

# Northeast Historical Archaeology

---

Volume 12 1983 *Symposium on Archaeology of the  
Revolutionary War Period Held at New Windsor  
Cantonment State Historic Site, New Windsor, New  
York*

Article 6

---

1983

## Geophysical and Soil Chemical Investigations at New Windsor Cantonment

Joseph Sopko

Follow this and additional works at: <http://orb.binghamton.edu/neha>



Part of the [Archaeological Anthropology Commons](#)

---

### Recommended Citation

Sopko, Joseph (1983) "Geophysical and Soil Chemical Investigations at New Windsor Cantonment," *Northeast Historical Archaeology*:  
Vol. 12 12, Article 6.  
<https://doi.org/10.22191/neha/vol12/iss1/6> Available at: <http://orb.binghamton.edu/neha/vol12/iss1/6>

This Article is brought to you for free and open access by The Open Repository @ Binghamton (The ORB). It has been accepted for inclusion in Northeast Historical Archaeology by an authorized editor of The Open Repository @ Binghamton (The ORB). For more information, please contact [ORB@binghamton.edu](mailto:ORB@binghamton.edu).

# Geophysical and Soil Chemical Investigations at New Windsor Cantonment

by Joseph Sopko

## INTRODUCTION

A current survey being conducted by the archaeology unit of the New York State Bureau of Historic Sites is at New Windsor Cantonment. Located north of the Hudson Highlands and southwest of the city of Newburgh, New Windsor Cantonment was the location of the American Continental Army's last winter encampment in 1782-83. The site is primarily an archaeological site situated on both public and private land. A large portion of the site is currently wooded, with limited access. It has largely retained its value as a historical resource as a result of this relatively undeveloped condition. The cantonment site contains the material evidence and remains of the huts occupied by Washington's army at the close of the Revolutionary War when his forces had been transformed from a ragged assemblage of volunteers to a well-trained and well-equipped army. As a result, the site reflects the initial transformation and growth of the American Army.

New York State has made a commitment to the interpretation and preservation of this historic property. The archaeological integrity of the site, the principal source of its value, must be maintained while site interpretation takes place. The preservation and interpretation of this resource requires a comprehensive archaeological plan for the entire historic site.

The archaeological strategy that has been developed to assess the nature and condition of the archaeological resources at New Windsor Cantonment has utilized a variety of field methods. The field methods chosen to complement the archaeological testing have included a geophysical and a soil chemical survey. Each of the survey methods has provided additional information and hypotheses for the interpretation of archaeological features which might not be provided solely through traditional methods of archaeological excavations.

## GEOPHYSICAL SURVEY

The geophysical survey was composed of two parts: a magnetic survey and a subsurface survey. The magnetic survey was conducted on a half-acre parcel of land in the area of the 4th Massachusetts Regiment of the 1st Massachusetts Brigade. The purpose of the magnetic survey was to see if any of the huts' structural remains, the hearths, or the refuse disposal areas could be located through the use of remote sensing techniques.

The magnetic survey located four magnetic anomalies (A,B,C, and D) that were subsequently evaluated through archaeological excavations. Anomaly A was discovered to be caused by the presence of fence wire. Anomalies B and C were located at hearth areas and were the flat stones that had been placed around the hearths as flooring. The most interesting anomaly was D. The test trench revealed anomaly D to be a rock concentration with burned bone, charcoal, and fired clay, which are usually associated with a hearth area. Anomaly D appears to be related to the south end fireplace of an enlisted men's hut. The large concentration of rock could represent the fireplace base or a part of the collapsed chimney (Fisher 1983).

Three of the four magnetic anomalies found during the magnetic survey were associated with hearth areas in the huts. However, there were no magnetic anomalies near the three other hearths that were located in the survey area. It appears that there is no reliable magnetic pattern associated with all the hearth locations in the huts (Bevan 1982).

The second part of the geophysical survey was a subsurface survey utilizing ground penetrating radar. The purpose of the radar was to determine if any of the structural evidence could be located as well as to see if there were any internal features associated within the huts such as the internal refuse pits found at Valley Forge (Parrington 1979-80). The radar profiled a length of 580 feet that crossed several hut sites. The radar profiles yielded little structural information. Because the archaeological structures are constructed of stone in a naturally stoney soil, there was little contrast.

