5.0 THE AIRPARK SITES IN CONTEXT

To begin this concluding section, some comments on the nature of the data and what was and was not accomplished at the Delaware Airpark sites are in order. As discussed in the preceding pages, not all of the goals of the original research design were able to be addressed, thereby once again proving the dictum that there has never been a data recovery research design that has survived initial contact with the data.

First and foremost, the anticipated number of intact features at the Airpark sites was not realized. Airpark East produced three, Airpark West possibly three. As discussed later, certainly other features were formerly present but are now destroyed. As a result, both sites failed to produce meaningful and usable floral, faunal, and radiocarbon samples for analysis. Thus, assessing the subsistence economy and seasonality at the sites is crippled, and no absolute dates for the various component occupations can be obtained. Fortunately, the artifactual and other data that were recovered allow important insights regarding site function and chronology.

As discussed at the outset, the attempt to reconstruct the paleoenvironment of the Airpark sites was not successful. The soil core borings proved to be contaminated and the single radiocarbon assay was erroneous and unusable (Appendix IV). Paleoenvironmental reconstruction of the Delaware headwaters environments will have to await future undertakings.

5.1 INTRASITE CHRONOLOGY, STRUCTURE, AND FUNCTION AT THE AIRPARK SITES

In the following pages, the Airpark East and Airpark West sites will be discussed both separately and together. Artifactual indicators of chronology are generally better at Airpark East. Here, two bifurcate base points (one each from Phase II and III) and a single Kirk Serrated point indicate some kind of presence at the site during the Archaic period (or Early-Middle Archaic period, if preferred). A similar case obtains at Airpark West, which also produced four bifurcates (two Phase II, two Phase III). To this might be added a single Brewerton-like point and a Morrow Mountain-like point from Airpark East found during the Phase II investigations. The nature of this ephemeral presence on the sites is difficult to assess. However, the sites' location corresponds well to current thinking on Archaic settlement patterns, in that interior wetland areas were emphasized, along with settlement along stream junctures, tributary floodplains, and other areas of resource concentration (Dent 1995:177). The Airpark sites certainly fit this description.

The Airpark sites were most heavily occupied during the Woodland I period (alternatively, the Late/Terminal Archaic and Early Woodland periods). The Piscataway points from Airpark East are thought to date to the Late Archaic (Dent 1995:178ff; Custer 1989:149-150; 1996:Fig. 48, 170-171; Custer and Bachman 1984). The "Piscataway-like" points from Airpark West are more equivocal, and some may indeed date to other periods. The various Untyped Stemmed and Untyped Side-notched points likely date to the Late Archaic, the former evidently representing the Piedmont Tradition (e.g. Kinsey 1972).

Decidedly equivocal are the Untyped Corner-notched points. These artifacts distribute all across the Airpark East site, but are uncommon at Airpark West. Possible typological analogues for these artifacts are not difficult to find, such as Brewerton Corner- and Side-notched, Jacks Reef Corner-notched, or even Vosburg. They seem to be relatively uncommon on other sites in the area but, as discussed previously, they do occur. Despite lacking good data, these artifacts may date to the greater early Woodland I (Middle/Late Archaic) period, and may represent some kind of occupation by an

as-yet poorly known group, possibly Brewerton-related. Alternatively, they may date later in the Woodland I period (see below).

The single artifact unequivocally representing the Terminal Archaic is the Perkiomen Broadspear from Airpark East. This point, deriving from Block F near the site center, appears to be made of Hardytson Formation jasper from Pennsylvania. The mechanism by which it became deposited at the site is unknown.

The two Rossville points from Airpark West were found near one another near the site center. These specimens nicely dovetail with the large quantity of Wolfe Neck Cordmarked pottery found in Feature 6 at the site and could indicate a component occupation during the Wolfe Neck Complex. Unfortunately, the ceramics were found a good distance from the points in the southern reaches of the site; though a Wolfe Neck presence at the site is clearly indicated, a spatially discrete Wolfe Neck occupation is not in evidence. No potential Wolfe Neck-related artifacts were recovered from Airpark East. Also dating to the early Woodland I are the three teardrop points from Airpark East.

A small amount of possible Mockley ceramics were found at Airpark East and Airpark West (during Phase II). If these identifications are accurate, then a small Carey Complex occupation is indicated. However, no unequivocal Carey-related lithic artifacts were found, so this inference remains speculative. More common are grit-tempered, cordmarked ceramics from Airpark East, which are tentatively identified as Hell Island ware. The Phase II results suggested that these sherds may be related to the Jack's Reef-like point and represent a Delaware Park Complex presence at the site (Siegel et al. 2004:15). Expanding on this supposition, to the extent that the Untyped Corner-notched points from Airpark East may approximate the Jack's Reef type, they may indeed relate to the ceramics and represent a Delaware Park or Webb Complex component; Custer (1989:176) has noted the co-occurrence of these types as defining the Delaware Park and Webb Complexes. If this is indeed the case, which seems credible, then this component is one of the largest at the site, and spreads nearly from one end to the other. Discrete spatial areas of occupation were sought but not found in the data, and it is assumed that the wide spatial spread of these materials indicates that the entire site area was used at one time or another.

Such was not the case at Airpark West. Here, prehistoric ceramics were lacking and Untyped Corner-notched points are rare. If this artifact pairing represents the Delaware Park or Webb Complex, it was clearly not present at Airpark West.

Minimal presence of Woodland II (Late Woodland) peoples at the sites is indicated by four artifacts. Three Madison and one Levanna points from Airpark East constitute the entire Woodland II artifact assemblage. No Woodland II ceramic types were identified.

To summarize, the artifact assemblages from the Airpark sites indicate sporadic occupation/use from the Archaic (Early-Middle Archaic) through Woodland II (Late Woodland times. The heaviest occupations took place during the Woodland I (Late/Terminal Archaic-Early Woodland) period.

The dearth of intact features from the sites was disappointing. Those that were identified appear to be dispersed hearths and shallow pits. One was found to contain Wolfe Neck sherds all belonging to a single vessel. Despite the rarity of identified features, other kinds of evidence indicate that fire was present at the site in greater quantity than indicated by the features alone. Fire-cracked rock was common at the sites, especially at Airpark East, and formed more-or-less discrete clusters in some locations. It is proposed herein that many features were sufficiently shallow as to have been wholly plowed-out and/or "smeared" in historic times. The geomorphological study of site soils deposition indicated that no eolian deposition has occurred here, thus the features were likely shallow and not

well-buried. Finally, it will be recalled that the soil chemical analysis isolated several "hot-spots" of high readings indicating the former presence of fire. Taken together, these lines of evidence argue that more fire-related features were formerly present on both sites than suggested solely by the ones that were identified.

Regarding site structure, the term "palimpsest" comes readily to mind. Contemporary archeologists have been using this term for some time to describe spatially overlapping occupations of the same space (i.e. a site) over a long period of time, and by many different occupying groups. This phenomenon renders it difficult to sort out the different component occupations one from the other. Add to this the fact that the site areas have undergone regular agricultural plowing for over one hundred years, which has served to further mix component occupations, and the result is the inability to accurately isolate cultural components on either site.

Despite the foregoing, the spatial analyses of the Airpark sites have demonstrated that not all materials were uniformly spread across the landscape. At both sites, though in particular Airpark East, clusters of artifacts were revealed that indicate activity areas of some kind; it may be speculated that had the sites never been plowed, these clusters would appear even more pronounced. At Airpark East, clusters of debitage, rough bifaces, broken finished tools, tips, and bases in the eastern and central areas of the site indicate that tool manufacture, maintenance, and replacement took place here, principally in Blocks F, A, and B, somewhat less so in Blocks E, C, and D. As demonstrated in the spatial analysis, all or nearly all lithic raw material types occurred in these concentrations, and it would appear that all materials were worked at more-or-less the same loci across the site. A similar situation is evident at Airpark West, where most lithic activity was concentrated in and around Block B, where the majority of debitage, rough bifaces, broken finished tools, tips, bases, and hammerstones were found. However, a discrete concentration of jasper debitage was found in Block D at the eastern end of the site. Two Piscataway-like points were the only diagnostic artifacts found in Block D (a hammerstone occurred here as well), tentatively indicating an early Woodland I (Late Archaic) temporal placement for this activity area. With this exception, the concentrations and presumed activity areas at Airpark West mirror those at Airpark East, where all lithic raw material types commingle with each other.

Two "exotic" drill-like artifacts were found at the Airpark East site. While nearly identical in form, these two artifacts were found widely separated across the site, one each in Block B and Block E. The former area was a focus of activity and artifact concentration, the latter rather less so. As discussed, the temporal and cultural affiliation of these specimens is uncertain. That these two highly distinctive artifacts cannot be better tied-down is unfortunate. In Block B, diagnostic (and "semi-diagnostic") tools included four Piscataway, two Untyped Corner-notched, one Teardrop, one Levanna, one Untyped Side-notched, and ceramics. These associations may suggest a temporal placement in the early Woodland I period. Likewise in Block E, where diagnostics included one Piscataway-like, one Untyped Corner-notched, one Teardrop, one Untyped Side-notched, and ceramics.

The 32 scraping tools recovered from the Airpark East site and the seven from Airpark West present an interpretational challenge. That is, up to this point in this discussion, the intrasite picture emerging was one of small interior procurement sites located near extensive wetland tracts providing a variety of foodstuffs, much as Siegel et al. (2004:14-16) concluded at the close of the Phase II investigations. Custer's (1989:130) definition of a procurement site is one where a limited number of activities were focused on the extraction of specific resources, principally plant foods; the limited nature of the use of the area should be reflected in a limited range of artifact classes found at a site.

