ANALYSIS OF HISTORIC SITE SURVEY RESULTS

SITE LOCATION ANALYSIS

The first type of analysis undertaken using the historic site location data for the Route 13 corridor was to consider the placement of historic sites in relation to natural and cultural features of the landscape. Many studies in historical geography have considered the relationship between historic site locations and natural and cultural geographic features; however, most of the studies have considered either limited time periods or limited types of sites (eg. - Carr and Menard 1979; Earle 1975; Earle and Hoffman 1976; Main 1976; Menard 1975). However, the most useful and applicable study, which can be used to guide the analysis of Route 13 data, is James T. Lemon's, The Best Poor Man's Country: A Geographical Study of Early Southeastern Pennsylvania (1972). Lemon's study considers a broad range of criteria which conditioned people's use of space in Lancaster County during the period between 1689 and 1800. Generally, Lemon's analysis proceeds by using broad historical data on population, land use, economics, and ethnic affiliation, from townships in Delaware, Bucks, Northampton, Berks, Lancaster, York, and Cumberland counties to document different patterns of land use. These varied patterns are then related to government land policies, developing economic systems, ethnic-related "cultural" decisions, and the natural environment. Lemon pays much attention to the historic context of historic settlement patterns, such as William Penn's land development plans, ethnic preferences for maintaining contiguous settlements and communities, and the developing pan-Atlantic market economy. However, his analysis of empirical site location data is usually limited to summaries of data at the township level. Site-specific patterns are usually mentioned only as limited examples of trends noted in the analysis of the township data (for an example see Lemon 1972:208-217). Nonetheless, the settlement patterns noted by Lemon can be used to guide the analysis of Delaware site location patterns.

Before utilizing Lemon's study, some comments about the limitations of its applicability should be noted. First, much of the settlement data analyzed by Lemon pertains to Pennsylvania German groups, including the Anabaptist sects whose social structure greatly affected settlement patterns (Lemon 1972:67-69), and these groups are not present in large numbers in Delaware. Nevertheless, southeastern Pennsylvania was a large scale multi-ethnic community (Lemon 1972:43-49) as was much of northern Delaware (Schwartz 1982). However, the southern Coastal Plain areas of Delaware were more ethnically homogeneous with English and Scotch-Irish being the most numerous (Munroe 1984:55-57). An additional limitation of the applicability of Lemon's analysis is based on the pronounced physiographic and geologic differences between the Piedmont Uplands and Lancaster-Fredrick Lowlands of southeastern Pennsylvania and the High Coastal Plain setting of the Route 13 project area. Because of the complex local geology of the Piedmont, the soils of Lancaster County are very diverse in terms of their morphogenesis and their agricultural productivity. Futhermore, the limestone/dolomite soils of the Lancaster Plain are some of the most fertile on the continent. In contrast, as a whole, the soils of the Delaware High Coastal Plain are less diverse and less productive given the agricultural technologies of the 18th and 19th centuries (Craven 1925; Gray 1933). It should also be noted that the lower amount of topographic relief in the Delaware Coastal Plain lowers the variability of terrestrial natural resources. However, this reduced variability is counter-balanced by the productive marshlands of the Delaware Coastal Zone. In sum, there are some important cultural and natural differences between Lemon's study area and the Route 13 study area. Nevertheless, Lemon's results can be used as a guide for exploratory analysis of Delaware historic settlement patterns. In fact, the analysis of the Route 13 data can be looked upon as a test of Lemon's description of general factors which have affected historic settlement patterns.

Lemon (1972:69) makes the following statement regarding settlement choices in southeastern Pennsylvania:

> By 1760 settlers had occupied most of southeastern Pennsylvania westward and northward from Philadelphia, the chief point of arrival from Europe. These colonists on land not previously occupied by white men responded to several forces in choosing sites. The distribution of national and denominational groups suggests that many settlers sought holdings next to those of the same regional background in Europe, and persons of the same theological persuasion. But substantial parts of the area contained a variety of groups; thus, other factors were also at work, notably actions of the proprietors and their agents, soil quality, availability of land, access to markets, and immigrants' time of arrival.

Because Delaware was not a part of Penn's proprietorship for as long as southeastern Pennsylvania was, and because Penn's system of control of land grants was notoriously ineffective (Lemon

1972:69), the effects of the proprietorship will not be considered in this study. Futhermore, the role of ethnic affiliations will not be considered because the particular study area is relatively ethnically homogeneous and because, as Lemon notes, other factors seem to be more important. The factors which will be considered are soil quality, access to markets via transportation networks, and immigrants' time of arrival. Consideration of time of arrival will also account for availability of land, for availability should obviously decrease through time.

The specific goal of this analysis will be to consider the variation of historic settlement patterns with respect to the following variables; soil setting, surface water setting, and transportation access. These attributes were recorded for each historic site location in the Route 13 study area and then crosstabulated with the site attributes recorded in Tables 9-11 by time periods. In many ways, the analyses described here are an exploration of possible sources of variation rather than an explicit test of hypotheses. In a certain sense, the analysis presented here will seek to see if any of these variables are "culturally relevant" (Chenhall 1975) with regard to historic settlement patterns. The methods used will focus on the empirical site data and will look for changes in site attribute relationships through time and at different functional site types. These methods are similar to those applied to prehistoric site location data (Custer 1979; 1980). Before the results of the exploration are presented, a more detailed discussion of the attributes is presented below.

Soil Settings. Consideration of soil productivity is an integral part of Lemon's analysis and will be included here. Lemon primarily considers the agricultural productivity of varied soils in his analysis, but it is usually done on a limited basis. This analysis of the Route 13 data will consider four aspects of soil settings: agricultural productivity, grazing productivity, woodlot productivity, and hunting/trapping/fishing productivity.

The USDA soil capability rating series for New Castle County (Matthews and Lavoie 1970:40-50) was used to measure agricultural productivity. Capability ratings show the suitability of various soil series for field crops, primarily corn and grains. Because wheat, corn and other grain crops, are important crops in the 18th and 19th centuries (Munroe 1984:58; Main 1973), the USDA capability ratings may be meaningfully applied to the analysis of historic settlement patterns. A total of eight different soil capability classes are noted in the USDA survey. For this study, the percentage of Class I soils within a 100 acre circle around the agricultural sites was recorded. Class I soils were considered because only these soils have few limitations that restrict their use. Given the low level of agricultural technology during much of the 18th and part of the 19th century (see discussion in Coleman et al 1984:28-43 and Craven 1925) these would have surely been the most productive settings for agriculture. For the High Coastal Plain, Class I soils include the Mattapeake, Mattapex, and Sassafras soil series all of which are deep and well-drained. A 100 acre catchment was used because this size area corresponds to the average size of farms in the region during the 18th and 19th centuries (Munroe 1954:19; Ball and Walton 1976:105).

Because animal husbandry was part of most agricultural enterprises in New Castle County (Bidwell and Falconer 1941: 84), soil productivity for grazing within a 100 acre catchment was also considered. Assessment of soil productivity for grazing was accomplished using the USDA wildlife capability ratings (Matthews and Lavoie 1970:52-57). One set of ratings considers the capacity of soils for supporting grasses and legumes such as lespedeza, alfalfa, clover, tall fescue, broomgrass, bluegrass, and timothy. Lemon (1972:159) notes the use of these grazing covers during the 18th and 19th century underscoring the validity of the use of this rating system. The percentage of any of the following soil series, which are all well-suited to grasses and legumes, was noted: Butlertown, Collington, Keyport, Mattapeake, Mattapex, Sassafras, or Woodstown.

Soil productivity for woodlots was also considered because firewood and building lumber were important resources during the 18th and 19th centuries (Munroe 1984:58). USDA woodland suitability ratings (Matthews and Lavoie 1984:50-52) were used for analysis and the percentage of Woodland Suitabiliby Group 10 within the 100 acre catchment was recorded. This group includes the Butlertown, Keyport, Mattapeake, Mattapex, Rumford, and Sassafras series which are well drained and moderately well-drained soils. These series are the best suited for oak, other hardwoods and loblolly pine, which are preferred sources of lumber and firewood.

The final group of soils considered included soils that would be most productive for hunting, trapping, or fishing. Some studies (Lafferty et al. 1981) have considered this aspect of historic subsistence, and some historic archaeological studies from the Southeastern United States (Lewis 1984; Otto 1984) and the Middle Atlantic (King and Miller 1984) have suggested that hunting, trapping and fishing might have been an important component of rural subsistence economies which could have affected historic settlement patterns. In order to measure wildlife productivity, the USDA wildlife capability ratings (Matthews and Lavoie 1970:52-57) were utilized. A preliminary analysis of the various wildlife ratings showed that almost all soils in the study area had a high rating for woodland and openland wildlife. However, wetland wildlife ratings showed more variability and were, therefore, used in the analysis. The percentage of the following soil series within the 100 acre catchment was noted: Bayboro, Elkton, Fallsington, Mixed alluvial land, Othello, Pocomoke, or tidal marsh.

Before considering the relationship of historic site locations to soils of varying productivity, it is important to know the natural distribution of soil types within the study area. For example, it may be seen that farmstead sites contain high percentages of highly productive soils. However, if these highly productive soils are common throughout the study area, their association with site locations may be entirely fortuitous. Table 39 shows the total acreage and percentage within all New

TABLE 39

TOTAL STUDY AREA HISTORIC SOIL TYPE FREQUENCIES

	Acres	%
Agricultural		
Class I	87,959	42
Others	122,825	58
Grazing		
Highest Prod.	112,347	53
Others	98,437	47
Woodlot		
Highest Prod.	105,482	50
Others	105,302	50
Hunting, etc.		
Highest Prod.	80,914	38
Others	129,870	62

Total High Coastal Plain soil acreage - 210,784

Castle County High Coastal Plain soils for each soil grouping of interest. It can be seen that there is a fairly even distribution of soils of interest and others in the study area, except in the case of the hunting/trapping/fishing case. These soils have a slightly more restricted ditribution.

An additional prerequisite to analysis of the soil distributions was a consideration of the statistical distribution of the soil percentage frequencies. Table 40 shows Q-Q correlation statistics for all four percentages and each has a normal, or near-normal, distribution. Therefore, parametric analytical techniques can be used.

