

**APPENDIX I**  
**THE GEOMORPHIC HISTORY OF THE LEWDEN**  
**ARCHAEOLOGICAL SITE**

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THE GEOMORPHIC HISTORY OF THE  
LEWDEN ARCHEOLOGICAL SITE

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## ABSTRACT

Three stratigraphic units have been defined at the Lewden Archeological site. The lowermost unit is a light brown sandy gravel, the middle unit is a light brown poorly sorted slightly gravelly muddy sand, and the upper unit is a dark yellowish brown sandy silt. The lowest unit is a fluvial gravel of the pre-Holocene Columbia Formation. The middle unit is probably a finer-grained fluvial unit of the Columbia Formation, and therefore it is probably pre-Holocene in age. The upper unit is a Holocene soil which has developed on the Columbia Formation. These observations suggest that the physiography of the site has not changed dramatically during the Holocene.

## INTRODUCTION

The goal of this study is to describe the Holocene history of the landscape at the Lewden Archeological Site. Artifacts discovered at the site suggest that this area was occupied during the Holocene. Since the geomorphic setting may have changed during the past 10,000 years or so, the present analysis is offered to better interpret the context of the cultural remains found at the site.

## METHODS

The north faces of 14 3 meter square test pits were observed in the field. The test units were selected to define two perpendicular transects of the site, one running N-S and the other running E-W (Figure 1). The texture, color, and mineralogy of the sediments were described in detail and similar sediments were grouped into sedimentary facies.

In addition, three sediment samples were obtained for laboratory analysis from the middle stratigraphic units (these units are discussed in detail below) of test units 2, 3, and 6. These samples were obtained by running a trowel up the face of the pit throughout the entire middle unit; thus, the samples are vertically integrated samples of the entire thickness of the unit. Thus, they provide a representative sample of the sediments of the entire thickness of the unit.

These three samples were returned to the lab. The grain size distribution of the samples was determined by sieving following methods described by Folk (1974). In addition, the mineralogy of the sediments was determined by observing the grains under a binocular microscope.

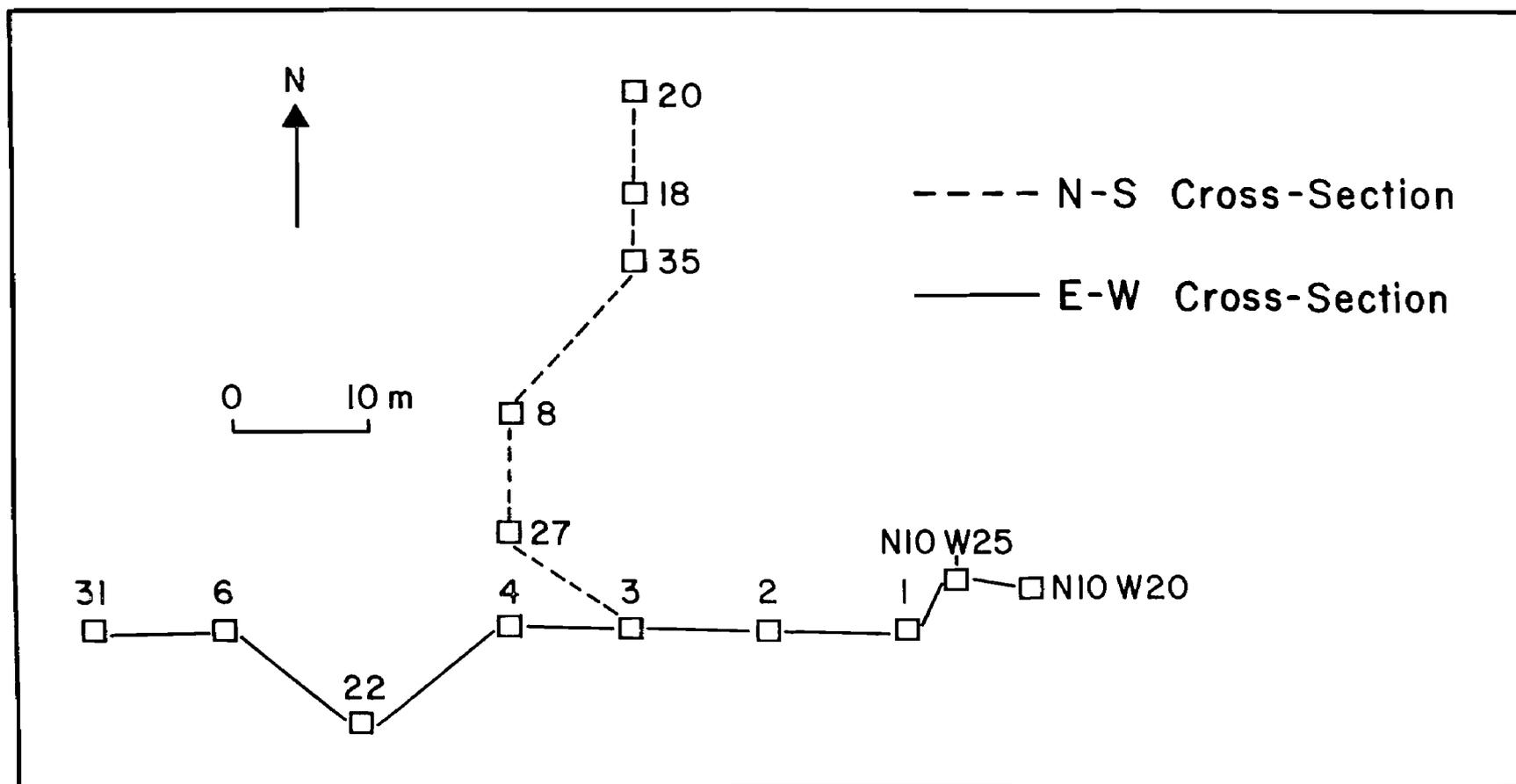
## RESULTS

Three stratigraphic units were present at each test unit (except at test unit 18, where only 2 units were found) (the detailed descriptions of the sediments found at each test unit are presented in Appendix I). The bottom unit is composed of a light brown sandy gravel (5 YR 5/6). Gravel sized sediments in this unit include granules, pebbles, cobbles, and occasional boulders. The upper surface of this unit is somewhat irregular (Figures 2 and 3).

The middle unit is a light brown (5 YR 5/6) silty fine- to medium - grained sand. Small amounts of gravel are ubiquitous, primarily of granule and pebble sizes. The gravel is more common towards the base of the unit, though gravel is always present to some degree throughout. The gravel is not confined to specific beds or laminae, but is scattered randomly throughout.