However, the ground penetrating radar did provide evidence that the general orders on camp cleanliness were carried out. The general orders of February 10, 1783 specified "...that the huts were to be swept out and cleaned every day, the rear and intermediate space between the huts be kept clean, and that the rubbish must be immediately removed to a suitable distance and either burned or piled in heaps..."(Fitzpatrick 1938:111-112). The radar gave supporting evidence that these duties were carried out because of the absence of any internal garbage pits or any sheet refuse deposits around the huts.

The geophysical survey, consisting of a magnetic survey and a subsurface survey, was successful in providing information on the cantonment features. The magnetic survey provided some of the locations of hearths which defined occupational features and provided some direction for the archaeological testing. The subsurface survey indicated that certain types of features that might be expected to be found on the interior of the huts were not present. Having this

information aided the further development of the archaeological testing strategy used for the New Windsor Cantonment site survey.

## SOIL CHEMICAL SURVEY

As a part of the archaeological survey of New Windsor Cantonment a soil chemical survey and analysis was also undertaken. The purpose of the soil chemical survey was to determine whether the areas of occupation and activity in the cantonment can be identified through their soil chemistry from the non-feature or historically unoccupied areas of the cantonment.

The cantonment was a short-term occupation of between 6000 and 8000 men for 10 months. The survey area was within the 4th Massachusetts Regiment where there were approximately 410 men occupying 30 huts. After the Continental Army was disbanded in June and July of 1783, the huts were auctioned and sold. The auctioning process thus removed any structural evidence from the site except for the stone hearths and chimneys which could not be moved.

After the huts were removed, the land area of the cantonment was used for agricultural purposes. The land was ideally suited for agriculture, with its proximity to the Hudson River, its fertile soil, and its having been already cleared by the Continental Army. By 1790 the land in the area of the cantonment was divided into small farmsteads. The land including the survey area continued to be used for agricultural purposes until the 1920s.

The area where the soil chemical analysis was initiated was never plowed and contained the hut areas and the other associated features of the 4th Massachusetts Regiment. Thus the area was ideal for initiating a chemical soil survey to determine whether the soil chemical array of the various features discovered during survey excavations differed significantly from the soil chemical array of the non-feature areas of the cantonment. If the soil chemical content of the features was significantly different from the soil chemical content of the historically unoccupied areas without features, then the soil chemistry could be used to identify and delineate the features.

### *Methodology*

The soil samples collected were divided into two classes: those from occupation and activity areas and those from non-feature areas. The two groups of soil samples were then compared to one another to determine if there was a soil chemistry difference between the feature areas and non-feature areas of the cantonment.

A total of 93 soil samples was taken during the preliminary soil survey. Of these,

35 soil samples from seven hut locations, six soil samples from possible trash trenches, eight samples from two kitchen areas, and nine samples from two necessities were collected to be compared to the soil chemistry of the 34 samples collected from non-feature areas. Of the 34 non-feature soil samples, 22 were collected from the gaps between the huts and 12 were collected from the parade area.

The soil chemical test that was conducted included the test for soil pH and for the amounts of phosphates, calcium, and potassium present in the soil samples.

The first test planned and conducted was determination of pH. Soil pH is tested to determine the availability and form of the phosphorus, potassium, and calcium ions. The soil pH of New Windsor Cantonment ranged from 5.2 to 5.6, which is a moderately acid soil. Thus we conclude the pH will have only a limited effect on the availability of phosphorus and the rest of the compounds being tested.

Phosphates are especially appropriate for detecting settlement-altered soils because of the universal association phosphates have with human activities (Eidt 1977:1327; Sjoberg 1976:448). The possible sources of phosphates include foodstuffs containing carbohydrates, sugars, fats, proteins, oils, resins, lignins, woody tissues, and cellulose; garbage; and organic waste products (Brady 1974:140). Thus a high phosphate value can be interpreted as chemical evidence of human settlement and activities (Eidt 1977:1327).