The first soil capacity considered in this analysis is for agricultural crops. Table 41 shows a series of descriptive statistics of the percentage of Class I (highly productive) soils found at historic sites of various data sets. The data sets noted include the total sample of agricultural related sites,

TABLE 40

Q-Q STATISTICS - HISTORIC SOIL DATA

Variable	n	Q-Q	P
WoodLot	144	.9561	$.05 < p < .10$
Crops	144	.9669	$.05 < p < .10$
Grazing	144	.9338	$.10 < p < .15$
Hunting	144	.9214	$.01 < p < .05$

four ranges of dates, three rural site functional classes, and each site functional type for each time period. The functional site types are based on the historic site function typology used in the original report (Custer et al. 1984:22-24). The age classes are derived from the atlas entries for sites and can be roughly equated with pre-19th century, first half of the 19th century, middle third of the 19th century, and final quarter of the 19th century. Although these age ranges do not necessarily correspond with significant historical periods, they do provide a rough measure of changes through time for historic site locations without requiring an undue amount of archival research to date sites and structures.

The first analysis undertaken was to see if high quality agricultural soils were indeed preferred by historic peoples. Almost all of the mean values (Table 41) show more than half of the 100-acre agricultural catchments composed of Class I soils. However, Table 39 shows that Class I soils account for almost half of the area of the Delaware High Coastal Plain. It is important to know if the mean percentage values noted in Table 41 could have arisen by chance alone, given the wide distribution of Class I soils, or if they were the result of human selection. Put another way, did historic people actually seek out productive agricultural soils, or did they just happen to settle on areas with lots of Class I soils because lots of places had Class I soils? A difference-of-proportion test was used to compare the various site percentage values for Class I soils with the total distribution percentage of Class I soils within the Delaware High Coastal Plain. The percentage values which show a significant difference are marked with an asterisk in Table 41. In all but one case, dwelling complexes (non-agricultural) of the period between 1849-1868, there are significantly high percentages of Class I soils among the historic sites. This pattern suggests that historic settlers sought out productive agricultural land.

Given that historic groups did indeed seek out high quality agricultural soils, the data in Table 41 can be used to investigate changes in site selection with respect to Class I soils through time. Also, differences among varied functional classes of sites, such as the one just noted, may be investigated more thoroughly.

TABLE 41

AGRICULTURAL SOIL CAPACITY - DESCRIPTIVE STATISTICS

Data Set	N	Mean	Std. Dev.	Skew	Kurtosis
Total	144	66.01	25.75	-.80	3.01
p1802	4	64.13*	37.10	-.61	1.82
1802-1849	54	70.72*	21.57	-.62	2.98
1849-1868	66	63.65*	27.66	-.77	2.70
1868-1893	15	66.57*	26.14	-1.12	3.88
AGCX	83	65.65*	23.28	-.58	2.93
DWCX	17	49.60*	36.50	-.15	3.50
AGTEN	42	73.20*	22.68	-1.18	3.80
AGCX, P1802	4	64.13*	37.10	-.61	1.82
AGCX, 1802-1849	46	71.73*	20.19	-.39	2.48
AGCX, 1849-1868	23	58.90*	23.81	-.63	2.90
AGCX, 1868-1893	6	59.23*	18.55	-.27	2.32
DWCX, P1802	0	-----	-----	-----	----
DWCX, 1802-1849	0	-----	-----	-----	----
DWCX, 1849-1868	11	43.69	37.08	.09	1.47
DWCX,1868-1893	5	62.91*	39.66	-.79	2.29
AGTEN, P1802	0	-----	-----	-----	----
AGTEN, 1802-1849	7	67.73*	30.41	-1.11	2.96
AGTEN, 1849-1868	31	73.29*	22.23	-.94	4.16
AGTEN, 1868-1893	4	82.15*	8.11	-.71	2.09

* - significant difference

Table 42 shows a series of difference-of-mean test statistics for changes in Class I soil percentages through time. Changes through time are noted for all site types, agricultural

TABLE 42

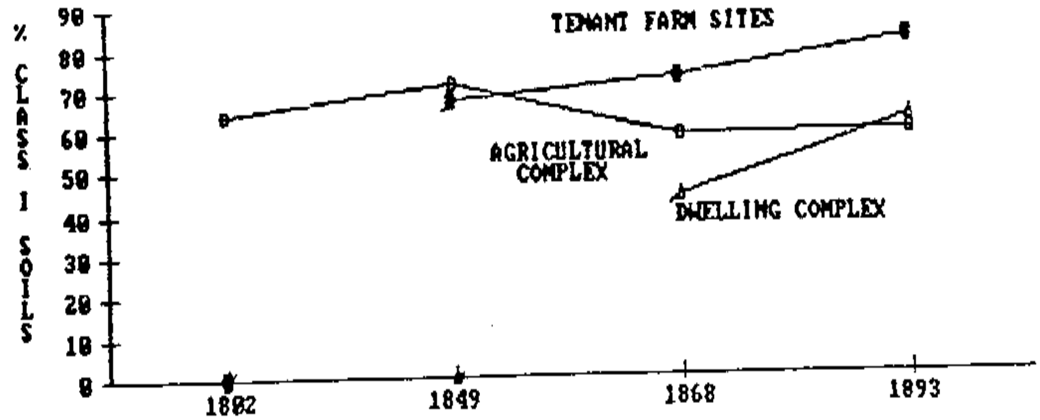
SIGNIFICANCE TESTS FOR CLASS I AGRICULTURAL SOILS PERCENTAGES THROUGH TIME

Time Period Comparison	Total Data	AGCX	DWCX	AGTEN
p1802 and 1802-1849	.351	.404	----	-----
1802-1849 and 1849-1868	1.572	2.216*	----	.457
1849-1868 and 1868-1893	.386	.004	.917	1.557

---- - No Data
* - Significant Difference (p <.10)

FIGURE 45

Class I Soils Percentages Through Time



complexes, non-agricultural dwelling complexes, and agricultural tenant sites. Figure 45 shows the same changes through time. Values for agricultural complexes show minimal change through time; however, a significant reduction in percentages of high productivity soils is seen around the middle of the 19th century (ca. 1850-1860). The limited data on non-agricultural dwelling complexes show no significant differences. Similarly, there are no significant changes through time for tenant farm complexes.

Significant differences can also be noted when comparing the varied site types' Class I soil percentages for different time periods (Table 43). When the total data are considered, the dwelling complexes show significantly lower percentages of Class I soils compared to tenant farm locations, as was noted earlier and as would be expected. For the 1802-1849 time period, the limited data show no significant differences. Between 1849 and 1868, the non-agricultural dwelling complexes show lower percentages of Class I soils than all other site types. For the 1868-1893 time period, non-agricultural dwelling complexes continue to show a lower percentage of Class I soils than agricultural tenant complexes and agricultural sites.

These data show that there are some interesting trends in historic site distributions with respect to agricultural soils of high productivity. The reduction in Class I soil percentages seen at agricultural sites through time probably reflects the simple reduction of availability of areas with high quality soils. As populations grew through the 19th century, availability of good land decreased. The data studied here indicate that a critical point was reached in southern New Castle County during the 1850's. Non-agricultural dwelling complexes

TABLE 43

SIGNIFICANCE TESTS FOR CLASS I AGRICULTURAL SOILS PERCENTAGES BY SITE TYPES

Total Data

AGCX	----		
DWCX	1.741	-----	
AGTEN	1.742	2.479*	------
	AGCX	DWCX	AGTEN

1802-1849

AGCX-AGTEN	.337

1849-1868

AGCX	----		
DWCX	2.259*	----	
AGTEN	1.243	2.493*	----
	AGCX	DWCX	AGTEN

1868-1893

AGCX	----		
DWCX	1.057	----	
AGTEN	.191	2.668*	----
	AGCX	DWCX	AGTEN

* - significant difference ($p < .10$)

originally have significantly lower percentages of highly productive soils; however, later non-agricultural dwelling sites do have high percentages of Class I soils. This pattern suggests that the earliest peoples coming into the area for non-agricultural pursuits did not select productive land for settlement. Either only small-scale subsistence farming, which did not require extensive use of Class I soils, was practiced by these peoples, or, these people had sufficient capital to buy food beyond what was grown at home. Nonetheless, after 1868 the non-agricultural dwelling complexes do show significantly higher proportions of Class I soils. Either a change in subsistence activities, or a change in the availibility of cash among later settlers who were not involved in agriculture could explain this pattern for southern New Castle County. Similar patterns are noted in a study of agricultural production and soil fertility in New Hampshire (Hamburg 1985).

Location of historic sites in relation to soils which are highly productive for woodlots was analyzed in a manner similar to that used for agricultural soils. Table 44 shows the mean percentages of soils of high woodlot productivity for various data sets. A difference of proportion test was applied to all of the percentages to see if the values were significantly higher than the natural distribution of high productivity woodlot soils. All of the percentages are significantly higher than the natural distribution percentage indicating that the historic sites are correlated with the high productivity woodlot soils.

TABLE 44

WOODLOT SOIL CAPACITY - DESCRIPTIVE STATISTICS

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	144	72.53*	23.61	-.90	3.09
p1802	4	64.13*	37.10	-.61	1.82
1802-1849	54	76.11*	20.57	-.95	3.38
1849-1868	66	71.86*	23.89	-.87	2.98
1868-1893	15	71.58*	24.38	-.68	2.43
AGCX	83	71.07*	22.67	-.70	2.83
DWCX	17	59.28*	29.54	-.36	2.09
AGTEN	42	79.57*	20.39	-1.47	4.69
AGCX, P1802	4	64.13*	37.10	-.61	1.82
AGCX, 1802-1849	46	76.54*	19.19	-.73	2.80
AGCX, 1849-1868	23	67.49*	22.01	-.32	2.16
AGCX, 1868-1893	6	62.08*	20.23	-.40	2.12
DWCX, P1802	0	----	----	----	----
DWCX, 1802-1849	0	----	----	----	----
DWCX, 1849-1868	11	54.66*	30.53	-.25	1.98
DWCX, 1868-1893	5	68.27*	31.49	-.51	1.89
AGTEN, P1802	0	----	-----	----	----
AGTEN, 1802-184	7	69.81*	28.87	-1.07	2.80
AGTEN, 1849-186	31	80.43*	18.77	-1.28	4.02
AGTEN, 1868-189	4	90.00*	10.91	-.79	2.13

* - significant difference (p <.10)

Trends through time and differences among varied site types were analyzed and Table 45 shows the difference-of-mean tests for changes through time. No significant changes through time are indicated.