Sieve analysis of three typical samples (Figures 4-9) demonstrates that sediments of the middle unit contain less than 1% gravel and from 30-55% mud (silt and clay). Two of the samples are classified as slightly gravelly muddy sand (following Folk, 1951, 1974) while another is a slightly gravelly sandy mud (Figure 10, Table 1). The mean grain size of all the samples is fine sand

Figure 1. Areal view of test units examined in the field. The units are grouped into 2 cross-sections. The numbers beside each square are test unit numbers.



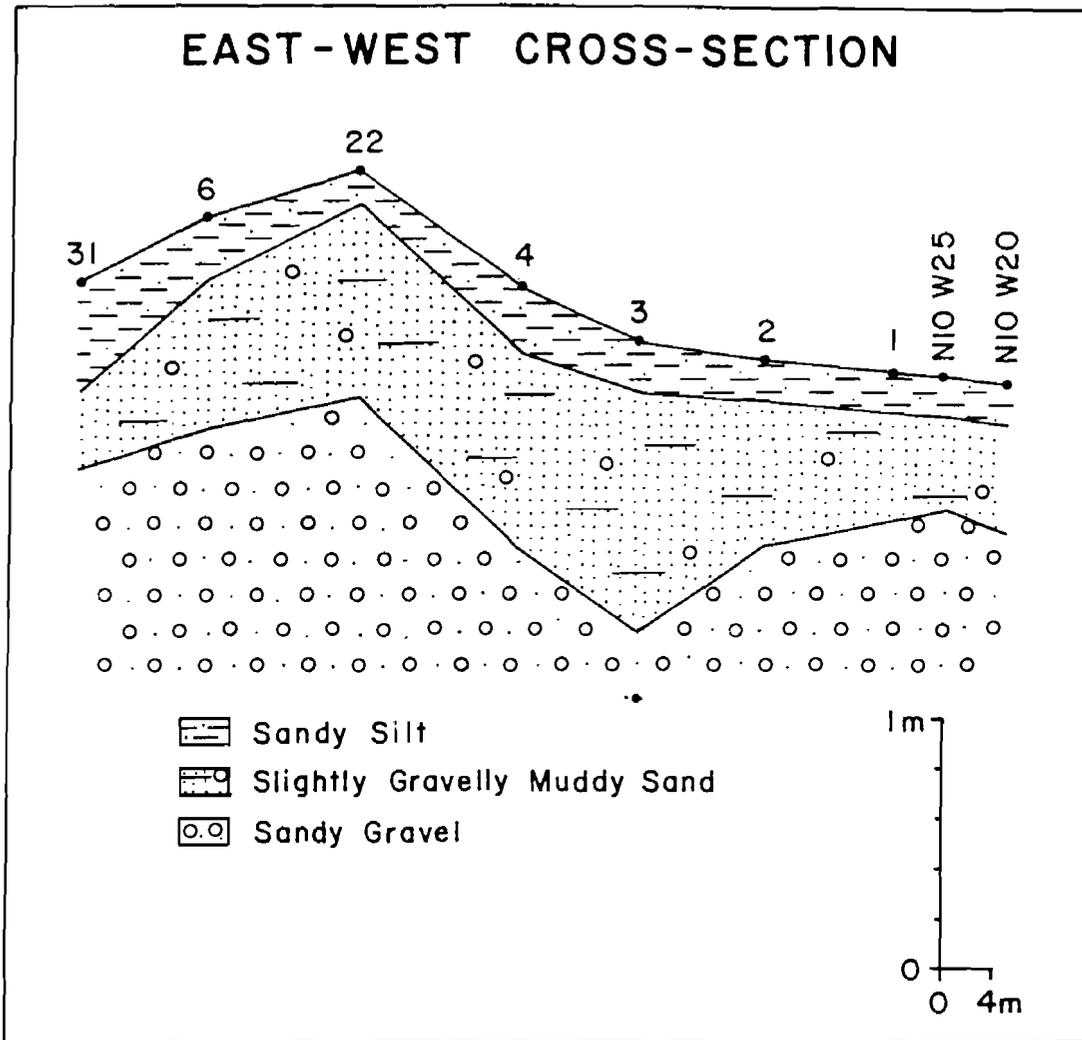


Figure 2. East-west stratigraphic cross-section. The numbers above each point refer to test unit numbers illustrated in Figure 1.