As discussed, scrapers are usually interpreted as indicating animal hide processing and/or woodworking. As such, a substantial number of these tools at sites otherwise resembling procurement sites might seem out-of-place; hide processing and woodworking are activities more typically ascribed to larger base camp-type sites. The situation presenting suggests that either activities at so-called procurement sites may have been more varied than previously thought, or that the Airpark sites do not represent procurement sites, at least not as defined by Custer (op cit.).

The position taken herein is that the former scenario is the more likely, and that strict definitions of "site types" may be too rigid a construct to accommodate the full range of subsistence-settlement variability in central Delaware. While the Airpark sites do indeed possess all of the characteristics of procurement sites – e.g. small size, interior locations, settings near water and harvestable resources, relatively low density of artifacts, few features – other kinds of activities took place here too. At least one component occupation engaged in activities involving steep-retouch end scrapers at the Airpark East site. Lacking hard data indicating what the nature of the activity was, it is logical to posit that hide processing may have been that activity. Any number of scenarios can be invented to account for this phenomenon, from combined hunting/gathering excursions from base camps further east to the opportunistic taking and butchering a single deer and processing the hide on-site.

Whatever the case, the point to be made is that the Airpark sites demonstrate that a wider range of activities can take place at an interior "procurement" site than simply the collection of plant foodstuffs. Indeed, this observation has been anticipated by LeeDecker et al. (2005) who, based on their analysis of the Puncheon Run and other sites on the St. Jones drainage, note that "…some of these [procurement] sites actually yield evidence of many different activities…including projectile points, knives, scrapers, utilized flakes, and grinding stones, as well as ceramics" (LeeDecker et al. 2005:42). Thus, the pattern noted by these authors is corroborated and supported by the Airpark data.

The various chopping tools found at the sites figure in here too. Precisely what kind of activity these tools were used for is uncertain. However, to the extent that the interpretation of the Airpark sites as resource procurement camps has merit, it may be posited that the chopper-related activity was likely done in addition to the principal focus of the site occupations, which presumably was the collection of plant resources.

To summarize, the Airpark East and Airpark West sites may be best interpreted as principally resource procurement sites. The interior location in close proximity to wetland resources suggests this interpretation. While in the process of procurement activities, some of the site occupants engaged in tool maintenance, resharpening, and replacement, and to a lesser extent, tool manufacture. Hunting, whether deliberate or opportunistic, likely also took place, as well as hide processing. Fire features were constructed and utilized. Siegel et al. (2004:16) speculated on the basis of the Phase II data that these sites might represent what Custer (1989:130) refers to as "micro-band base camps", that is, small base camp-type sites used on a seasonal basis by only a few families or a single family. This possibility remains open, but if so one would have expected more evidence of a substantial settlement, e.g. more features, denser artifact distributions, house pits, and so on. Rather, sites of this nature have been thought to be found further downstream in central Delaware, typically at and around the freshwater/saltwater interface (see below). It is unfortunate that the lack of data precludes the identification of seasonality of the sites.

5.2 LOCAL SITE RELATIONSHIPS AND COMPARISONS

As of this date, numerous sites have received both light and intensive excavation and analysis in the central Delaware region. Settlement pattern models for the Woodland I period in the area have been

offered (e.g. Custer 1989, 1994; cf. LeeDecker 2005), and it remains to assess the position of the Airpark sites vis a vis these models.

Numerous Woodland I period sites have been identified in the greater Leipsic and St. Jones River drainages. The Carey Farm and Island Farm sites are located on the St. Jones near Dover (Custer et al. 1996). These sites produced ample components associated with Mockley and Hell Island ceramics, as well as earlier and later components. Carey Farm yielded numerous features but no subsistence information. These sites are located near the freshwater/salt water divide on the St. Jones. Not far upstream from these sites is the Hickory Bluff site, also located near the water divide (Petraglia et al. 2002). Here, an early Woodland I occupation is indicated by the presence of numerous "pebble points", which have herein been included in the Piscataway type. Features included firepits, storage pits, and pit houses.

Across the St. Jones from Hickory Bluff is the Puncheon Run site (LeeDecker et al. 2005). It is probably more accurate to refer to Puncheon Run "sites", since the area included numerous spatially discrete loci covering approximately 20 acres. The early Woodland I period is represented by numerous "pebble points", many of which retain cortex on the base of the stem, just as is the case at the Airpark sites. Hell Island ceramics indicate a component later in the Woodland I period. Some areas of the site produced storage pit features.

Close to the Delaware Airpark are Sites 7K-C-360 and 7K-C-365; the latter is located on the St. Jones and the former on a tributary of the Leipsic (Riley et al. 1994). Both sites produced lithics, including projectile points, scrapers, and grinding tools, indicating Archaic and Woodland I components. The sites' settings are on small raised knolls within the vast swamplands, which is identical to the Airpark sites. Also like the Airpark sites, few features and relatively few ceramics were found.

Closer still, the Deneumoustier site is located along a small tributary of the St. Jones just 2-3 kilometers east of the Airpark. This highly unusual site was summarized by LeeDecker et al. (2005:31-32), who report that, in addition to artifacts dating to the entirety of prehistory, over 300 points dating to the Woodland I period have been collected by the landowner. Over 600 artifacts have been collected from the site surface, and include axes, celts, pestles, and atlatl weights; the nature and function of this site is unclear, but it may have more to do with some kind of ideological significance rather than being subsistence-related.

Two sites on the Leipsic River are relevant to the Airpark sites. The Leipsic site lies perhaps six kilometers east-northeast of the Airpark. At this site, which occupies an environmental setting similar to the Airpark sites, Custer et al. (1996) excavated over 350 features, most of which were interpreted as house pits with internal storage pits. The Woodland I was represented by approximately 200 sherds of Hell Island ceramics. Finally, the Pollock site is located across the river from the Leipsic site (Custer et al. 1994). The Woodland I is represented by mostly stemmed points. Like the Leipsic site, numerous pit features were interpreted as house pits. The lithic technology at the sites revolved around the reduction of cores into bifaces; local cobble cherts were widely used.

The preceding brief summaries demonstrate numerous similarities and differences in Woodland I period site structure and content in the area. At least three occupations of the area are in evidence, one early in the Woodland I and represented principally by stemmed points, a later occupation evidenced primarily by Mockley ceramics, and a later occupation involving notched points and Hell Island ceramics. The Airpark East and Airpark West sites both contain a palimpsest of overlapping occupations, ranging minimally from the Archaic, Woodland I, and Woodland II, with Woodland I (or Late Archaic though Early/Middle Woodland) predominating. The site locations, on slightly

elevated ground surrounded by wetlands, would have dictated that repeat visitors to the sites would have had to occupy more-or-less the same real estate as previous visitors, or get wet. At Puncheon Run, by contrast, the 20-acre landform there permitted subsequent site users to select discrete locations for activities that were not previously occupied. One might suspect a preference for this, as opposed to settling in on previous peoples' refuse. Different kinds of site structures were dictated by the nature of the local geography.

As mentioned, Sites 7K-C-360 and 7K-C-365 occupy identical environmental settings as the Airpark sites, i.e. small raised landforms surrounded by swamps. A similar tool kit is further indicated, including points, scrapers, and grinding stones. The four sites also share a dearth of features and relatively sparse pottery. It is suggested that Sites 7K-C-360 and 7K-C-365 and the Airpark sites may be functional equivalents: principally procurement sites but where other activities were also conducted. That these sites, and presumably others like them, occur in the headwaters of the Leipsic and St. Jones not far from one another is not coincidental.

By contrast, the Leipsic and Pollack sites also lie not far from the Airpark, but yielded numerous storage and house pit features, quite unlike Airpark. That these sites were located on the main stem of the Leipsic River – albeit not far from the headwaters – might account fort the presence of structural features at these sites and lack thereof at Airpark, because the latter were less accessible by water transport. This scenario is speculation, of course, but is offered in the effort toward accounting for the structural variability seen in these sites.

Custer has attempted to come to grips with settlement patterning in Delaware, and has offered several now well-known models to account for settlement variability (e.g. Custer 1989, 1994). The model for the Woodland I period involves three principal site types: the macro-band base camp, the micro-band base camp, and the procurement site. This system was "…oriented around macro-band base camps with periodic forays and population movements to smaller micro-band base camps and procurement sites" (Custer 1989:188). As applied to the Woodland I in the Leipsic and St. Jones drainages, macro-band base camps are expected near the mid-drainage zone mark, where saltwater gives way to fresh water; micro-band base camps are envisioned in and near marshes along the Atlantic coast, while procurement sites can be located just about anywhere, but especially in the freshwater wetlands near the river headwaters (Custer 1989:Figure 74). Base camps are substantial settlements with houses, storage features, and evidence of a wide variety of activities; base camps can be occupied year-round or during the fall/winter/spring seasons. Procurement sites would be small and specialized in nature, and the artifact assemblage should reflect this. In this scheme, the Airpark sites and Sites 7K-C-360 and 7K-C-365 would function as procurement camps utilized by people from the base camp(s) further down stream, perhaps a site like Carey Farm and/or Island Farm. Further, Custer notes that the pattern is similar to that of the preceding Archaic, but that "…the variety of activities at procurement sites decreased. The variety of activities at macro-band base camps, on the other hand, increased" (Custer 1989:188).

