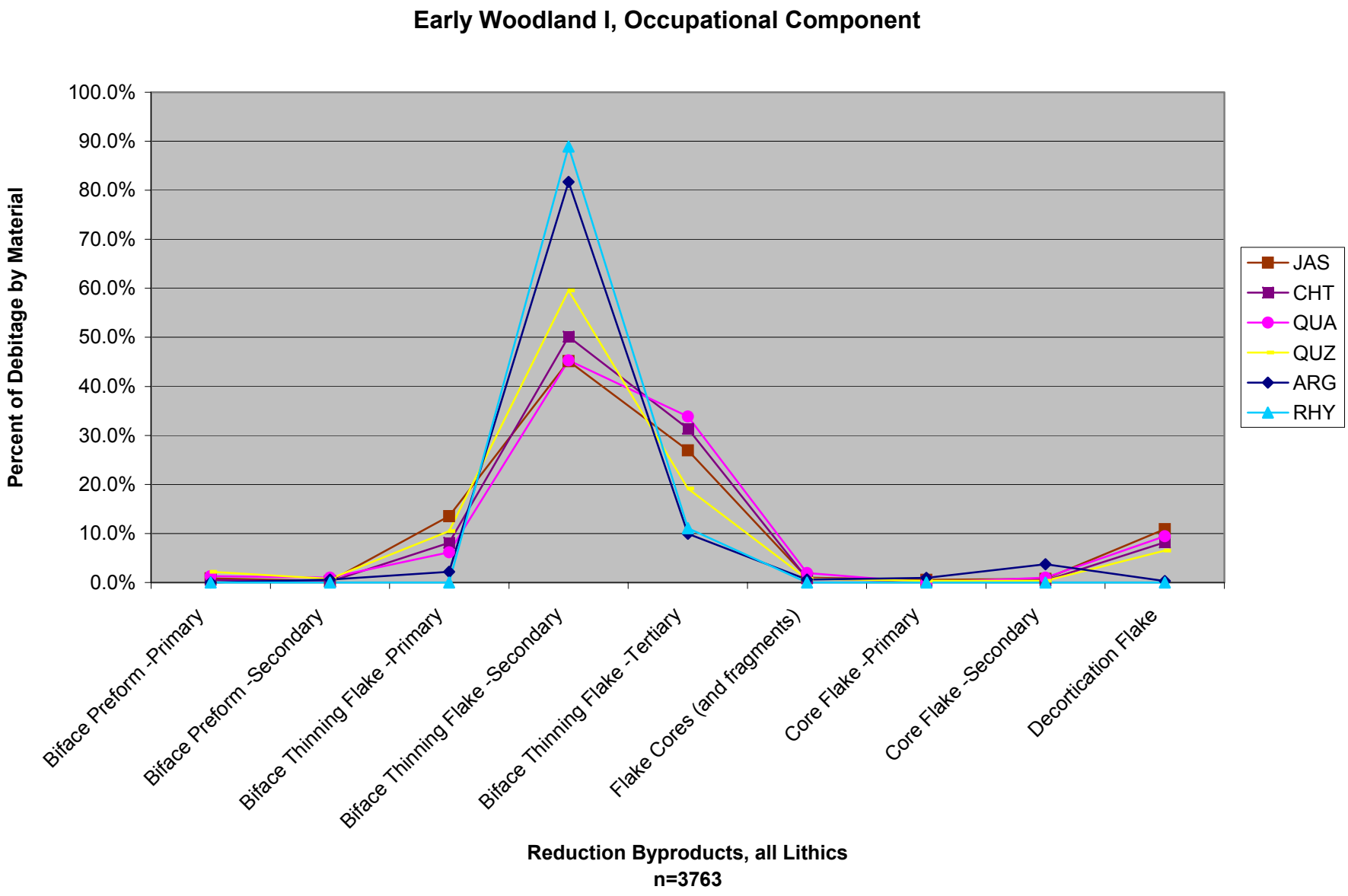


Figure 6.29 Early Woodland I Occupational Component Lithic Reduction Byproducts

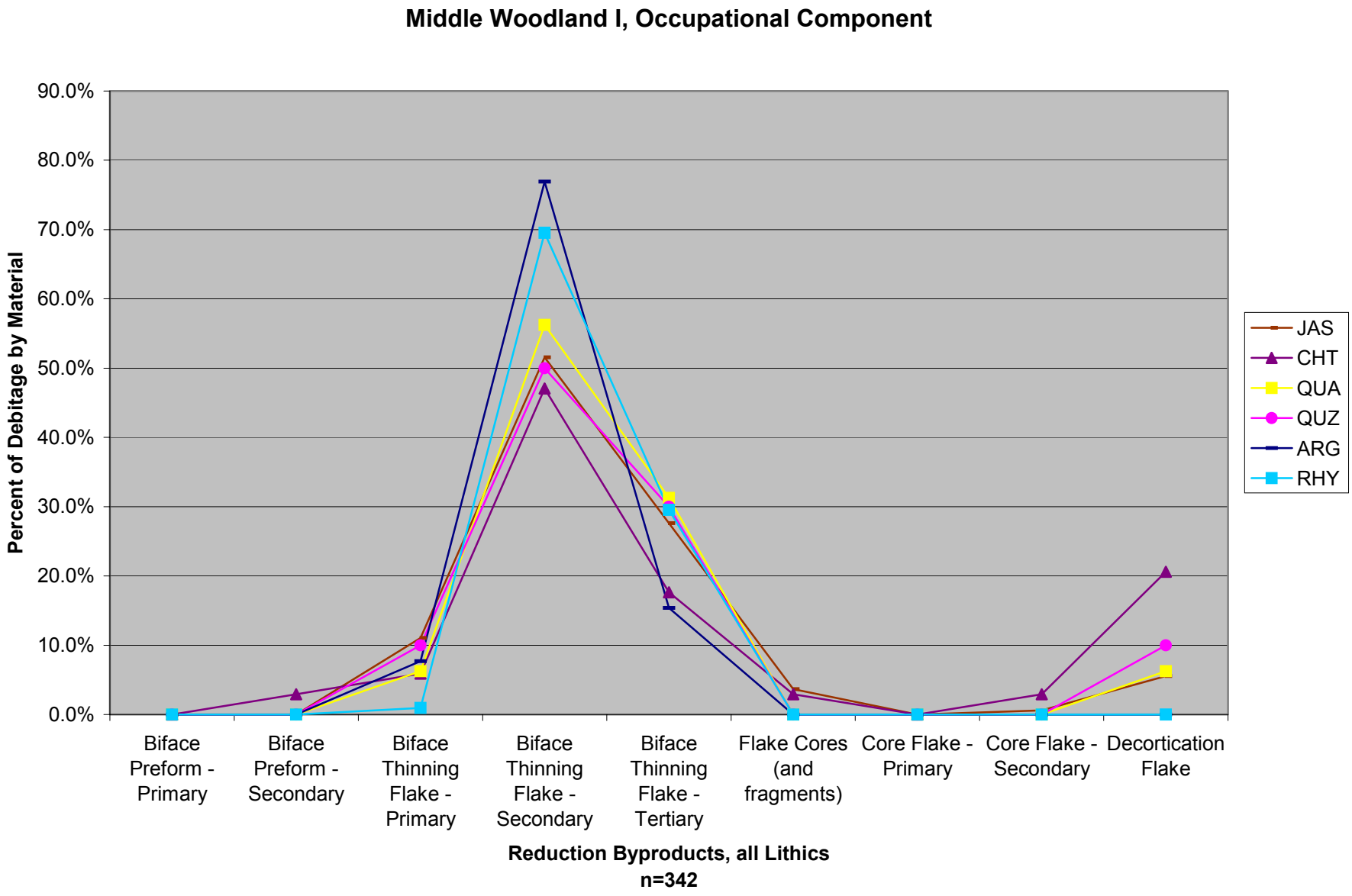


Figure 6.30 Middle Woodland I Occupational Component Lithic Reduction Byproducts

One exception was quartz debitage, which exhibited an unusually high percentage of secondary biface thinning flakes (Figure 6.31). Although the reasons were not clear, it would appear that this least tractable of lithic raw materials was processed in a different manner during this potentially earlier episode of site utilization. As noted above, flake core debitage was minimal. Allowing for some variability due to lower sample sizes, the middle Woodland I activity area 1 and activity area 2 patterns followed the overall assemblage pattern (Figures 6.32 and 6.33). Due to its small size, however, the middle Woodland I activity area 2 component debitage sample contained no quartzite, argillite, or rhyolite. Its unusually high percentage of quartz secondary biface thinning flakes was probably also distorted due to the small size of its sample. The pattern exhibited by the Woodland II component assemblage exhibited an unusually high percentage of quartzite tertiary biface thinning flakes (Figure 6.34).

Although to some extent obscured by variability attributable to small samples, component-specific reduction analysis suggested that the principal lithic raw materials present at the site were procured and processed in generally similar ways during the various episodes of site use. In all components, flake core debitage was a minor assemblage constituent, and was perhaps attributable to accidental production during biface reduction activities. Also in all cases, jasper, chert, quartz, and (where present in sufficient amounts) quartzite consistently exhibited the percentages of early and late stage reduction byproducts that would be expected of lithic raw materials available in the vicinity of the site. As indicated, when present in sufficient amounts to be analyzed, argillite and rhyolite exhibited percentages indicative of imported exotic raw materials brought to the site as previously prepared preforms.

Chipped Stone Tools

Chipped stone tools in the Site 7K-F-11/169 assemblage fell into the usual categories found at prehistoric sites, and included projectile points, other bifaces and biface fragments, drills, side scrapers, end scrapers, choppers, spokeshaves, otherwise unidentifiable unifaces, and various types of utilized flakes. Very small utilized flakes, unifaces, and bifaces were unusually prevalent at the site, and were collectively referred to as microtools, described in detail below (this section).

Projectile Points (n=82): The typological and raw material composition of the projectile points in the Site 7K-F-11/169 assemblage is discussed above (see Section 6.2). To summarize, 82 bifaces that were sufficiently complete to be recognizable as projectile points, or projectile point/knives (PPK), were recovered during Phase I, II, and III investigations at the site. Of the 67 points recovered from Phase III excavations, 18 (27%) were jasper, 12 (18%) were chert, 13 (19%) were quartz, 8 (12%) were quartzite, 13 (19%) were argillite, one (1%) was rhyolite, and two (3%) were of other minor lithic raw material types (Table 6.8). Sixteen projectile point types were recognized in the collection, including Kirk/Palmer (n=1), Lamoka (n=1), Savannah River (n=1), Teardrop (n=1), Goose Creek Spike (n=1), MacPherson (n=1), Lehigh/Coens Krispin (n=1), Untyped Broadspear (n=2), Rossville (n=15), Bare Island (n=8), Piney Island (n=4), Poplar Island (n=11), miniature Rossville/Poplar Island (n=1), Basal Notched (n=1), Fox Creek (n=1), Wharton Corner Notched (n=1), and Levanna (n=3). Untypeable points were classified as untyped stemmed (n=4) and untyped (n=25).

