Site Formation at Ayia Varvara Asprokremnos and Predictive Modeling for Neolithic Sites, Cyprus
AN ABSTRACT OF THE THESIS OF

Darby E Barnett for the degree of Master of Arts in Applied Anthropology presented on June 6, 2008.
Title: Site Formation at Ayia Varvara Asprokremnos and Predictive Modeling for Neolithic Sites, Cyprus
Abstract approved:

________________________________________________________________________

Loren Davis

Abstract:

Site formation processes at Ayia Varvara Asprokremnos, a potentially early Neolithic archaeological site on Cyprus, are examined in order to build a larger predictive model. The study area immediate to the site encompasses 6.33 hectares and includes the site and alluvial terraces on both sides of the Gialias River. Fourteen soil map units, largely developed on Holocene colluvium, were identified. Stratigraphic profiles of the excavation trenches indicate a buried A horizon overlying what is thought to be a Pre-Pottery Neolithic B cultural component. Construction of a checkdam stopped site erosion and promoted the burial and preservation of a stratified archaeological sequence. The site is located next to a contact between the Lefkara Formation (limestone) and the Upper Pillow Basalts where vitreous chert commonly occurs on the island. Using the geoarchaeological data collected from Ayia Varvara Asprokremnos, satellite imagery and Geographic Information Systems data, a model was built the location of other further Neolithic Quarry sites on the island. The predictive model considers proximity to the contact, proximity to a 4th to 7th order stream, landscape position and relative level of ground disturbance. Over 38 areas were identified on 23 1:5,000 scale maps that could be explored by field survey and sub-surface testing.
Site Formation at Ayia Varvara Asprokremnos and Predictive Modeling for Neolithic Sites, Cyprus

by
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APPROVED:

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Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

______________________________________________________________
Darby E. Barnett, Author
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1 Introduction: Project Context, Significance and Study Area

The island of Cyprus is located in the eastern Mediterranean (Figure 1.1). It is the third largest island in the Mediterranean measuring 9,251 square kilometers and is currently divided between the Republic of Cyprus, which controls the majority of the landmass, and Turkey, which occupies the northeastern portion of the island. The current political arrangement is just the most recent in a long series of migrations and occupations of the island starting almost 10,000 years ago. Cyprus is on the western edge of an area that is collectively referred to as the Levantine Corridor. The belt of land that stretches from the Dead Sea to the Balikh River and the Euphrates of northern Syria and southeast Anatolia (Peltenburg et al. 2001a). It is the Levant that is credited with being the birthplace of agriculture. Because of its strategic location in the Mediterranean, the island of Cyprus offers archaeologists a unique opportunity to attempt to answer numerous questions in regards to the rise and spread of agriculture and the transmission or acquisition of cultural patterns (Peltenburg et al. 2000; Peltenburg et al. 2001a).

The Elaborating Early Neolithic (EENC) team is interested in addressing the gap in archaeological evidence on Cyprus between 10,000 B.C. and 8,200 B.C., during a time period also know as the Pre-Pottery Neolithic. Two of the key questions the EENC is attempting to address are, “Who were the first Cypriots?” and “What was in their toolkit?” To answer these questions, we must examine the evidence left at early archaeological sites that may give us a clue to their homeland. Early prehistoric sites on Cyprus are few. The best-documented early sites include Shillourokambos (Guilaine and Briois 2001) and Mylouthkia (Peltenburg et al. 2001b) and are described below in section 2.1 below. These sites represent established communities and give us a partial glimpse into the cultural systems of the people who inhabited them. Smaller, more discrete sites likely predate or support these established communities. In order to address questions of settlement patterns, cultural systems and resource use regarding early Cypriots we must find and analyze more early Neolithic, or more specifically, Pre-Pottery Neolithic B
Figure 1.1 Cyprus and its position in the Eastern Mediterranean (inset). The Troodos ring is indicated with a dashed line. The three research sites are indicated with triangles and three major cities are indicated with circles.
(PPNB) sites. This is best accomplished by using a multidisciplinary approach, so that we may gain a more holistic view of our past.