Based principally on the results from their analysis of the data from the Puncheon Run site other sites in the area, LeeDecker at al. (2005) have offered a well-thought-out examination of settlement patterns in the St. Jones drainage. First off, these researchers question the existence of a macro-band base camp on the St. Jones at the mid-drainage zone, or anywhere else for that matter. That is, despite a flurry of archeological excavation and analysis in the region in recent years, no bona fide base camp-type sites have been found (Leedecker et al. 2005:277-279). The Carey Farm and Island Farm sites have been regarded as potential candidates, but to date no solid evidence that these sites were base camps has been forthcoming. Indeed, the plentiful features and dense lithic and ceramic detritus at these sites could be the result of repeated reoccupations of the sites by mobile groups, i.e. a palimpsest component pattern. LeeDecker et al. (2005:278-279) illustrate their point with data from

the Puncheon Run site. Here, a 20-acre landform was variously occupied/utilized by many groups over time, mostly in spatially-discrete loci across the site area. Viewed separately, none of these loci approximate a base camp-type site. However, had all of these occupations/activities taken place on the same spot on the landscape, a palimpsest assemblage would obtain and could very well resemble a base camp with all its necessary elements, e.g. storage pits, dense middens, evidence for a wide variety of activities, and so on.

Add to the foregoing the fact that several sites have now been excavated in the interior wetlands zone of central Delaware, locations where previous models would have predicted the occurrence of numerous procurement camps or sites. A limited tool kit and set of activities would be expected to obtain, since these sites were specialized toward specific resource procurement. Recent data suggest otherwise: the Airpark East and Airpark West sites, along with Sites 7K-C-360 and 7K-C-365, indicate that while specialize procurement activities may indeed have taken place at these sites, other kinds of "domestic" activities were conducted as well. It now appears that settlement patterns during the Woodland I were not so straightforward as envisioned by Custer, and that greater functional variability in site types is present beyond a three-site-type model.

To sum up the preceding discussion, the following observation is particularly poignant:

The closer we examine the archeological record, the more complex it seems, and the harder it is to fit our data into neat behavioral models…. A problem with all schematic diagrams of settlement patterns is that they impose a false sense of regularity on human behavior (LeeDecker et al. 2005:280).

The truth in this statement is clear to see. It also points toward the future of settlement pattern studies in central Delaware. Enough data has been recovered by this time to indicate that site variability in this region is much greater than previously thought, and future studies should endeavor to use these data to further refine settlement pattern models.

5.3 REGIONAL CONTEXT: PREHISTORIC SETTLEMENT IN THE LEIPSIC AND ST. JONES DRAINAGES – AN EXPLORATORY ANALYSIS

5.3.1 Introduction

Spatial analysis, as stated by Kintigh and Ammerman (1982:31), is "a process of searching for theoretically meaningful patterns in spatial data." Given that archeological data more often than not have a spatial component, the search for meaningful spatial patterns has concerned archeologist for decades. Within the Airpark project area and surrounding landscapes, there exists a body of plentiful archeological spatial data. Through this analysis, comparisons between cultural and environmental attributes are made for each archeological site in two watersheds, the St. Jones and Leipsic; three physiographic sections; and six physio-sheds (the intersection of a single watershed and a single physiographic section). Additionally, comparisons are made between two prehistoric sites within the Airpark project area, Airpark East and Airpark West, and all prehistoric sites within the two-watershed study area.

The two Airpark sites are located in the Atlantic Headwater physiographic section of the Leipsic watershed within 1500 ft of the St. Jones watershed drainage divide. The outcome of this analysis characterizes prehistoric site settings, variations between these settings and the natural landscape, and the similarity of the Airpark project sites to various environmental contexts. Ultimately, the intent of this spatial analysis is to characterize the environmental and temporal variables associated with site

location between the two neighboring watersheds and evaluate the quantitative and qualitative observations to tease out hypothesis that can help inform the overall cultural context.

5.3.2 Methods

The location of 591 prehistoric archeological sites within the St. Jones and Leipsic watersheds of central Delaware (Figure 68) were characterized, entered into a database, and subjected to various statistical tests. The data on the 591 sites was collected from the site files at the Delaware State Historic Preservation Office (SHPO). Central to the four analytical tests is a profile of each prehistoric archeological site characterized by watershed, physiographic section, and five environmental variables. The physiographic sections are the Atlantic Headwaters, Mid-Drainage, and Delaware Shore. The environmental variables used in the four quantitative tests are distance to wetlands, distance to streams, elevation, solar insolation gain, and a topographic wetness index (TWI). Finally, no claim is made that bias does not exist in this sample; 591 sites were not selected randomly, and some degree of sample bias is no doubt present. There is little that can be done about this situation, other than to point it out.

The choice of these five environmental variables is based on a number of factors including, availability, generality, and applicability within the context of the study area. Availability in this case denotes that the data for the variable was available in a consistent format and measure for the entirety of the study area. This is important in that the variables are all measured as continuous interval data types. The generality of these variables allows for an ease of use across the broad study area and across a wide scope of time. The distribution of these variables are not tied to point specific sources or sources that are wholly confined to a single physiographic section; although wetlands are somewhat constrained. With the assumption that as the climate fluctuated throughout prehistory, we can assume that these variables fluctuated rather uniformly across the project area with the climate. Therefore, if the TWI decreased by 25% in an area due to a dry climate at some point in prehistory, it is assumed that the TWI decreased by 25% across the entire project area. This is very important because a full paleo-environmental study is well beyond the scope of this project. Furthermore, TWI and solar insolation gain are general in that they are a measure of numerous more elementary variables, such as slope, curvature, and aspect. On their own, these elementary variables have a narrow range in the relative homogeneity of the project area's geomorphology, but as composite measurements, they gain more distinction and are more likely to differ between analytical units. Finally, these variables are used because they are general measures of the character of a particular spot within the study area; a site or non-site's "landform". These variables are explicitly not used as predictive variables. These choices of these variables was not predicated on archaeologists' noting that variable X at measure Y is a good place to find sites. While the measurement of distance to water, for example, has obvious utility in judging the sensitivity of certain areas for the presence of archaeological sites, none of the variables in this study is weighted in this fashion. None of the following statistical tests gives precedence to areas of "high sensitivity" over areas of "low sensitivity."

The goal of these statistical tests is to create a general characterization of the landform at 591 site locations and compare these landforms across two watersheds and numerous physiographic sections. These comparisons are illustrative of general differences between site landforms within these watershed and physiographic sections, but not *why* precontact inhabitants chose one site or another. These statistical generalizations are used to guide archeologists to fruitful research questions that address the "*why*" and "*how*."

The environmental variables for distances to wetlands and streams are calculated by a Euclidian distance measure. Elevation is measured as feet above mean sea level from 10x10 meter, or 1/3 arc

second, resolution Digital Elevation Models (DEMs). Solar insolation gain is a secondary environmental variable, measuring the intensity and duration ([kW·h/(m²·day)] kilowatt-hours persquare meter per day) of solar radiation energy received on a given surface area in a given time-value. Solar insolation gain is a complex variable at the intersection of the primary variables of slope, aspect, elevation, and latitude (Duncan and Beckman 2000:41-42). The salient modeling parameters for solar insolation gain used within the current project are a latitude of 39.14 degrees north and a time-value of sunrise to sunset on a single day, December 22, the shortest day of the year. The TWI (Boehner et al. 2002) models the soil moisture at a topographic location by indicating the amount of surface runoff for each grid cell. The higher the TWI value, the more likely a topographic location is to have high water saturation of the soil (Olaya 2004:116-117).

For each of these environmental variables, multiple groups of observations, or populations, were tested against each other. These populations are archeological components of a given chronologic periods (Paleoindian, Archaic, Woodland I, and Woodland II), archeological sites in the Leipsic watershed, archeological sites in the St. Jones watershed, archeological sites in each of the three physiographic sections, and, finally, a sample of 1477 random "non-site" locations. Physiographic sections are used here to test between watersheds because, by definition, they minimize the natural variability of environmental attributes, leading to a more controlled test. Additionally, the "random" locations were chosen to reflect assumed non-site location. The random sample excludes areas in marshes, streams, or standing water, and areas within 30 meters of a known prehistoric site; the random points are no closer than 30 meters from each other. These locations were not field tested and in a small number of cases may contain an archaeological site, but taken as a whole they offer a reliable back-ground sample that the known sites can be tested against.

The archeological dataset was subjected to four analytical tests: the T-test for the difference of means, the χ^2 (Chi-squared) test for independence, a hierarchical clustering visualized by a dendrogram, and bivariate scatter-plots. These specific tests were used for their simplicity and ability to broadly define and categorize the data. Obtaining a rigorous statistical profile is not the intention of this suite of tests. Instead, they are used to obtain quantitatively sound observations that are then used to guide hypothesis building. Applying quantitative tests to guide research in this manner is considered a heuristic approach (Kintigh and Ammerman 1982). Computer software used in the creation of this Geographic Information System (GIS) and subsequent analysis include ESRI ArcGIS v9.0, System for Automated Geoscientific Analyses (SAGA) v2.0.2, Microsoft Excel 2007, and R v2.6.2 statistical computing software.

5.3.3 Results: Two-Tailed T-Test Assuming Unequal Variance

The first analysis performed is the two-tailed T-test (assuming unequal variance) for difference of means. The intention of this test is to see which attributes differ significantly from the norm by comparing the means and variance of two different populations. In other words, the mean and variance of one variable, for example the distance of Paleoindian components to streams, is compared to the mean and variance of another variable, possibly the distance of Woodland II components to streams. If the distribution of the distances is significantly different, then the hypothesis can be made regarding the cause of the difference. If Paleoindian sites are significantly further from streams, an hypothesis may be created based on, but not limited to, paleo-hydrography, site selection pressures, site preservation, or survey bias.