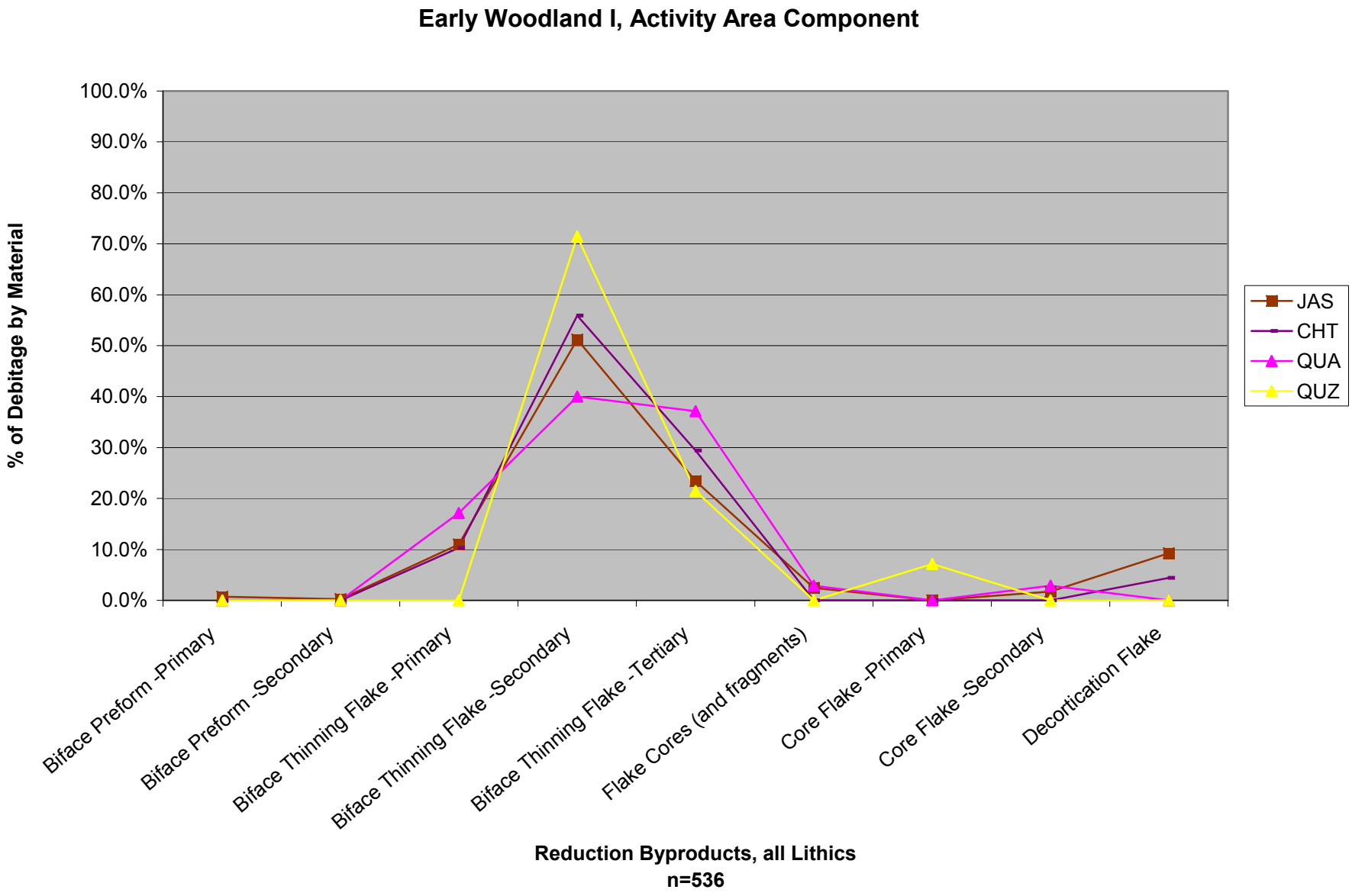


Figure 6.31 Early Woodland Activity Area Lithic Reduction Byproducts

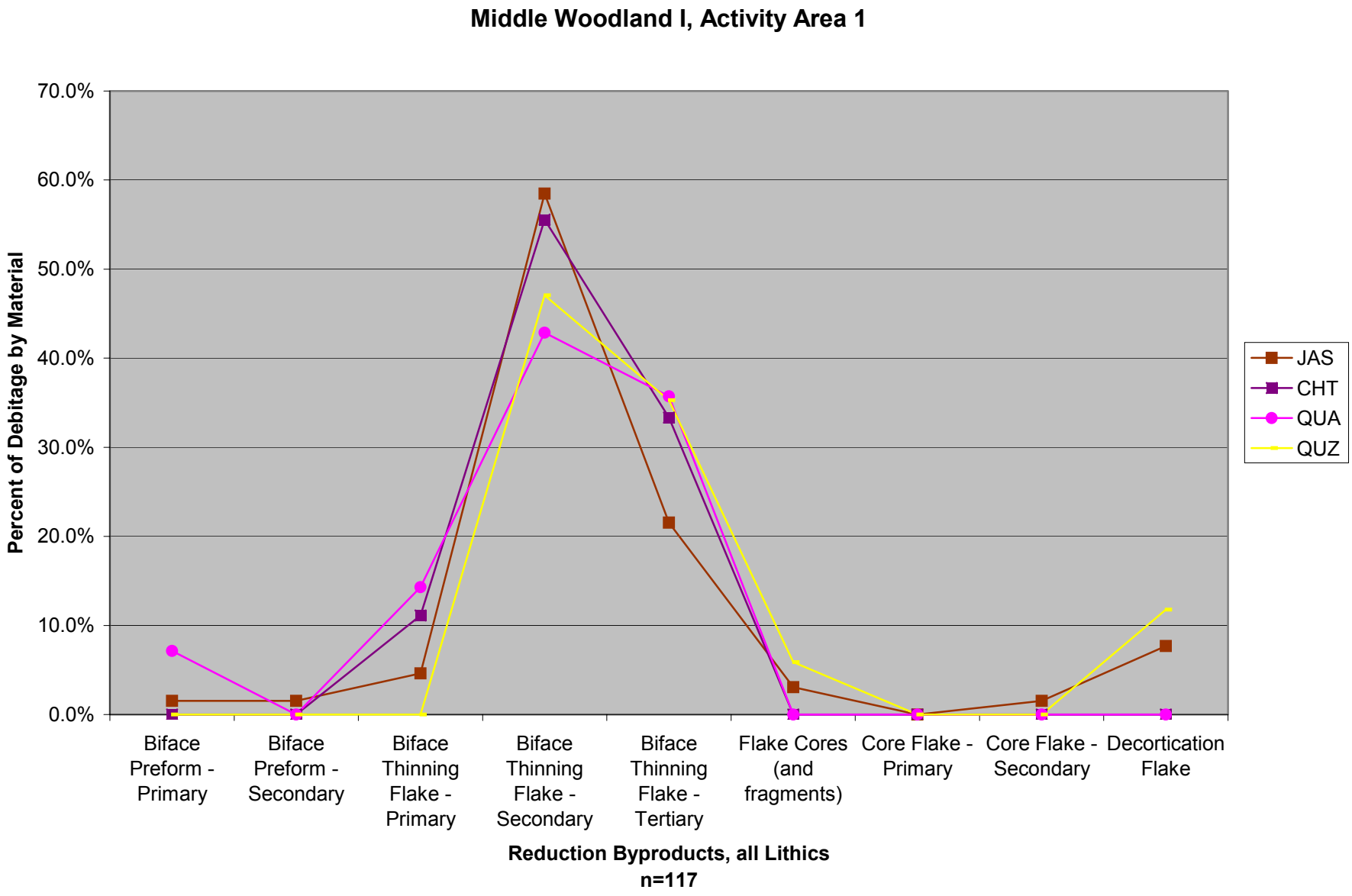


Figure 6.32 Middle Woodland I Activity Area 1 Lithic Reduction Byproducts

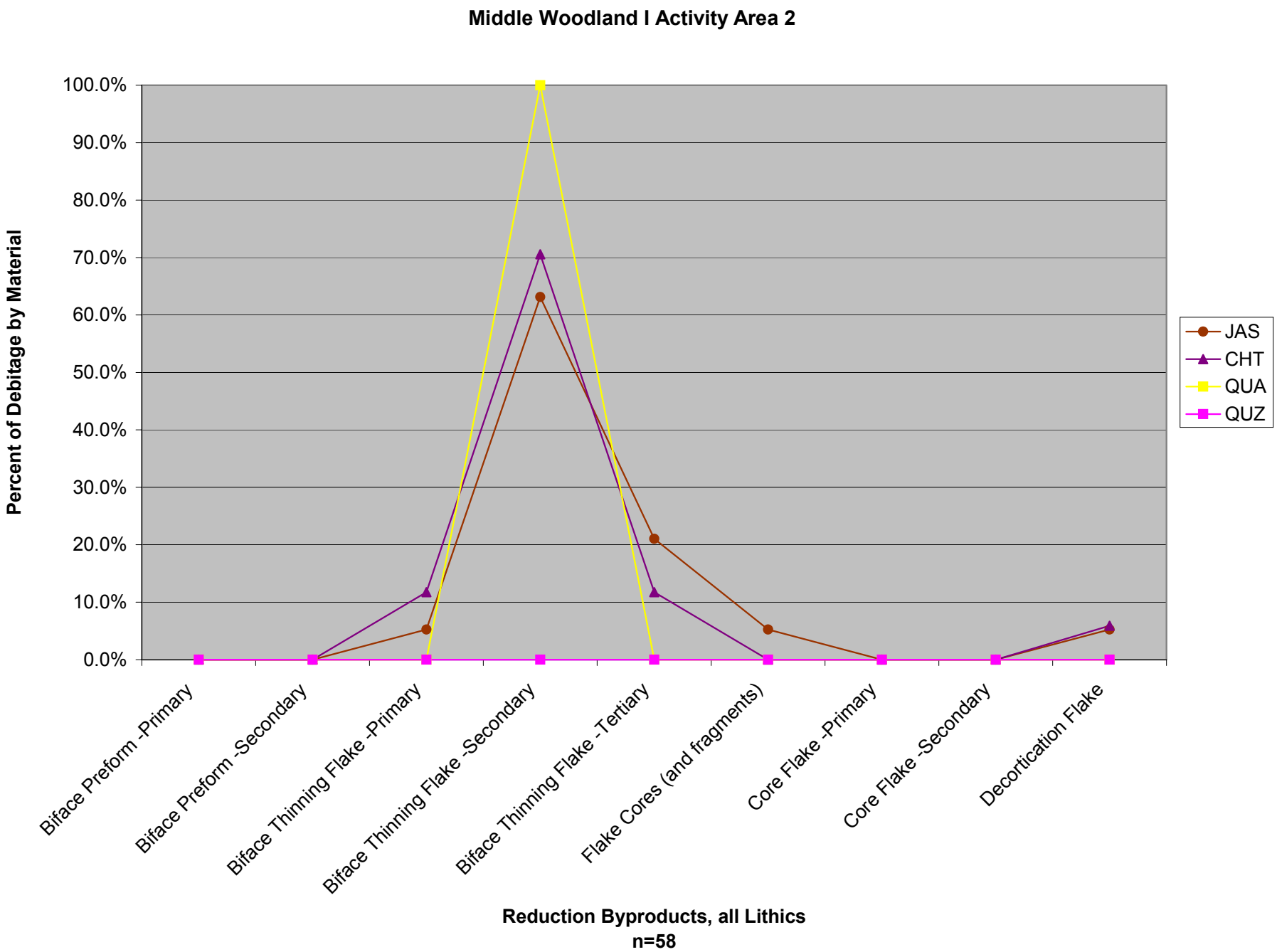


Figure 6.33 Middle Woodland I Activity Area 2 Lithic Reduction Byproducts

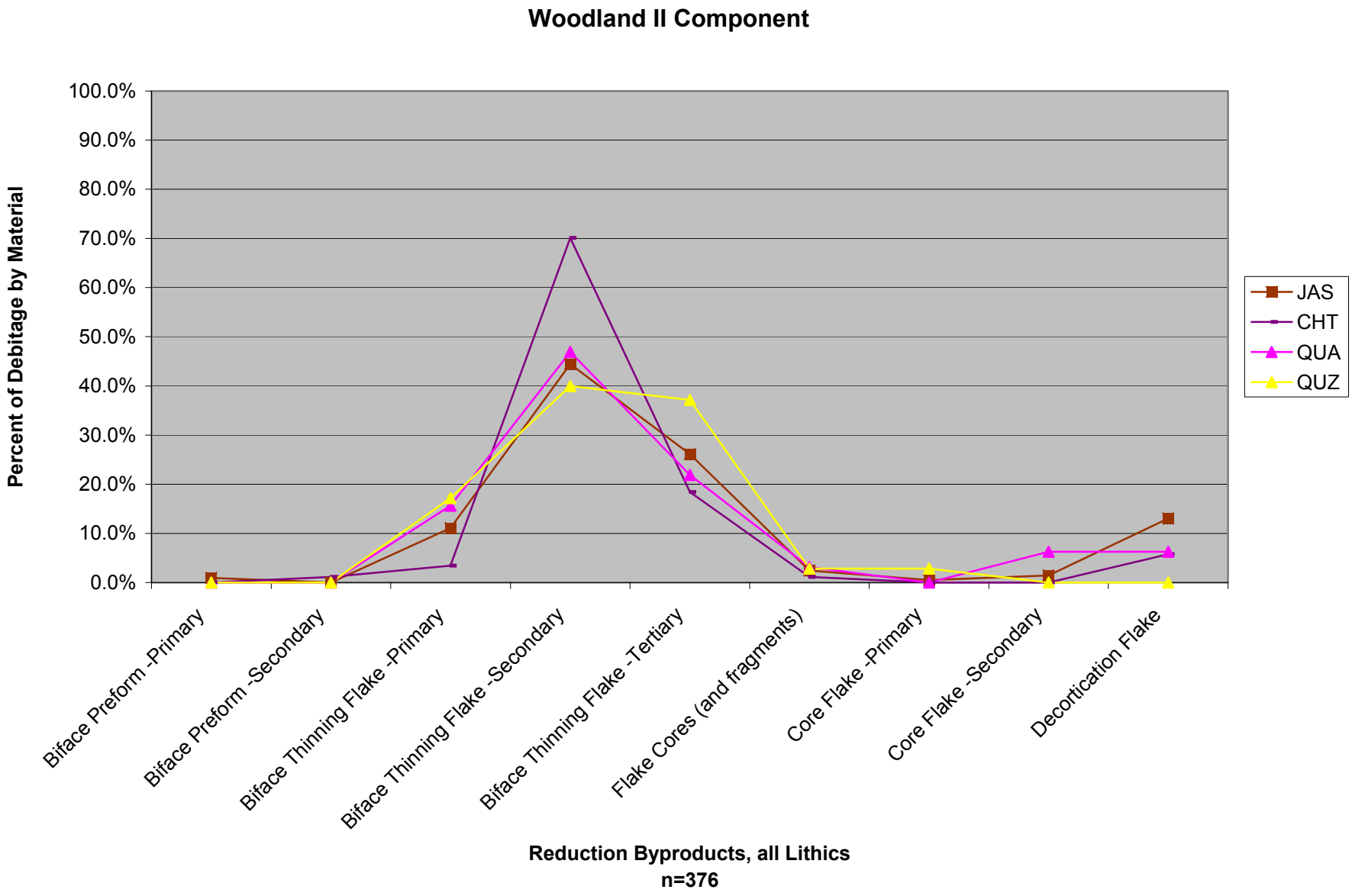


Figure 6.34 Woodland II Occupation Component Lithic Reduction Byproducts

Table 6.8
Stone Tools and Lithic Raw Materials

Artifact Description		JAS		Chert		QUA		QUZ		ARG		RHY		HEM		SAS		SIL		Other		
		Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Grand Total
Projectile Point		18	26.9%	12	17.9%	13	19.4%	8	11.9%	13	19.4%	1	1.5%							2	3.0%	67
Biface	-Unidentifiable Fragment	32	40.5%	19	24.1%	15	19.0%	6	7.6%	6	7.6%	1	1.3%									79
Drill		3	60.0%	1	20.0%					1	20.0%											5
End Scraper		2	50.0%			1	25.0%	1	25.0%													4
Scraper		7	35.0%	4	20.0%	4	20.0%	3	15.0%	2	10.0%											20
Side Scraper		1	100.0%																			1
Chopper										1	50.0%	1	50.0%									2
Microtool		194	86.6%	31	13.8%	2		1	0.4%											1	0.4%	229
Spokeshave		2	100.0%																			2
Uniface	-Unidentifiable	2	50.0%			1	25.0%			1	25.0%											4
	SubTotal	261	63.2%	67	16.2%	36	8.7%	19	4.6%	24	5.8%	3	0.7%		0.0%		0.0%		0.0%	3	0.7%	413
Utilized Biface Thinning Flake	-Primary	8	36.4%	3	13.6%	4	18.2%	4	18.2%	3	13.6%											22
	-Secondary	24	45.3%	21	39.6%	2	3.8%	3	5.7%	3	5.7%											53
Utilized Blade-Like Flake		3	50.0%	1	16.7%					2	33.3%											6
Utilized Core Flake	-Primary	3	50.0%	1	16.7%					2	33.3%											6
	-Secondary					1	50.0%	1	50.0%													2
Utilized Decortication Flake		1	9.1%	6	54.5%	2	18.2%	1	9.1%							1	9.1%					11
Utilized Shatter		3	42.9%	3	42.9%					1	14.3%											7
	SubTotal	42	39.3%	35	32.7%	9	8.4%	9	8.4%	11	10.3%		0.0%		0.0%	1	0.9%		0.0%		0.0%	107
Grinding stone														1	7.7%	12	92.3%					13
Grooved Abrader																36	100.0%					36
Groundstone	-Unidentifiable Fragment							1	14.3%							6	85.7%					7
Groundstone Axe																3	100.0%					3
Hammerstone		1	2.8%			1	2.8%	2	5.6%							31	86.1%					36
Nutting Stone																1	100.0%					1
Polished Stone																3	75.0%	1	25.0%			4
	SubTotal	1	1.0%			1	1.0%	3	3.0%		0.0%		0.0%	1	1.0%	92	92.0%	1	1.0%		0.0%	102
	Grand Total	304	48.9%	102	16.4%	46	7.4%	33	5.3%	35	5.6%	3	0.5%	1	0.2%	93	15.0%	1	0.2%	3	0.5%	622

Nine projectile points were submitted for microwear analysis (see Section 10.1.3). All belonged to the generalized narrow bladed stemmed point family that was so prevalent at the site, and was thus of special interest Seven of these nine points showed evidence of hafting in the form of hard/high silica polish and abraded ridges and striae on and near the stem. Six of the seven hafted specimens were interpreted as having been used as projectiles based on impact fractures and/or the lack of evidence for other uses. The seventh hafted point had striae and hard high silica polish near the tip, suggesting use as a drill in addition to, or instead of, use as a projectile. The remaining two points had minimal evidence of hafting. One had an impact fracture on the tip, suggesting use as a projectile despite the lack of hafting wear. The other had hard/high silica polish near the distal end and may have been used unhafted to cut a hard material.

In addition to evidence of use wear, residues and other organic remains were observed on the projectile points during microwear analysis. A fragment of wood fiber was present on the hafting element of one point, and identified as likely of larch/tamarack. This wood is not currently native to Delaware, but does occur nearby in New Jersey, Maryland, and Virginia. Another point exhibited a microscopic fragment of skin near its tip, and a fragment of otherwise unidentifiable hair was observed on a third. No other residues or other organic materials were observed on any of the nine projectile points examined.

Based on the microwear results, two projectile points were included in the sample of tools submitted for protein residue analysis (see Section 10.1.5). One was the point with a fragment of skin, the other was the point with the piece of hair. The point with skin reacted positively to rabbit antisera, the one with the hair was negative for protein residues.

Biface Fragments (n=79): Items classified as otherwise unidentifiable biface fragments included pieces of projectile points or knives that were broken during use or resharpening as well as nearly finished bifacial tools that were broken during manufacture. The biface fragments included 32 (41%) that were jasper, 19 (24%) that were chert, 15 (19%) that were quartz, 6 (8%) that were quartzite, 6 (8%) that were argillite, and one (1%) that was rhyolite. The frequency of biface fragments by lithic raw material differed notably from the pattern for projectile points. Biface fragments of jasper, chert and quartz were relatively more prevalent than projectile points of those materials. In contrast, biface fragments of argillite and rhyolite were relatively less prevalent than projectile points of the same materials. Presumably, this was attributable to the greater use of local lithic raw materials in the reduction activities that occurred on site, while the exotic lithic raw materials tended to arrive at the site in finished or more nearly finished forms. Because many or perhaps most biface fragments were likely unused broken biface preforms, none were submitted for microwear or protein residue analysis.

Drills (n=5): Three of the five artifacts that were identified as bifacial drills were of jasper, one was chert, and one was argillite (Photograph 6.17). Three drills were included in the microwear analysis. Two had soft polish and fragments of hair, suggesting use to perforate hides. Neither of these tools showed hafting wear, and both may have been hand held. The other drill had hafting wear and what appeared to be blood residue near the tip. These three drills were also included in the protein residue sample. The hafted drill with blood residue reacted positively to rabbit antisera, the other two specimens were negative for protein residues.