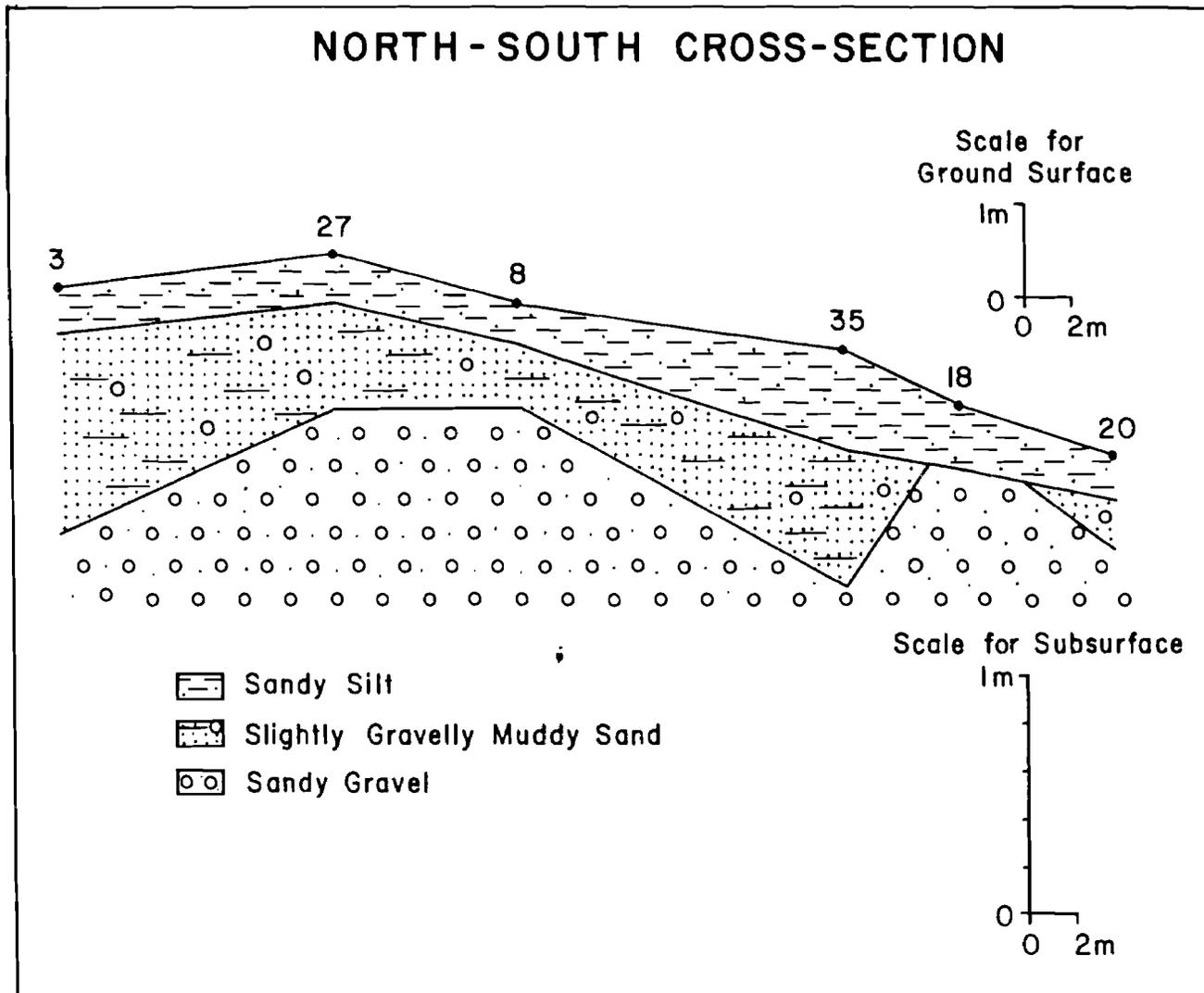


Figure 3. North-south stratigraphic cross-section. Numbers refer to the test units illustrated in Figure 1. Note that the vertical scale for the subsurface is different from that of the topography.

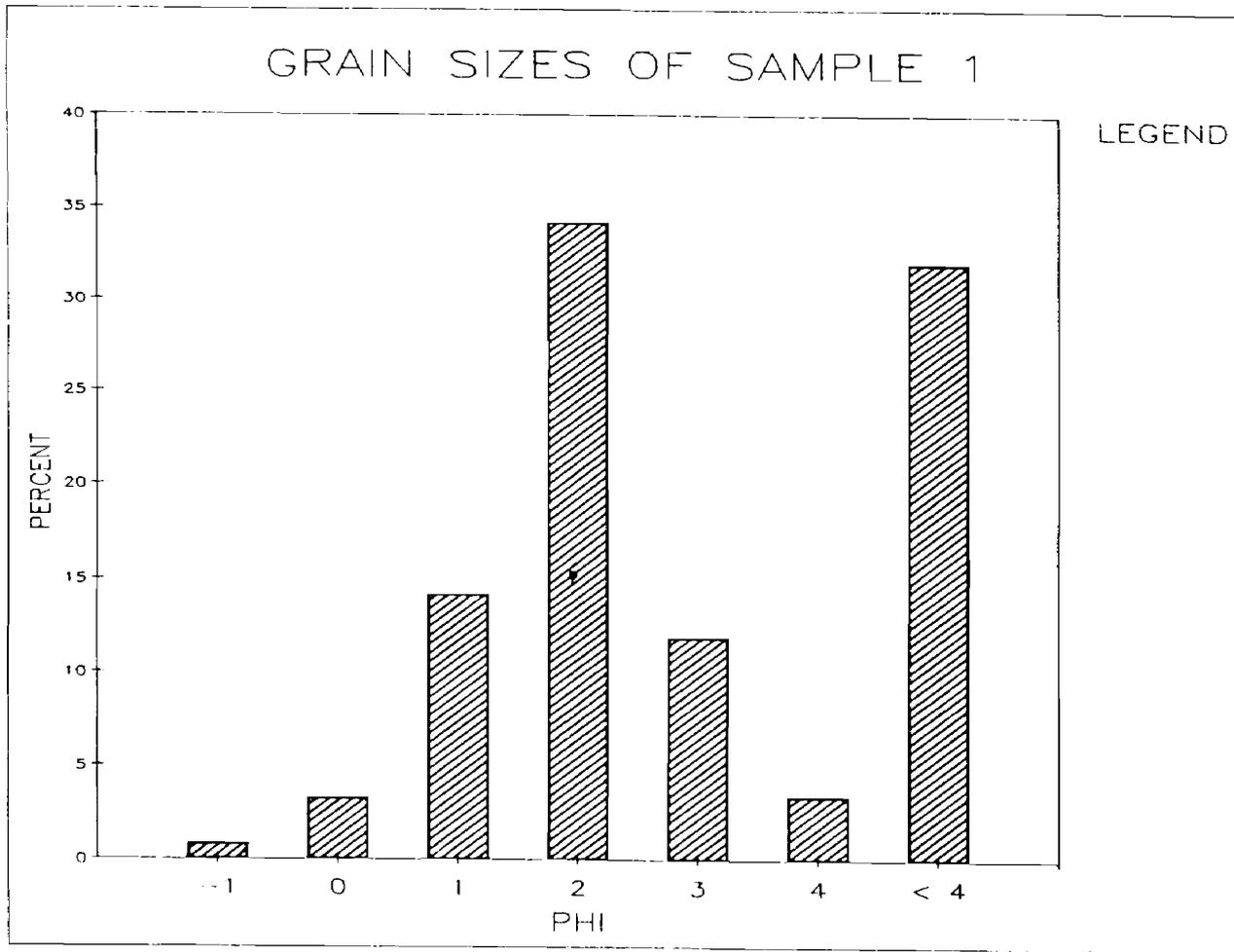


Figure 4. Histogram showing the grain size distribution of sediments from the middle unit of Test Unit 6. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