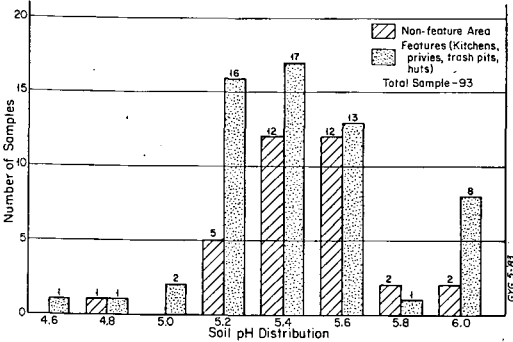
The third test conducted as an indicator of human activity was the test for the calcium content of the soil. Calcium is an indicator of a trash or activity area since it is derived from bone or shell remains. An abnormally high calcium value can therefore be interpreted as indicative of possible areas of food preparation, consumption, or disposal (Keeler 1977:4).

The fourth test that can possibly indicate human activity is the test for the potassium content of the soil. Potassium is an indicator of possible wood ash deposition. Wood ash upon decomposition forms a muriate of potash which is a form of potassium (Carr 1980). High potassium readings could therefore indicate a hearth or an area where wood ash was deposited.

### *Test Results*

Once the soil chemical analysis was completed, it was necessary to determine whether the soil chemistry of the features was significantly different from the soil chemistry of the non-feature areas. The distribution of the pH, phosphorus, calcium, and potassium values for the feature and non-feature areas is shown in Figures 1 to 4. The soil chemical values of the feature and non-

**Soil pH Distribution**  
in the area of the First Massachusetts Brigade  
Town Land Survey, New Windsor Cantonment

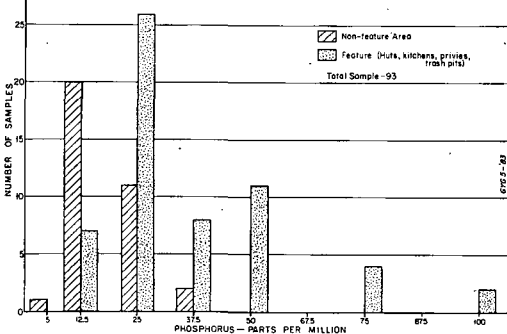


**Figure 1. Soil pH distribution in the area of the 1st Massachusetts Brigade, New Windsor Cantonment.**

feature areas overlapped, which required further evaluation. The methodology chosen to compare the two groups and to measure the significance of the difference was the "Student" t-test. The "Student" t-test is a statistical method that determines population congruency (Hoel 1971).

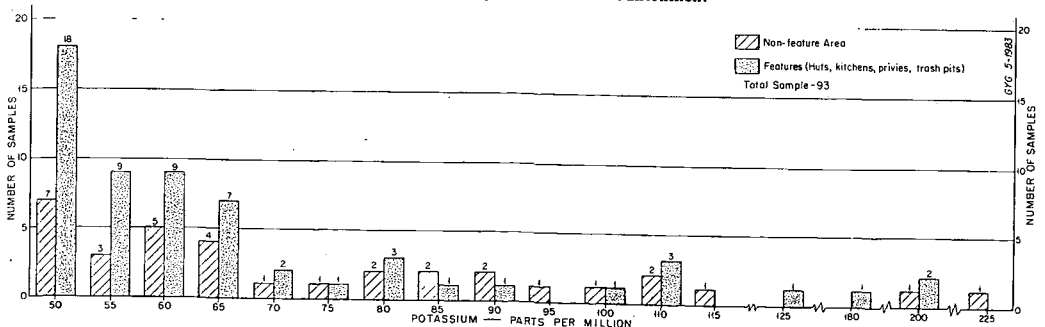
The results of the t-test indicate that the phosphate and calcium content of the

**Phosphorus Distribution in the area of the First Massachusetts Brigade**  
Town Land Survey, New Windsor Cantonment



**Figure 2. Phosphorus distribution in the area of the 1st Massachusetts Brigade, New Windsor Cantonment.**

**Potassium Distribution in the area of the First Massachusetts Brigade**  
Town Land Survey, New Windsor Cantonment

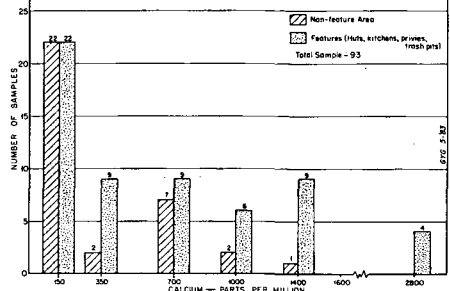


**Figure 4. Potassium distribution in the area of the 1st Massachusetts Brigade, New Windsor Cantonment.**

features belong to a different statistical population than the non-feature areas, while the potassium and pH of the features belong to the same statistical population as the non-feature areas. Therefore, we conclude the difference between the phosphate and calcium values of the feature areas as compared to the non-feature areas is significant and could be of use to identify the occupational and activity areas of the cantonment.