Photograph 6.17 Drills. *Left to right:* jasper (Lots 213.A, 1432.A, 1831.B)

Photograph 6.18 Scrapers. *Left to right:* Jasper (Lots 184.C, 1059.C)

Scrapers and End Scrapers (n=24): Twenty of the items identified in the site assemblage as scrapers were side scrapers and four were end scrapers (Photograph 6.18). Nine scrapers were of jasper, four were chert, five were quartz, four were quartzite, and two were argillite. Three scrapers were included in the microwear sample. One had hafting wear, the other two lacked evidence of hafting and presumably were hand-held. All three exhibited soft polish, and hair fragments were observed on two. All three were interpreted as having been used to scrape hides. The two scrapers with fragments of hair were included in the protein residue sample. One reacted positively to rabbit antisera, the other was negative for protein residues.

Choppers (n=2): Both items that were identified as choppers were large flake blanks exhibiting coarse bifacial flaking along one edge. One was of argillite and one was rhyolite.

Microtools (n=224): An unusual and surprisingly prevalent chipped stone tool type in the Site 7K-F-11/169 assemblage, microtools were identified as small but otherwise morphologically diverse flakes that exhibited evidence of having been intentionally shaped, used, or both. They varied in length from 8 to 30 mm and in width from 5 to 19 mm. Most of the microtools were triangular in shape and had unifacial micro-flaking, but the category also included some examples with other shapes, or with evidence of bifacial micro-flaking. A few could conceivably have been fragments of larger tools that were broken in use; others may have been small pieces of shatter with micro-scarring from "scrubbing" the edges of bifaces during lithic reduction. However, their prevalence in the assemblage, accounting for nearly one-half of all chipped stone tools and utilized flakes, suggested that the majority were intentionally shaped/used as special tools.

Of the 224 micro-tools identified in the site assemblage, 191 (85%) were of jasper. In contrast, jasper tools and utilized flakes comprised only 38% of the overall assemblage of shaped tools and utilized flakes when microtools were excluded, reflecting a clear preference for jasper as the raw material of choice for the fabrication of microtools. In addition to those of jasper, there were 40 chert, two quartz, and one quartzite microtools in the assemblage.

Due to their unusual prevalence and distinctive size, microtools were of special interest in the overall interpretation of the site. Fourteen microtools were included in the microwear sample. Only three showed no evidence of use, further indicating that microtools in general comprised a special type of tool at this site. The eleven utilized microtools exhibited a range of wear types indicative of perforating hide, scraping and piercing soft material, scraping or piercing hard material, and scrapping a resinous plant material. Six microtools exhibited residues and other types of animal tissue, including skin, raphides associated with starch grains, resin, possible blood residue, hair, and otherwise unidentifiable plant material. Despite their small size, none of the microtools examined showed evidence of hafting, in the form of hard/high silica polish or abraded ridges and striae. Two microtools were included in the protein residue analysis sample; the one with skin and the one with a resinous material. Both were negative for protein residues.

Collectively, the results of the microwear analysis suggested that at Site 7K-F-11/169 microtools were generalized multi-functional tools that may have been hand-held and used as scrapers and perforators on a variety of materials.

Review of site reports and consultation with other archaeologists showed that microtools have been found at other sites in the region, but in such low frequencies as to be generally unremarked. Such artifacts were occasionally observed, but were commonly classed with utilized flakes. One study of debitage from 28 sites in the mid-Atlantic Region indicated that a high proportion of flakes had evidence of use wear that could only be discerned through microscopic inspection (Neumann 1992). These small, utilized flakes in that study were found to be consistent in size, suggesting that they were manufactured for use in compound tools. Three types of potential compound tools were identified from ethnohistoric sources. In the first type, lithics are aligned to form a continuous cutting edge, such as the obsidian blade edged swords described by the Spanish in Mesoamerica. In the second type, lithics are arranged to form separate or discontinuous cutting edges, such as the barbs on a spear or harpoon. In the third type, lithics are arranged as teeth on a continuous surface, such as the manioc graters known from the Caribbean.

Unlike the microliths identified by Neumann, the microtools from Site 7K-F-11/169 showed retouch or use wear that was visible without microscopic inspection. In most cases, the lithics classified as microtools were unifacial tools formed on small flakes, with retouch or use wear along two edges of a triangular form (Photograph 6.19). Artifacts of similar size and form have been found on Mississippian sites. Based on use wear, they were identified as drills, also called Jaketown perforators, used in the production of shell beads (Yerkes 1983). Analysis of microwear on microtools from Site 7K-F-11/169 showed evidence of drilling, but also showed that these small tools were used for a variety of other activities.