The end of the Pleistocene coincides with a time of great change in the cultural patterns of humans living in the Levant. The Younger Dryas can be generalized as a colder, dryer climatic period at the end of the Pleistocene (Bottema 1995; Robinson et al. 2006). The dates for the Younger Dryas vary, but can be generalized for the Levant as occurring between 10,900 and 9,600 cal BP (Bar-Yosef 2001:131). It is during and directly after this period that we see a transition from a primarily foraging based economy to a herding and early farming-based economy collectively called the early Neolithic. These changes in economy spread relatively quickly and eventually led to the growth of multiple civilizations throughout the Middle East and Europe.

The early Neolithic has been subdivided into two periods referred to as the Pre-Pottery Neolithic A and B (PPNA and PPNB). Prior to the PPNA, humans in the Levant lived in mobile egalitarian groups. The PPNA (9,600-8,200 cal BC ) is marked by the emergence of non-egalitarian agricultural society (Bar-Yosef 2001:131). Burials during this period indicate differences in social ranking. Imported goods such as obsidian indicate foreign trade and communal structures within villages are evidence of growing complexity in social organization. Humans still relied on hunting and gathering during this time, but the cultivation of cereals and legumes led to a rapid increase of populations. This population increase led to the more varied settlement pattern of the PPNB.

During the PPNB (8,500-6,200 cal BC), we see a rise in large central villages and increased social complexity (Bar-Yosef 2001:131). The PPNB lithic technology emerged first in the northern Levant. The knapping technology produced long, flat blades suited for producing arrowheads or sickle elements (Bar-Yosef 2001). PPNB sites show an increased sophistication in technology including stone tools, architecture, trade and seafaring when compared to PPNA sites. Bar-Yosef is hesitant to use the term tribe to describe the political structure of these peoples, but it appears that larger sites could have accommodated 400-500 people and territories may have been inhabited by over 1000 people (Bar-Yosef 2001:146). Territories were marked by sacred localities indicating
land ownership. Economic and social inequality can be seen in differences in house size, ceremonial areas and burial practices (Bar-Yosef 2001). Settlements of the PPNB relied on annual crops such as barley, wheat, rye, flax and legumes. Domesticated animals mainly include goats and sheep followed by cattle and pig during the Middle and Late PPNB. Foragers inhabited agriculturally marginal areas of the Levant during the PPNB. It may have been these foragers that implemented trade amongst PPNB groups.

There are several theories as to the cause of the collapse of the PPNB civilization. There were material cultural differences between the northern and southern Levant towards the end of the PPNB. Pottery production began in the northern Levant and appeared in only a few southern sites. There may also have been increased resource use and environmental degradation resulting from the increased demands of large stratified societies. At approximately 6,400-6,200 BC, a drought occurred in the Levant leaving large settlements unable to produce enough surplus to support the populations. Climate change may have been one of the catalysts for the end of the PPNB civilization (Bar-Yosef 2001).

Of particular interest to this research are questions regarding the environment, landscape, context and the manner of resource exploitation among the early Cypriots. Such broad questions regarding settlement patterns require methodologies that move the focus of archaeological inquiry away from site-specific research to broader landscape-based studies (Stafford and Hajic 1992; Zvelebil et al. 1992). These landscape-based studies use multidisciplinary approaches to relate changes in material culture and settlement patterns to environmental patterns and natural resources and vice versa in the Mediterranean and beyond (van Andel et al. 1990; Given et al. 1999; Broodbank 2000; Bintliff 2002; Given et al. 2002; Bevan and Conolly 2004). In rural Greece, researchers found that landscape-based archaeological surveys allowed them to collect data on smaller, more-discrete archaeological sites in tandem with paleoenvironmental studies. This provided a way to study the dynamic interplay between prehistoric humans and their environment leading to a better appreciation of the human-landscape relationship (van Andel et al. 1990; van Andel and Runnels 1987). In order to study the first Cypriots and
the PPNA-B gap, we must find other early Neolithic sites on Cyprus. Geoarchaeology aids in doing this by finding landforms old enough to have supported early sites and examining their potential for occupation and site preservation.
2 Literature Review: Early Sites, Interdisciplinary Survey Methods and Theory

In order to address questions regarding the early Neolithic occupation of the island, we must first examine what these early Neolithic sites might look like. Below, I have summarized the findings from three of the earliest archaeological sites on Cyprus. These sites represent the PPNB occupation of Cyprus. Projectile point typology and associated artifacts indicate that Ayia Varvara may also date to the early Neolithic.