Once the preliminary soil chemistry tests results demonstrated that the phosphorus and calcium contents in the soil

**Calcium Distribution in the area of the First Massachusetts Brigade**  
Town Land Survey, New Windsor Cantonment



**Figure 3. Calcium distribution in the area of the 1st Massachusetts Brigade, New Windsor Cantonment.**

could be used to distinguish the feature areas from the non-feature areas, the next attempt was to locate and specifically delineate the feature areas through the use of soil chemistry. To test whether soil chemistry tests can be used in this way, two different types of features were chosen for the preliminary test. The two features used were sites of a second row enlisted men's hut and of a third row officers' kitchen.

**Methodology of Tests in Feature Areas**

A grid system was first imposed over the feature areas chosen for the preliminary tests, and soil samples were taken at set intervals. Since Feature 29 is a second row enlisted men's hut site with an area of 18 feet by 35 feet, a 30 foot by 40 foot area

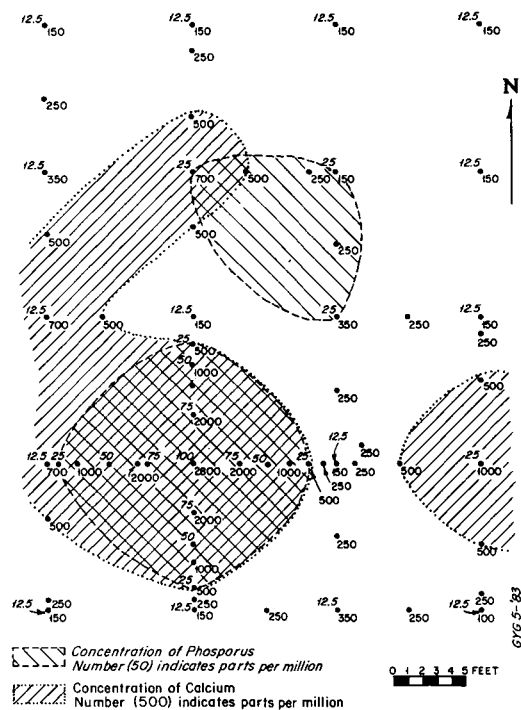
grid was laid out over the area containing probable features, and the soil samples were taken every 10 feet for a total of 20 soil samples. Feature 24, an officers' kitchen, was a 12 foot by 12 foot structure that encompassed a smaller area, so a 15 foot by 15 foot grid was laid out over the site. The soil samples were taken every 5 feet for a total of 16 soil samples.

The soil samples were then tested for their phosphorus and calcium content, and the phosphorus and calcium values were mapped on the grid. Contour lines were then drawn to show the areas of high phosphorus and calcium concentrations.

**Interpretations**

The phosphorus and calcium map of the hut site shows some very interesting results (Figure 5). In the 30 foot by 40 foot survey area, a 30 foot by 17 foot area of high phosphorus and calcium concentrations was discovered which is quite close to the estimated size of an enlisted men's hut. Figure 6 shows a hut outline superimposed over the high phosphorus and calcium concentrations, the magnetic anomaly, and the test excavations.