At the Hoko River Site in Washington, six hafted microlith tools were among the organic tools recovered from this well preserved wet site (Flenniken 1981). A microlith of quartz had been hafted between flat pieces of split cedar lashed together. Experimental reproduction of this tool type showed that it functioned very well for filleting salmon. The microwear study showed no evidence of hafting wear on 14 microtools from Site 7K=F-11/169, suggesting that they were not hafted in a similar manner. They could have been used in compound tools by being mounted in a resin instead, such as the stones "glued in with Turpentine" described historically in Virginia (Beverley 1705, quoted in Neumann 1992).

The microtool industry at Site 7K-F-11/169 may have been associated with several specialized activities. Given the setting of the site on a major stream, they may have been used in fishing, as either harpoon barbs or filleting tools. Alternatively, they could have been used in graters to process tubers. But whatever their specific function(s) might have been, they were clearly used primarily during the early Woodland I period of site occupation, and exhibited statistically significant spatial associations with both the early Woodland I occupational site component and the early Woodland I activity area site component (see below, Section 6.5).

Spokeshaves (n=2): Two spokeshave type scrapers were identified in the assemblage. Both were of jasper. Neither was included in the microwear or protein residue samples.

Unidentified Unifaces (n=4): Otherwise unidentifiable unifacial tools included two of jasper, one of quartz, and one of argillite. None of these tools were further analyzed.

Photograph 6.19 Microtools from Feature 371, shown larger than life size. All jasper except second row, fourth from left (Lots 1622, 1625, 1626, 1629, 1630, 1632, 1633, 1635, 1637, and 1639).

Utilized Flakes (n=107): The majority of utilized flakes identified in the assemblage were primary or secondary biface thinning flakes. Evidence of use on other types of flakes was less common, perhaps simply due to the relative prevalence of these less numerous flake varieties. Jasper and chert utilized flakes (n=77) were most prevalent, together accounting for approximately 72% of all the utilized flakes in the assemblage. Utilized flakes of other lithic raw materials were uncommon, and none were of argillite. Identified based on macroscopic evidence of utilization in the form of unifacial or bifacial micro-scarring along one or more edges, utilized flakes presumably reflected generalized scraping and cutting of relatively hard materials such as wood and perhaps bone and antler. Because they needed to be washed in many cases to reliably confirm their identification, they were not included in the microwear or the protein residue samples.

6.4.2 Ground Stone Technology and Tools

Lithic Raw Materials

The majority of the ground stone tools recovered at Site 7K-F-11/169 were fashioned from sandstone. No bedrock exposures from which the material could have been procured are present in the vicinity of the site. Like locally available lithic materials for chipped stone tools, it must instead have been procured from stream cobble deposits. It may have derived ultimately from the Columbia Formation, which contains concentrations of cobbles and occurs in the headwater areas of local streams.

Six groundstone tools were made of other lithic raw materials. Four were hammerstones. One of these hammerstones was of jasper, one was quartz, and two were quartzite. As indicated above, all of these types of stone were likely procured from local stream cobble deposits. One grinding stone was made of hematite. This material occurs naturally in the B-horizon gravels at the site, and was presumably also available locally in streams. Natural hematite was found in prehistoric features at the site, and was clearly present in significantly higher concentrations in some features than in others. This suggested that the material was being used for some purpose by the site occupants. An obvious possibility was the manufacture of red ochre. Red ochre was not observed at the site as a separate material or adhering to other artifacts. However, it may have been removed by groundwater movement in the permeable site soils.

Ground Stone Tools

Ground stone tools included grinding stones, ground stone axes, hammerstones, a nutting stone, polished stones, and otherwise unidentifiable ground stone tool fragments.

Grinding Stones (n=13): The ground stone tools classified as grinding stones were identified based on coarse modified surfaces with visible striations. Twelve were of sandstone. The one non-sandstone grinding stone was made of hematite. This tool may have been used in the production of red ochre.

Grooved Abraders (n=36): The most abundant ground stone tools recovered were grooved abraders. All were fashioned of sandstone. Due to their unusual prevalence at the site, they were the focus of a special research effort, and are described in detail below (this section).

Groundstone Axes (n=3): All three of these tools were grooved, and all were of sandstone (Photograph 6.20).

Photograph 6.20 Ground stone ax from Feature 9, 3/4 grooved (Lot 725).

Hammerstones (n=35): Presumably used in lithic reduction, hammerstones may also have been used for other purposes such as pecking ground stone tools to shape, opening and pulverizing hard-shelled nuts on stone anvils, and generalized hammering and pounding activities. Like grooved abraders, they were a prevalent ground stone tool type at the site. The majority (n=31) were sandstone, but one was of jasper, one was quartz, and two were quartzite.

Nutting Stone (n=1): A single item exhibiting a pitted modified surface was identified as a nutting stone. It was fashioned from sandstone.

Polished Stones (n=3): Three ground stone items exhibited areas of polish. All were sandstone.

6.4.3 Abrader Research

Grooved abraders are tools with a flat surface characterized by one or more linear grooves, presumably for abrading shafts of one or another material. A total of 34 grooved abraders found at Site 7K-F-11 were included in a detailed analysis (Table 6.9). Twenty-two abraders were

from cultural features, while the remaining 12 were from tree throws, other non-cultural disturbances, and plowzone contexts.

Table 6.9 Preserved Wooden Artifact Diameters

Tool	Diameter (mm)
Digging sticks	25-35
Wooden awls	4-8
Arrows	6-8
Prayer stick (pahos)	4-11
Weaving tools	13
Flute	11

(from Gifford 1980, in Adams 2002:53-54)

Previous Research: Until recently, there was a lack of systematic research on ground stone tools in North American archaeology. In one experimental archaeological study, the use of grooved stones as arrow shaft straighteners was tested (Cosner 1951). It was found to be quite effective in straightening arrow shafts made of cane, especially if the stone was heated and the cane dampened.

The most extensive analysis of ground stone tools consists of a number of studies conducted by Adams (2002). Adams developed an analytic approach that focused on characteristics of design, manufacture, and use, rather than assumed function. Her work relied on archaeological examples from Arizona, ethnographic literature review, and experimental archaeology. The research focused primarily on metates and manos, but included analysis of a wide range of polishers and abraders.

In Adams' analytic system, abraders were characterized by a natural or manufactured rough surface texture, and were used to alter surfaces through abrasion. Grooved abraders were distinguished from flat abraders by the presence of grooves, which could be either U-shaped or V-shaped in cross-section. Adams classifies U-shaped grooves as manufactured grooves, meaning that the groove was pecked or ground into to the abrader by design. It would then have been used with an abrasive, such as sand, to make shaft tools. She classified shaft straighteners as a subset of grooved abraders, distinguished by evidence of heat treatment. She suggested that wear or polish in the grooves could be used to indicate whether the wear pattern was longitudinal (drawing a shaft back and forth) or cross wear (rotating a shaft within the groove).

In Adams' typology, V-shaped grooves resulted from use wear, thus representing an expedient tool that was modified as a result of use rather than being designed for use. V-shaped grooves tended to be randomly placed on the surface of a tool, and grooves of different sizes were found on the same tool. She suggested that abraders with V-shaped grooves were used to sharpen the points of bone tools such as awls or needles, or to dull the bases of projectile points before hafting (Adams 2002). Similar tools have been identified elsewhere as sinew stones.

Gifford (1980, in Adams 2002) provided information on the diameters of preserved wood tool shafts from cliff dwelling and cave sites (Table 6.9). However, several of the shaft types Gifford recorded had overlapping ranges in diameter, so the data could not be used to infer the type of tool made using abraders with different groove sizes. For example, a groove with a diameter of 8 mm could have been used to shape a wooden awl, a prayer stick, or an arrow shaft. Arrow shafts from nearby sites were fashioned from reeds instead of wooden shafts, which would not have required the use of a grooved abrader. Furthermore, other shaft tool types were not represented in his sample, such as bow drills, fire starters, spindles, or spear shafts and foreshafts.

Abrader Analysis: All but two of the 34 grooved abraders from Site 7K-F-11/169 were formed on sandstone cobbles, although the texture of the sandstone varied from fine to very coarse. Two of the abraders were made of a crumbly, weakly cemented but otherwise unidentified material. Linear grooves were found on one or more facets of each grooved abrader. The grooves were straight and horizontal. They pinched out where the edge of a stone curved away from the alignment of the groove. This indicated that something rigid was drawn through the groove, such as an arrow shaft or stick. In contrast, the grooves in sinew stones would follow the curved surface, as a flexible material such as sinew or cordage would be drawn over the edge of a stone.

All of the grooves were U-shaped in cross-section, with the exception of a shallow groove that may have resulted from plow scarring. Adams had indicted that abraders with U-shaped grooves were more likely to have been manufactured by design, while V-shaped grooves resulted from use wear. In other characteristics, however, the grooved abraders from Site 7K-F-11/169 did not show evidence of having been designed. Instead they fit Adams' characteristics for incidental tools, having randomly oriented grooves.

The diameter and depth of each groove was measured, using digital calipers. Analysis of the distribution of measurements showed that the grooves formed three distinct size classes (Figure 6.35). Most of the grooves measured between 1 mm and 7 mm in diameter, a second cluster had grooves 8-10 mm in diameter, and a third cluster had grooves of 16-20 mm in diameter. This clustering suggested that grooves of different sizes may have been used to form tools for different activities, as suggested by Adams. For example, the small diameter grooves may have been used to make projectile foreshafts, while the large diameter grooves to make the spear or atlatl shafts to which the foreshafts were attached. Gifford's research on the diameters of preserved wood tools suggests that the small and medium sized grooves found on the Site 7K-F-11/169 abraders may have been used for a number of tools with similar diameters. Bow drills and fire starters, for example, may both have required well smoothed shafts to operate efficiently.

The suggestion that grooves of different size classes were used to make different tools is reinforced by the observation that most of the Site 7K-F-11/169 abraders had grooves representing a single size class only. Thus, 26 abraders had only small grooves, 1 had medium grooves, and 4 had large grooves. Only two abraders had a mix of both small and medium sized

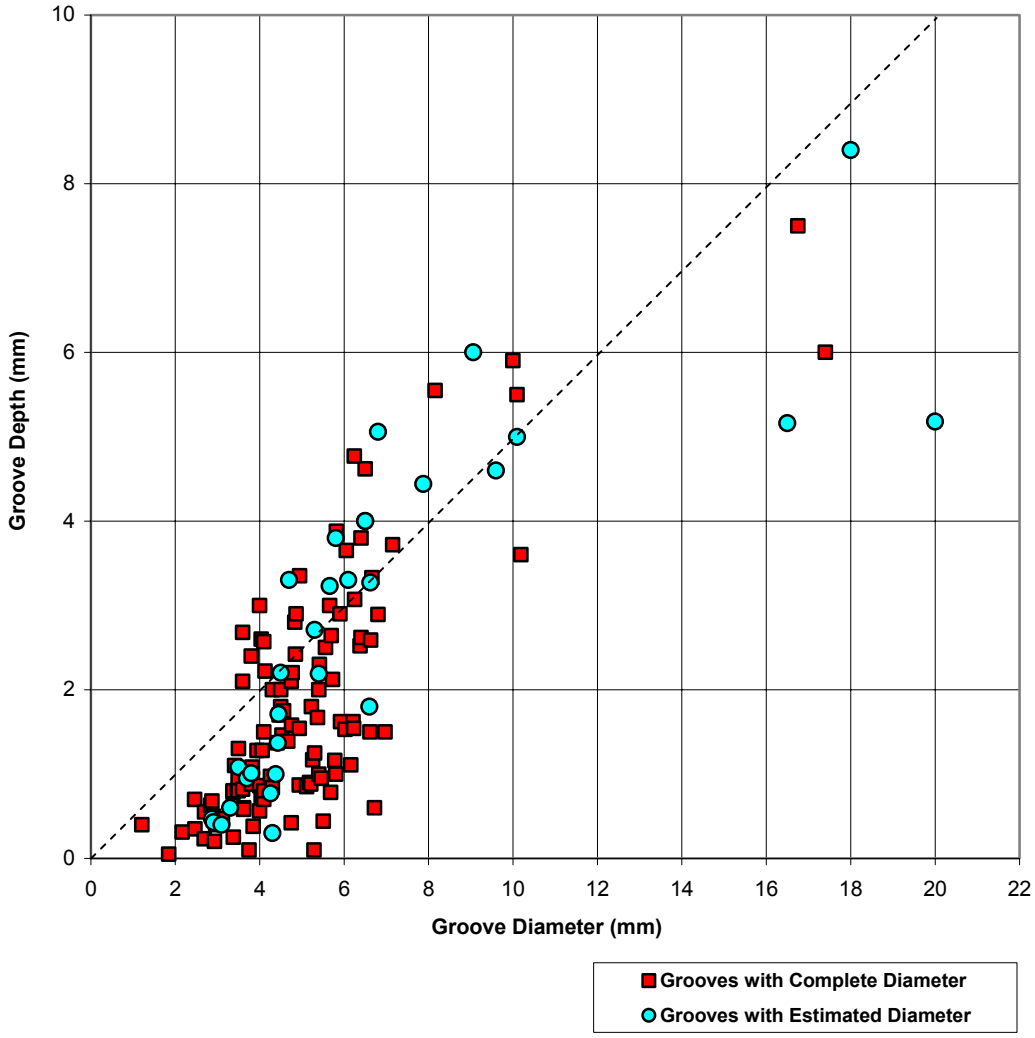


Figure 6.35 Analysis of Grooved Abraders by Groove Diameter

grooves. Since both of these were tools with high numbers of grooves (n=8 and 12), it was not surprising that they were used for multiple functions.