In this analysis, each archeological site is grouped by temporal component, and each component is grouped by physiographic section. Then each of the five environmental variables is compared between watersheds for each of the 15 temporal/physiographic groupings of archeological sites. Additionally, the sample of 1477 random "non-site" locations is subject to the same procedure.

Through the T-tests conducted on 75 permutations of chronologic periods, environmental variables, watersheds, and physiographic sections, a number of statistically significant differences emerge. However, on their own, a significant difference does not necessarily make an interesting observation.

To make sense of these findings, a broad interpretation using the results of multiple population comparisons is necessary. Table 6 synthesizes the results of the 75 individual T-tests by showing which environmental attributes have a different distribution, between watersheds and within physiographic sections, as compared to random non-site locations for the same areas. The difference in distribution noted here is the significance finding of the T-test. Environmental attributes in plain text indicate a variable where the random non-site points differ significantly ($p < 0.1$, $p < 0.05$ for each tail) between watersheds within a given physiographic section, but the same variable calculated for a given archeological temporal component *did not* differ significantly ($p > 0.1$, $p > 0.05$ for each tail) between watersheds. This finding is referred to as a "constrained" variable relationship. Alternatively, the variables listed in bold italics indicates an attribute where the archeology sites *do* differ significantly ($p < 0.1$, $p < 0.05$ for each tail) between watersheds within a given physiographic section, but random non-site points do not differ significantly ($p > 0.1$, $p > 0.05$ for each tail). This finding is referred to as an "expanded" variable relationship.

Based on the results of the T-tests, environmental attribute relationships referred to as "constrained" and "expanded" highlight the possibility of observing choices made by prehistoric inhabitants in selecting site locations. Constrained variable relationships, for which there are 19 examples on Table 6, show where each watershed has a significantly ($p < 0.1$, $p < 0.05$ for each tail) different range of an environmental attribute to offer, but prehistoric sites, or those choosing the location of them, constrain themselves to a narrower range of the variable that is consistent across the significantly different environments of each watershed.

Table 6. Synthesis of T-test analysis.

	Compiled T-Test Results		
	Atlantic Headwaters	Delaware Shore	Mid-Drainage
Woodland II	Wetland Stream TWI	Elevation	***Solar Insolation***
Woodland I	Wetland Stream Elevation	Elevation	***Solar Insolation***
Archaic	Wetland Stream TWI	N/A	Wetland Stream
Paleoindian	Wetland Stream TWI	N/A	Wetland TWI Stream

In the Atlantic Headwaters, much of the constraints are seen on hydrologic variables. Within this physiographic section, there are significant differences between each watershed in drainage patterns and the amount of land between streams. However, the T-tests suggest that across all time periods, prehistoric inhabitants, on average, chose sites in both watersheds with similar settings relative to the

distance to wetlands, distance to streams, and TWI even when a significant variability exists between watersheds. This observation is not wholly unexpected. Archeologists have always deduced that sites generally occur within similar distances to water sources regardless of environment. However, the statistics show that the opportunity existed, but not taken, to produce a settlement pattern, relative to water sources, that corresponded to the differing hydrologic environs of each watershed.

Also interesting is the observation that the distance to streams and distance to wetlands within the Mid-Drainage physiographic section is significantly different ($p < 0.1$, $p < 0.05$ for each tail), as it is in the Atlantic Headwater section, but Woodland I and Woodland II period sites are also significantly different ($p < 0.1$, $p < 0.05$ for each tail). This observation runs counter to the previous in that Woodland period sites apparently utilized the watershed environs differently, relative to distance to streams and wetlands. However, Paleoindian and Archaic sites, using the same variables, followed a constrained settlement approach as was the case in the Atlantic Headwaters section. Paleoindian and Archaic period site locations did not differ significantly relative to distance to wetlands or distance to streams (and TWI in the Paleoindian period) in the Mid-Drainage physiographic setting. This signals a distinction between the Paleoindian/Archaic versus Woodland I/Woodland II settlement patterns in the Mid-Drainage section.

The final example of constrained settlement locations relative to an environmental variable is the case of elevation in the Delaware Shore physiographic section. The elevations of random non-site locations in each watershed of the Delaware Shore section differ significantly ($p < 0.1$, $p < 0.05$ for each tail). However, the elevations of Woodland I and Woodland II archeological sites do not differ significantly ($p > 0.1$, $p > 0.05$ for each tail) between the two watersheds. The sample of Paleoindian and Archaic components recorded in the Delaware Shore section is too small to calculate. Woodland period sites are confined to a narrower range of elevations that is offered by the two watersheds and this range does not differ significantly based on watershed. This finding may result from a co-correlation between elevation and water sources, but this is not conclusive with the T-test results showing no significant ($p > 0.1$, $p > 0.05$ for each tail) difference between the watersheds based on distance to water or distance to wetland for both random non-site and archeological site locations.

In contrast to the 19 constrained variable relationships are two examples of expanded variable relationships. The essence of an expanded variable relationship is that prehistoric site locations, relative to the variable, differ significantly ($p < 0.1$, $p < 0.05$ for each tail) between the two watersheds, while the random non-sites locations do not. The choice of site locations is expanded beyond the average distribution of the natural environment to a point that the location of archeological components, relative to a variable, differ significantly ($p < 0.1$, $p < 0.05$ for each tail) between the two watersheds. Within this study, it was found that the amount of solar insolation gain does not differ significantly ($p > 0.1$, $p > 0.05$ for each tail) between watershed for any physiographic section, but the same measure taken at the location of archeological sites with Woodland I and Woodland II components in the Mid-Drainage section does differ significantly ($p < 0.1$, $p < 0.05$ for each tail).

As stated by Duncan and Beckman (2000: 42), the use of solar insolation gain as a model parameter has more application for the colder months of the year because more solar insolation equals more warmth. Building on this, it is possible that the observation of Woodland I and Woodland II period inhabitants expanding the natural distribution of solar insolation between watersheds may signify winter versus summer settlement patterns. While the Mid-Drainage section of the two watersheds have statically similar ($p > 0.1$, $p > 0.05$ for each tail) amounts of solar insolation for random non-site points, Woodland period archeological sites in the St. Jones watershed have significantly ($p < 0.1$, $p < 0.05$ for each tail) higher amounts as compared to the Leipsic drainage.

5.3.4 Results: χ^2 (Chi-squared) Test

The non-parametric Pearson's chi-square (χ^2) test is applied to determine if any physio-shed regions had a higher than expected frequency of given prehistoric temporal components and to test the independence of the physio-shed and chronological period variables. This rather simple test is important in framing the validity of observations dealing with the frequency of sites in one area relative to another. Note that this is not a measure of archeological site density; a given region's surface area is not a factor. Conversely, the χ^2 test uses the frequency of sites observed in a region to develop the theoretical distribution of how many site *should* be in that region. Essentially, the χ^2 test in this case calculates how many of each temporal component should be in each spatial region if they were independent variables and distributed according to the chi-square distribution. If the magnitude of differences between how many components *should* be there and how many *are recorded* there is great enough, then the p-value is exceeded and the null hypothesis (H_0) of independence can be rejected. The χ^2 test is applied to two variations of the frequencies of temporal components present in each physio-shed (Table 7 and Table 8).

Table 7. Contingency table for all temporal components by physio-shed.

Chi-Squared (χ2) test for all temporal components

Basin - Physiographic Province	PI	AR	WI	WII	Total
Atlantic Headwaters - Leipsic River	2	4	26	15	47
Atlantic Headwaters - St. Jones River	8	14	51	25	98
Delaware Shore - Leipsic River	0	1	10	6	17
Delaware Shore - St. Jones River	0	0	7	5	12
Mid-Drainage - Leipsic River	7	10	41	26	84
Mid-Drainage - St. Jones River	3	3	50	29	85
Total	20	32	185	106	343

In the first χ^2 test, applied to the contingency table, Table 7, the null hypothesis (H_0) is that the frequency of temporal components is independent of physio-shed location. This χ^2 test results show that the null hypothesis of independence (H_0) is accepted, χ^2 (df = 15, n=343) = 14.856, p = 0.4618. In this result, no quantity of components for a given archeological temporal period significantly stood out in the whole body of components, therefore chronological component frequencies grouped in this way are not related to physio-shed location. Sites appear to be distributed as would be expected when they are distinguished by Paleoindian, Archaic, Woodland I, or Woodland II components. However, within the matrix of χ^2 values, two physio-shed / temporal combinations stand out, although not with statistical significance. In the Atlantic Headwaters region of the St. Jones watershed, the χ^2 tests expected 9.1 Archaic sites, but there are actually 14 recorded. The second interesting, but not significant, observation is that the χ^2 test expected 7.9 Archaic sites in the Mid-Drainage of the St. Jones watershed, but only three are recorded.

Table 8. Contingency table for grouped temporal components by physio-shed.