**Phosphorus & Calcium Values  
in the area of  
Feature 29. a Second Row Hut**

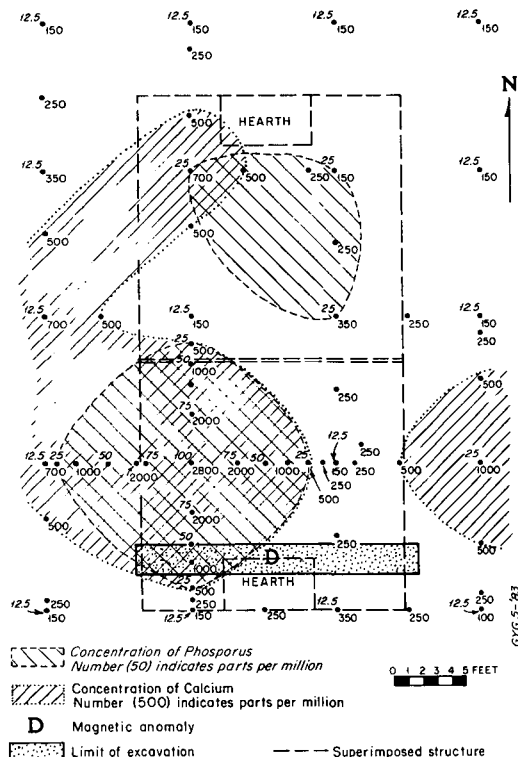


**Figure 5. The phosphorus and calcium distribution in the area of Feature 29, an enlisted men's hut in the 1st Massachusetts Brigade area.**

is presented includes information on the occupation, the possible internal arrangement, and the activity areas within the hut.

It appears that the south side of the hut was more intensely occupied than the north side of the hut. The possible explanation for the difference in the phosphorus and calcium concentrations could be that it is evidence (1) of different types of flooring, such as a dirt or stone floor instead of a wood floor, (2) of differences in living habits or cleaning activities, or (3) that the north side was indeed lightly occupied. Since New Windsor Cantonment was the last encampment of

**Phosphorus & Calcium Values  
in the area of  
Feature 29. a Second Row Hut**



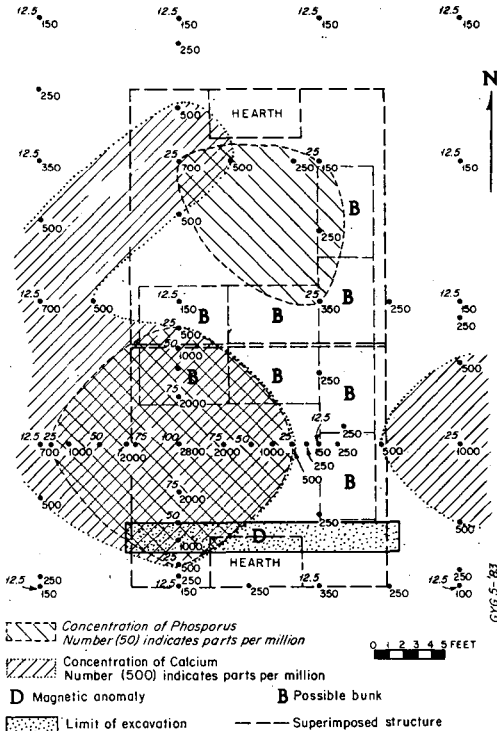
**Figure 6. A hut outline superimposed over the phosphorus and calcium concentrations, the magnetic anomaly, and the test excavation.**

the Continental Army, many of the soldiers received winter furloughs or were assigned to other duties. The 4th Massachusetts returns for February 1783 provide evidence the Regiment was not at full strength. Out of 394 privates, 14 were absent, 14 were assigned to other duties, and 18 were furloughed (Lesser 1976:244). The absence of 12% of the Regiment from New Windsor could account for a portion of the huts being lightly occupied or not occupied at all.

The soil chemical survey of Feature 29 also could offer information on the internal

arrangement of the hut. The hut drawings from the Pickering papers depict two proposed types of internal arrangements, a single wall and a double wall bunk arrangement (Pickering n.d.). The internal arrangement that best fits Feature 29, based upon the soil chemistry, is perhaps the double wall bunk arrangement. Figure 7 shows this internal

**Phosphorus & Calcium Values  
in the area of  
Feature 29. a Second Row Hut**



**Figure 7. The possible internal arrangement of the bunks in relation to the high values of calcium and phosphorus.**

arrangement in relation to the high values of calcium and phosphorus. The high calcium and phosphorus values are located in the center of the hut, which would have been the center of activities, while the bunks would have been located in the areas that had the low values, since the bunk structures would have prevented activities from occurring in those areas. Another interesting observation is that the hearths appear to be located in the vicinity of the intersection of the high phosphorus and calcium values. This concentration of calcium and phosphorus could be related to the activities of food preparation and consumption which were centered around the hearths.