Grooves extended to varying depths, but in most examples the depth was less than half the diameter. This suggested that when a groove was worn to the point where half the thickness of a shaft was encased in the groove it may have been difficult to use, and was abandoned to form a new groove. Grooves often crossed each other, with new grooves being worn down through previously existing grooves. Among tools with multiple grooves, 21 had crossed grooves, while only 4 did not.

Breakage was common among the grooved abraders. Ten abraders were whole pebbles, including six with a single groove and four with multiple grooves. In contrast, 24 of the grooved abraders were broken stones, and only two of these had a single groove. In some examples,

breakage occurred along the bottom of a groove, suggesting that it was worn to exhaustion (Photograph 6.21). In other cases, breakage was not along a groove, and may have resulted from heating. Grooved abraders that were heated would likely have been used to straighten shafts.

One pair of grooved abraders was found together in Feature 371, a pit located in the early Woodland I occupation area (Photograph 6.22). Both were flat stones with a single groove, and one was broken, possibly by heating. If they were used together as a pair, they likely functioned as abraders, i.e., shaft smoothers rather than shaft straighteners. Cosner indicated that paired stones used as smoothers were usually made of sandstone, based on early excavations in the southwest and descriptions of Ishii, the last Yana, making arrow shafts (Cosner 1951).

Four grooved abraders were submitted for microwear analysis. They showed evidence of longitudinal wear in the grooves, indicating linear movement of a shaft in the grooves. Otherwise unidentifiable plant fibers and tissue were also observed. Seven grooved abraders were included with samples submitted for protein residue analysis. All seven were negative for reactions with protein antisera. One grooved abrader was also submitted for starch grain analysis, based on the plant fibers observed in the microwear analysis, but the results were negative.

Distribution: The distribution of grooved abraders within the site showed that they were predominantly associated with the early Woodland I period, and analysis indicated that the association was statistically significant (see below Section 6.5). Twelve abraders were found in features that were attributed to the early Woodland I occupation on the basis of radiocarbon dating or diagnostic artifacts. Ten were found in other cultural features in the same occupation area and three were found in the early Woodland I activity area component. Together, 25 of the 33 abraders (76%) were attributable to this period. The other eight abraders were from plowzone and tree throw contexts. No abraders were found in features attributed to other periods.

Photograph 6.21 Grooved abrader from Features 326, with grooves worn across each other (Lot 1414.AF). Note break through central groove.

Photograph 6.22 Pair of grooved abraders from Feature 371 (Lot 1637.AQ). Groove in base stone (left) is deeper than groove in top stone (right).

6.5 Site Function

6.5.1 Subsistence

Microwear and Microscopically Detectable Residues

Results of microwear and residue analysis of stone tools from Site 7K-F-11/169 are presented below in Section 10.1.3 and are also summarized above in Section 6.4. To reiterate, a sample of 33 stone tools were submitted to Bruce Hardy of Kenyon College, who performed microscopic examinations to identify residues, plant and animal parts, and polishes/striations resulting from use. Included in the sample were nine projectile points, three scrapers, 14 microtools, three drills, and four grooved abraders. Because the majority of the projectile points recovered at the site were narrow bladed stemmed forms that at this site appeared to date to the early Woodland I period, the nine points in the sample all belonged to this generalized family of points. The large number of microtools in the sample reflected the prevalence of this type of tool in the assemblage, and the importance of the manner of their use in an overall interpretation of the site. For the same reasons, the ground stone tools submitted consisted exclusively of grooved abraders. The drills and scrapers were included to investigate other possible types of tool use that might be represented in the stone tool assemblage.

Of the nine projectile points examined, seven showed evidence of hafting in the form of hard/high silica polish and abraded ridges and striae on and near the stem. Six of the seven hafted specimens were interpreted as having been used as projectiles based on impact fractures and/or the lack of evidence for other uses. The seventh hafted point had striae and hard high silica polish near the tip, suggesting use as a drill in addition to or instead of use as a projectile. The remaining two points had minimal evidence of hafting. One had an impact fracture on the tip, suggesting use as a projectile despite the lack of hafting wear. The other had hard/high silica polish near the distal end and may have been used unhafted to cut a hard material.

In addition to evidence of use wear, residues and other organic remains were observed on the projectile points during microwear analysis. A fragment of wood fiber was present on the hafting element of one point, and identified as likely of larch/tamarack. This wood is not currently native to Delaware, but does occur nearby in New Jersey, Maryland, and Virginia. Another point exhibited a microscopic fragment of skin near its tip, and a fragment of otherwise unidentifiable hair was observed on a third. No other residues or other organic materials were observed on any of the nine projectile points examined.

One of the three scrapers included in the microwear sample had hafting wear, the other two lacked evidence of hafting and presumably were hand-held. All three exhibited soft polish; hair fragments were observed on two. All three were interpreted as having been used to scrape hides.

Three of the 14 microtools showed no evidence of use. The eleven utilized pieces exhibited a range of wear types indicative of perforating hide, scraping and piercing soft

material, scraping or piercing hard material, and scrapping a resinous plant material. Six microtools exhibited residues and other types of animal tissue, including skin, raphides asspociated with starch grains, resin, possible blood residue, hair, and otherwise unidentifiable plant material. Despite their small size, none of the microtools examined showed evidence of hafting. Collectively, the results of the microwear analysis suggested that at Site 7K-F-11/169 microtools were generalized multifunctional hand-held tools used as scrapers and perforators on a variety of materials.

Of the three drills included in the microwear analysis, two had soft polish and fragments of hair, suggesting use to perforate hides. Neither of these tools showed hafting wear, and both may have been hand-held. The other drill had hafting wear and what appeared to be blood residue near the tip.

Three of the four grooved abraders that were examined showed localized areas of striations within their grooves, and plant tissue and fibers were found on two. The results were consistent with the presumed function of these tools as implements used in the preparation of the wooden shafts for use as projectiles or for other purposes such as bow drills or fire sticks.

Macrobotanical Remains

Thirty soil samples from 28 features were analyzed for macrobotanical remains by archaebotanical consultant Justine W. McKnight (see Section 10.1.4). Samples were selected for flotation and macrobotanical analysis to insure representation of the five different cultural feature types (AIAs, basins, pits, cylindrical pit features, and FCR concentrations) and to the extent possible, the three principal chronological periods of site occupation (early Woodland I, middle Woodland I, and Woodland II). As recovered in the field, the majority of samples contained either 1 liter or 1.5 liters of soil, although two samples from large cylindrical pits contained 3 liters of soil, one sample from a very small feature contained only 0.24 liters of soil, and one feature was listed as having an unknown volume, presumably due to a data recording error. The soil samples were processed by A&HC using the Flote-Tech flotation system, and both light and heavy fractions were submitted for analysis.

The flotation samples were examined under low magnification (10X-40X) to identify their botanical constituents. Carbonized and non-carbonized materials were identified. Non-carbonized materials (primarily rootlets and seeds) were considered to be modern. Carbonized materials included wood charcoal, nut shells, seeds, and unidentifiable spherical and amorphous carbon. Wood charcoal was identified as such and counted and weighed. Up to twenty fragments per sample were then examined in more detail to determine more specific taxonomic classifications. All nut shell fragments and seeds were identified taxonomically if possible.

Wood charcoal was ubiquitous in the analyzed features, and was the most prevalent sample constituent by total number of fragments. Nutshell was not present in all features,

but was the second most prevalent constituent by number of fragments and was the predominant constituent by weight.

Based on the samples of the wood charcoal that were analyzed taxonomically, Quercus sp. (oak) was most prevalent at 19%, including white oak, red oak, and otherwise unidentifiable oak. Carya sp. (thick walled hickory) was next at 16%, followed by Acer sp. (maple) at 1%, Pinus sp. (pine) at <1%, and Castanea dentata (American chestnut) also at <1%. The remainder of the analyzed samples consisted of otherwise unidentifiable deciduous (46%), ring porous (1%) and unidentifiable (15%). Considering the likely composition of forests surrounding the site, the wood charcoal from analyzed features suggested that oak and hickory were intentionally selected by site occupants for use as fuel.

Wood charcoal was not distributed equally among feature types. AIAs, pits, and cylindrical pits generally had relatively high densities of wood charcoal, while basins and (surprisingly) FCR concentrations produced less wood charcoal.

The nutshell recovered was all identified as Carya sp. (thick walled hickory). It occurred in 70% of the analyzed features and, as indicated was the predominant carbonized feature constituent by weight. Clearly, hickory nuts were not only an important food for the prehistoric site occupants, but were also selectively gathered, presumably to the exclusion of other nut bearing trees such as Juglans sp. (walnut), Quercus sp. (oak), Castanea dentata (American chestnut), and the Fageceae (beech family), at least some of which would probably have been present in the site vicinity.

Like wood charcoal, hickory nutshell was not equally distributed among the features analyzed, but was instead most prevalent in pits and cylindrical pit features. It was also unequally distributed among features of different ages. Examination of the data indicated that nutshell frequency in features was bi-modally distributed, with nine feature samples containing relatively high frequencies of nutshell (20 or more fragments or 0.20 to 1.2 gm per liter) and the remaining features containing no nutshell or only a trace of nutshell, (generally less than five fragments or 0.0 to 0.06 gm per liter). The nine high nut density features were all pits or cylindrical pits, and all but two were concentrated within the early Woodland I occupational component portion of the site. One of the remaining two high nut density features was within the early Woodland I activity area component; the other was within the Woodland II component. In contrast, the remaining 18 low nut density features were scattered across the site, with six occurring within the early Woodland I occupational component, seven within the middle Woodland I occupational component, two within the Woodland II component, three within in portions of the site that were not within any of the identified cultural components, and one that was a non-cultural tree throw.

The differential distribution of hickory nuts within features provided evidence that exploitation of this resource was an especially important activity for the groups that visited the site during the early Woodland I Period, was considerably less important or

unimportant for groups that came there during the subsequent middle Woodland I Period, but had become important again by the time Woodland II people were visiting the site.

Only seven carbonized seeds were found during the examination of flotation samples and of these, only three were taxonomically identifiable. One of the identifiable seeds belonged to Rupus sp. (raspberry or blackberry), one belonged to Vitus sp. (grape), and one belonged to the Poaceae (grass family). The presence of carbonized seeds in features at such low densities was consistent with accidental inclusion of seeds into fires from plants growing on or near the site, from bird droppings, and the like. The recovered seeds thus did not provide unambiguous evidence that the food resources represented were actually utilized to any significant extent by the prehistoric site occupants. Consistent with results from other Delaware sites, no Zea mays (maize) kernels or cob fragments were found.

Protein Residues

Protein residue analysis was performed by the Laboratory of Archaeological Science, California State University, Bakersfield, California. Their report is included below in Section 10.1.5. To summarize, 23 artifacts were submitted for analysis of possible protein residues. The sample was selected to further assess the ways in which tool types of special interest were used, and also included items on which animal/plant tissues or residues had been detected during general artifact processing and/or microwear analysis. Included were seven grooved abraders, two microtools, four ceramic sherds, two steatite sherds, three chipped stone drills, two chipped stone scrapers, two projectile points, and one argillite blade-like flake that had been recovered from a cache of other argillite flakes. Two bulk soil samples for control were also submitted.