Chi-Squared (χ2) test for grouped temporal components

Basin - Physiographic Province	PI-AR	WI-WII	Total
Atlantic Headwaters - Leipsic River	6	41	47
Atlantic Headwaters - St. Jones River	22	76	98
Delaware Shore - Leipsic River	1	16	17
Delaware Shore - St. Jones River	0	12	12

Chi-Squared (χ2) test for grouped temporal components			
Mid-Drainage - Leipsic River	17	67	84
Mid-Drainage - St. Jones River	6	79	85
Total	52	291	343

The second χ^2 test is applied to the contingency table in Table 8. In this case, the temporal components are grouped into Paleoindian-Archaic and Woodland I-Woodland II. Again, the null hypothesis (H_0) is that the frequency of temporal components, this time in more general groups, is independent of physio-shed location. This χ^2 test results show that the null hypothesis of independence (H_0) is *rejected,* χ^2 (df = 5, n=343) = 13.561, p = 0.0187. When combined, Paleoindian and Archaic components are distributed among the physio-sheds differently than expected based on the total population of prehistoric components. Therefore, the variables of phsyio-shed and temporal components are not independent from each other. Paleoindian/Archaic versus Woodland I/Woodland II components when grouped are distributed meaningfully across physio-sheds.

Using the χ^2 values as a guide, two observations stand out. First, the 22 recorded sites in the Atlantic Headwater section of the St. Jones watershed with Paleoindian or Archaic components is significantly more that the 14.9 expected by the χ^2 test. Similarly, the six recorded Paleoindian/Archaic components in the Mid-Drainage of the St. Jones watershed is many fewer than the 12.8 expected. These observations mirror those findings of the first χ^2 test, but gain significance by combining temporal components and amplifying the discrepancies.

5.3.5 Results: Bivariate Scatter Plot

The third test conducted on this dataset is the construction of bivariate scatter plots using environmental variables measured at archeological site locations in each watershed. The scatter plot is a visualization tool for observing and comparing the correlation of two variables. The strength of the correlation can be obtained by drawing a linear best-fit line through the scatter plot point cloud and determining the lines squared correlation coefficient (R^2). An R^2 value of 1 indicates a linear regression line is perfectly fit to the data points.

In this case, the scatter plots are constructed with two environmental variables, understood to not be fully independent, and three data groups. The data groups are archeological sites in the St. Jones watershed, archeological sites in the Leipsic watershed, and the Airpark East and Airpark West sites, two of the sites within the Airpark project area in the Leipsic watershed. On each scatter plot the measures of the two environmental variables, as taken at sites in each watershed and the two Airpark sites, is overlain and differentiated by a unique symbol. Finally, linear trend lines and their associated R^2 values are plotted. The intention of constructing the scatter plot in this manner is twofold. First, comparing the point clouds and linear trend lines for each watershed, per scatter plot, gives an indication of how strongly environmental attributes are differentiated between watersheds. If the trend lines and point clouds have observably different slopes and good separation, that is an indicator that archeological sites in each watershed occupy different landforms based on the variable measured. If the trend lines and point clouds greatly overlap or show very little correlation at all, this may indicate that the variables have little in common where archeological sites are recorded. Secondly, the trend line and point coordinates of the two Airpark sites are coupled with a general understanding of relationships discussed above. A close fit between the Airpark sites and the point cloud of one shed versus another indicates that the Airpark sites are more closely related to one watershed than another, based on the environmental variables measured. Four sets of variables are used in the scatter plot diagrams, these are: 1) Distance to Stream vs. Distance to Wetland, 2) TWI Index vs. Distance to Stream, 3) TWI vs. Solar Insolation, and 4) Elevation vs. Distance to Wetland.

Figure 69 is a scatter plot measuring the distance to streams and distance to wetlands at archeological sites within the St. Jones and Leipsic watersheds and Airpark East and Airpark West. There is a general positive trend in the relationship between distance to streams and wetlands. As archeological sites increase in distance from streams they also increase in distance from wetlands. While not an unexpected finding, the more interesting aspect is that within the Leipsic watershed, archeological sites adhere more strongly to this relationship ($R^2 = 0.4571$). Also, in general, archeological sites in the St. Jones watershed are scattered further in the direction of nearer to wetlands while being quite far from streams. There is a pretty strong trend for sites that are close to a wetland to also be close to a stream, but the relationship is not as strong in the opposite direction; except for one outlier. The five outlying data points that are equally far from streams and wetlands (~500 feet) make an interesting subset across both drainages that should be explored in further detail. The final observation of this scatter plot is the adherence of the two Airpark sites to any of the observations noted above. The coordinates of the Airpark points do not suggest that they are more related to either drainage. One Airpark point falls almost directly on the linear trend line for the Leipsic watershed, but the other signifies no relationship.

Figure 70 is a scatter plot measuring the TWI and distance to streams at archeological sites within the St. Jones and Leipsic watersheds and the Airpark East and Airpark West sites. The general trend is for archeological sites further from streams to have a higher TWI; however this is not a highly positive trend. The Leipsic watershed archeological sites have a more positive trend and generally lower TWI. Leipsic sites are also not found as far away from streams as compared to the St. Jones watershed. The relationship of the two Airpark sites is more clear in Figure 70 than in Figure 69. The coordinates of the sites fit very well to the linear trend line drawn for the variables of the sites in the Leipsic watershed. The Airpark sites are more similar to sites in the Leipsic watershed in respect to distance to streams and TWI.

Figure 71 is a scatter plot measuring the TWI and solar insolation at archeological sites within the St. Jones and Leipsic watersheds and the Airpark sites. The point clouds and trend lines show a rather weak relationship between the two variables. Generally, in the Leipsic watershed, solar insolation increases with the TWI, but the trend is reversed in the St. Jones. Likely, this reversal is due to the sensitivity of the regression line to the highly clumped nature of the data points. One clear observation is that the archeological sites in the St. Jones watershed exhibit an overall narrower range of solar insolation gain values as compared to the Leipsic watershed. The sites of the Leipsic watershed have generally lower TWI values and a broader range of solar insolation gain values. The location of the Airpark sites on the figure correspond more closely to the linear trend line of the Leipsic sites, but are not outside of the range of the St. Jones sites.

The final scatter plot, Figure 72 is a scatter plot measuring the elevation and distance to wetlands at archeological sites within the St. Jones and Leipsic watersheds and the Airpark sites. An overall positive trend is noted between increases in elevation with increases in distance from wetlands. Generally, sites within the Leipsic drainage have lower elevations, but show a very similar relationship to distance to wetlands. The fit of the linear trend line in the Leipsic watershed ($R^2 = 0.2011$) is slightly better than the fit for the St. Jones ($R^2 = 0.0616$), indicating a narrower range of elevations for each distance away from wetlands. The two Airpark sites appear on the figure as close to wetlands at a high elevation. While this appears to be more favorable to the St. Jones drainage, the result is inconclusive since the sites are very close to the drainage divide and at the higher elevations of the Leipsic watershed.

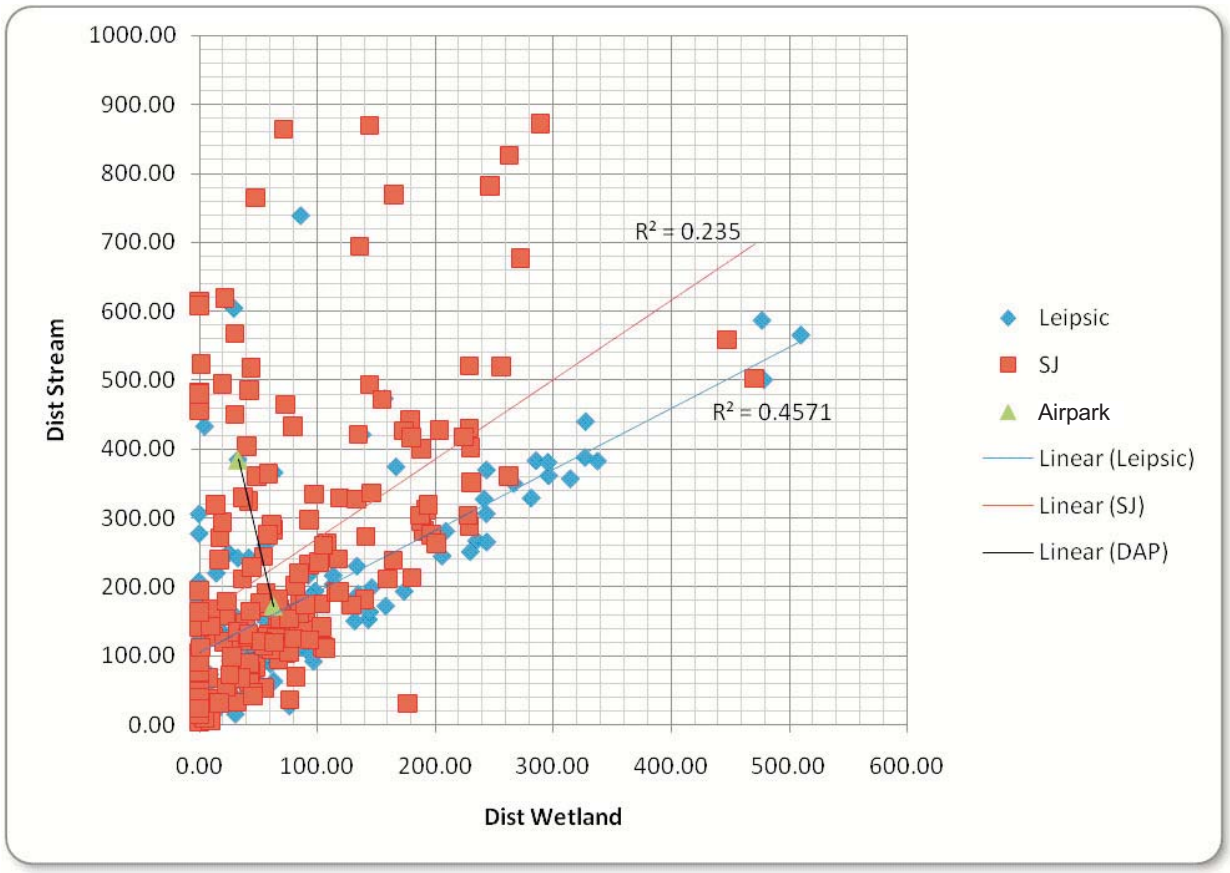

Figure 69. Scatter plot of distance to streams, distance to wetlands, and Airpark sites.