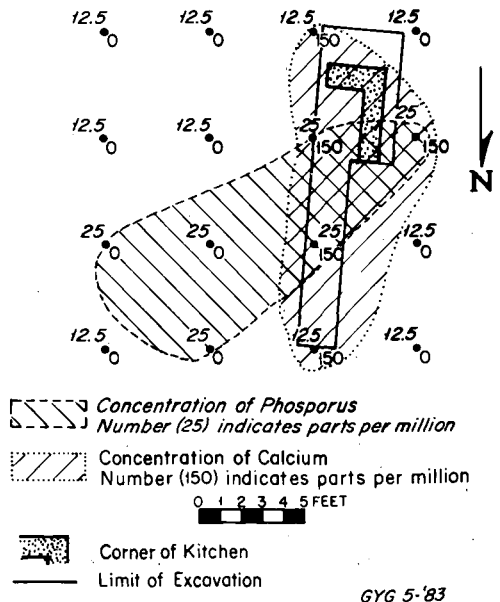
The two concentrations of calcium located to the east and west of the hut could indicate (1) the outside activity areas, (2) the traffic patterns around the hut, (3) the downhill movement of soil through erosion, or (4) a combination of these factors. The most likely explanation for the two calcium

concentrations is the down slope movement of the calcium ions through erosion. If the two areas also contained phosphorus, then the two concentrations could be related to the exterior activity areas, or the traffic patterns around the huts. But since the calcium ions tend to be less tightly absorbed than the phosphorus ions and since the cantonment in the area of the 4th Massachusetts Regiment was constructed on a fairly steep slope, the calcium could have migrated down the slope through erosional processes.

The soil chemical survey of the enlisted men's hut appears to have been very successful. The soil chemical survey on the site of a hut has provided information on its probable location, occupation, floor construction, internal spatial organization, and activity areas, all of which enhance the interpretation of an enlisted men's hut.

The soil chemical survey of an officers' kitchen also showed some very interesting results (Figure 8). The calcium concentration appears to be oriented on the west side of the soil survey area, while the phosphorus concentration is oriented to the northeast. Since the southwest corner of the kitchen, Feature 24, was discovered during the 1982 field season, the location of the kitchen can

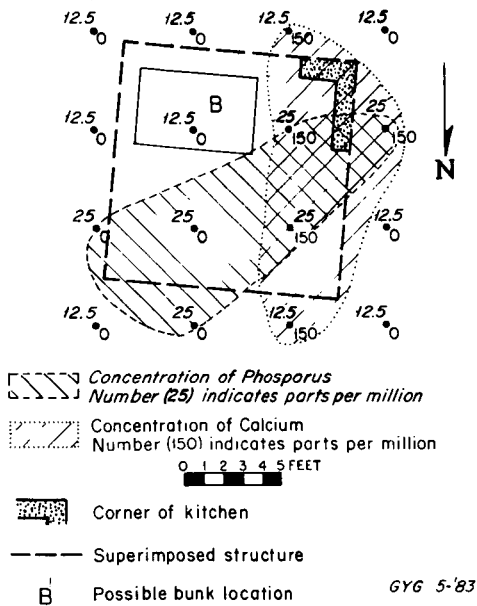
**Phosphorus & Calcium Values  
in the area of  
Feature 24. an Officers' Kitchen**



**Figure 8. The excavated area with the phosphorus and calcium distribution in the area of Feature 24, an officers' kitchen in the 1st Massachusetts Brigade area.**

be projected in relationship to the concentration of phosphorus and calcium in Figure 9. The soil map of the kitchen is very similar in appearance to the north side of the enlisted men's hut. The calcium concentration is again on the down slope side and may indicate (1) the slope erosion pattern or (2) the traffic pattern between the kitchen and the officers' hut. The phosphorus concentration in the northeast corner could represent the proximity of a hearth or food

### Phosphorus & Calcium Values in the area of Feature 24, an Officers' Kitchen



**Figure 9. A kitchen outline and the possible internal arrangement superimposed upon the excavated corner and the soil chemistry results.**

preparation area, as it did for both sides of the hut, while the southeast corner which shows no concentration of phosphorus or calcium is a space that could have been a bunk area similar to the bunk areas in the hut (See Figure 9). The documentary evidence for the occupation of the kitchens again can be found in the returns of the 7th Massachusetts Regiment's 4th Company. In the February returns, two privates were listed as not present since they were on duty as servants to General Glover and General Greene. These privates did not have to report back to their company for muster, due to an order from Washington in November of 1782 which stated "...that officers and others who have drawn men from the line for servants...do not send them back to their corps to appear at the monthly inspection..." (Fitzpatrick 1938:369).