Of the 23 artifacts included in the protein residue analysis sample, only three reacted positively to protein antisera. All three were artifacts on which animal tissue had been detected during microwear analysis, and all reacted positively to rabbit antisera. Included were a projectile point, a drill, and a scraper.

The investigators suggest three reasons for the absence of identifiable proteins on artifacts – poor preservation of protein, insufficient protein, or that they were not in contact with any of the organisms included in the available antisera. Presumably, one or several of these factors negatively affected the results for the Site 7K-F-11/169 sample.

Starch Grains and Phytoliths

The results of starch grain and phytolith analysis are presented in detail in Section 10.1.6.. To summarize, 15 artifacts were submitted to PaleoResearch Institute, Golden, Colorado for starch grain and phytolith identification. Included were eight ceramic sherds, two steatite sherds, four ground stone tools identified as likely having been used as grinding stones, and a chipped stone microtool. Items were selected for analysis based on their chronological associations, on the presence of discernable residues on their

surfaces, and on typological characteristics suggestive of use in the processing of foodstuffs.

In all, 19 individual identifiable starch grains or starch grain clusters and 29 phytoliths were extracted from the surfaces of the 15 artifacts submitted for analysis. Starch grains were recovered from nine artifacts, and phytoliths or non-phytolith xlem plant parts were also recovered from nine artifacts. Only two artifacts failed to produce microscopic remains of plants of economic importance to humans.

Starch grains and phytoliths identifiable at the genus or family level included Hordeum sp. (wild barley), Setaria sp. (bristlegrass) and/or Zea mays (maize), Sagitaria sp. (Indian potato), Scirpus sp. (bulrush), Asteraceae (sunflower/marsh elder family), Cyperaceae (sedge family, of which Scirpus is a member), and Poaceae (grass family of which Hordeum sp. and Setaria sp are members). The results are further summarized here by major chronological component rather than artifact type or provenience to highlight possible changes in use of plant foods over time.

Early Woodland I: Artifacts in the starch grain sample that were attributable to the early Woodland I period included two steatite sherds (from Features 3 and 279) and two ground stone tools (both from Feature 279). One of the steatite sherds did not produce plant remains of economic importance. Two starch grains and two phytoliths were extracted from the other steatite sherd. One starch grain was identifiable as Setaria sp. (bristlegrass), the other was identifiable at the family level as Poaceae (grass family). One phytolith also belonged to the Poaceae family; the other to the Asteraceae (sunflower/marsh elder family).

One early Woodland I ground stone tool produced a Setaria sp. (bristle grass) starch grain and three phytoliths, two identifiable as Poaceae (grass) and the third as Asteraceae (sunflower/marsh elder). Another ground stone tool produced four phytoliths, all identifiable as Poaceae (grass).

Collectively, starch grains and phytoliths found on early Woodland I artifacts suggested that a variety of plant foods were commonly prepared or stored by the site occupants, including wild grasses, including Setaria sp. (bristlegrass) in particular, and seeds of sunflower, marsh elder, or some other member of the Asteraceae family.

While starch grains of Setaria sp. and Zea mays overlap in both size and morphology, those found on early Woodland I artifacts were assigned the former genus because they were smaller than Zea mays starch grains and earlier in presumed age than the known span of Zea mays use in the mid-Atlantic region.

Middle Woodland I: Middle Woodland I artifacts included three ceramic sherds belonging to the Marcey Creek, Seldon Island, and Dames Quarter types. Three individual starch grains and nine phytoliths were extracted from the Marcey Creek Sherd. One starch grain was identifiable as Hordeum sp. (wild barley), one was Setaria sp. or Zea mays (bristlegrass/maize), and the third was tentatively identified as Sagittaria sp.

(wapato or Indian potato). The nine phytoliths were all from a member of the Cyperaceae (sedge) family, and were tentatively identified as Scripus sp. (bulrush).

A single starch grain, belonging to Setaria sp. or Zea mays (bristlegrass/maize) was extracted from the Seldon Island sherd. The Dames Quarter sherd did not produce remains of economically useful plants.

Like the early Woodland I starch grain/phytolith assemblage, the evidence extracted from middle Woodland I artifacts suggested use of a variety of wild plant foods for subsistence, including wild grasses, especially Setaria sp. (bristlegrass) and Hordeum sp. (wild barley). Also present, however, were wetland plants including Scripus sp. (bulrush) and Sagittaria sp. (wapato or Indian potato). Although the Setaria sp./Zea mays starch grain fell within the Zea mays size range, it was attributed to the former genus due to the early age of the artifacts on which it was found and the lack of corroborating evidence for the use of maize.

Late Woodland I: Because so few artifacts attributable to the late Woodland I period were recovered from the site, this period was not represented in the starch grain sample.

Woodland II: Five Woodland II sherds, one Killens and four Townsend, were analyzed for starch grains and phytoliths. The Killens sherd produced large numbers of starch grains, including both individual specimens and starch grain clusters. The predominant genus represented was Hordeum sp. (wild barley), although other varieties of wild grass were probably present as well. The evidence was unequivocal that the Killens vessel had been used to cook and/or store wild barley seeds with perhaps some admixture of seeds from other grasses.

Large numbers of starch grains were also extracted from one of the four Townsend sherds. However, Setaria/Zea mays (bristlegrass/maize) grains were predominant rather than Hordeum (wild barley) grains. Many of the grains were within the Zea mays range, and the vessel could thus have been used in the cooking and/or storing of maize kernels, bristlegrass seeds, or both. Of the remaining three Townsend sherds, one produced a single phytilith attributable to the Poaceae (grass) family, one produced two phytoliths attributable to the Poaceae, and the third produced three individual starch grains and a starch grain cluster. The individual grains belonged to Hordeum sp. (wild barley), Setaria sp./Zea mays (bristlegraass/maize), and the Poaceae (grass) family. The cluster of starch grains was identifiable as predominantly Poaceae (grass). This latter sherd also produced a single phytolith of Poaceae.

The Woodland II assemblage of starch grains and phytiliths differed from the early and middle Woodland I assemblages in the much greater prevalence of starch grains and the presence in the assemblage of wild grasses (and perhaps maize) exclusively. The data clearly suggested a more focused and specialized food gathering/producing strategy.

Discusion: Since Site 7K-F-11/169 was situated in what was formerly a cultivated field, the prevalence of Setaria sp./Zea mays (bristle grass/maize) starch grains in the overall

starch grain/phytolith assemblage raised questions concerning possible contamination of samples by historic/modern corn. In their report, the PaleoResearch Insitute states "…extra care was taken to remove post-use soil and debris from these artifacts that may contain microfossils deriving from modern agricultural activities." Additionally, observations of the recovered starch grains themselves and the contexts from which the artifacts derived provided corroboration of the aboriginal origin of the extracted starch grains and phytoliths. Of the thirteen Setaria starch grains that were individually examined during the analysis, at least three were outside the size and morphological range of Zea mays and could be unequivocally attributed to Setaria sp, and therefore could not be attributed to contamination by historic/modern agricultural activities. Two additional Setaria/Zea mays grains showed modification/damage attributable to cooking, again indicating that they were not a result of historic/modern agriculture. Finally, all but two of the 15 artifacts submitted for analysis were from sealed sub-plowzone feature fill contexts where they would have been protected from contamination by historic/modern agricultural activities. Collectively, the evidence suggested that the extracted starch grain/phytolith assemblage could be reliably attributed to the aboriginal occupants of the site.

Another concern related to sample size. The numbers of starch grains and phytoliths extracted from artifacts of the early Woodland I and middle Woodland I periods were small and clearly not entirely representative of the types of food being processed. In contrast, however, the starch grain clusters on the Woodland II sherds contained from tens to hundreds of individual starch grains, and were more likely to be representative of the foods prepared in the vessels studied. Since all five of the Woodland II sherds examined failed to produce any microfossils except for those of wild grasses and perhaps Zea mays, the results appeared to reflect an economic focus on wild grasses as a stable food, at least at this site and during this period of prehistory.

Also of interest was the complete absence of starch grains of any mast (nut) producing genera in the extracted sample, which was surprising considering that carbonized Carya (hickory) nut fragments were a predominant constituent of the floatation light fractions (see above, this section). In this regard, Site 7K-F-11/169 was similar to many other prehistoric sites in the northeast and mid-Atlantic, where carbonized hickory nut fragments are the most prevalent macrobotanical remains (Messner 2011). But hickory starch grains are apparently rare to absent at northeast and mid-Atlantic sites. Although much of the research is recent and a comprehensive review of it is beyond the scope of this study, one prominent example may be typical. In his study of starch grains from 12 Woodland Period sites within and near the Delaware River watershed, Messner (2011) found no Carya starch grains, although he did extract starch grains from several other mast producing trees, including Castanea (chestnut), Quercus (oak), and Fageceae (beech family). Several of the starch grain taxa found at Site 7K-F-11/169 were also present at sites included in Delaware watershed study, including Sagitaria (wapato or Indian potato) and Hordeum (wild barley). Hordeum was especially prevalent, present at seven of the 12 sites, suggesting that seeds of this grass were important in the prehistoric diet. At sites dating to the Late Woodland (here Woodland II), Zea mays (maize) was ubiquitous and by far the most prevalent starch grain found. However, it was absent at sites predating

the Late Woodland. In contrast to the Site 7K-F-11/169 sample, no starch grains of Setaria (bristlegraass) were found.

Of the six plant taxa identified or tentatively identified in the Site 7K-F-11/169 starch grain/phytolith sample, most prefer moist habitats. The most extreme – Sagitaria (wapato or Indian potato) – grows in permanent standing or gently flowing water. Its root is edible and can be collected in the fall when fully developed at the end of the growing season. Scirpus (bulrush) prefers marshy sites, and is a prevalent component of coastal marsh communities. Its roots are edible, and can be gathered and eaten throughout the growing season. Hordeum (wild barley) grows on moist sites that are unable to sustain continuous cover by other grasses, such as wet meadows and seasonally flooded flats and bars along rivers. Hordeum ripens rapidly, and multiple generations can germinate and mature during a single growing season. It can be harvested with cutting implements shortly before it is fully ripe. Today, Setaria (bristlegrass) is an opportunistic weed that colonizes disturbed areas along roads, cultivated fields, construction sites and the like. Prehistorically, it presumably grew in similar situations, caused primarily by natural forces and perhaps by cultivation by humans. Like Hordeum, Setaria ripens rapidly and several generations can germinate and mature during a single growing season. The Asteraceae (sunflower family) are more varied in habitat preference. Iva (marsh elder), for example, is a deciduous shrub that is a prevalent component of coastal marsh communities along with bulrushes. Its seeds are edible and ripen in the fall. Today, wild species of Helianthus (suflower) are opportunists that colonize disturbed sites. Their edible seeds ripen in late summer to early fall.

Located on nearly level lowlands near the confluence of two tidal waterways, environments favorable for all or most of the plants represented in the Site 7K-F-11/169 starch grain/phytolith sample were present in the immediate vicinity. As suggested above, the assemblage subset from early and middle Woodland I artifacts is consistent with a generalized wild plant food gathering strategy that exploited the rich wetlands so prevalent in the vicinity of the site. In contrast, the assemblage subset from the Woodland II artifacts reflects a more focused and specialized strategy of intensive gathering of wild grass seeds, perhaps supplemented by maize horticulture.

Collectively, the edible plants represented in the starch grain/phytolith assemblage from Site 7K-F-11/169 provided wild food resources for humans during much of the growing season, from late spring through late fall. However, only during early to mid fall were all of them likely to be available at the same time.

The starch grain/phytolith results were not conclusive as to whether or not maize horticulture was practiced by the occupants of the site. Considering the absence of charred maize kernels or cobs in the macrobotanical remains from the site, as well as the general lack of evidence of maize cultivation at Delaware sites in general, it is entirely possible that the Setaria sp./Zea mays starch grains extracted from the Site 7K-F-11/169 artifacts all derived from the former genus. Both Hordeum and Setaria seeds were apparently being collected at the site prior to the earliest known use of maize in the mid-Atlantic region, and it would not be surprising that seeds of the same two wild plant

varieties continued to be gathered in the Woodland II period. If so, they had apparently by then become food staples, while many of the other wild plant foods available in the site vicinity no longer seem to have been important dietary resources.