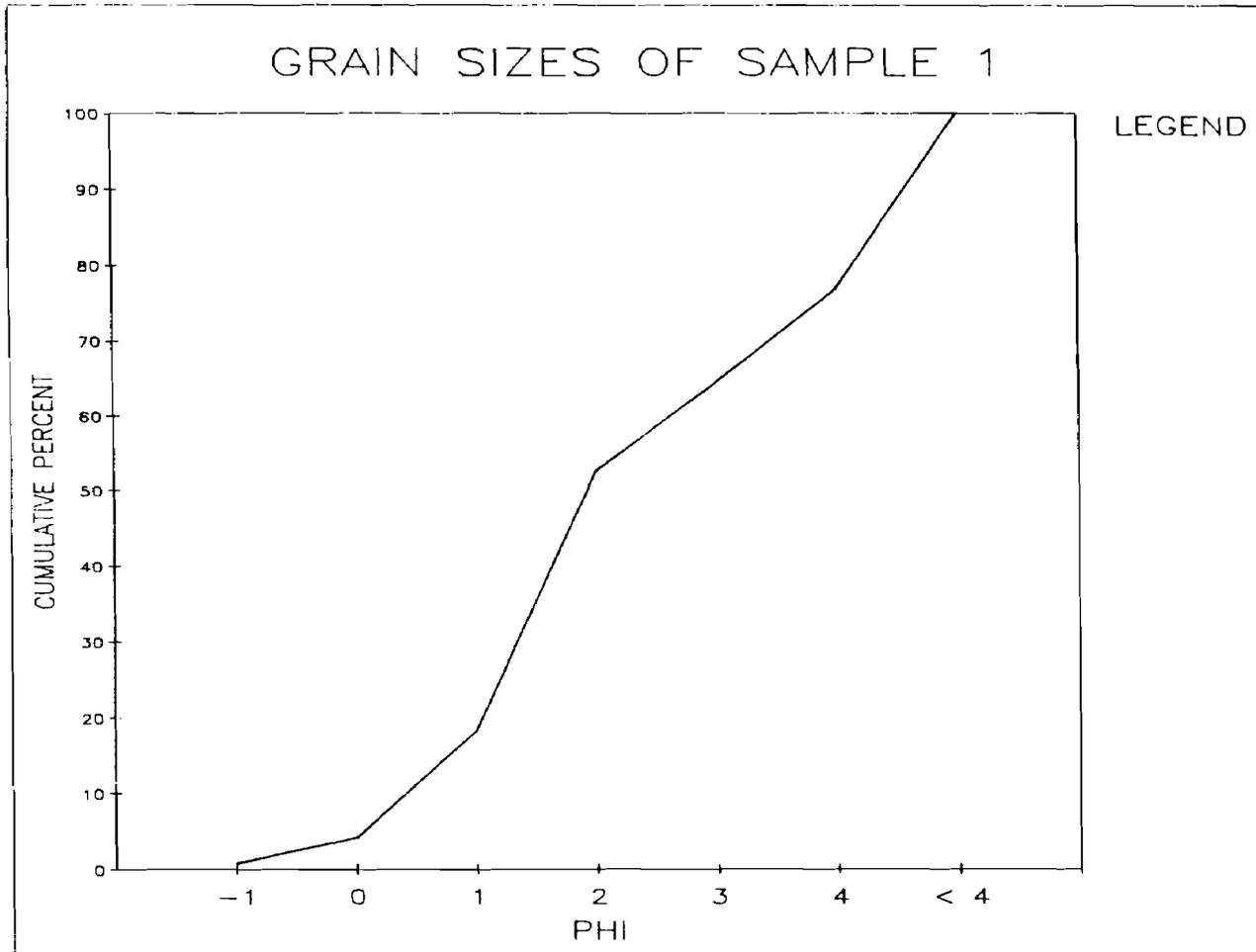


Figure 5. Cumulative grain size distribution of sediments from the middle unit of Test Unit 6. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

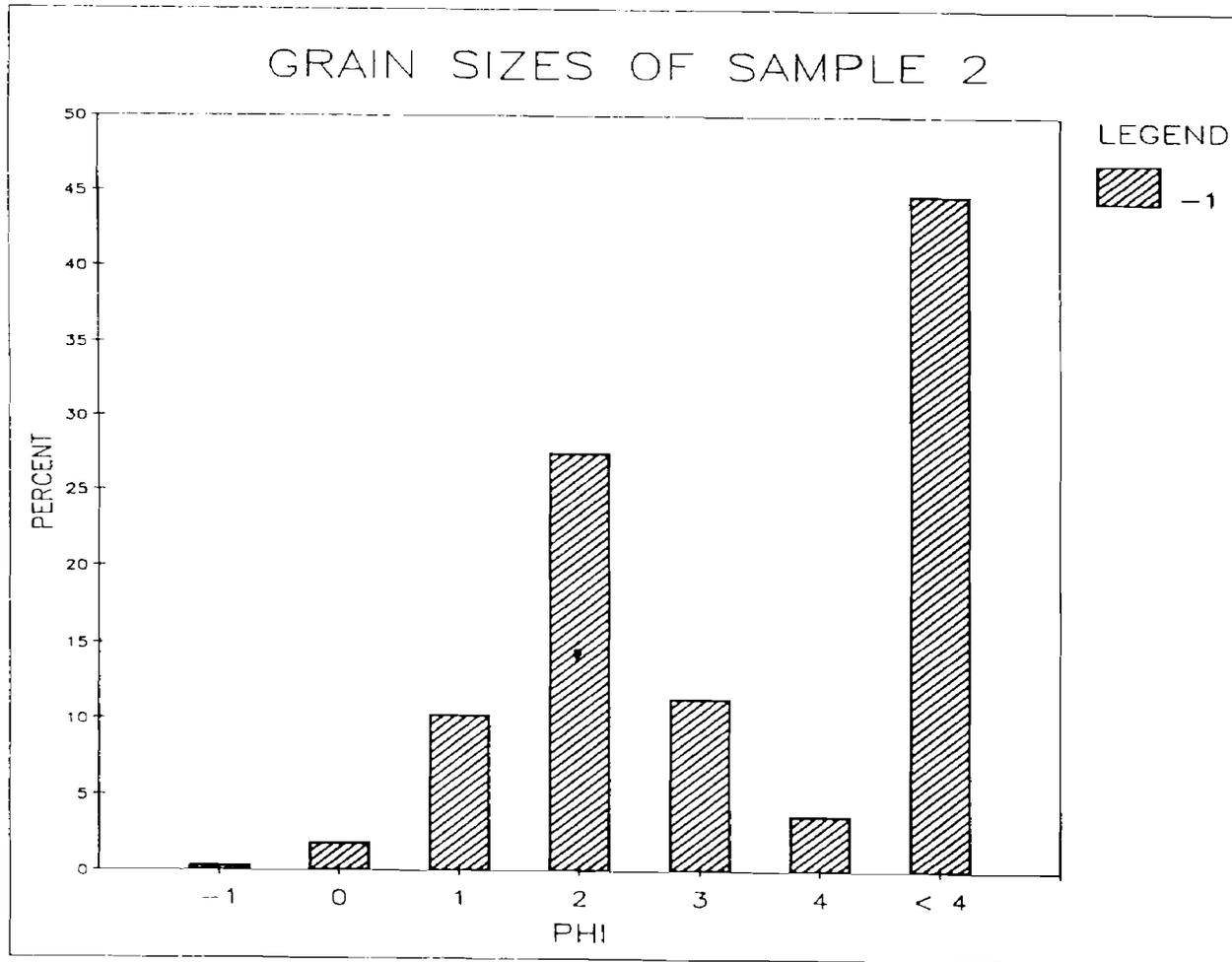


Figure 6. Histogram showing the grain size distribution of sediments from the middle unit of Test Unit 3. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