Since these men were not with their company and were not living in their company huts, it is likely that the men were occupying the kitchen structures located behind the officers' huts.

The chemical soil survey of the officers' kitchen was similar to the pattern found in the north section of the enlisted men's hut. The information that can be extrapolated from this pattern is the probable location of the hearth area, the possible locations of a bunk area, the activity area of food preparation, and the doorway and traffic patterns.

### CONCLUSION

The geophysical and soil chemical surveys used to complement the archaeological site survey at New Windsor Cantonment appears to have been successful. Both of the surveys provided additional information and hypotheses for the interpretation of archaeological features.

The magnetic survey provided the location of some of the hearths or occupational areas of the cantonment. The radar survey, however, provided negative information revealing the absence of types of features one might expect otherwise in the presumed areas of huts, such as well defined structural remains, internal refuse pits, and sheet refuse around the outside of huts.

The soil chemical survey demonstrated that the phosphorus and calcium content in the occupation and activity areas were significantly different from the non-feature areas and could be used to locate and delineate the features and activity areas. The soil chemical surveys of the enlisted men's hut and the officers' kitchen provided information possibly locating or identifying internal spatial organization, occupation, floor construction, and activity areas. However, the locations of the hearths, the occupation areas, and the activity areas in the hut and kitchen are still only hypothetical. It is hoped these locations will be tested in future field seasons to evaluate further the validity of using soil chemistry to locate the various historic features and activity areas of New Windsor Cantonment.

### REFERENCES CITED

- Bevan, Bruce  
1982 A Geophysical Survey at New Windsor Cantonment. In Archeological Reconnaissance Survey in the Area of the 1st Massachusetts Brigade, New Windsor Cantonment, Orange County, New York by Charles Fisher. New York State Office of Parks, Recreation and Historic Preservation, Bureau of Historic Sites, Peebles Island, Waterford.

- Brady, Nyle C.  
1974 The Nature and Properties of Soils.  
MacMillian Publishing Co., Inc., New  
York.
- Carr, Christopher  
1980 The Chemistry of Archaeological Soils  
From an Ecosystemic, Temporal  
Perspective. Paper presented at the  
13th annual meeting of the Society  
for American Archaeology,  
Philadelphia.
- Eidt, Robert C.  
1977 Detection and Examination of  
Anthrosols by Phosphate Analysis.  
Science 197:1327-1333.
- Fisher, Charles  
1983 Report on the 1982 Field Season of  
Archaeological Survey in the Area of  
the 1st Massachusetts Brigade, New  
Windsor Cantonment, Orange County,  
New York. New York State Office of  
Parks, Recreation and Historic  
Preservation, Bureau of Historic  
Sites, Peebles Island, Waterford.
- Fitzpatrick, John C. (editor)  
1938 The Writings of George Washington  
from the Original Manuscript Sources  
1745-1799. Vol. 26. United States  
Government Printing Office,  
Washington, D.C.
- Hoel, Paul G.  
1971 Elementary Statistics. John Wiley  
and Son, Inc., New York.
- Keeler, Robert W.  
1977 An Earthy View of Life on a 17th  
Century Farm. Paper presented at the  
10th annual meeting of the Society  
for Historical Archaeology, Ottawa.
- Lesser, Charles  
1976 The Sinews of Independence. The  
University of Chicago Press, Chicago.
- Parrington, Michael  
1979- Revolutionary War Archeology at  
80 Valley Forge, Pennsylvania. North  
American Archaeologist 1:161-175.
- Pickering, Timothy  
n.d. Plan & Disposition proposed for the  
huts of the winter following 1782.  
Vol. 56, frame 391. Pickering Papers  
Microfilm, United States Military  
Academy, West Point. Copy on file  
at New York State Office of Parks,  
Recreation and Historic Preservation,  
Bureau of Historic Sites, Peebles  
Island, Waterford.
- Sjoberg, Alf  
1976 Phosphate Analysis of Anthropoc  
Soils. Journal of Field Archaeology  
3:447-454.
- author:  
*Joseph Sopko*  
*New York State Office of Parks,*  
*Recreation and Historic Preservation*  
*Bureau of Historic Sites*  
*Peebles Island*  
*Waterford, New York 12188*