The common tourist in Cyprus can visit the ruins of numerous ancient Greek, Roman, Bronze Age and early Christian archaeological sites. These sites have been well documented by scholars and well developed by the government of Cyprus. The smaller, more discrete sites often go unnoticed by many, but not by archaeologists interested in studying the development and spread of humans, ideas, technologies and cultures. Finding these sites requires systematic surveys of entire landscapes. In section 2.2, I summarize three of the survey projects whose methods and analyses directly influenced my fieldwork and greatly contributed to my understanding of Cypriot prehistory as well as archaeological methodology.

Technology plays an important role in landscape-based surveys. One problem with these types of surveys, however, is defining landscape into a manageable area. This is where predictive models prove useful. By using technology such as satellite imagery and geographic information systems (GIS), archaeologists can begin the search for archaeological sites without leaving the office. In section 2.3, I will summarize how satellite imagery has been used in the Middle East to aid in finding archaeological sites.

2.1 The First Cypriots

The earliest evidence of humans on Cyprus has now potentially been pushed back to the 10th millennium B.C.E. thanks to findings at the Akrotiri Aetokremnos rockshelter on the southern coast of Cyprus (Simmons 1991; Mandel and Simmons 1997; Simmons 2001). This site contains a stratigraphic association between chipped stone artifacts and burned and unburned bones of at least two extinct species: the pygmy hippopotamus (Phanourios minutus) and pygmy elephant (Elephas cypriotes) (Mandel and Simmons...
The lithic artifacts at this site include flakes, blades, bladelets, thumbnail scrapers, and a few cores. Based on the lithic debitage, it appears that tool manufacturing or retouching and core reduction occurred at this site (Simmons 1991). Other cultural items found at the site included shell and picrolite beads and pendants (Mandel and Simmons 1997). The faunal assemblage from the site includes large mammals, marine invertebrates, birds and few fish, turtles and snakes (Reese 2001). Between 374 (Ammerman and Noller 2005) and 500 (Simmons 1991) individuals of pygmy hippopotamus of all ages and at least three pygmy elephant sub-adult individuals were also found at the site. Twenty percent of the bone is burned and much of it is disarticulated (Simmons 1991). According to Mandel and Simmons (1997), bones and artifacts are found in association at Aetokremnos in Stratum 2A and 2B and in Stratum 4A, 4B, and 4A/B. The case for human artifact and bone association is greatest in Stratum 2A and is highly questionable in Stratum 4 (Ammerman and Noller 2005). Ammerman and Noller (2005) also question the radiocarbon dates currently associated with the site. The current series yields a date of 9,825 B.C. calibrated (Simmons and Wigand 1994). Simmons (2001) argues the association of human artifacts with the hippopotamus bones coupled with the early radiocarbon date of this site make this a significant site which can contribute to numerous discussions on early seafaring technologies, mainland-island interactions, and the economic shift of the Neolithic revolution. It is unclear if the humans at this site were the earliest colonizers of the island or just visiting to exploit a specific resource. It is clear that a new series of dates from Stratum 2 and 4 are required to positively date this site, but the possibility that this site represents human activity prior to the previously considered oldest sites on Cyprus is intriguing.

If the 10th millennium B.C. date for the site of Akrotiri Aetokremnos is upheld, then there is a near two-thousand-year gap in evidence for people on the island of Cyprus. The earliest components of Parekklisha Shillourokambos (Early Phase A and B) have been radiocarbon dated at 8,200-7,500 B.C.E. (Guilaine and Briois 2001). This site is the earliest large Aceramic Neolithic site on the island. The site is located in southern
Cyprus, 6 km east of Limassol. The earliest phase (Early Phase A) of this site is poorly preserved due to erosion and predominately comes from deposits within backfilled wells that had been dug into the bedrock. Post holes and shallow circular depressions filled with red/brown clay and long shallow trenches cut into the secondary limestone are also associated with this phase. The arrangement of these postholes are interpreted as animal enclosures (Guilaine and Briois 2001). The fill within the Early Phase A component contained the bones of pig, fallow deer, sheep goat and a few cattle (Vigne 2001). Early Phase B is represented by a layer of densely packed cobbles in a grey matrix that is rich in faunal remains, lithics and stone vessels (Guilaine and Briois 2001). Early Phase B also contains dog and European fox (Vigne 2001). The dog and pig bones from both phases are small, and the pig from Early Phase B show selective kill off patterns suggesting domestication. Sheep, goat and cattle remains suggests some form of pre-domestication like herding (Vigne 2001). The lithics from these early phases are abundant and are dominated by flakes. The existence of bipolar blade production and projectile points suggests an association with the technologies of the PPNB of the Levant. The presence of obsidian in these early phases also suggests frequent contact with the mainland (Guilaine and Briois 2001:47). Groundstone pounders, querns (used to grind grain to make flour) and thick walled limestone bowls are also associated with the earliest phases (Guilaine and Briois 2001). Parekklisha Shillourokambos shows us that by the 8th millennium B.C.E. there were permanent colonies on Cyprus with domesticated animals, permanent or semi-permanent settlements (as evident by the hand dug wells) with a tool kit resembling that of the mainland’s PPNB.