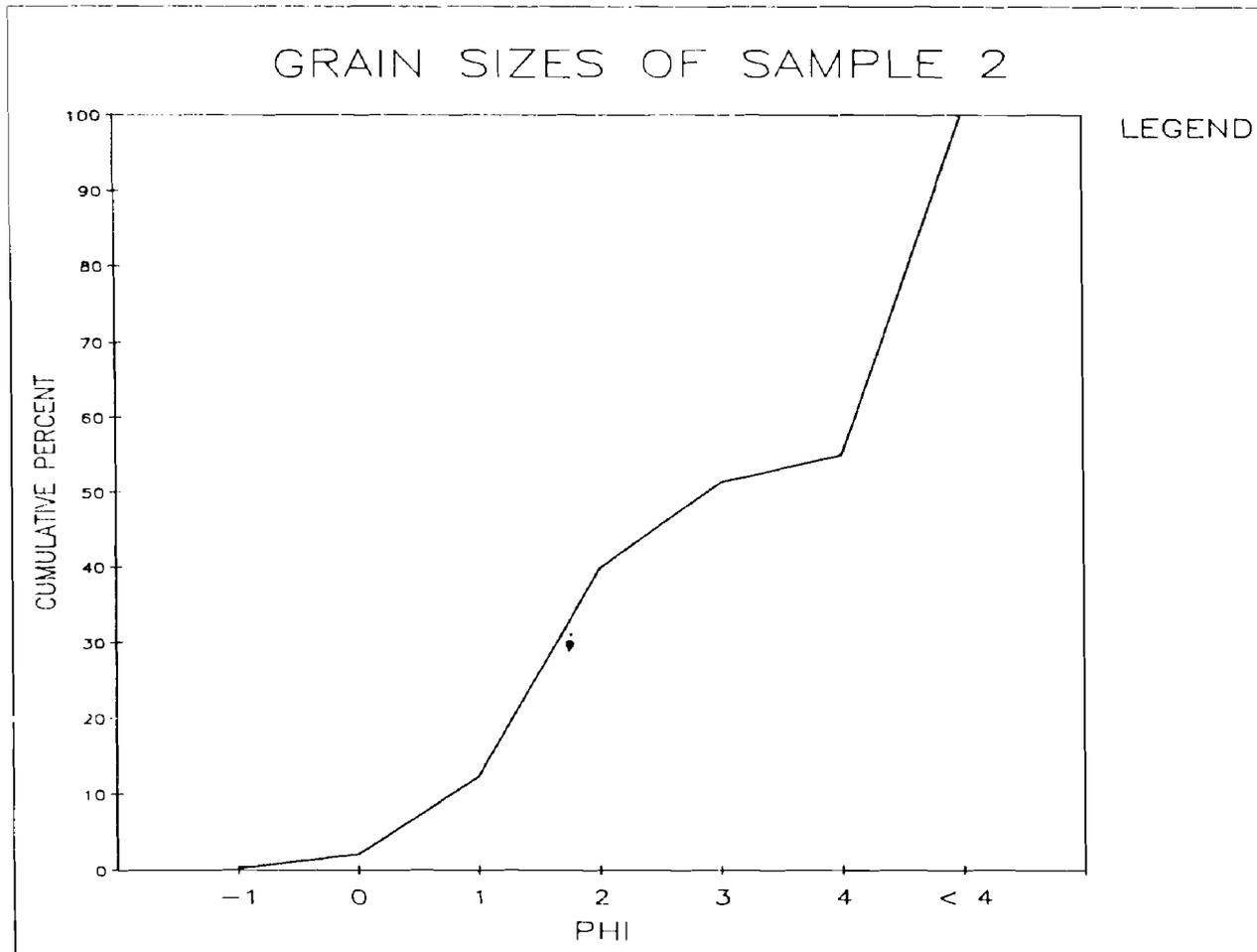


Figure 7. Cumulative grain size distribution of sediments from the middle unit of Test Unit 3. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