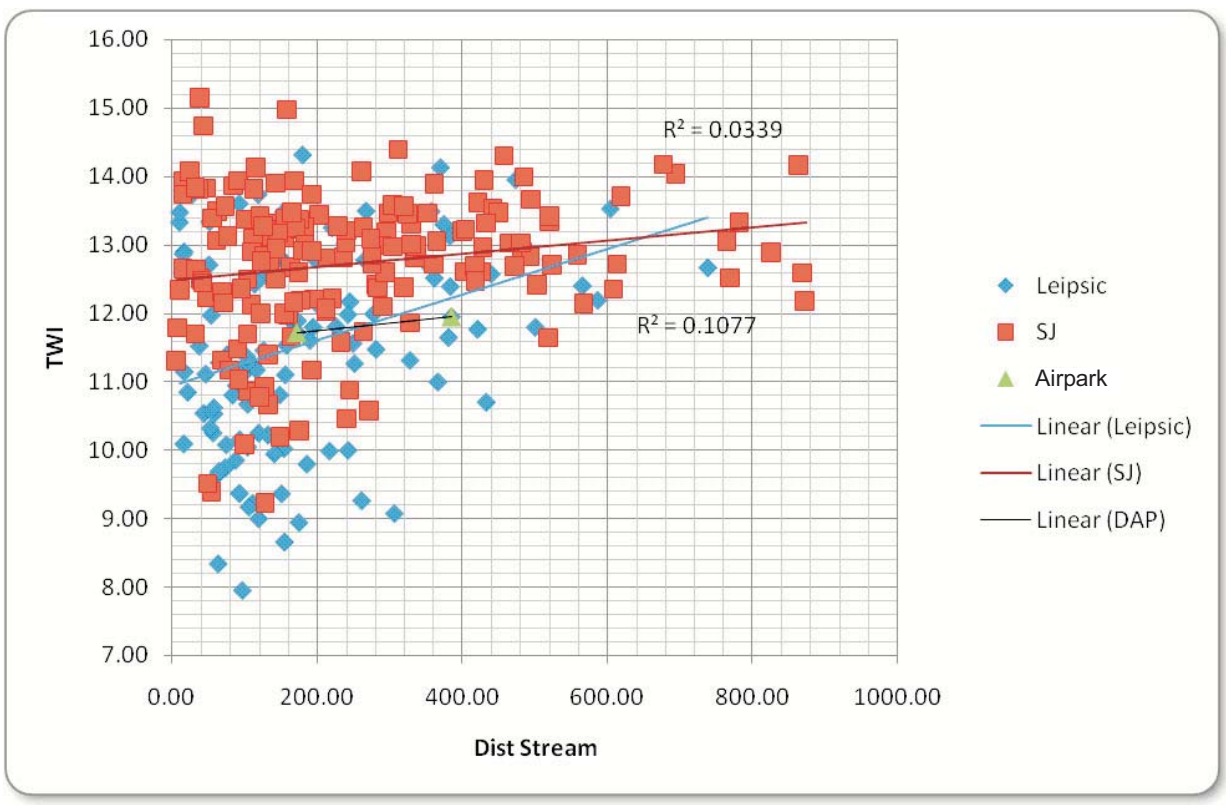

Figure 70. Scatter plot of TWI, distance to streams, and Airpark sites.

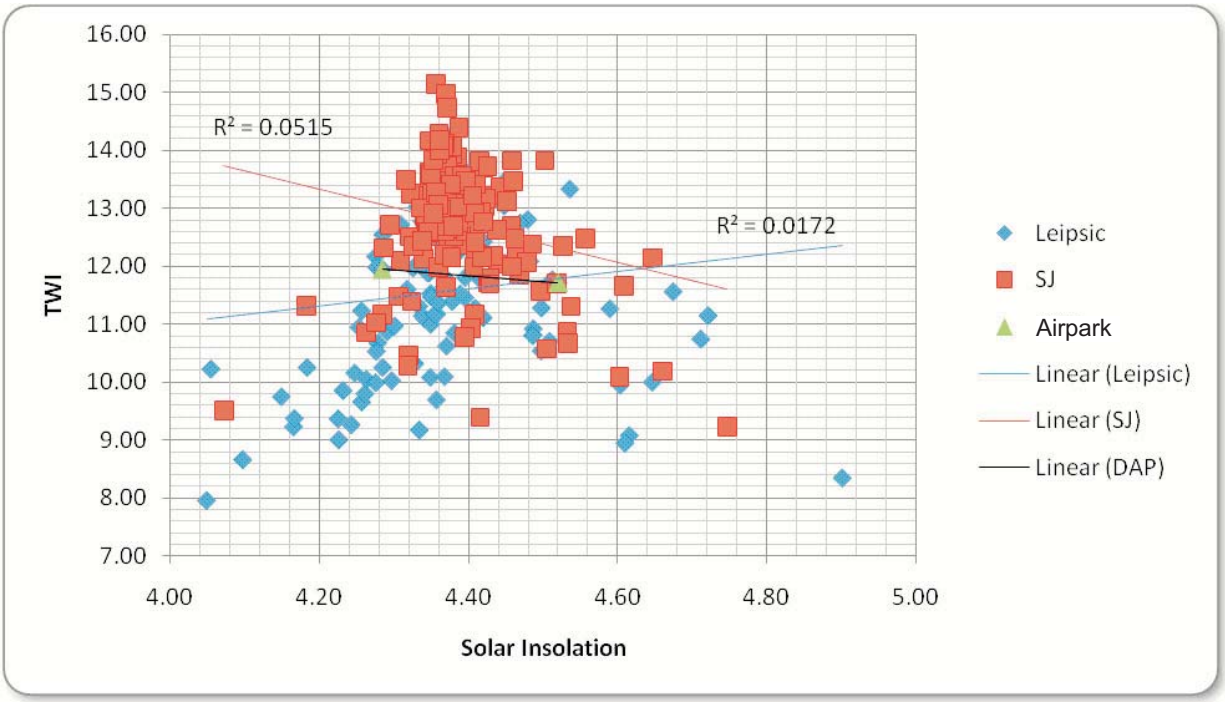

Figure 71. Scatter plot of TWI, solar insolation gain, and Airpark sites.

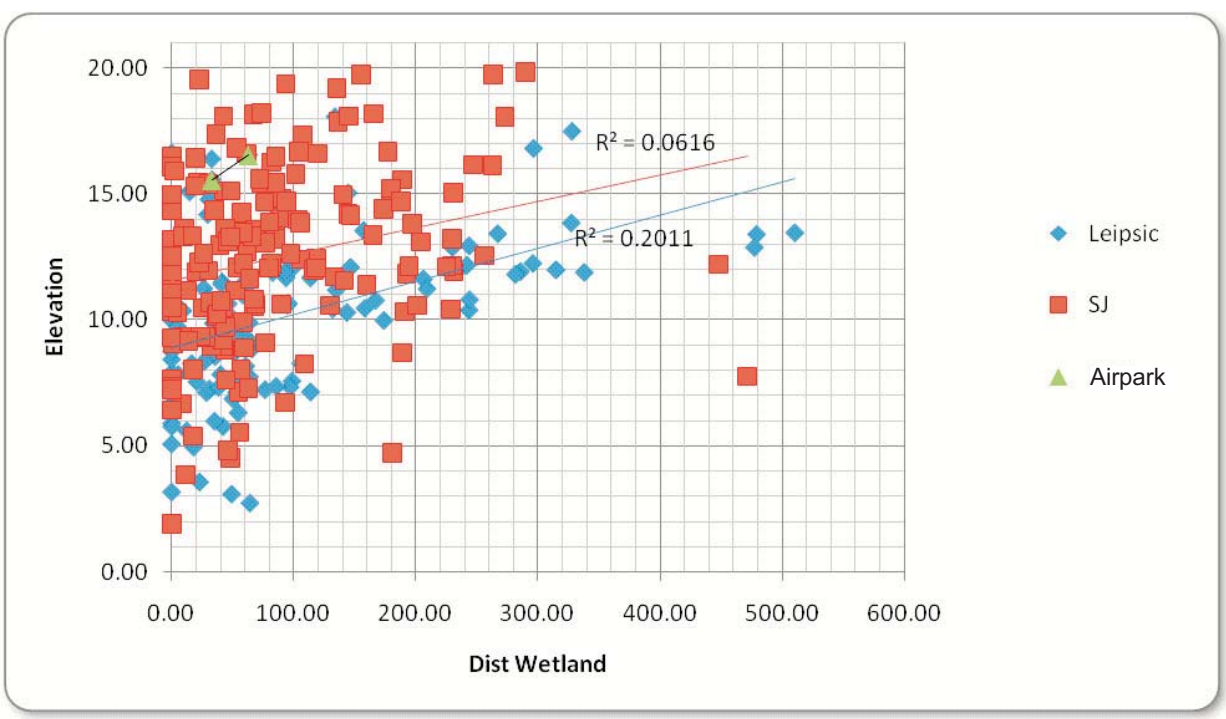

Figure 72. Scatter plot of elevation, distance to wetland, and Airpark sites.