TABLE 45

SIGNIFICANCE TESTS FOR WOODLOT SOILS PERCENTAGES THROUGH TIME

Time Period Comparison	Total Data	AGCX	DWCX	AGTEN
p1802 and 1802-1849	.639	.661	----	-----
1802-1849 and 1849-1868	1.047	1.679	----	.930
1849-1868 and 1868-1893	.004	.573	.809	1.492

---- - No Data

Table 46 shows the distributions of woodlot soil percentages for various site classes during different time periods. The total data show some significant differences among site classes. The percentage of high quality woodlot soils among tenant sites

TABLE 46

SIGNIFICANCE TESTS FOR WOODLOT SOILS PERCENTAGES BY SITE TYPES

Total Data

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.555	----	
AGTEN	2.119*	2.593*	------

1802-1849

AGCX-AGTEN	.597

1849-1868

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.247	----	
AGTEN	2.272*	2.639*	----

1868-1893

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	.379	----	
AGTEN	2.821*	1.439	----

* - significant difference

is significantly higher than for either non-tenant agricultural dwelling sites or non-agricultural dwelling sites. A similar pattern is noted for sites dating to the 1849-1868 time period and the high productivity woodlot soils percentages for tenant sites are also high during the 1868-1893 period. Because there is a large amount of overlap among the high productivity wood lot and agricultural soil types, it is not clear how closely these patterns of wood lot soil proportions are related to agricultural site selection patterns. A discussion of these relationships will be deferred until later when the results of a factor analysis can be presented.

Table 47 shows the descriptive statistics for proportions of high productivity grazing soils. All but one proportion that for 1849-1868 non-agricultural dwellings, are significantly higher than the total proportions for the High Coastal Plain according

TABLE 47

GRAZING CAPACITY - DESCRIPTIVE STATISTICS

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	144	73.89*	24.51	-1.22	3.91
p1802	4	71.41*	26.05	-.37	1.61
1802-1849	54	78.88*	19.34	-1.09	3.50
1849-1868	66	72.02*	26.46	-1.18	3.56
1868-1893	15	72.02*	27.40	-1.30	4.08
AGCX	83	72.95*	23.08	-1.05	3.63
DWCX	17	56.04*	34.40	-.45	1.86
AGTEN	42	81.82*	18.44	-1.50	4.56
AGCX, P1802	4	71.41*	26.05	-.37	1.61
AGCX, 1802-1849	46	78.60*	19.08	-1.06	3.53
AGCX, 1849-1868	23	66.89*	26.06	-.83	3.12
AGCX, 1868-1893	6	67.06*	21.18	-.89	2.55
DWCX, P1802	0	----	-----	----	----
DWCX, 1802-1849	0	----	-----	----	----
DWCX, 1849-1868	11	53.11	35.11	-.36	1.63
DWCX, 1868-1893	5	63.93*	39.22	-.82	2.34
AGTEN, P1802	0	----	-----	----	----
AGTEN, 1802-1849	7	77.66*	22.23	-1.14	3.09
AGTEN, 1849-1868	31	81.76*	18.45	-1.51	4.63
AGTEN, 1868-1893	4	89.57*	11.71	-.84	2.15

* - significant difference

to difference-of-proportion tests. Table 48 shows results of significance sites for changes in grazing soils percentages through time. Only one significant difference, a decrease ca.

TABLE 48

SIGNIFICANCE TESTS FOR GRAZING SOILS PERCENTAGES THROUGH TIME

Time Period Comparison	Total Data	AGCX	DWCX	AGTEN
p1802 and 1802-1849	.562	.540	----	-----
1802-1849 and 1849-1868	1.638	1.913*	----	.454
1849-1868 and 1868-1893	0.000	.017	.528	1.161

---- - No Data
* - Significant Difference

TABLE 49

SIGNIFICANCE TESTS FOR GRAZING SOILS PERCENTAGES BY SITE TYPES

Total Data

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.939*	-----	
AGTEN	2.328*	2.925*	------

1802-1849

AGCX-AGTEN	.106

1849-1868

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.158	----	
AGTEN	2.336*	2.582*	----

1868-1893

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	.166	----	
AGTEN	2.155*	1.387	----

* - significant difference

1850 for agricultural complex sites, is noted. Table 49 shows test statistics for different site types during different time periods. For the total data, there are significant differences among all site types. Tenant sites have the highest proportions and non-tenant agricultural sites have a higher proportion than non-agricultural dwelling complexes. For the 1849-1868 data, tenant sites have significantly higher percentages of grazing soils than any other site types. A similar pattern is noted for the 1868-1893 time period. Again, the overlap of grazing and agricultural soils is high and a discussion will be deferred until later.

The final soil data considered were those associated with high productivity wildlife settings. Table 50 shows the descriptive statistics for various data sets and difference-of-

TABLE 50

HUNTING CAPACITY - DESCRIPTIVE STATISTICS

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	144	20.54*	20.52	1.36	4.37
p1802	4	28.59*	26.05	.37	1.61
1802-1849	54	16.47*	16.54	1.48	4.81
1849-1868	66	20.61*	20.53	1.21	3.78
1868-1893	15	21.92*	23.86	1.29	3.59
AGCX	83	21.66*	20.25	1.24	4.22
DWCX	17	32.08*	25.78	.73	2.53
AGTEN	42	13.22*	16.12	1.96	6.41
AGCX, P1802	4	28.59*	26.05	.37	1.61
AGCX, 1802-1849	46	17.60*	17.48	1.32	4.16
AGCX, 1849-1868	23	22.78*	18.03	.82	3.12
AGCX, 1868-1893	6	29.18*	22.73	.98	2.77
DWCX, P1802	0	----	----	----	----
DWCX, 1802-1849	0	----	----	----	----
DWCX, 1849-1868	11	34.12*	26.05	.68	2.43
DWCX, 1868-1893	5	27.21*	30.32	.91	2.51
AGTEN, P1802	0	----	----	----	--
AGTEN, 1802-1849	7	11.39*	6.39	.11	1.44
AGTEN, 1849-1868	31	14.77*	18.23	1.63	4.78
AGTEN, 1868-1893	4	17.70*	3.12	-.82	2.03

* - significant difference

proportion tests show that all of the observed proportions are lower than the natural proportions of the High Coastal Plain. This finding would seem to indicate that selection of high productivity wildlife soils was not an important factor in historic site selection for the study area. Table 51 shows significant test data on wildlife soils through time and no significant differences are noted. Table 52 shows the same data for functional site types. The total data show that tenant sites

TABLE 51

SIGNIFICANCE TESTS FOR WILDLIFE SOILS PERCENTAGES THROUGH TIME

Time Period Comparison	Total Data	AGCX	DWCX	AGTEN
p1802 and 1802-1849	.917	.828	----	-----
1802-1849 and 1849-1868	1.223	1.136	----	.831
1849-1868 and 1868-1893	.197	.639	.441	.808

---- - No Data

TABLE 52

SIGNIFICANCE TESTS FOR WILDLIFE SOILS PERCENTAGES BY SITE TYPES

Total Data

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.570	-----	
AGTEN	2.530*	2.803*	------

1802-1849

AGCX-AGTEN	1.758

1849-1868

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	1.302	----	
AGTEN	1.607	2.274*	----

1868-1893

	AGCX	DWCX	AGTEN
AGCX	----		
DWCX	.120	----	
AGTEN	1.220	.697	----

* - significant difference

types of rural sites. Changes in soil correlations through time reveal some interesting trends which seem to be restricted to agricultural soils. Where there are other changes in soil proportions through time, such as in wood lot or grazing soils, they are not as clear-cut and only mirror trends in the agricultural soils proportions. The absence of a correlation with wildlife soils suggests that hunting, trapping, and/or fishing were not important subsistence activities during the 19th century. At least, these activities were not important enough to affect site selections. Furthermore, the absence of game animals in 19th century rural faunal assemblages from northern Delaware (eg. Coleman et al. 1984) supports this contention.

One of the most interesting sidelights of this analysis is the fact that the high productivity soil settings are similar to those used to map edaphic soil zones in analyses of prehistoric site locations (Eveleigh et al. 1983; Wells 1981). These soil zones have been mapped using LANDSAT multispectral scanner data and it is possible that the correlations between soil types and site locations could be used to develop historic site prediction models using LANDSAT data.

Surface Water Setting. Although water collection technologies of the European settlers of the historic period were more advanced than those of the prehistoric groups, access to fresh water was an important factor in settlement. Lemon (1972:63) notes that in southeastern Pennsylvania most settlers were probably more concerned with accessible water supplies than with soil qualities and that most settlers wanted to avoid digging wells. Consequently, springs and permanent streams were preferred site locations. In the Delaware Coastal Plain, fresh water is an even more critical resource given the brackish nature of the major watercourses and the low moisture-retention capacity of some of the major soil associations (Brush 1982). In order to measure the effects of surface water setting three variables were measured: type of surface water setting, presence/absence of stream confluences, and distance to nearest fresh water.

Four basic types of surface water setting were recorded for historic site locations: flowing stream, ephemeral stream, bay/basin, and bay/basin/stream. Flowing streams and bay/basin-related settings represent extant surface water available to sites' occupants. Ephemeral streams of the High Coastal Plain can be used as indicators of springheads. Tables 54 and 55 show crosstabulations of the varied surface water settings with site age and site function. The chi-square test statistics show that there are no dependent relationships between the variable combinations. The crosstabulations do show that flowing and ephemeral streams are the most common surface water settings associated with historic sites. Although bay/basins are at times associated with historic sites, they are not commonly associated with historic sites and, presumably, they are not preferred historic settlement locations. The absence of dependent relationships in the crosstabulations indicates that these trends in location are constant through time among all functional site types.

have significantly lower percentages of wildlife soils than either of the other site types.

As was noted earlier, there is overlap of the constituent soil series that make up the varied soil capability classes used in this analysis. A factor analysis was undertaken to ascertain the degree of this overlap before the analytical results can be discussed. Table 53 shows the results of the factor analysis. The principal factor loadings matrix shows that in general all four soil classifications correlate with a single factor. However, grazing and wildlife soils show negative correlations with the second factor. The negative correlation with Factor II is highest for the high productivity wildlife soils. The zero-one cluster-centroid matrix, which highlights differential factor correlations among the variables shows that Woodlot and Agricultural soils are most closely correlated while grazing and wildlife soils are correlated.