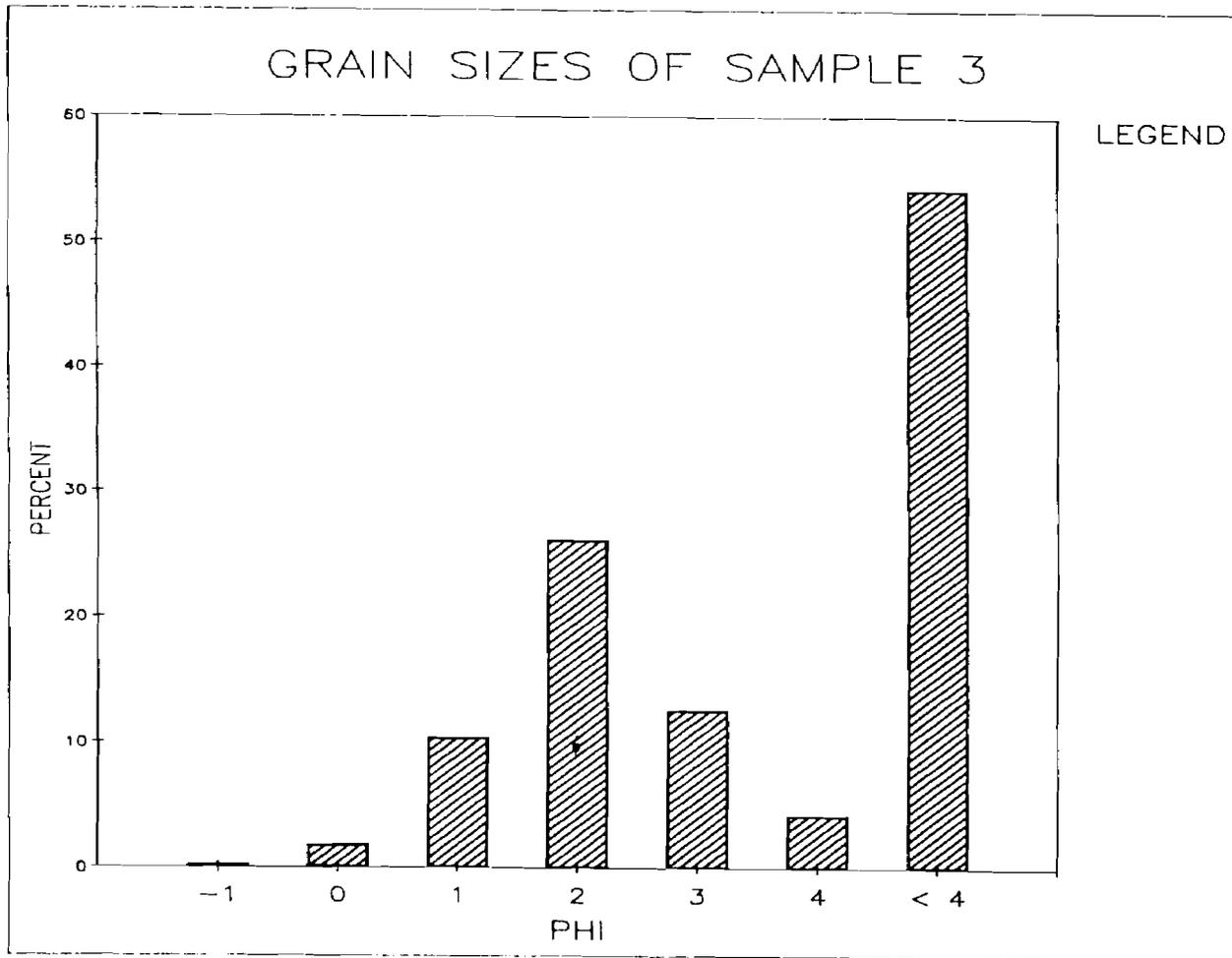


Figure 8. Histogram showing the grain size distribution of sediments from the middle unit of Test Unit 2. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

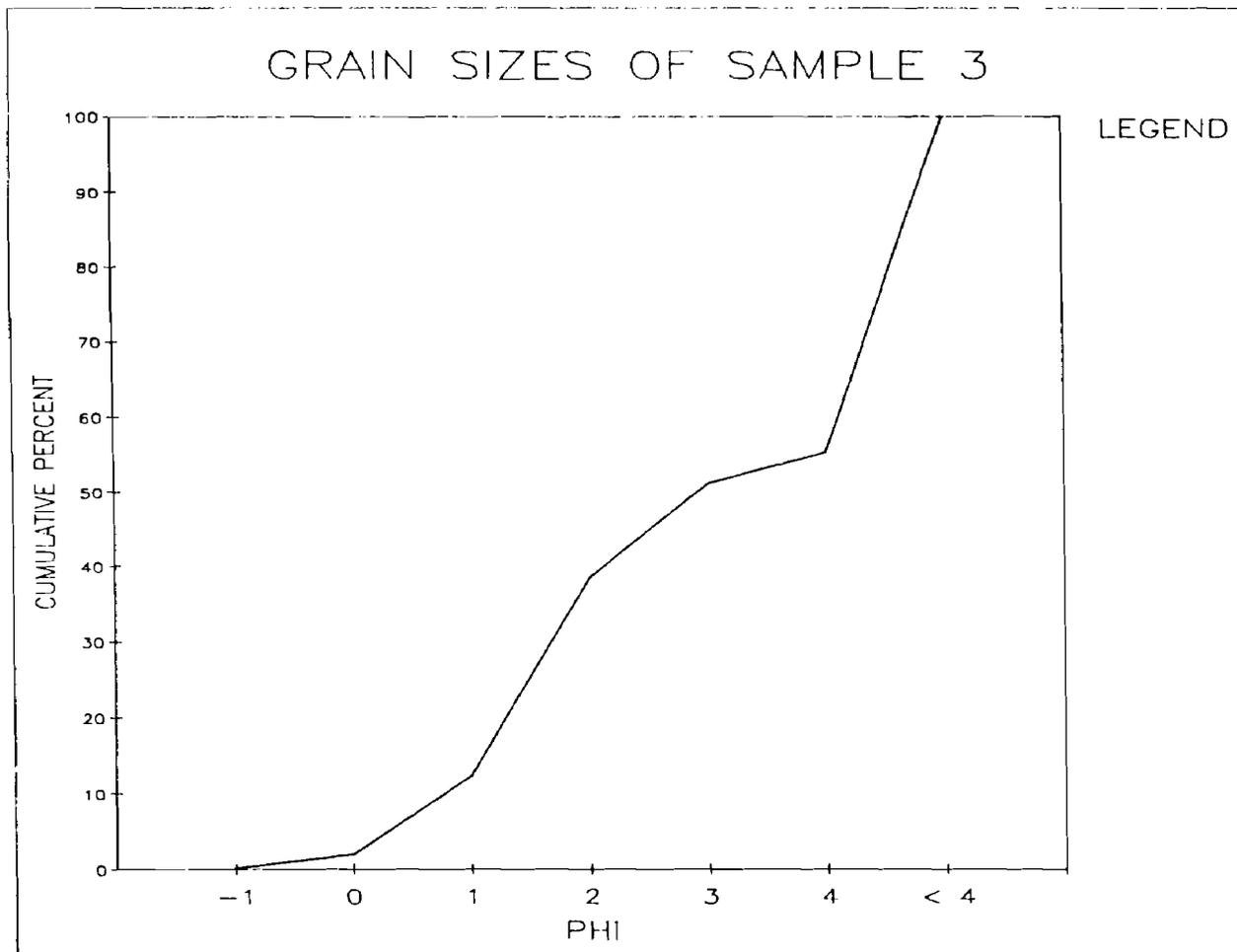


Figure 9. Cumulative grain size distribution of sediments from the middle unit of Test Unit 2. Sediments smaller than 4 phi are silt or clay sized, while sediments larger than 0 phi are gravel sized.