On the western coast of Cyprus near Paphos, the site of Kissonerga Mylouthkia provides further evidence of well-established communities with hand-dug wells, possible structures and domesticated plants and animals dating from approximately 8,500 B.C.E. (Peltenburg et al. 2001b). The wells at Mylouthkia represent the earliest components of the site and were built in two phases separated by about a millennium. These wells were filled with various cultural debris including bone refuse from food animals, human remains, plant remains, and ground stone (Peltenburg et al. 2001b). The seed remains
from the wells at Mylouthkia indicate that the type of agriculture seen in the later Khirokitia culture was already established by the time this site was inhabited (Peltenburg et al. 2001b). Stone vessel fragments and hammerstones dominate the ground stone assemblage from the site. The low sub-rectangular vessels with convex profiles from Period 1B are similar to those of from Khirokitia. In general, there is a greater difference than similarity in the vessels from this and other Aceramic sites on the island, but comparisons can be made with assemblages from PPNA and PPNB sites on the mainland. Finally, the lithics from Mylouthkia also suggest mainland connections. The earliest phase at Mylouthkia is represented by a blade-based industry with the use of bidirectional cores (Peltenburg et al. 2001b).

The link in technology between the early phases of Parekklisha Shillourokambos and Kissonerga Mylouthkia suggest that humans with knowledge of the mainland Aceramic Neolithic toolkit and agricultural lifestyle had established on Cyprus by 8,000 B.C.E or 9,000 B.P. The origin, dispersal and accompanying toolkit of the people who inhabited these sites are of great interest, but are not the focus of this research (see Hansen 2001; Peltenburg et al. 2001a; Peltenburg et al. 2001b and Kardulias and Yerkes 1998 for further discussion). The focus of this research is whether or not there was a hunter-gatherer based community established on the island prior to these early agriculturalists and whether or not we can find the archaeological sites associated with them. As of today, there are very few sites that may represent this early occupation of the island. The site of Ayia Varvara Asprokremnos may eventually help fill in the gap. Before we can make the grand assertions regarding this site’s significance and place within early Cypriot chronology, we must build a solid base of information regarding the context of the site and the artifacts found therein.

2.2 Interdisciplinary Archeological Survey on Cyprus

For more than a decade, teams of multidisciplinary researchers have been surveying and mapping aspects of the Troodos Mountain foothills of Cyprus. This research has included the work of archaeologists, geologists, geomorphologists, GIS
specialists, ethnographers, botanists and many more. The overarching goal is to better understand the diachronic relationship between natural resources and human activities on the island since human occupation.

2.2.1 The Sydney Cyprus Survey Project

From 1992 to 1997, the Sydney Cyprus Survey Project (SCSP) studied past human-environmental interaction by examining the relationships between copper mining, agriculture, site development and changes in the physical landscape coinciding with human social systems (Given et al. 1999; Given and Knapp 2003). The SCSP researchers used intensive survey techniques and stratified sampling to document the current and past natural resources of the survey area. These descriptions helped to define the changing ecological setting in which human activities were patterned upon and in conjunction with. Geomorphological and botanical descriptions also allow researchers to address visibility and context of artifacts. The methodology of the SCSP included the concepts of delineating Special Interest Areas (SIA), which are defined as large horizontal areas that may contain material of different functions or different time periods. These SIAs may contain several Places Of Special Interest (POSI), which were defined as areas of limited expanse and diversity of materials, such as lithic scatters (Given et al. 1999:24; Given and Knapp 2003:28). The SCSP researchers found the expected pattern of mining and smelting sites near the geologic zones of igneous rocks. It is within the sedimentary zones or alluvial plains that the agricultural villages that are presumed to support these mining and smelting sites are found (Given et al. 1999: 36; Given and Knapp 2003:315-316).