TABLE 53

FACTOR MATRICES - HISTORIC SITE SOIL DATA

	Zero-One Cluster-Centroid Matrix		Principal Factor Loadings Matrix	
Soil Types	Factor I	Factor II	Factor I	Factor II
Wood Lot	0	1	.9868	.2005
Agricultural	0	1	.9752	.2390
Grazing	1	0	.9706	-.0969
Wildlife	1	0	.9229	-.3650

The factor analysis shows that there is a high degree of similarity among all the soil capability ratings; however, woodlot and agricultural soils are most closely related as are grazing and wildlife soils. The high productivity woodlot and agricultural soils are generally the best-drained while grazing soils are somewhat more poorly drained. High productivity wildlife soils are the most poorly drained. The correlations of historic site locations and high productivity agricultural and woodlot soils are probably monitoring the same soil characteristics; namely, well drained (but not excessively well-drained) soils with high degree of moisture retention and high organic content. High proportions of high quality grazing soils represent a similar selection factor, but the discrimination is not as distinctive. High productivity wildlife soils with low proportions show an avoidance of the poorly drained soils.

In sum, of the soil data considered high productivity agricultural soils are the most restrictive soils that can be correlated with rural historic site locations of all periods. Except for a few instances, the correlations hold for almost all

TABLE 54

CROSSTABULATION OF HISTORIC SITE AGE AND SURFACE WATER TYPE

Age	Surface Water Flow.Stream	Eph.Stream	Bay/Basin	Bay./Basin/Str.
p1802	5	4	0	0
1802-1849	35	20	5	7
1849-1868	41	19	7	9
1868-1893	9	8	1	6

Chi-square=5.90 d.o.f.=3 p>.10

TABLE 55

CROSSTABULATION OF HISTORIC SITE AGE AND SURFACE WATER TYPE

Function	Surface Water Flow. Stream	Eph. Stream	Bay/Basin	Bay./Basin/Stream
Agricultural	59	43	10	16
Non-agri-cultural	31	8	3	6

0 = 3 $X^2 = 5.90$ $p > .10$

A related variable is the presence/absence of stream confluences at historic site locations. Table 56 shows crosstabulations of stream confluences and site function and date. No dependent relationships are noted and most historic sites (97%) are not associated with stream confluences.

In order to more carefully consider the importance of surface water for historic site locations, the distance to nearest fresh water source was recorded and analyzed for all historic site locations. Before any analysis, water distance measures were examined for normality using the Q-Q test. Table 57 shows the Q-Q statistics for various sets of water distance data and, for the most part, the data sets are not normally distributed. Consequently, parametric analytical techniques cannot be used.

Table 58 shows a series of non-parametric range statistics for various data sets. The very large value of the 75th percentile-maximum range for the total data set indicates that the non-normality of the distributions is caused by a series of outlying, and very high, distance values. When range statistics

TABLE 56

CROSSTABULATIONS OF STREAM CONFLUENCES AND HISTORIC SITE AGE AND FUNCTION

	Confluence	
Function	Absent	Present
Agricultural	124	4
Non-agricultural	46	2

0 = 1 $X^2 = .11$ $p > .10$

Age	Absent	Present
p1802	9	0
1802-1849	63	4
1849-1868	74	2
1868-1893	24	0

0 = 3 $X^2 = 2.64$ $p > .10$

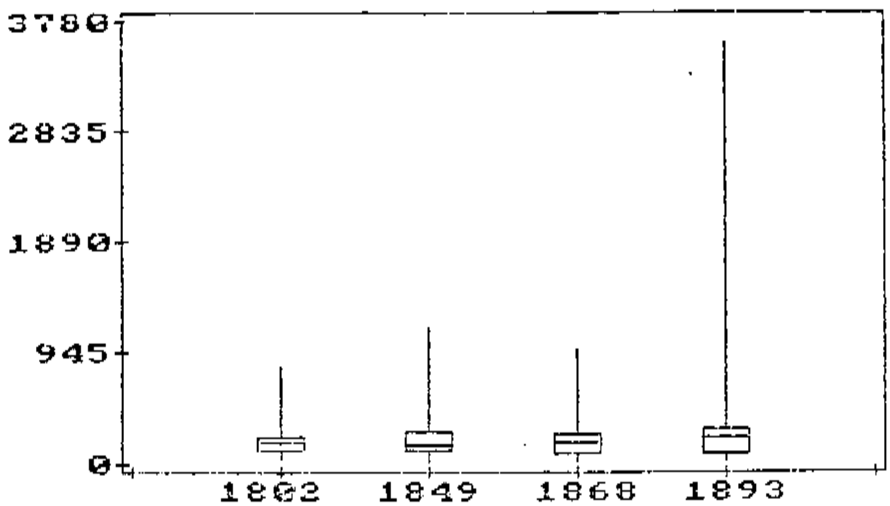
TABLE 57

Q-Q STATISTICS FOR WATER DISTANCE DATA

Data Set	Q-Q Statistic	Probability Value
Total Data	.6946	p > .10
p1802	.8596*	.05 < p < .10
1802-1849	.8695	p > .10
1849-1868	.9103	p > .10
1868-1893	.5686	p > .10
Agricultural	.6879	p > .10
Non-Agricultural	.9358*	.05 < p < .10
Flowing stream	.9026	p > .10
Ephemeral stream	.8649	p > .10
Bay/basin	.9102*	.05 < p < .10
Bay/basin/stream	.5558	p > .10

* - normal distribution

FIGURE 46
Box Plot of Water Distance by Time Period for Historic Sites



for the varied time periods are considered, some trends in the data are apparent. Median values are relatively constant up to 1868; however, for the period from 1868 - 1893 there is a significant increase in the median distance value indicating that more sites are located further away from water during this time period. Furthermore, the box plot of water distances by time period categories noted in Figure 46 shows a marked increase in the overall value ranges for the 1868-1893 time period. This trend may indicate that post-1868 groups had to use less favorable site locations with regard to surface water settings; or, post-1868 groups were more dependent on wells than natural surface water sources. However, even during the post-1868 period, 50% of the historic sites are located within 250 meters of surface sources of fresh water. Therefore, the role of natural surface water seems to be an important part of historic site locations decisions. Wells were important, as evidenced by the increased number of sites in later time periods which are far from surface water sources, but access to fresh surface water was important throughout the 19th century.

FIGURE 47

Box Plot of Water Distance by Site Function for Historic Sites

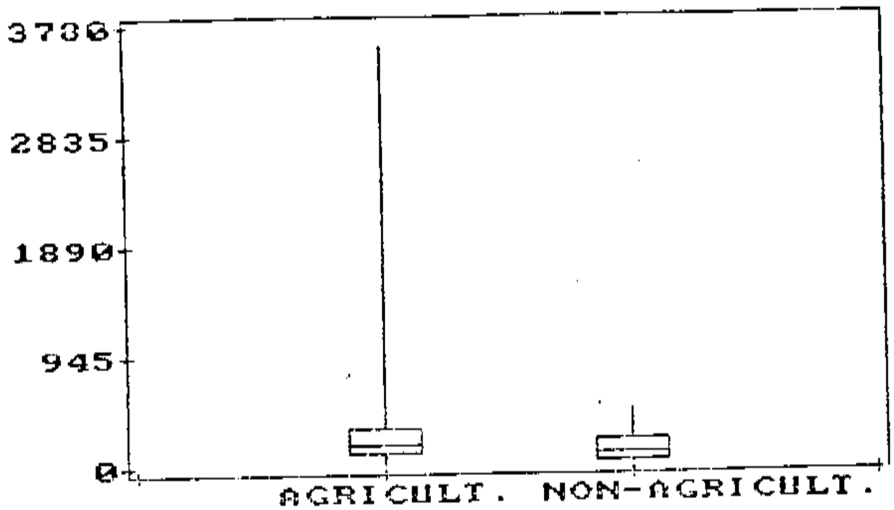


FIGURE 48

Box Plot of Water Distance by Surface Water Type for Historic Sites

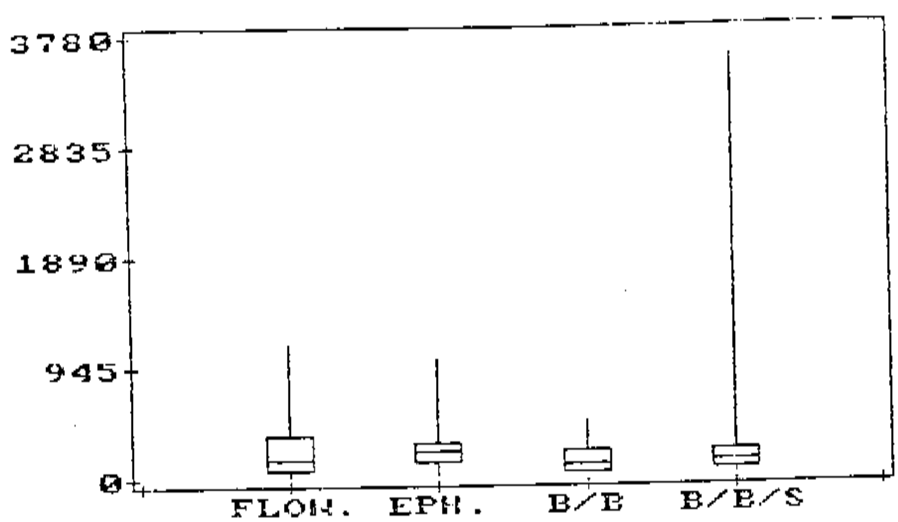


TABLE 58

NON-PARAMETRIC RANGE STATISTICS FOR WATER DISTANCE DATA

Data Set	Min	25th-ile	Median	75th-ile	Max	Range	75th-ile-Max Ra.
Total Data	24	108	192	288	3600	3576	3312
p1802	48	120	192	840	840	792	0
1802-1849	24	120	168	288	1152	1128	864
1849-1868	24	96	180	264	960	936	696
1868-1893	24	96	240	300	3600	3576	3300
Agricultural	24	120	192	312	3600	3576	3288
Non-agricultural	24	48	120	240	480	456	240
Flowing stream	24	72	156	336	1152	1128	816
Ephemeral stream	24	144	240	312	1008	984	696
Bay/basin	48	48	120	240	480	432	240
Bay/basin/stream	24	72	144	240	3600	3576	3360

It should also be noted here that the distance measures used for this analysis were derived particularly for fresh water rather than navigable water. Thus, the proximity to water noted above is related more to potable water than to access to water transportation. The relatively large number of sites associated with ephemeral streams and bay/basins, neither of which are navigable (see Table 54), supports this contention.

Surface water distance data were also analyzed for sites of different functions. The values in Table 58 and the box plot in Figure 47 show that the values are relatively similar for the different functional site types. However, the agricultural sites show the largest range of values.