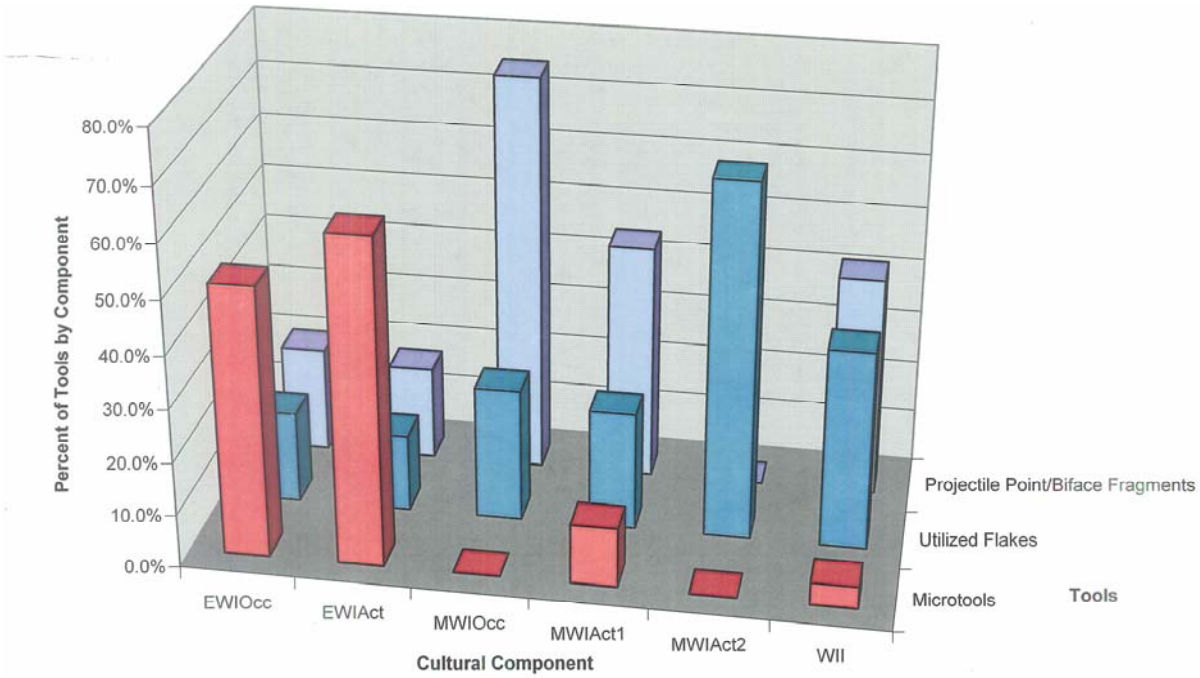
Despite the lack of macrobotanical evidence for its use, there are ethno-historic accounts that suggest that Woodland II people in Delaware did in fact cultivate maize. Ceramics subconsultant Dan Griffith reports, for example, that in the mid-seventeenth century, the Swedes occupying Whorekill (now Lewes) referred to the Whorekill area as Horn Kill or Haert Kill and to the local Native Americans as the Sironesack, who they described as "…a powerful nation and rich in maize plantations" (Weslager 1961:23). And he notes additionally that Setaria sp./Zea mays starch grains were found on Townsend sherds from Feature 10 at Site 7K-F-11/169, which returned radiocarbon dates of AD 1460-1650 (wood charcoal) and AD 1470-1560 (shell), which could indicate that the feature was in use shortly before the time of initial European contact. While it is possible that maize cultivation was introduced into the area post-contact, it may also be that the absence of maize in Delaware macrobotanical samples is due to other factors, such as poor preservation of delicate carbonized organic material in regional soils.

6.5.2 Artifact Associations

Analyses were performed to identify whether the different types of artifacts recovered from the site tended to cluster in one or another of the cultural components identified within the overall site area, and whether subsets of tool types tended to be chronologically or functionally interrelated. Analysis was of necessity limited to those types of tools that were sufficiently numerous that clustering/interrelationships could potentially be discerned. The stone tool types meeting this criterion included early Woodland I projectile points, all other projectile points and point fragments, microtools, grooved abraders, scrapers (including both end and side scrapers), hammerstones, and utilized flakes. Also included in the analysis were chronologically diagnostic ceramics, lithic debitage of the six principal raw material types, FCR, and natural hematite nodules.

Analysis began with a simple three-dimensional bar graph illustrating the relative prevalence within the defined cultural components of the three stone tool types -- projectile points, microtools, and utilized flakes -- that were sufficiently numerous to generate reliable frequency distributions (Figure 6.36). The results illustrated what appeared to be distinct clustering of these types of tools by component. Microtools appeared to be especially prevalent in the two early Woodland I components, projectile points in the middle Woodland I occupational component and the middle Woodland I activity area 1 component, and utilized flakes in the Woodland II component. The exceptionally high percentage of utilized flakes in the middle Woodland I activity area 2 component was attributable to its small sample size.

Although the frequency distribution indicated that certain tool types appeared to be concentrated in one or another of the defined site components, this type of analysis proved to be unreliable with the less common tool types, due again to small sample sizes. However, data inspection had suggested that other chronological and/or functional



	EWIOcc	EWIAct	MWIOcc	MWIAct1	MWIAct2	WII
Microtools	50.9%	61.3%	0.0%	11.1%	0.0%	4.2%
Utilized Flakes	17.1%	14.5%	25.0%	22.2%	66.7%	37.5%
Projectile Point/Biface Fragments	20.0%	17.7%	75.0%	44.4%	0.0%	41.7%

Figure 6.36 Distribution of Numerically Prevalent Tools by Component

relationships among certain tool types might nevertheless exist. For example, during analysis, it was noticed that the two most distinctive types of tools in the assemblage, microtools and grooved abraders, tended to be found in the same features, and that these same features frequently contained early Woodland I narrow-bladed stemmed projectile points. Furthermore, the features exhibiting these characteristics appeared to be especially prevalent in the portion of the site included in the early Woodland I occupational component.

Stated as an hypothesis amenable to statistical evaluation, the observation could be restated as follows:

> Microtools, grooved abraders, and early Woodland I projectile points constitute a group of inter-related tool types, either chronologically, functionally, or both, and should therefore co-occur in archaeological contexts.

Statistical consultant Durland Shumway of The Pennsylvania State University performed statistical analyses to test this and the other hypotheses, and his results are presented in Section 10.1.7. To summarize, because overall sample sizes for many types of tools were low, statistical analysis focused initially on the ability of the variables in the data set to predict the presence or absence of the specific artifact types of interest. This was followed by a suite of univariate and multivariate statistical analyses using continuous data measures, either number or numerical density of artifact types. Furthermore, because co-occurrence of artifacts in cultural features was considered to be a more reliable indicator of chronological or functional interrelationship than, for example, simple spatial proximity, the analysis was limited to artifacts that occurred in features.

Analysis of Presence-Absence Data: The initial analysis of the presence-absence data for microtools, grooved abraders, and early Woodland I projectile points employed the Fishers Exact Test in combination with Odds Ratio Estimates, and indicated that a strong association among these three tool types did indeed exist. For example, when a microtool was present in a feature, it was 14 times more likely that a grooved abrader would also be present there, and when an early Woodland I projectile point was present in a feature, it was ten times more likely that a microtool would be present and seven times more likely that a grooved abrader would be present. These probabilities were found to be statistically significant at the $p \leq 0.05$ level.

To search for other associations among the variables in the analysis, Fishers Exact Tests and Odds Ratio Estimates were calculated for all possible combinations of microtools and and grooved abraders with all other projectile points and point fragments, other types of stone tools, diagnostic ceramics, lithic raw material types, FCR, and hematite nodules. In addition to significant associations with early Woodland I projectile points and grooved abraders, the results indicated that microtools were significantly associated with quartzite (seven times more likely to occur), rhyolite (four times more likely to occur), and argillite lithic raw material (seven times more likely to occur), but occurred independently of jasper and chert lithic raw materials. Microtools were also associated with utilized flakes (nine times more likely to occur) and hematite nodules (six times more likely to occur), but occurred independently of diagnostic ceramics of all periods, all other projectile points and point fragments, scrapers, hammerstones, and FCR.

Due probably to smaller sample sizes, grooved abraders were found to be significantly associated only with early Woodland I projectile points, microtools, argillite lithic raw material (16 times more likely to occur), and utilized flakes (ten times more likely to occur). Interestingly, however, these variables were also the strongest predictors of the occurrence of microtools. Fishers Exact Tests of the association between grooved abraders and quartzite and hematite were found to be significant at the $p \leq 0.05$, but Odds Ratio Estimates could not be calculated because the validity of the model fit was questionable. This indicated that a strong association between these two variables and the occurrence of grooved abraders also existed, but due to zero cells, the statistical significance of the association could not be measured mathematically.

Collectively, statistical analysis of the presence/absence data revealed strong associations among a subset of tool types and other variables. Included in this interrelated subset were four types of stone tools -- early Woodland I projectile points, microtools, grooved abraders, and utilized fakes -- all of which exhibited statistically significant and/or demonstrably strong associations with one another. These types of stone tools had clearly been used together during the early Woodland I period of site occupation, and may, to some extent, have also been used together in the performance of certain specific tasks or related sets of tasks. Associated with these tool types were exotic lithic raw materials including argillite and rhyolite, as well as quartzite, a presumably local lithic raw material, and hematite, which may have been quarried at the site for processing into red ochre.

Analysis of Continuous Data: In addition to the Fishers Exact Tests and Odds Ratio Estimates, which evaluate associations among variables based on presence-absence data only, other statistics, both univariate and multivariate, that evaluate relationships using continuous variables (e.g., artifact counts or densities in features), were employed to further explore possible associations/correlations in the data. The first such approach that was used was stepwise regression, which evaluates the probability of a dependent variable being present based on continuous measures for other (independent) variables. The only statistically significant result of multiple stepwise regressions was that microtool density was a significant predictor of the presence of grooved abraders, a result that emphasized the strength of the relationship between these two types of tools.

Exploring further, logistical regression examined potential correlations among each independent variable and a dependent variable to identify a subset of independent variables that together best predicted the value (rather than the presence) of the dependent variable. One outcome of interest occurred. The results identified a statistically significant regression model for numbers of microtools in features (the dependent variable) using two independent variables, early Woodland I stemmed points, which were positively correlated with microtools, and ceramics of all periods, which were negatively correlated with microtools. This result was consistent with the Fishers Exact Tests and Odds Ratio Estimates.

An alternative method for assessing complex inter-correlations among multiple variables is multivariate analysis of variance (MANOVA). Here, the technique was used to evaluate whether the frequency of chronologically diagnostic artifacts of different periods successfully predicted the prevalence of other, non-diagnostic types of artifacts. Accordingly, chronologically diagnostic artifacts were separated into three diagnostic groups, early Woodland I points only, middle Woodland I or late Woodland I ceramics and/or all other points, and Woodland II ceramics only. The MANOVA results did not identify any significant differences in the distribution of any of the other, chronologically non-diagnostic variables vis-à-vis the three diagnostic groups. However, follow-up univariate analysis of variance (ANOVA) did reveal significant differences among some variables for the diagnostic groups. Specifically, variable specific ANOVAs revealed significant correlations between early Woodland I points and quartzite and chert lithic raw materials, early Woodland I points and microtools, and Woodland II ceramics and

chert lithic raw material. Additional correlations that approached but did not achieve significance at the $p \leq 0.05$ level included early Woodland I points and jasper debitage, as well as early Woodland I points and hematite. In general, these results were consistent with those of the Fishers Exact Tests and Odds Ratio Estimates, although the correlations of early Woodland I points and jasper and chert lithic raw materials were not consistent with earlier findings, and the correlation of Woodland II ceramics and chert lithic raw material was not previously revealed.

Principal Component Analysis (PCA) was applied to the data in a further attempt to elucidate inter-correlations among multiple variables in the data. Three principal components (or axses) were discernable in the output. The first and dominant component was heavily loaded on eight variables, including microtools, grooved abraders, hematite, and FCR as well as jasper, chert, quartz, and quartzite lithic raw materials. This component was clearly separating a group of features with the basic early Woodland I complex of tools that was identified in the presence-absence data using Fishers Exact Tests and Odds Ratio Estimates. Heavy loadings on FCR and jasper, chert, and quartz debitage presumably represented a second set of inter-related variables.