5.3.6 Results: Dendrograms

The final quantitative test applied to this dataset is a hierarchical agglomerative, or bottom-up, clustering algorithm, visualized through a dendrogram. Hierarchical clustering uses observations or grouped observations to generate clusters based on the previous clusters so that every cluster has a parent or child cluster. This technique is agglomerative in that it begins with many clusters of observations and continuously lumps them into fewer classes until a single class representing all observations is reached. The dendrograms (Figures 73, 74, and 75) presented below are visual representations of the hierarchical cluster structure and distance between each cluster level. The distance metric used in this technique to distinguish between classes is based on the mean and variance of one or many variables recorded for each observation, i.e. archeological sites. In this example, the five environmental variables used in previous tests are used here to define each archeological site location. The three dendrograms below are generalized schematics of the statistical results. The basic structure of these figures show how closely related the landforms are of sites in different groups. In the case of Figure 69, the sites are grouped by time period, while in Figure 70 and 71, sites are grouped by location. The "Distance" at which each group is clustered is a statistical measure of how similar the landforms in those clusters are. However, the intention of these figures is to show the relative distance at which each group clusters; the shorter the cluster bracket, the more similar the landforms are.

Figure 69 is a dendrogram showing the statistical distance between temporal clusters of archeological sites based on their similarity in measures of the five environmental variables. Archeological sites are sorted only by temporal components; watershed is not a variable. This figure clearly indicates that groups 1 and 2 (Archaic sites and Paleoindian sites) are found on landforms that are much more like each other than they are like Woodland period sites. The statistical distance between the first and second grouping level is rather significant. Clearly this also means that Woodland I and Woodland II period sites are found on similar landforms to each other, as defined by the five environmental variables. Secondary components on multi-component archeological sites, which are only few, are ignored in this calculation.

Figure 70 uses the same methods and environmental variables as Figure 69, but is grouped spatially by physiographic section and watershed (physio-shed) as opposed to temporal component. The most similar archeologically sensitive landforms are shared between the Mid-Drainage of the Leipsic and Delaware Shore of the Leipsic. The next class in similarity to the previous grouped, the Mid-Drainage of the St. Jones watershed. However, the Atlantic Headwaters of the St. Jones and Atlantic Headwaters of the Leipsic are more alike each other than the Mid-Drainage of the St. Jones is to the grouped Delaware Shore of the Leipsic and Mid-Drainage or the Leipsic. The interesting observation here is that in some cases, such as the Atlantic Headwaters classes, archeological sites are more similar within physiographic boundaries than in watersheds. On the contrary, the Mid-Drainage and Delaware Shore of the Leipsic watershed show that the in some areas, archeological site locations within watersheds takes precedence over physiography. Drawing from this, the dendrogram technique can be used to tease out subtleties in archeological site location preference that vary from area to area and may reflect distinctions in settlement patterns and resource procurement strategies.

The final group to take note of here is the Airpark East and Airpark West sites. While the sample size is only two, comparing the landform of these sites to sites in other areas is instructive. It is clear that the statistical distance between the Airpark site locations and all of the classes is the greatest. The Airpark sites, as a group, are not located on landforms that correspond closely to any one physio-shed in the Leipsic or St. Jones watershed.

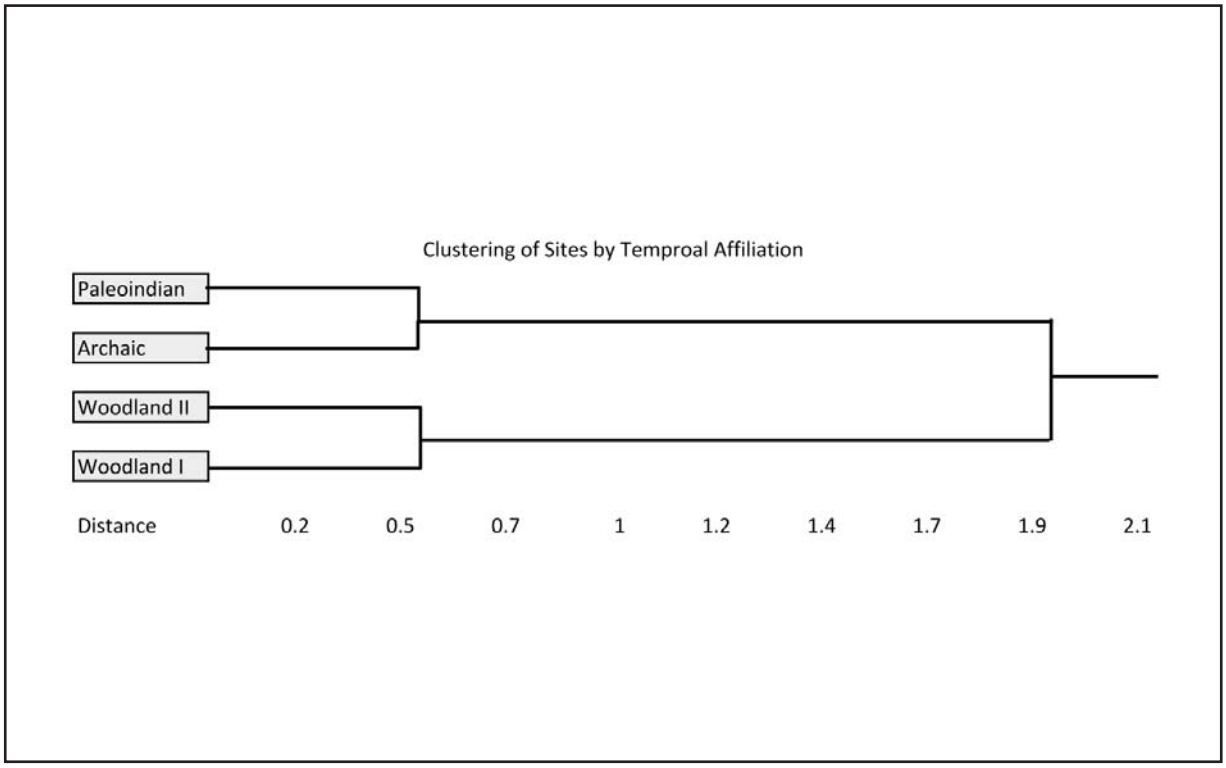

Figure 73. Dendrogram of statistical distances between environmental variables grouped by time period.

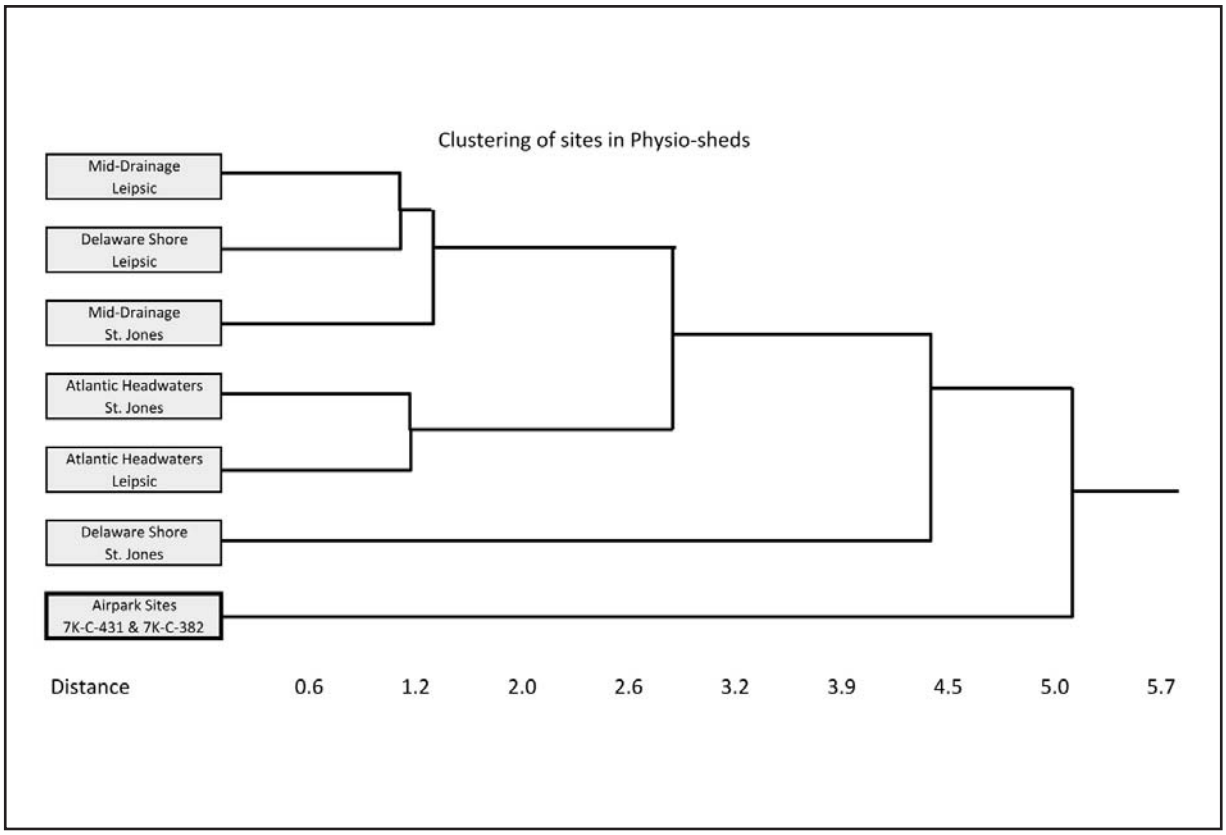

Figure 74. Dendrogram of statistical distances between environmental variables grouped by physio-shed.