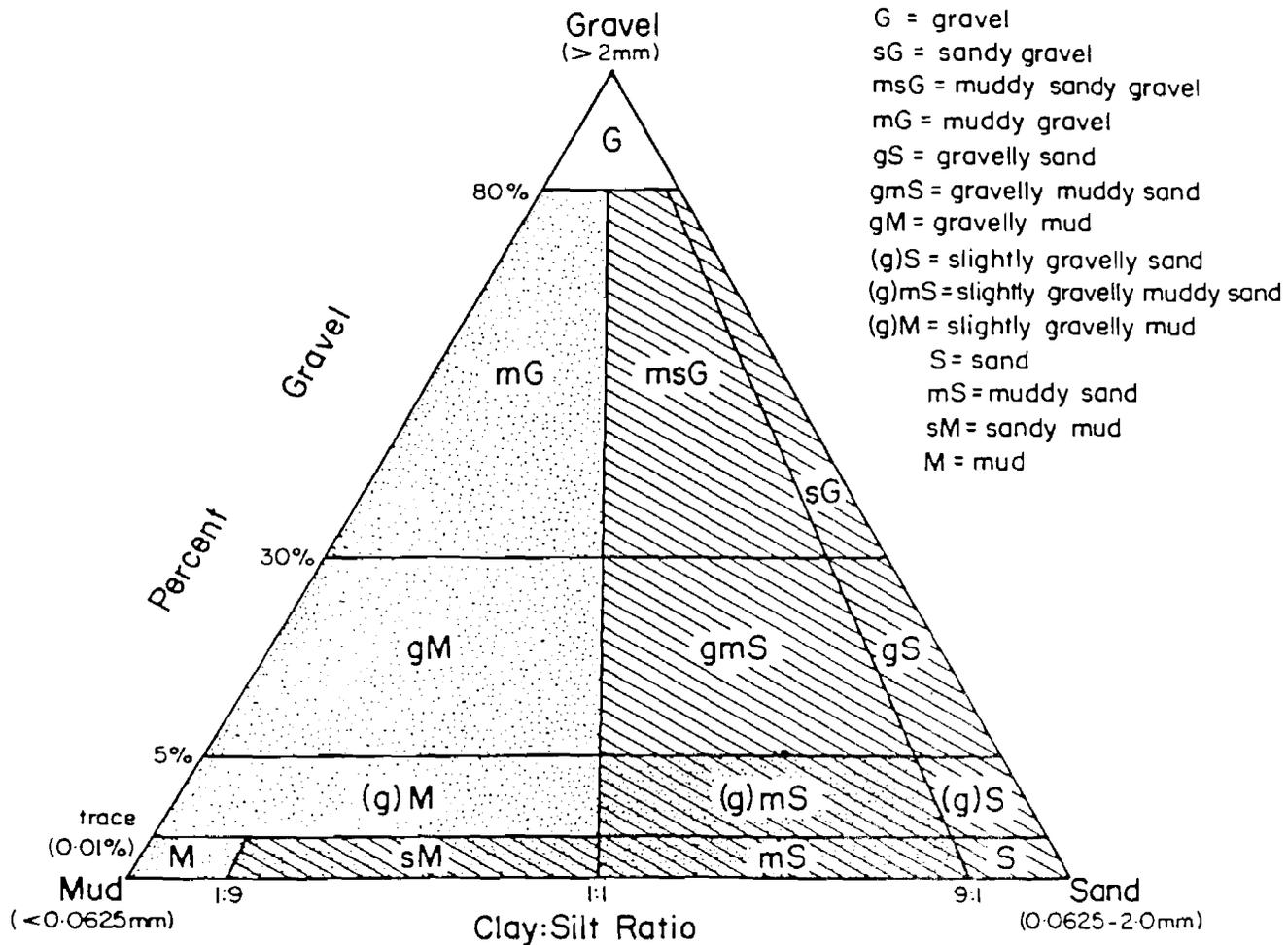


Figure 10. Classification system for gravel-bearing detrital sediments (after Folk, Andrews, and Lewis, 1970). Two of the samples analyzed are slightly gravelly muddy sand ((g)mS), while the other is slightly gravelly mud ((g)M) (see Table I for further details).

Table I - Grain Sizes of Three Samples  
from the Middle Stratigraphic Unit

Test Unit	Graphic Mean*	Graphic Std. Dev.*	Classification
6	2.3 $\phi$ (.20 mm)	1.8 $\phi$ (.29 mm)	slightly gravelly muddy sand
3	2.8 $\phi$ (.14 mm)	1.8 $\phi$ (.29 mm)	slightly gravelly muddy sand
2	2.8 $\phi$ (.14 mm)	1.7 $\phi$ (.31 mm)	slightly gravelly mud

\*after Folk (1974)

(Table 1). All samples are poorly sorted and submature according to the classification of Folk (1951, 1974) (Table 1).

The sediments of the middle unit are composed of approximately 90% angular to subrounded quartz grains. The remaining 10% is approximately equally divided between feldspar and heavy minerals, with minor amounts of rock fragments. According to most classifications of sandstones, this composition is termed subarkosic (Folk 1974, McBride 1963, Pettijohn 1957).

The uppermost stratigraphic unit is composed of a dark yellowish brown (10 YR 4/2) sandy silt with rare granules and pebbles. This unit is typically around 20 cm thick, and it is rather uniformly distributed throughout the study area (Figures 2-3).

#### DISCUSSION

The lowest unit is clearly part of the fluvial pre-Holocene Columbia Formation defined by Jordan (1964, 1974). The sediments described here are similar in color, grain size, and stratigraphic position to those which typify the Columbia Formation. Furthermore, the geologic map of the Newark area (Woodruff and Thompson 1972) indicates that the Columbia Formation is the uppermost major stratigraphic unit in the study area. Woodruff and Thompson indicate a thickness of about 3 meters for the Columbia Formation here.

There are at least two possible origins for the middle unit. It could be a finer-grained fluvial unit of the Columbia Formation, or possibly an eolian unit which was deposited after the

deposition of the Columbia. If eolian, the unit could be either Holocene or Pleistocene in age.

Two independent tests suggest (but do not prove) that the middle unit is fluvial. First, the middle unit is poorly sorted and it contains gravel and a high proportion of mud; as is indicated above these sediments are considered to be texturally submature. Eolian deposits rarely contain gravel, and although they may contain silt, it is unusual for eolian deposits to contain subequal amounts of sand and mud (ie, they are rarely poorly sorted). Eolian deposits are typically mature or supermature (Figure 11). Thus, while these sediment could be eolian, they are not similar to typical eolian sediments. They are more similar to typical fluvial sediments (Figure 11).

Stratigraphic evidence may also help resolve this problem. If the middle unit is both eolian and Holocene (or any age which is substantially younger than the Columbia Formation), then some soil development should be found at the contact between the Columbia Formation and the middle unit. No soil development, however, was observed in the field. Therefore, it is unlikely that the middle unit is significantly younger than the Columbia Formation (it is possible, of course, to hypothesize that a soil was in fact present, and that this hypothetical soil has been eroded away, but there is no evidence of this). These observations suggest that it is most reasonable to include the middle unit within the Columbia Formation, a Formation which is universally considered to be pre-Holocene in age and (in this area) fluvial in origin. Thus, the middle unit is probably pre-Holocene in age and fluvial.