Varied types of surface water settings were also analyzed for surface water distance and the results shown in Table 58 and Figure 48 reveal that the values are relatively constant. However, the median value for ephemeral streams is larger than those for the other surface water settings. On the other hand, the bay/basin/stream settings show the largest range of distance values.

In sum, surface water settings show important relationships to historic site locations for all types of sites during all time periods. Half of the sites are within approximately 200 meters of a freshwater source and 75% are within 300 meters. During the post-Civil War period, more agricultural sites are located at increasingly large distances from fresh water settings. Also, lower order streams and springs are used more commonly during the post-Civil War time period.

Access to Transportation Networks. One of the important site location factors noted by Lemon (1972:69) is access to markets. Main (1973) has categorized the New Castle County area as a commercial farm community which sold a high proportion of its agricultural produce. Consequently, access to transportation networks was quite important for the maintenance of a successful farm economy. For the study area, there were three main transportation networks available at different time periods: water transportation, the road network, and the railroad system.

Water transportation was the most important transportation method for most of the historic period in the Delmarva and Chesapeake (Earle 1975; Middleton 1953) region because until well into the 19th century the road networks were very poorly developed (Gray 1961:311). Access to water transportation was measured in two ways. The straightline distance from site locations to the nearest navigable water was measured along with the distance to local historically documented landing sites. Landings were chosen for measurement based on an examination of Beer's Atlas. For the Appoquinimink area, distances to Thomas Landing, Stave Landing, Taylor's Bridge, and Blackbird Landing were calculated. Distances to Blackbird Landing, Short's Landing, Fleming's Landing, Eagle Nest Landing, and Brick Store Landing were measured for sites in the Blackbird area. No landing measurements were taken for the sites in the St. Georges area due to the limited number of sites and the proximity of major transshipment points such as Port Penn, St. Georges, and Delaware City.

Although the road networks of the study area were very poorly developed, they were still important transportation corridors throughout the 18th and 19th centuries (Main 1973; Gray 1961). Road networks were so important that in some cases entire farmsteads in Delaware (Coleman et al. 1984; Heite 1984) and New Jersey (Manning 1984) were reorganized and reoriented in response to shifts in road placement. Access to road networks was measured in two ways. First, straightline distance to the closest major road of the 18th and 19th century was measured. The roads used for these measurements were the major trans-peninsular connectors including the major north-south route (Route 13) and various east-west connectors. The roads used for measurements were consistent with those used in the development of predictive zones for the original Route 13 planning study (Custer et al. 1984: Attachments VI and VII). In all cases the roads utilized for measurement were extant at the time the sites were occupied.

As part of the analysis of road networks, distance to major crossroads and transhipment points was also measured. Crossroads used for measurements in the St. Georges area included Port Penn, St. Georges, and Delaware City. For the Appoquinimink area, distances to Port Penn, Odessa, and Smyrna Landing were measured. Smyrna Landing was also the major crossroad measured in the Blackbird area.

Access to rail transportation for post-1850 sites was measured by recording the distance to the nearest railroad depot for structures post-dating 1850, which was the date of the construction of the railroad through the study area (Hayman 1979; Custer et al. 1984:15). Railroad depots were chosen for measurement based on Beer's Atlas. Railroad depots used for analysis in the St. Georges area included Mount Pleasant and St. Georges Station. The major depots studied in the Appoquinimink area were Middletown, Townsend, and Blackbird. In the Blackbird area, the major depots studied were Blackbird, Sassafras (Green Springs), and Clayton.

In all cases where there were multiple measures of transportation network access, such as landings, crossroads, and railroad depots, the minimum distance for each historic site was recorded. Thus, for each site there were both measurements to specific landings, crossroads, and railroad depots and measurements of the minimum distance to each of these major transportation nodes. All of the measures were checked for normal distributions using the Q-Q test and Table 59 shows the results. Most of the distributions are normal and the three which are not normal are still close to normal. Therefore, parametric statistical tests could be utilized.

Table 60 shows the descriptive statistics for minimum navigable water distances for the total data set, varied time periods, and varied functional site types. The large values for the standard deviations and kurtosis and the relatively low skewness values indicate distributions that are centered, yet fairly dispersed. Varied combinations of means were tested for significant differences and the resulting test statistics are noted in Table 61. None of the differences are significant; however, there is a tendency for sites to be located at increasingly greater distances from navigable water through time. This tendency is probably related to the increased use of roads and railroads for transportation through the 19th century (Hayman 1979). It is interesting to note, however, that the shift to alternate transportation networks was a gradual process such that when the varied time periods are compared on a serial basis there are no significant differences. The cumulative difference is significant, nonetheless. There are no apparent differences among the site types.

A related measure is minimum distance to the major landing sites and the descriptive statistics are noted in Table 62 for varied data sets. The distributions are all negatively skewed toward the smaller values and the standard deviations are relatively small compared to the other distance distributions. Table 63 shows the test statistics for difference-of-mean tests among the sites of different functions and time periods. No significant differences are noted. The distances to landings can be compared with distances to navigable water and the results are noted in Table 64. In all cases, the distances to navigable water are smaller indicating that the direct distance to major landings is probably not an important consideration in historic site

TABLE 59

Q-Q STATISTICS FOR TRANSPORTATION ACCESS MEASURES

Variable	Data Set	Q-Q	Probability
Navigable Water Distance	Total Data	.9751*	.05 < p < .10
	p1802	.8171	p > .10
	1802-1849	.9668*	.05 < p < .10
	1849-1868	.9767*	.05 < p < .10
	1868-1893	.9937*	p < .01
	Agricultural	.9676*	.05 < p < .10
	Non-agricultural	.9550*	.05 < p < .10
Road Distance	Total Data	.9751*	.05 < p < .10
	p1802	.9166*	.05 < p < .10
	1802-1849	.9710*	.05 < p < .10
	1849-1868	.9758*	.05 < p < .10
	1868-1893	.9446*	.05 < p < .10
	Agricultural	.9713*	.05 < p < .10
	Non-agricultural	.9739*	.01 < p < .05
Minimum Crossroad Distance	Total Data	.9610*	.05 < p < .10
	p1802	.9292*	.01 < p < .05
	1802-1849	.9649*	.05 < p < .10
	1849-1868	.9621*	.05 < p < .10
	1868-1893	.9365*	.05 < p < .10
	Agricultural	.9646*	.05 < p < .10
	Non-agricultural	.9470*	.05 < p < .10
Minimum Railroad Distance	Total Data	.8833	p > .10
	1849-1868	.9820*	.01 < p < .05
	1868-1893	.9466*	.01 < p < .05
	Agricultural	.8726	p > .10
	Non-agricultural	.9040*	.05 < p < .10
Minimum Landing Distance	Total Data	.9820*	p < .01
	p1802	.9670*	p < .01
	1802-1849	.9775*	.05 < p < .10
	1849-1868	.9812*	p < .01
	1868-1893	.9640*	.01 < p < .05
	Agricultural	.9826*	.05 < p < .10
	Non-agricultural	.9750*	.05 < p < .10

* - normal distribution

TABLE 60

DESCRIPTIVE STATISTICS NAVIGABLE WATER DISTANCE

Data Set	N	Mean	Std.Dev.	Skew.	Kurtosis
Total	176	1394.59	1024.32	.58	2.57
p1802	9	690.67	952.98	1.95	5.57
1802-1849	67	1274.15	933.62	.88	3.28
1849-1868	76	1477.58	1098.28	.42	2.32
1868-1893	24	1732.00	924.75	.21	2.64
Agricultural	128	1426.50	1029.17	.76	2.79
Non-agricultural	48	1309.50	1017.11	.06	1.71

TABLE 61

DIFFERENCE-OF-MEAN TEST STATISTICS - NAVIGABLE WATER DISTANCE

Data Combination	Test Statistic	Probability
p1802 - 1802-1849	1.73	p>.10
1802-1849 - 1849-1868	1.20	p>.10
1849-1868 - 1868-1893	1.21	p>.10
Agricultural - Non-agricultural	.68	p>.10

* - significant difference

TABLE 62

DESCRIPTIVE STATISTICS - MINIMUM LANDING DISTANCE

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	176	3678.82	1974.06	-.28	2.49
p1802	9	5053.00	2274.78	-.60	2.63
1802-1849	67	3373.52	2097.16	-.17	2.11
1849-1868	76	3789.14	1862.79	-.31	2.74
1868-1893	24	3666.42	1692.30	-.69	2.83
Agricultural	128	3502.61	1975.85	-.23	2.39
Non-agricultural	48	4148.73	1910.65	-.41	2.84

TABLE 63

DIFFERENCE-OF-MEAN TEST STATISTICS - MINIMUM LANDING DISTANCE

Data Combination	Test Statistic	Probability
p1802 - 1802-1849	.83	$p > .10$
1802-1849 - 1849-1868	1.39	$p > .10$
1849-1868 - 1868-1893	1.40	$p > .10$
Agricultural - Non-agricultural	.56	$p > .10$

TABLE 64

DIFFERENCE-OF-MEAN TEST STATISTICS - MINIMUM LANDING DISTANCE AND NAVIGABLE WATER DISTANCE

Data Combination	Minimum Landing Distance	Navigable Water Distance	Test Statistics	Probability
	mean(std.dev.)	mean(std.dev.)	13.63	$p < .001$
Total Data	3678.82(1974.06)	1394.59(1024.32)	5.31	$p < .01$
p1802	5053.00(2274.78)	690.67(952.98)	7.49	$p < .01$
1849	3372.52(2097.16)	1274.15(933.62)	9.32	$p < .001$
1868	3789.14(1862.79)	1477.58(1098.28)	4.91	$p < .01$
1893	3666.42(1692.30)	1732.00(924.75)	10.54	$p < .001$
Agricultural	3502.61(1975.85)	1426.50(1029.17)	10.63	$p < .001$
Non-agicul-tural	4148.73(1910.65)	1309.50(1017.11)	9.08	$p < .001$

selection. Distance to roads and site-specific distances to navigable water are more important and meaningful.

Table 65 shows the descriptive statistics for road distance measures and the skewness and kurtosis figures show quite varied distributions. Table 66 shows the difference-of-mean statistics for varied combinations of data and no significant differences are noted. There are no consistent trends through time. Therefore, the mean value for the total data set (1.06 km) can be viewed as a good approximation of the common distance of historic sites from major road transportation routes.