2.2.2 Troodos Archaeological and Environmental Project

In 2001, work began on the Troodos Archaeological and Environmental Project or TAESP (Given et al. 2002). This survey focused on the north-central Troodos Mountains. Once again, the goal was to gain a better diachronic understanding of the relationship between humans and their environment. This relationship was seen as a two-way interaction. The environment’s impact on human choice is reflected in settlement
patterns and resource use. Human impact on environment is expressed through environmental modifications. This project continued the use of POSIs and SIAs from the Sydney Cyprus Survey Project (Given et al. 1999; Given and Knapp 2003) as analytical units and refined other survey techniques to yield desired data. The resulting surveys produced data inter-connecting the geomorphological structure of the valleys along with human use. The results of the TAESP surveys can be exemplified by their work in the Lagoudhera Valley. The Lagoudhera Valley was one of five river valley systems chosen for intensive survey that would allow for individual examination of cultural patterns and cultural connections between the valleys (Given et al. 2002). In the Special Interest Area of Xyliatos Mavrovouni, which includes slag heaps from ancient copper production and Roman pottery, the researchers found that the river terraces had been developed and maintained by the Cypriots for tens of centuries. The tops of these terraces were and are covered in by a rich organic horizon (Given et al. 2002:28) and the pottery found in the block survey of the area suggests the largest settlement between the Fifth and Sixth centuries AD (Given et al. 2002:31). The slag heaps of Mavrovouni show a large scale production process for copper smelting and reflect the importance of locating this process near both water and clay resources (Given et al. 2002:36). The findings of the team within the Xyliatos Mavrovouni SIA suggest that this was a mining settlement capable of other self-sustaining activities like agriculture and metal working, but there seems to be a lack of an elite habitation (Given et al. 2002:31). In the Asinou valley the TAESP researchers found evidence of over 800 years of human activity in the area. The evidence of which was clearly limited by the nineteenth-century forest boundaries established by the British (Given et al. 2003:33). In the central Karkotis Valley, TAESP found evidence of over 4,000 years of settlement spurred by both the agricultural and mineral resources of the area (Given et al. 2002:34). By investigating multiple valleys within one large survey area, and collecting data on environment and archeology, researchers can provide a broader perspective on the relationship between human activity and landscapes.
In the summer of 2005, the Elaborating Early Neolithic Cyprus (EENC) began its quest to gain a better understanding of the nature of the occupation of the island between 10,000 B.C. and 8,200 B.C. (McCartney et al. 2005). This research takes a chronologically specific, i.e. the Pre-Pottery Neolithic B (PPNB), approach in survey efforts to target sites inhabited by early mobile hunter-gatherers specifically: lithic scatters (McCartney et al. 2005). One goal is to further understand the linkages between natural resources, principally lithic sources, and lithic technologies. This was achieved through intensive archaeological pedestrian surveys along with geoarchaeological investigations. The surveys focused on landscapes that would have provided early hunter-gatherers with desired resources. This included the contact between the Troodos Massif and the Lefkara Limestone (Figure 1.1). This contact is an area with abundant high quality chert, basalt for grinding tools and access to both lowland and highland resources. Another broad concern of the survey is understanding the rise of the agro-pastoralist cultural pattern in the early Holocene environment of Cyprus (Kassianidou et al. 2005; McCartney et al. 2005). A benefit of this research will be a contribution to the discussions of colonization, cultural identity and cultural change on the island (McCartney et al. 2005). The 2005 surveys investigated eleven lithic scatters between Lymbia and Agrokipia along the NE edge of the Troodos range. Four chert source sites with evidence of lithic reduction were investigated, and twelve chert sources were mapped. The project also resurveyed the site of Ayia Varvara Asprokremnos and the surrounding landscape around the Gialias River. The team confirmed abundance of high quality chert exhibiting core reduction as well as groundstone and evidence of plant processing (McCartney et al. 2005). In May of 2006 EENC returned to the site of Ayia Varvara Asprokremnos to conduct excavations and further investigations of the site.