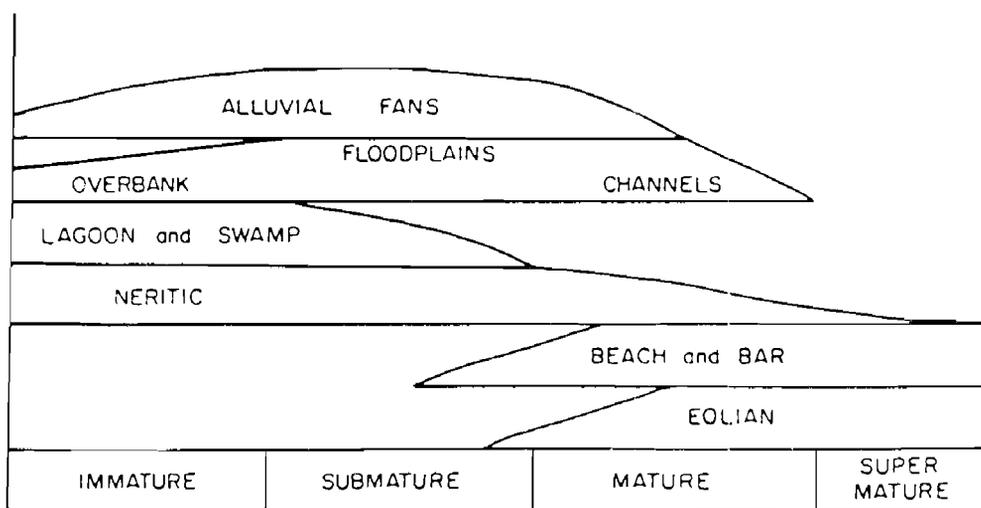


Figure 11. Expected relationships between environments and textural maturity (after Lewis, 1984).

The upper unit is clearly a soil which has developed during the Holocene on the landscape created by the pre-Holocene Columbia Formation. This conclusion is supported by the presence of artifacts found within the upper unit at least 5000 yrs B.P. in age (Jay Custer, personal communication). No artifacts have been found in any other stratigraphic unit at the site.

#### CONCLUSION

Three stratigraphic units have been defined at the Lewden Archeological site. The lowermost unit is a light brown sandy gravel, the middle unit is a light brown poorly sorted slightly gravelly muddy sand, and the upper unit is a dark yellowish brown sandy silt. The lowest unit is a fluvial gravel of the pre-Holocene Columbia Formation. The middle unit is probably a finer-grained fluvial unit of the Columbia Formation, and therefore it is probably pre-Holocene in age. The upper unit is a Holocene soil which has developed on the Columbia Formation. These observations suggest that the physiography of the site has not changed dramatically during the Holocene.

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## APPENDIX I - Descriptions of Test Units

### Test Unit #2

Depth (cm)	Description
0-16	sandy silt, 10 YR 4/2 (dark yellowish brown)
16-73	silty fine sand with rare granules, 5 YR 5/6 (light brown)
> 73	sandy gravel

### Test Unit #3

Depth (cm)	Description
0-20 cm	silty sand, a few granules, 10 YR 4/2 (dark yellowish brown)
20-115 cm	silty fine to med. grained sand, rare coarse sand, very rare granules, 5 YR 5/6 (light brown)
> 115 cm	gravel

### Test Unit #4

Depth (cm)	Description
0-26 cm	silty sand, 10 YR 4/2 (dark yellowish brown)
26-104 cm	silty fine sand, 5 YR 5/6 (light brown)
> 104 cm	sandy gravel, 5 YR 5/6 (light brown)

Test Unit #6

Depth (cm)	Description
0-24 cm	silty med.-coarse sand, 10 YR 4/2 (dark yellowish brown)
24-84 cm	silty fine-med. grained sand, 5 YR 5/6 (light brown)
> 84 cm	gravelly med.-coarse sand (mostly pebbles and gravels in the gravel size range), 5 YR, 5/6 (light brown)

Test Unit #8

Depth (cm)	Description
0-18 cm	silty fine-medium grained sand. Rare granules, 10 YR 4/2 (dark yellowish brown)
18-46 cm	silty-fine-med. grained sand with occasional granules and pebbles. This unit is similar to those above and below except there is more gravel here than above and less gravel than below. Also, lower unit is generally coarser. 5 YR 5/6 (light brown)

Test Unit #18

Depth (cm)	Description
0-27 cm	sandy silt-silty sand with occasional granules and pebbles, 10 YR 4/2 (dark yellowish brown)
> 27 cm	sandy gravel (granules, pebbles, and occasional cobbles).

Test Unit #20

Depth (cm)	Description
0-17 cm	sandy silty, 10 YR 4/2 (dark yellowish brown)
17-38 cm	silty fine-medium grained sand, occasional pebbles and granules, 10 YR 4/2 (dark yellowish brown)
> 38 cm	gravelly sand, 5 YR 5/6 (light brown)

Test Unit #22

Depth (cm)	Description
0-13 cm	silty sand, 10 YR 4/2 (dark yellowish brown)
13-90 cm	silty medium-coarse-grained sand, 5 YR 5/6 (light brown)
> 90 cm	sandy gravel, 5 YR 5/6 (light brown)

Test Unit #27

Depth (cm)	Description
0-21 cm	silty fine-medium sand, rare granules, 10 YR 4/2 (dark yellowish brown)
21-66 cm	silty fine micaceous sand, rare med.-coarse sand, granules, 5 YR 5/6 (light brown)
> 66 cm	gravelly med.-coarse sand, locally crudely stratified. Gravel is composed of pebbles and cobbles. 5 YR 5/6 (light brown)

Test Unit #31

Depth (cm)	Description
0-41 cm	silty fine-med. sand w/rare granules and pebbles, 10 YR 4/2 (dark yellowish brown)
41-72 cm	silty fine-med. sand w/occasional granules and pebbles, 5 YR 5/6 (dark yellowish brown)
> 72 cm	(med.-coarse) gravelly sand. Gravel is mostly granules and pebbles.

Test Unit #35

Depth (cm)	Description
0-43 cm	silty fine sand with occasional granules and pebbles, 10 YR 4/2 (dark yellowish brown)
43-105 cm	silty fine-med.-grained sand with occasional granules and pebbles, 5 YR 5/6 (light brown)
> 105 cm	gravelly med.-coarse grained sand, 5 YR 5/6 (light brown)

N10 W25

Depth (cm)	Description
0-16 cm	sandy silt, rare granules and pebbles, 10 YR 4/2 (dark yellowish brown)
16-55 cm	silty fine sand with rare granules and pebbles, 5 YR 5/6 (light brown)
> 55 cm	gravelly med.-coarse sand (gravel: pebbles, granules, rare cobbles).

NW10 W15

Depth (cm)	Description
0-16 cm	silty sand or sandy silt with rare granules and pebbles, 10 YR 4/2 (dark yellowish brown)
16-59 cm	silty fine sand with rare granules and pebbles, 5 YR 5/6 (light brown)
> 59 cm	sandy gravel (pebbles, cobbles, and granules), 5 YR 5/6 (light brown)