A related measure is the minimum distance to the major crossroads of the area. Table 67 shows the descriptive statistics and the varied skewness and kurtosis coefficients indicate a series of distributions of different shapes and

TABLE 65

DESCRIPTIVE STATISTICS - ROAD DISTANCE

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	176	1056.95	761.26	.26	2.21
p1802	9	1248.00	944.88	-.38	1.65
1802-1849	67	975.76	751.45	.42	2.33
1849-1868	76	1151.37	757.07	.01	1.88
1868-1893	24	913.00	724.45	1.06	4.91
Agricultural	128	1038.56	791.09	.39	2.25
Non-agricultural	48	1106.00	680.66	-.21	2.03

TABLE 66

DIFFERENCE-OF-MEAN TEST STATISTICS - ROAD DISTANCE

Data Combination	Test Statistic	Probability
p1802 - 1802-1849	.93	p>.10
1802-1849 - 1849-1868	.37	p>.10
1849-1868 - 1868-1893	1.24	p>.10
Agricultural - Non-agricultural	1.15	p>.10

TABLE 67

DESCRIPTIVE STATISTICS - MINIMUM CROSSROAD DISTANCE

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	176	6503.98	3709.71	.01	1.55
p1802	9	5068.33	3716.23	.88	2.48
1802-1849	67	6279.24	3542.98	.05	.58
1849-1868	76	6496.14	3643.16	.01	1.55
1868-1893	24	7694.54	4262.96	-.50	1.69
Agricultural	128	6302.59	3657.62	.07	1.59
Non-agricultural	48	7041.00	3832.32	-.15	1.49

compositions. Table 68 shows the difference-of-mean statistics for varied data combinations and one significant difference is noted for the ca. 1868 time period. The significant difference is an increase in crossroads distance for the 1868-1893 time period and this increase is part of a trend of increasing distance which is seen through all time periods. This trend may indicate that the preferred locations closest to crossroads, which were also market and social interaction centers, were settled first. Later people coming to the area had to choose less desirable locations farther from the crossroads, especially during the post-1868 time period. Trends in choices of less than

TABLE 68

DIFFERENCE-OF-MEAN TEST STATISTICS - MINIMUM CROSSROAD DISTANCE

Data Combination	Test Statistic	Probability
p1802 - 1802-1849	.52	p>.10
1802-1849 - 1849-1868	1.39	p>.10
1849-1868 - 1868-1893	2.09	p>.10
Agricultural - Non-agricultural	1.25	p>.10

optimal soils settings also showed similar trends for the post-Civil War time period.

The final distance measure to be considered was distance to railroad depots. Table 69 shows the descriptive statistics and the skewness coefficients show a preponderance of larger values. Table 70 shows the difference-of-mean statistics and the only significant difference noted is between agricultural and non-agricultural sites with the agricultural sites being located significantly closer to railroad depots than non-agricultural sites. Proximity to railroad depots was probably especially important for late-19th century farmsteads given the importance of marketing agricultural products of all types.

TABLE 69

DESCRIPTIVE STATISTICS - MINIMUM RAILROAD DISTANCE

Data Set	N	Mean	Std. Dev.	Skew.	Kurtosis
Total	100	2021.67	2582.25	1.00	2.69
1849-1868	76	3639.26	2399.36	.17	2.06
1868-1893	24	3304.42	2842.65	.52	1.88
Agricultural	68	1846.75	2489.93	1.18	3.23
Non-agricul-tural	32	2488.12	2787.44	.58	1.81

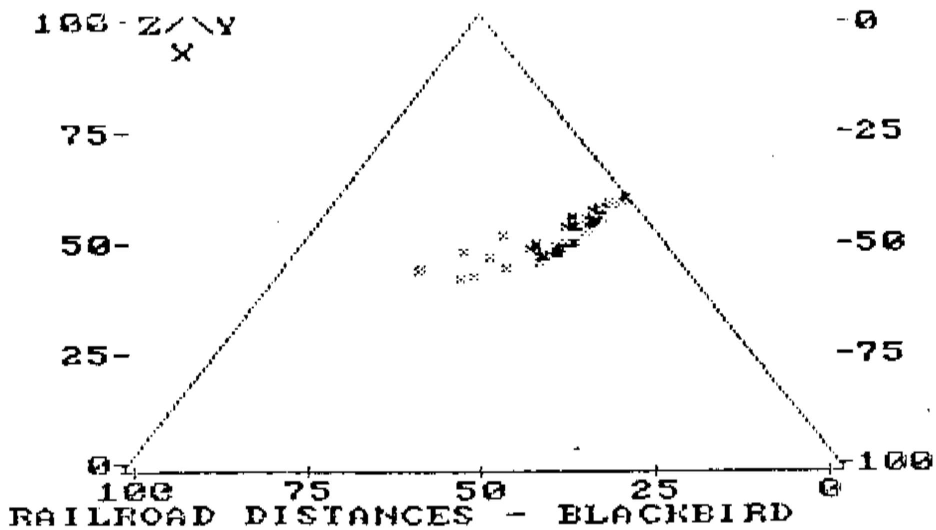
TABLE 70

DIFFERENCE-OF-MEAN TEST STATISTICS - MINIMUM RAILROAD DEPOT DISTANCE

Data Combination	Test Statistic	Probability
1849-1868 - 1868-1893	.30	p>.10
Agricultural- Non-agricultural	1.97	p>.10

* - significant difference

FIGURE 49
Railroad Distances – Blackbird Area



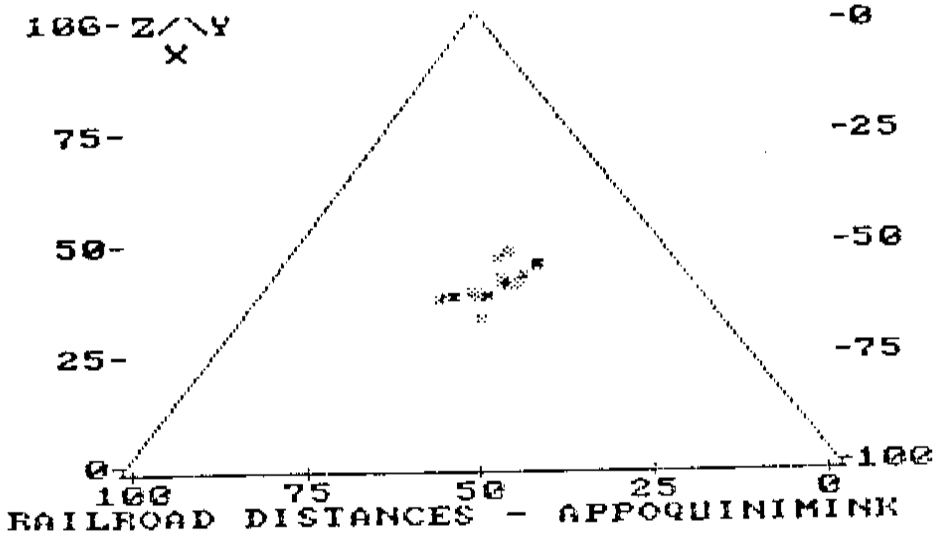
X–Blackbird Y–Sassafras Z–Clayton

In addition to considering the minimum distance data noted above, a series of analyses of distance to specific railroad depots, crossroads, and landings were undertaken for those areas where multiple measurements were available. The analyses consisted of development of three-way scatter plots of the distance measurements to see which of the railroad depots, crossroads, and landings had the largest number of minimum distances. In other words, the analysis sought to identify the railroad depots, crossroads, and landings around which the greatest number of sites clustered. Although proximity to a certain transportation node does not necessarily mean that that particular node was most commonly used, proximity can be used as a rough measure of the relative importance of the various nodes.

Figure 49 shows the scatter plot for railroad depots in the Blackbird area. Most of the sites are closest to Blackbird Station and are relatively evenly spaced between Sassafras and Clayton. Figure 50 shows the scatter plot for railroad distances in the Appoquinimink area. In this case the historic sites are pretty much equidistant from the major railroad depots. It would be interesting to see if there are any differences in the frequency of railroad depot use in the Blackbird area given the fact that Blackbird has more closer sites. Furthermore, it would be interesting to see if there are differences in railroad depot use between the Blackbird and Appoquinimink areas given the differing relationships among historic sites and railroad depots between the two areas.

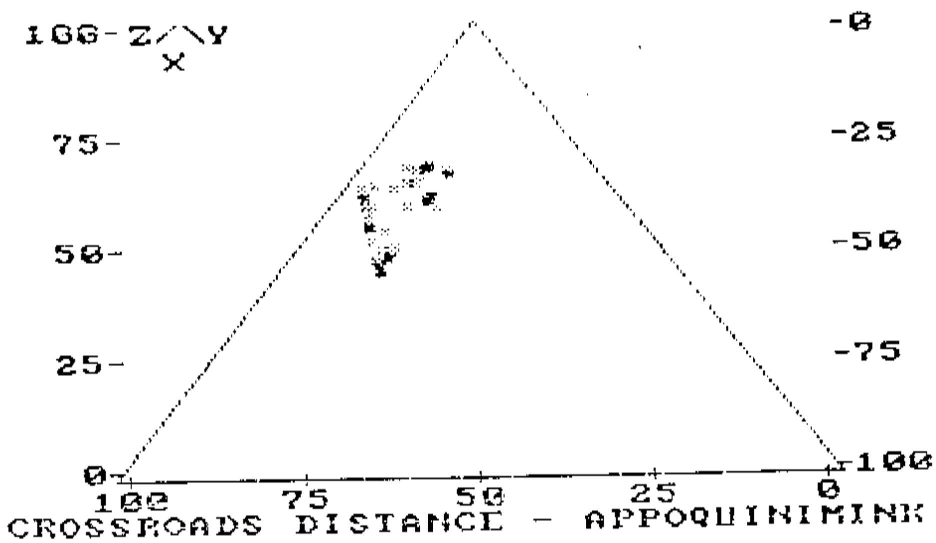
The Appoquinimink area was the only area with sufficient data on proximity to several crossroads and Figure 51 shows the three-way scatter plot of these data. The majority of the historic sites are closest to Odessa as would be expected.