The second Principal Component separated by the analysis was heavily loaded on only three variables, scrapers, hammerstones, and steatite. This association of tools was not observed in other analyses. The presence of steatite suggested that this component might represent a second group of features that dated primarily to the early Woodland I site occupation. Alternatively, the component may have been based on some as yet undetected functional grouping of tools used in the performance of a task or related tasks.

The third Principal Component was also loaded on three variables, hammerstones, hematite, and FCR. By process of elimination, this component might reflect either a middle Woodland I or a Woodland II group of features. Alternatively, a functional association of some kind was also a possibility.

Discussion: Collectively, statistical analyses of the both presence/absence and continuous data revealed strong associations among a subset of tool types and other variables. Included in this interrelated subset were four types of stone tools -- Early Woodland I projectile points, microtools, grooved abraders, and utilized fakes. Associated with these tool types were exotic lithic raw materials including argillite and rhyolite, as well as quartzite, a presumably local lithic raw material, and hematite, which may have been quarried at the site for processing into red ochre. Also correlated inconsistently with some of these artifact types were jasper, chert and quartz lithic raw materials, all of which were presumably acquired locally.

One explanation of the association among early Woodland I points, microtools, grooved abraders, and utilized flakes was that they all functioned together somehow within the context of a distinctive hunting technology specific to the early Woodland I period of site occupation. As indicated above (see Section 6.2), results of data recovery at the Metate Block excavation at Puncheon Run suggested that the narrow bladed stemmed points that were so prominent in that assemblage may have functioned within the context of

specialized spear hunting of anadromous fish. Some circumstantial evidence exists to support possible roles of grooved abraders and microtools in such a scenario. There are ethnographic examples of microtool-like stone flakes being hafted in various ways, and experimental archaeological replications have indicated that at least one such approach produced a tool that was effective for filleting fish (see above, Section 6.4). And the multi-modal size of the grooves in the grooved abraders from the site might reflect smoothing both relatively thick main shafts and thinner fore-shafts of the various sections of composite atlatl darts used in spear fishing.

However, other evidence from Site 7K-F-11/169 would not appear to support this hypothesis, since unlike the Puncheon Run Metate Block points, the Site 7K-F-11/169 points produced no fish protein residues. Additionally, the Site 7K-F-11/169 microtools had no evidence of having been hafted and exhibited the varied types of microwear consistent with use as multipurpose tools rather than the prevalent soft polishes that would be expected on tools used to filet fish.

These considerations did not entirely rule out the possibility that fish resources were important to the early Woodland I site occupants, or that narrow bladed projectile points, microtools, and grooved abraders were associated with this activity, since the only fish antisera used in the protein residue analysis was Atlantic salmon, which is not native to Delaware waters, and hafted microtools used to process fish could have been used for other purposes as well. Nevertheless, there were obvious alternative hypotheses to explain the association among these tool types. For example, they may have been used in some way within the context of a terrestrial hunting technology or a mixed terrestrial/riverine hunting technology. And it was also possible that the observed associations among them were simply due to the fact that they were all being used contemporaneously, and thus tended to occur together in feature contexts.

The association of quartzite, argillite, and rhyolite debitage, as well as natural nodules of hematite, with the four stone tool types appeared to be primarily chronological rather than functional. Rather than being used for specific tasks or sets of related tasks, exotic lithic raw materials were presumably acquired through trade/exchange networks, at least in some cases extending over long distances. As indicated above, these types of networks appear to have been especially prevalent in the terminal phases of the early Woodland I period, resulting in increases in the debitage of exotic raw materials in assemblages dating to that period. Their co-occurrence with certain tool types was likely due simply to the fact that collectively they were all more or less contemporaneous. Similarly, the differential distribution of hematite in the early Woodland I occupational area suggested that this material was also being acquired and perhaps processed contemporaneously with exotic lithics, microtools, grooved abraders, utilized flakes, and early Woodland I points, but presumably did not suggest that these stone tools were in some way functionally related to the processes by which hematite nodules were being acquired/processed.

The association of quartzite lithic debitage with the suite of early Woodland I tools and exotic lithic raw materials was unexpected, since as a locally available material, the expectation was that it would have been used more or less interchangeably with jasper,

chert, and quartz throughout the sequence of site occupation, and would as a consequence vary in prevalence independently of the early Woodland I complex of tools and lithic materials. Perhaps quartzite was a local lithic raw material that the early Woodland I site occupants preferred because, as a granular rather than chryptocrystalline material, its knapping properties were more similar to those of argillite and rhyolite.

The artifact types that were not found to be consistently related to those included in the early Woodland I included all other projectile points and point fragments, scrapers, hammerstones, chronologically diagnostic ceramics, lithic debitage of jasper, chert and quartz, and FCR. Subsets of these latter artifacts did, however, co-occur with one another in various analyses. The univariate ANOVAS revealed statistically significant correlations between Woodland II ceramics and chert debitage, and the Principal Component Analysis suggested further that there were correlations among scrapers, hammerstones, and steatite, as well as hammerstones, hematite, and FCR. Whether these correlations were chronological, functional, or a combination of both, was not clear.

6.6 Site Formation Processes

Geomorphological investigations of Site 7K-F-11/169 were performed by John Stiteler. His report is included below in Section 10.1.2, and a brief summary is offered here. The site is situated on the south facing lower slope of a low sloping upland just to the north of the confluence of Spring Creek, a major tributary, and the Murderkill River. It is near extensive tidal marsh environments extending along both streams. The land surface on which the site is located formed in pre-Wisconsinan time and is composed of fluviomarine sediments deposited at a time of continental glacial retreat and local coastal plain inundation. During intervals in Late Pleistocene and Holocene times, fine textured aeolian silts and sands were deposited on the pre-Wisconsinan surface, forming a thin cap of fine grained sediment which, at least at the location of the site, was later incorporated into the plowzone, although remnants are preserved elsewhere in the immediate site vicinity. Despite its low elevation adjacent to tidal marches along two sizeable streams, the site was rarely flooded during Holocene or historic times and any resulting overbank alluvial deposits were thin and have also been incorporated into plowzone. Similarly, there has been little accumulation of slopewash on the site surface, and the plowzone is of generally uniform thickness. The current site surface has thus been essentially stable since pre-Wisconsinan time.

Chronological diagnostics indicated that the site was occupied by prehistoric people at least as early as the Early Archaic Period, and has witnessed at least occasional use throughout the remainder of prehistoric time. As the foregoing indicates, periods of more intensive site use occurred during the early Woodland I Period and to a lesser extent during the middle Woodland I and the Woodland II Periods.

Throughout the prehistoric period of site use, a factor which may have played an important role in the formation and use of the site was a rise in the level of the groundwater table, which appears to have occurred most rapidly in the late Holocene. This process was a collateral effect of ongoing sea level rise and the infilling of coastal plain stream valleys. Several consequences appeared to have ensued. A rise in the elevation of the groundwater table might, for example, explain why during archaeological excavation especially deep cultural features at the site were found to extend below the current groundwater table, but were presumably dry when created by the prehistoric site occupants.

However, an alternative but not mutually exclusive explanation of this latter phenomenon suggested itself during post excavation analysis. It was noted in the field that natural hematite nodules occurred in the fills of some features, and because hematite was used by prehistoric peoples to manufacture red ochre, the material was collected during fieldwork when found. Later, analysis revealed that hematite nodules were not evenly distributed among site features but were instead concentrated in features attributed to the early Woodland I period of site use. This in turn suggested that the hematite nodules were not of purely natural origin, but instead had been manipulated in some way by the early Woodland I site occupants.

Hematite nodules precipitate out of iron-rich ground water, and are therefore present in soils below the groundwater table. Thus it seemed plausible that certain features may have been excavated by the early Woodland I site occupants to procure hematite for use in the production of red ochre, and these features would thus of necessity have had to extend below the groundwater table. Possible candidates, for example, included large amorphous pits, some of which extended to depths below the current groundwater level, and cylindrical pits, all of which extended below the groundwater level. It should be noted that the former features seemed more likely candidates than the latter, since the uniform size and shape and the carefully fashioned vertical sides of the cylindrical pits presumably reflect a level of care during preparation that would be unnecessary in the excavation of what was essentially an expedient quarry pit.

A second possible consequence of a rising water table involved the formation of one of the most prominent types of feature found at the site. These features were large, round to ovoid stains. Excavation revealed large deep pits that in many cases had one steeply sloping side and one rounded or more gently sloping side. In a number of instances, a dark linear tapering stain extended from one side of the oval stain. The profiles of the appended stains were shallow, but were deepest on the end adjacent to the oval stain. The fill in the pits generally varied in color in both plan and profile., including material that appeared to be dark, organic-enriched A horizon soil material as well as pale, bleached soil (E or EB horizon material) and some gravelly medium to coarse sand C horizon material. In some features, cross-sectioning revealed vertical stratigraphy that closely resembled the A/E/Bt/C stratigraphy of the site, but rotated 90°. In all these respects, the fills in these features were distinctive, and were unlike the fills in any of the other features at the site that were identified as of cultural origin.

Soil samples were taken to test the hypothesis, developed in the field, that the distinctive characteristics of these features were formed during the formation and gradual decomposition of the root balls of toppled trees. The results of soil particle size analysis revealed a strong correlation in particle size distribution between rotated soil columns found in these types of features and the un-rotated soil column characteristic of the site as a whole.

The distinctive characteristics of the soil fills in these types of features, with their distinguishable areas of A, E/Bt, and C horizon soil material that sometimes formed a rotated soil column, and the particle size resemblance of this rotated column with the un-rotated column found elsewhere on the site, strongly suggested that these features were the pits left by toppled trees, which were subsequently filled as the soil from the root ball slumped and eroded into the pit it had made, and soil material from areas adjacent to the pit also eroded/slumped into it. Rotated soil columns in parts of these features were formed when the downwind side of the root ball forced the soil within and below it downwards and then sideways as the tree fell and its root ball rotated from a horizontal to vertical position. The shallow appendages were presumably formed by the impression made when the root ball finally decayed, allowing the trunk of the tree to come to rest on the ground surface.

It was theorized that the prevalence of tree throw features at Site 7K-F-11/169 could be attributed at least partially to the rising level of the local groundwater table, since a potential effect of a rise in groundwater levels is a decrease in the effective rooting depth of trees. While some tree species (e.g., willow, red maple, sweetgum, some species of birch, etc.) are capable of surviving in areas of high water table, prolonged periods of soil saturation damage or destroy root systems in species not adapted to these conditions. Trees in an area subjected to groundwater table rise may be damaged and weakened; unadapted species growing in an area of high water table may survive for some time but suffer from restricted depth of rooting, and thus also be more prone to toppling by wind, snow, ice, etc.

Radiocarbon dates from six of these tree throw features returned dates ranging from 2280 BC to AD 1950 (see above, Section 6.2), suggesting that trees at the site were falling episodically before, during, and after the more intensive period of prehistoric site occupation. Feature boundaries confirmed this conclusion, as in some instances, tree throw features clearly intersected cultural features, indicating that the tree throw had occurred after the feature was used and abandoned by humans. In other cases the reverse was true, with cultural features intersecting, or in a few cases actually occurring within, tree throw features, indicating that the tree throw was older than the cultural feature. Clearly, falls of trees that post dated cultural features had the potential to impact site formation, since they would have partially or completely obliterated the features within the area included in their root balls. In portions of the site area, tree throws occurred at a density that, if they postdated the period(s) of occupation in that area, might have obliterated the majority of the features that had originally been present there.

In conclusion, the primary non-cultural factor influencing site formation appears to have been a rise in the groundwater table, which was itself a collateral effect of the post-Pleistocene world wide rise in sea level. This potentially affected the formation of the site in two ways, one cultural and the other natural. Culturally, the rising groundwater table would have limited the depth to which deep cultural features could feasibly be excavated by the prehistoric site occupants, and also affected the archaeological excavation of those same features when water from the current and still higher level of groundwater entered those same features. Alternatively or perhaps additionally, the presence of ground water at a level that was readily accessible to the prehistoric occupants of the site may have led them to excavate pits to acquire the hematite nodules, and these pits had of necessity to extend to the level of the groundwater table. The natural affect of rising ground water appears to have been on the pre-contact forest that covered the site, leading to an increase in the frequency with which trees were toppled by storms, and which in turn resulted in the partial or complete destruction of some of the cultural features that originally existed there.

ADDITIONAL INFORMATION COMMENTS 24 through 33