The site of Ayia Varvara Asprokremnos is located approximately 2.8 kilometers southeast of Ayia Varvara Lefkosias, Cyprus, and approximately 20 kilometers south of Nicosia (Figure 1.1) is situated on an upland terrace on the east bank of the Gialias River, as seen in Figure 2.1 and Figure 2.1. The terrace is approximately 10 vertical
Figure 2.1 Ayia Varvara Asprokremnos site overview looking northeast from southern most basalt hill. Main concentration of artifacts and excavation units were located in oat-covered field to the east. The break in vegetation is the highest checkdam.
Figure 2.2 Ayia Varvara Asprokremnos site map.
meters above the current river level. The site was originally described as a scatter of lithic artifacts in a recently plowed oat and barley field. Initial assessment of the artifacts collected from the surface of the site indicate that cores and core reduction debris of high-quality translucent chert dominates the assemblage (McCartney 1998). The main concentration of artifacts is on the highest terrace. It is bounded to the north and south by low pillow basalt hills. It is within the main artifact concentration that several archaeological excavation units were placed in 2006.

Three dry-stacked stone checkdams bisect the 12-degree (westward) slope that trends away from the main artifact concentration between the pillow basalt hills. The highest checkdam has slowed erosion and allowed sediments to build up in the area of the main artifact concentration. It is unknown how many years the site eroded before the checkdam was built or how many times the checkdam has been modified. Checkdams in Cyprus date to at least the late Bronze Age and many show continued used over millennia (Jay Noller, personal communication 2006). As you move east, the sediments and soils become much shallower and are dominated by the limestone slopewash of the Lefkara Formation outcrops over 100 meters away. There is a modern two-track dirt road about 20 meters east of the current excavation site that leads around the southern pillow basalt slope to the Gialias River. By September of 2006, there was little evidence of the road (Jay Noller, personal communication 2006). The entire area up to the toe of the basalt slopes is plowed on at least an annual basis. At the time of investigations a healthy growth of oat and barley dominated the field of the main concentration, but the terraces below had recently been plowed and not yet reseeded.

The study area for this research encompasses 6.33 hectares and includes alluvial terraces on both sides of the Gialias River (Figure 2.1). The study area was designated in order to include the range of variation in the landscape in both geomorphological activity and natural resources. The contact between the Lefkara Formation limestone and the Upper Pillow Lavas of the Troodos Ophiolite is present under the center of the main artifact concentration. Parent materials of the study area are differentiated into five general groups based on their surface expression: the Upper Pillow Lavas, the umbers of
the Perapedhi Formation, the Lefkara Formation, colluvial sediments and alluvial sediments. The Upper Pillow Lavas underlie the western two-thirds of the study area and supplies sediments in the form of colluvium to other portions of the study area. The Perapedhi Formation umbers (silicified iron manganese sediments) represent the top of the igneous sequence of the Troodos Ophiolite and the beginning of the sedimentary rock sequence. Just outside the southeastern edge of the study area is a vertical face of the Perapedhi Formation. Numerous cobbles and pebbles of this umber are found throughout the study area. Lefkara Formation limestone slopewash that has weathered to Entisols also covers the northeastern portion of the study area.

It may be the geology of the site that attracted the early inhabitants to this area for lithic processing purposes. There are two broad types of chert on the island: vitreous chert, which is crypto-crystalline silicate that breaks predictably with chonchodial fracture; and granular chert, which is a grainy siliceous rock, and is more irregular in its fracture patterns (Robertson 1977). As stated before, the site is adjacent to the contact between the Upper Pillow Lava and Lefkara Formation (limestone) contact. It is in these locations on the island where limestone and basalt intersect that vitreous chert is present. Bedded vitreous cherts discontinuously crop-out in beds up to 10 centimeters thick and 100 meters long at the base of limestone beds (Robertson 1977: 16). Vitreous cherts that are nodular or lenticular are located in the chalks along the north margin of the Troodos (Robertson 1977: 16), which is in proximity to the Ayia Varvara Asprokremnos site.