FIGURE 50
Railroad Distances – Appoquinimink Area



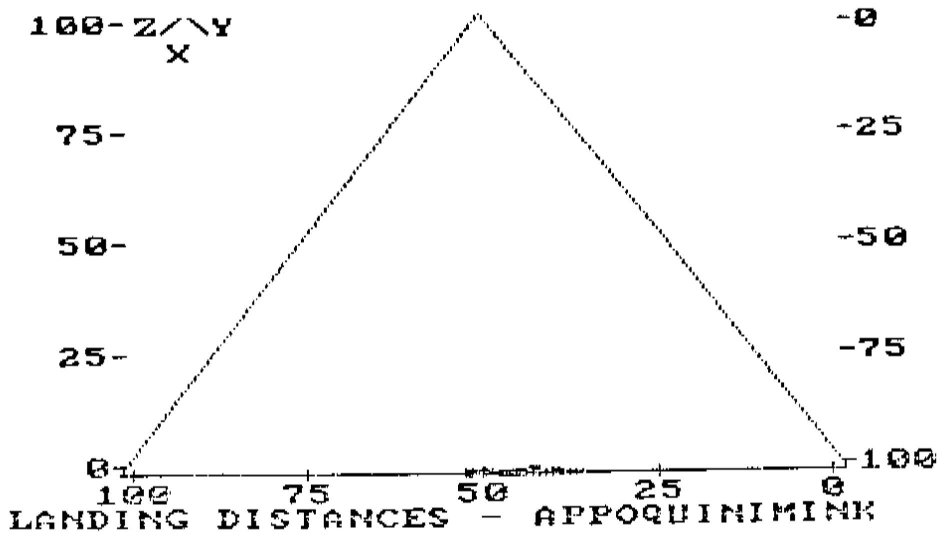
X–Middletown Y–Townsend Z–Blackbird

FIGURE 51
Crossroads Distances – Appoquinimink Area



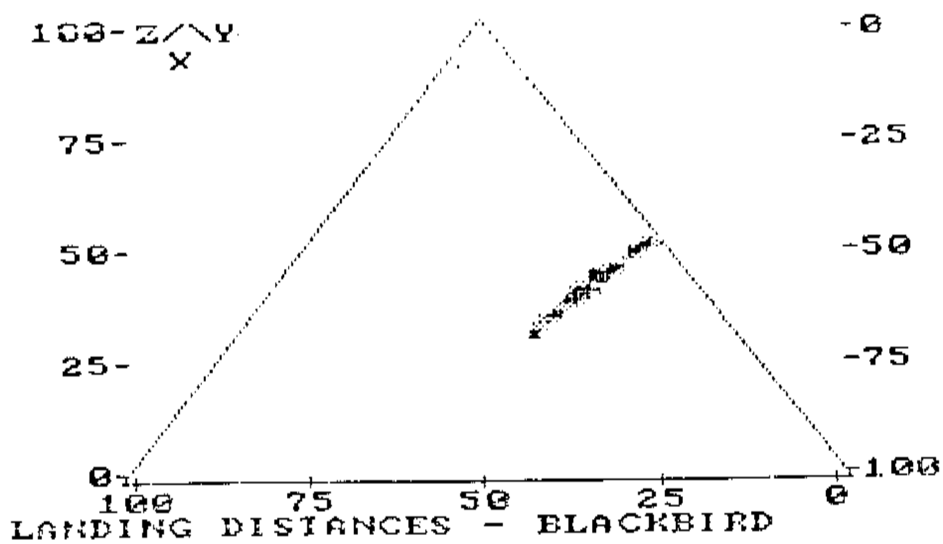
X–Port Penn Y–Odessa Z–Smyrna Landing

FIGURE 52
Landing Distances – Appoquinimink Area



X–Thomas Y–Stave Z–Blackbird

FIGURE 53
Landing Distances – Blackbird Area



X–Blackbird Y–Fleming Z–Brick Store

Distances to landings were plotted for the Appoquinimink area and the Blackbird areas and these plots are shown in Figures 52 and 53. In the Appoquinimink area (Figure 52), by far all of the sites are closest to Blackbird Landing and are equidistant from Thomas and Stave Landings. In the Blackbird area (Figure 53), most of the sites are closest to Fleming's Landing and equidistant from Blackbird and Brick Store Landings. In both of these cases, it would be interesting to see if the most proximate landings are the landings used most frequently. It should also be noted that this quick analysis of distance distributions suggests that a gravity model of differential distances to transportation nodes may be appropriate for mapping out economic and social interaction patterns (Coleman et al. 1984). However, such an analysis is beyond the scope of this report.

A final analysis undertaken using the distance data and the agricultural soil productivity data was a factor analysis to see how the variables overlapped. Table 71 shows the zero-one cluster-centroid transformation matrices for a two-factor and three-factor analysis. The two-factor analysis separated out minimum crossroads distance and all other measures were clustered in a similar factor. In the three factor-analysis, minimum

TABLE 71

ZERO-ONE CLUSTER-CENTROID TRANSFORMATION MATRIX - DISTANCE MEASURES

	F1	F2	F1	F2	F3
WDIS	1	0	0	0	1
NWDIS	1	0	1	0	0
RDIS	1	0	1	0	0
MINCD	0	1	0	1	0
MINRR	1	0	1	0	0
MINLAND	1	0	1	0	0
AGRICULTURAL SOILS	1	0	0	0	1

crossroads distance remained a separate factor and water distance and agricultural soils were grouped into a factor of their own. The remaining factor consisted of navigable water distance, road distance, minimum railroad distance and minimum landing distance. These factors may be interpreted as follows:

Factor I - Subsistence Factor

Water Distance
Agricultural Productivity Factor

Factor II - Market Factor

Minimum Crossroads Distance

Factor III - Transportation Factor

Navigable Water Distance
Road Distance
Minimum Road Distance
Minimum Landing Distance

Discussion of Historic Site Location Analysis. The data analyzed above can be used to generate a series of descriptions of typical historic site locations for different site types and time periods. These descriptions are listed in Table 72 and only the most useful variables are listed. These typical settings can be used as guides to likely locations of historic sites (eg. - Lafferty et al. 1981) and will be used to develop refined historic site sensitivity areas in the management section of this report.

TABLE 72

TYPICAL HISTORIC SITE LOCATIONS

Site Type	Water Dis.(km)	Percent Class I Soil(%)	Min. Cross Road Dis. (km)	Nav. Water Dis.(km)	Road Dis. (km)	R.R Distance (km)
General	1.9	66	6.5	1.4	1.1	N/A
p1802	1.9	64	5.1	.7	1.2	N/A
1802-1849	1.7	70	6.3	1.3	1.0	N/A
1849-1868	1.8	64	6.5	1.5	1.2	3.6
1868-1893	2.4	67	7.7	1.7	.9	3.3
Agricul-tural	1.9	70	6.3	1.4	1.0	1.8
Non-agricul-tural	1.2	49	7.0	1.3	1.1	2.5

It should be noted that the results of the site location analysis are consistent with trends noted in general histories of the area. The importance of marketing of agricultural produce throughout the 19th century is underscored by the fact that farmsteads are generally within approximately 1 kilometer of a road or within 1.5 kilometers of navigable water. The importance of productive soils is underscored by their high percentage within 100 acre site catchments. These two factors, plus surface water, seem to be the major determinants of historic site locations in the areas studied. It would be interesting to use these variables in a multivariate analysis of the site locations, such as a logistical regression, and see how much of the variation in site locations they account for.

An interesting fact pointed out by the site location analysis is that it was during the period immediately after the Civil War that there is a significant shift in settlement patterns within the areas studied. During the post-Civil War period farmsteads do not contain as high percentages of Class I agricultural soils, nor do they have as easy access to transportation networks. A simple explanation for this phenomenon is the fact that the best locations were already taken and the study area was beginning to fill up. A similar phenomenon seems to have taken place earlier in the more northern parts of the Delmarva Peninsula (Karinen 1958; Coleman et al. 1984:41-43). It would be interesting to see if the quality of life varied between sites which appear to be in more optimal settings and those sites which are in the less desirable settings. Such a comparison could be part of Phase II and III archaeological research at sites impacted by the proposed highway.

In many ways, this preliminary analysis of historic site locations opens many more questions for further research and has several applications. For one thing, it would be interesting to carry out identical analyses with a larger data base. Because the data used here are a non-random sample of a limited geographical area, the conclusions about site locations presented here may not be applicable to a larger area. The existing listing of known historic sites available for the entire Route 13 corridor (Custer et al. 1984: Attachments II and III) would be a more representative data base for analysis. These locational data may also be used within a geographic information system to generate more sophisticated predictive models. It may also be possible to apply LANDSAT satellite data to these predictive models.

NEAREST-NEIGHBOR ANALYSIS

A final analysis of historic site locations that was undertaken used nearest-neighbor analysis. Nearest-neighbor analysis was originally developed in biology to describe the degree to which items of interest are spatially clustered or dispersed (Clark and Evans 1954). The mean distance to the nearest-neighbor is measured from empirical data and compared to the expected distance given a random Poisson distribution of a certain density (Parsons 1974:241-246). The two values are compared as a ratio with the observed value divided by the expected random value. The ratio will vary between 0 and 2.1491 with 0 indicating a completely clustered distribution (all individuals at one location), 1 indicating a random distribution, and 2.1491 indicating an even hexagonally-spaced distribution. The value 1 acts as a dividing point with values greater than 1 indicating a trend toward regular spacing and values less than 1 indicating spatial aggregation. The ratio can be viewed as a measure of the degree of spatial autocorrelation of the data points (Cliff and Ord 1973). In other words, the nearest-neighbor statistic tells you how much the location of one site is dependent on the location of other sites. The most useful applications in archaeology have been those which used the nearest-neighbor statistic to look for the presence and absence of site clustering, or to look for changes in the degree of site clustering through time (eg. - Earle 1976). However, in these analyses one of the biggest problems is controlling for the contemporaneity of sites (see Tolstoy 1981:3-4 for a discussion of this problem with respect to Earle's 1976 study).

The historic site data from the Appoquinimink and Blackbird areas are especially suitable for nearest-neighbor analysis because both of these study areas are large in extent and include many potential data points. Furthermore, the relatively precise dating of historic sites minimizes the problem of assuring relative contemporaneity of the sites used in the analysis. For each of the areas, the empirical minimum distances to contemporaneous nearest-neighbor sites were calculated from the sites' Universal Transverse Mercator coordinates. Time periods utilized to organize the chronological variation were the same as those used for the other historic site analyses. One problem that does arise when applying nearest-neighbor analyses to the Appoquinimink and Blackbird areas is termed the "boundary effect" imposed by the shape of the study area (McNutt 1981). Generally, the boundary effect is an artificial inflation of the nearest-neighbor empirical measures which occurs when the boundaries of the study area cut off some sites from their nearest-neighbors which lie outside the study area boundaries. However, McNutt (1981) and Pinder, Shimada, and Gregory (1979) offer correction factors to account for this difficulty.