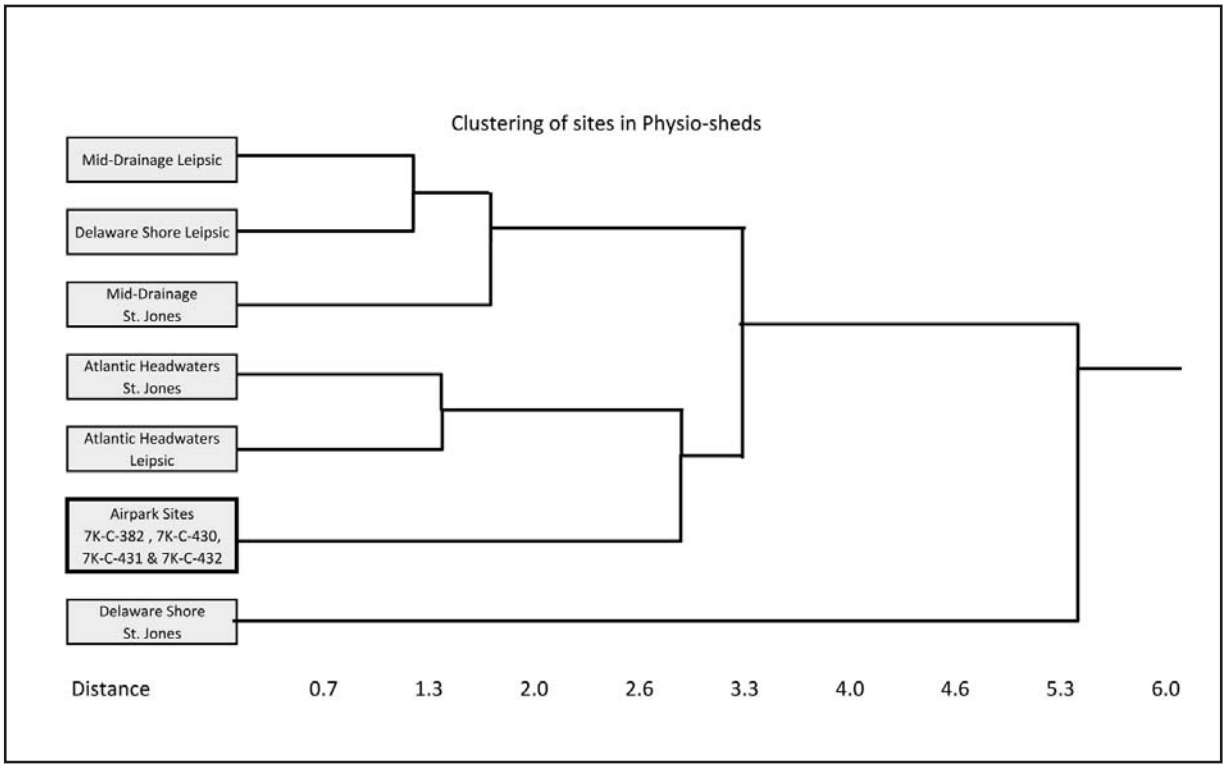

Figure 75. Dendrogram of statistical distances between environmental variables grouped by physio-shed; all Airpark sites included.

The final dendrogram, Figure 71 adds to the previous dendrogram (Figure 70) in that the sample of Airpark sites is expanded from two sites to four sites. The major change in class structure is the alignment of the Airpark sites to the Atlantic Headwaters of the St. Jones and Atlantic Headwaters of the Leipsic. The four Airpark sites are located in the Atlantic Headwaters section of the Leipsic watershed. However, the statistical distance indicates that the Airpark sites are only marginally more similar to the Atlantic Headwater site landforms than the grouping of the Mid-Drainage of the Leipsic and St. Jones and the Delaware Shore of the Leipsic. The likeliness of the Airpark site sample to other Atlantic Headwater sites in both watersheds is not unwelcome. Primarily this and the other findings of the dendrogram point out that in most cases the physiographic section as opposed to watershed is the primary division when studying archeological site landform selection. However, the cases where this does not hold show interesting research potential.

5.3.7 Conclusions

These four analytical tests demonstrate that statistical tests applied to archeological site location data within a heuristic framework can produce valuable observations. Based on these observations, inductive hypothesis can be built, tested, and refined. The statistical tests, as utilized here, only reveal relationships and give a context to the magnitude of a relationship's importance. Connecting the dots, so to speak, to derive explanatory meaning is the province of the researcher. The expression of an archeological pattern studied here contains a record of past formative and taphonomic events. From an initial point of view, this record has an infinite number of possible histories leading to the current configuration. Inductively probing this archeological pattern in this manner can reveals clues pointing to a finite number of possible histories. Of course, the one true history is unknowable. Kintigh and Ammerman (1983) clearly state this when discussing that the patterns we observe in the archeological record could have been produced by many combinations of generative processes, processes we can infer from observation, but "the choice among the set of alternative choices will be made by reference to other evidence: hence, the importance of context in the interpretive process" (Kintigh and Ammerman 1983:61).

The results from the T-test analysis show that while archeological/environmental statistical relationships alone are not very informative on their own, a synthesis of many relationships can be very informative. Through the cross-tabulation of significance findings from archeological sites in separate geographic areas with non-site points as an environmental background, useful archeological/environmental correlations emerged. These correlations, termed "constrained" and "expanded" relationships, represent the interesting outliers within the morass of variables and statistics.

The analysis of environmental differences and similarities between the St. Jones and Leipsic watersheds for both archeological components and random non-site locations leads to interesting observations in the choices involved in prehistoric site location. Free will, social pressure, nutritional requirements, and environmental determinism likely all play parts in prehistoric populations constraining location choices to a narrow range of spatially varying environmental variables, or expanding beyond the narrower distribution shared by each watershed. Research questions are easily gathered from the T-test results, such as Paleoindian and Archaic constraints on higher elevation sites in the Mid-Drainage of the Leipsic basin, and the Woodland period preference for higher solar insolation gain in the Mid-Drainage Leipsic, should to be further pursed to prove validity and ultimately aid in the interpretation of prehistoric life.

For the χ^2 test, the non-parametric quality allows for the testing of observations that may not fit under the normal distribution, i.e. the Bell curve. Free from this constraint, the frequencies of archeological components across the study area, which may adhere to any number of distributions, are tested for

independence. Test findings show that the variables of individual chronological components and physio-sheds are unrelated and independent. However, group into Paleoindian/Archaic and Woodland I/Woodland II, the χ^2 test shows that in these broader groups, chronologic components and physio-sheds are related and dependent.

The results of the χ^2 tests suggest a difference in the settlement patterns of Paleoindian and Archaic components versus Woodland components. However, a note should be made regarding the sample sizes used in these tests. First, Woodland sites outweigh Paleoindian and Archaic sites pretty handily creating a bit of a skewed distribution, but the overall sample size is not large enough to sub-sample. Secondly, the χ^2 test approximated distribution is not as reliable if there are many instances of low expected values. In the case of the first test, nearly 30 percent of the expected values are below a frequency of five. In order to gain confidence in the χ^2 test results, a G-Test (Sokal and Rohlf 1994), a log-likelihood test similar to the χ^2 test but better able to handle small sample sizes, is used as a second opinion. In both test cases (Table 7 and Table 8), the G-Test result confirmed the χ^2 test findings of statistical significance (Table 7: (G) = 18.1908, df = 15, p-value = 0.2528; Table 8: (G) = 16.001, df = 5, p-value= 0.006841).

The use of bivariate scatter plots helped to test the independence of archeological site locations measured by the five environmental variables across watersheds and to assess the likeness of prehistoric sites Airpark East and Airpark West to either watershed. While still quantitative, the scatter plots are more visual than statistical in analytic capacity. The interpretation of the point clouds, linear fit lines, and R^2 values suggest two things. First, for the variable combinations of distance to streams plotted against distance to wetlands, elevation versus distance to wetlands, and to a lesser degree TWI versus distance to streams all have linear regression lines and trends that suggest the archeological sites in the St. Jones and Leipsic occupy mildly discernable landforms. Second, the variable combinations of TWI versus distance to streams and TWI versus solar insolation gain suggest that the two sites in the Airpark project area more closely resemble, base on these variables, site locations in the Leipsic watershed.

These tests and observations do not discount the role that environmental background values play in the differentiation of the two watersheds. The intent of the scatter plot analysis is not to find variables the discriminate archeological sites from non-sites. Instead, the intent is to find variables that discriminate archeological sites location in one shed from another, naturally encouraged or not, and assess the fit of the Airpark sites to these variables.

Finally, the hierarchical clustering visualized through the dendrograms reinforced observations derived though other tests. Namely that when taken together Paleoindian and Archaic sites share a similar settlement pattern that differs from a pattern shared by Woodland I and Woodland II sites. Furthermore, the dendrograms show that generally, site location is governed more by physiographic setting than watershed. However, a few clusters that group site locations more closely to watershed than physiography deserve further exploration. Culturally driven settlement pattern dynamics over printing environmental background values may lead to these interesting findings.

Certainly more observations and analysis can be drawn from the test results, but even a quick glance at the findings of these four analytic tests suggests a great utility in this approach. Additionally, with the use of more refined data sets and sophisticated tests, hypothesis proposed at this level can be confirmed or denied. Using the statistical findings as a baseline coupled with the context of the researcher's knowledge, this type of heuristic approach to archeological pattern recognition is highly applicable to many research situations.