Table 73 shows a series of nearest-neighbor statistics for the Appoquinimink and Blackbird areas during different time periods. There is an insufficient number of pre-1802 sites in the Blackbird area for analysis and no statistics were calculated. Uncorrected values, and corrected values of the nearest-neighbor statistic are all noted. The values from the McNutt corrections were utilized here for interpretation because they fell within the middle of the range of values produced by the alternative calculation methods. Standard error statistics were calculated using the formula provided by Pinder et al. (1979:437). The values are low for all cases except for the pre-1802 sites of the Appoquinimink area. Consequently, the pre-1802 data are somewhat suspect.

Pinder et al. (1979:439) provide a series of charts which show how to interpret the R-statistics given variations in sample size and standard errors of the statistics. The final column of Table 73 shows the interpretations of the study area statistics. In the Appoquinimink area, the sites show random distributions prior to 1849. However, between 1849 and 1868 the distributions tend to become clustered and they retain this characteristic throughout the remainder of the 19th century.

TABLE 24: NEAREST - NEIGHBOUR STATISTICS

Area	Time Period	n	D.O.(km)	D.Ran.1	P1	D.Ran.2	P2	D.Ran.3	P3	σ'Ran.	Distrib. Type
Upperpond-ward	pre-1802	7	1.21	1.28	.94	2.07	.58	1.59	.76	.25	random
	pre-1849	30	.58	.61	.95	.98	.59	.67	.87	.05	random
	pre-1860	50	.33	.43	.77	.53	.62	.46	.72	.03	cluster
	pre-1893	65	.30	.42	.71	.50	.60	.43	.70	.03	cluster
Blackford	pre 1802	2	4.50	----	----	----	----	----	----	----	--------
	pre-1849	37	.52	.42	1.24	.45	1.15	.46	1.13	.04	random
	pre-1860	70	.34	.29	1.17	.34	1.00	.32	1.06	.02	random
	pre-1893	95	.30	.27	1.11	.31	.97	.28	1.07	.01	random

D.O. - Observed Distance D.Ran. - Random Distance P - D.O./D.Ran

1 = uncorrected
2 = Pinder et al. 1979 correction
3 = McNutt correction

Figure 54 shows the varied site distribution through time for the Appoquinimink area. The post-1850 clusters that appear are located near Middletown, the Boyd's Corner/Drawyer's Church area, and the Mathews Corner/Hangman's Branch area. It should be noted that these clusters should be interpreted as lower-order clusterings of historic settlement because the areas of greatest site clustering, the towns of Middletown and Odessa, were not included in the analysis. Thus, the measures of clustering are really measuring the clustering of rural sites outside the limits of the emerging town centers. The largest of the clusters identified is to the west of Middletown and is no doubt associated with the juxtaposition of the major transpeninsular road (US 301) and the railroad. The association of a secondary cluster with the primary cluster center of Middletown suggests that Middletown was growing rather rapidly after the introduction of the railroad. This is hardly a big suprise. However, it is interesting to note the absence of any secondary clusters associated with Odessa. Clearly, Middletown was eclipsing Odessa as a center of new settlement after the middle of the 19th century.

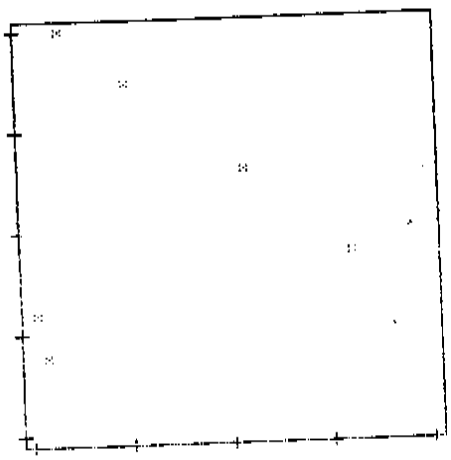
It can further be noted that when site clustering did occur in the areas away from Middletown, such as the clusters identified at the Boyd's Corner/Drawyer's Church and Mathews Corner/Hangman's Branch areas, the clusters were not associated with Odessa, which had been a major transhipment point during earlier time periods and which was an established community that could provide major services. Rather, the clusters are in the vicinity of secondary crossroads which appear to have acted as secondary service centers. Thus, population growth and economic development in the middle and late 19th century favored some existing population centers and fostered the development of others which were somewhat distant from the previous service centers. Further documentary research on the role of these emerging secondary service centers and emerging transportation networks (Cleland 1985) would be profitable and archaeological research at sites may show the emergence of different types of purchase and consumption habits in light of these developments.

In the Blackbird area, the sites retain a random distribution through time. It is important here to stress what the randomness of the distributions means. It does not mean that there is no patterning to the placement of sites. The previous analyses have shown that indeed there are patterns for the locations of historic sites. What randomness in the nearest-neighbor statistic does indicate is that the historic sites do not cluster, nor are they patterned in their placement, with respect to one another, i.e., their spatial autocorrelation is low. Figure 55 shows the site distributions for the Blackbird area through time.

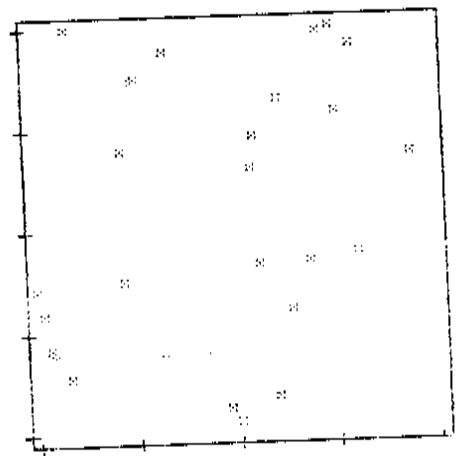
The absence of clustering in the Blackbird area, and its presence in the Appoquinimink area suggests that the patterns of economic development were different between the two areas. It is possible that the growth of secondary service centers and site

FIGURE 54

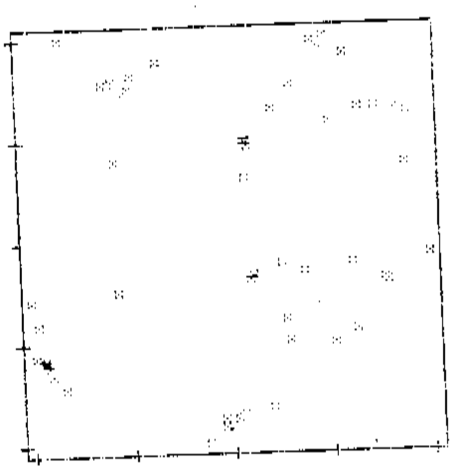
Appoquinimink Area Historic Site Distributions



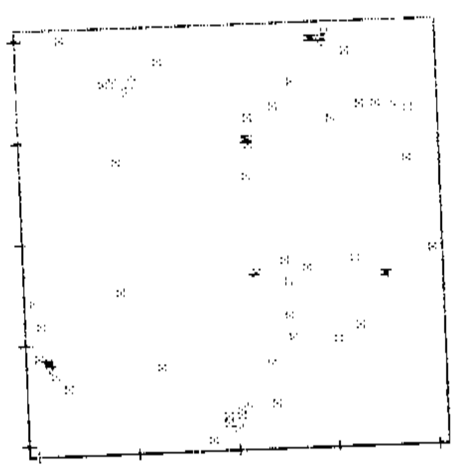
PRE-1802



PRE-1849

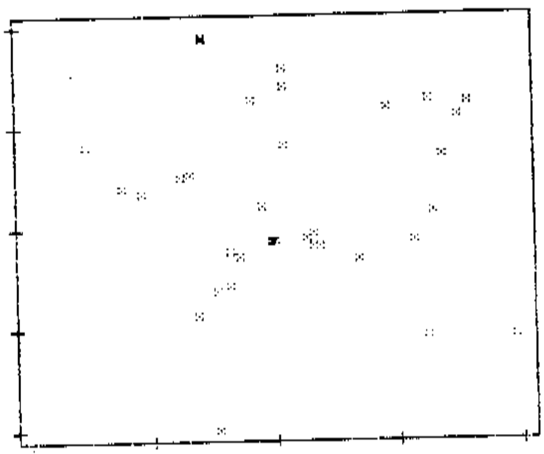


PRE-1868

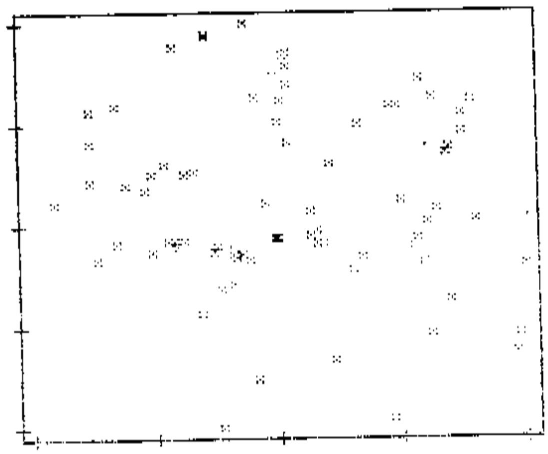


PRE-1893

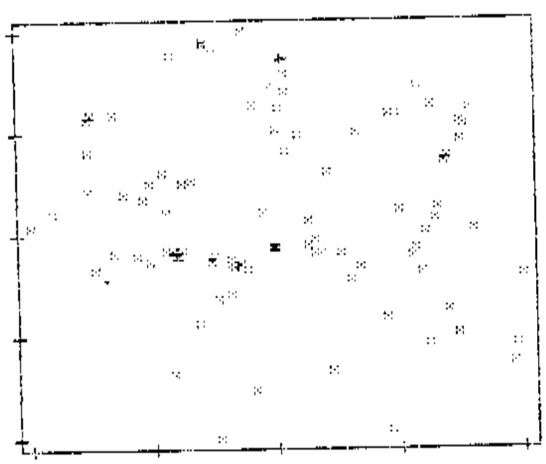
FIGURE 55
Blackbird Area
Historic Site Distributions



PRE-1849



PRE-1868



PRE-1893

clusters is conditioned by the presence of primary clusters. Such relationships have been demonstrated for more modern data in the geographical literature (Abler, Adams, and Gould 1971: Chapter 9). These different growth patterns provide yet another interesting avenue for future research and another problem framework within which future historic archaeological research in the Route 13 corridor can focus.