The elevation of the study area ranges from approximately 316 meters to 326 meters above sea level. Flooding on the study landscape is limited to the Gialias River channel. Climate regime is Mediterranean with hot summers and cool, wet winters. Winter rainfall does exacerbate erosion. Current use of the landscape is primarily agricultural. Parts of the landscape are used as a grazing route for a local herd of goats and sheep. The river terraces have been reinforced to maintain horizontal treads and the construction of checkdams controls erosion during winter rains and summer thunderstorms.
2.3 Satellite Imagery and Model Building

Remote-sensing methods offer powerful approaches to understanding patterns of site distribution at landscape scales. High-resolution satellite imagery became widely available in 1995 when the CORONA satellite photographs, images taken in the 1960s and 1970s of the Middle East, were declassified (Wilkinson et al. 2006). With the development of Google Earth and other such websites, some form of high-resolution satellite imagery is available to almost anyone with a high-speed internet connection. Satellite images and remote sensing are now being used in a number of disciplines including archaeology. Among the images available today is Quickbird, a high-resolution satellite that collects panchromatic image data at 0.61 m pixel resolution. Remote sensing is when information is extracted from images. Specialists can isolate specific kinds of sensor data designed to reveal desired information (Campbell 2002:11). A camera can view a physical object and capture sensor data by recording electromagnetic radiation emitted or reflected from the landscape (Campbell 2002:11).

Archeology has found use of remote sensing useful in site prospection and resource management. The sparse landscapes of the eastern Mediterranean and Middle East are ideal settings for using satellite imagery in archaeological applications. Satellite data provides a valuable base map of environmental data and for navigation (Beck et al. 2007). This means a significant amount of information can be gathered prior to entering the field. If an archaeological site can be detected remotely, what properties influence site visibility? Aside from obvious topographic features, light absorbance and light reflectance are the means by which archaeological sites are identified in satellite imagery (Philip et al. 2002; Wilkinson et al. 2006; Beck et al. 2007). The spectrum of light reflected by the Earth’s surface can indicate changes in color and temperature that cannot be sensed by the human eye alone. These changes in temperature and color are reflective of differences in vegetation, moisture, soil, rock composition and more. Archaeological sites consist of human modifications to the existing landscape and therefore a standardized archaeological signature cannot be created that will identify sites in every environment (Beck et al. 2007).
Work in western Syria has shown that archaeological sites associated with marls produce an increased contrast with the local landscape, which can be enhanced digitally for easier detection (Wilkinson et al. 2006; Beck et al. 2007). When dry, the archaeological sites in question were lighter in color than off-site soils (Beck et al. 2007:170). This increased light reflectance could be due to the soil at a site being less able to retain moisture than surrounding soils. Laboratory tests suggest this is possibly due to fine average grain size and high clay content combined with poor sorting (Wilkinson et al. 2006:740). These contrasts may, for example, represent decayed and ploughed mud brick structures (Beck et al. 2007). The researchers were able to find archaeological sites using both Corona and Ikonos satellite imagery. Though the newer Ikonos proved more reliable, there still a significant amount of “false signatures” (Beck et al. 2007: 170). As of yet, using this technique has no way of easily distinguishing between ancient settlements and some other source of the contrast. Ground verification is still a necessity.

What if you are looking for a site of a specific kind or from a specific time period? If the earliest Cypriots were hunter-gatherers, then their dwellings or habitation sites reflected this non-permanent living arrangement. This hypothesis points to the inhabitants of Mylothkia and Shillokambros as later immigrants who came to the island with some sort of cultivator toolkit with the intent on settlement. So, in our search for the first and earliest Cypriots, we are looking for discrete archaeological sites that represent some sort of use, processing or extraction of a resource. These sites would be easily obliterated over the last 10,000 years or so of human occupation of the island. The only hope for preservation would be relatively rapid burial by sediments or the rare chance that the location is so remote that subsequent human impact has not intensified its erosion. So, in order to look for these sites we must locate all of the places that may contain resources that are on landforms older than 10,000 to 8,000 years, have not been significantly eroded, and have likely been buried. Obviously, this task is overwhelming given the area under consideration and therefore these criteria must be narrowed and managed. As described above, we have very little information on what to expect from
early PPNB sites on Cyprus. This makes using previously tested techniques of remote sensing for PPNB sites on Cyprus difficult. We do not yet have a sample big enough, if one exists.

2.4 Theory: Landscapes, Places and People in Archaeology

Armed with the landscape-scale perspective provided by remote-sensing methods, how can we begin to predict where early Cypriots decided to create archaeological sites? In short, we can look at cultural and natural elements of site formation at similar landscape scales (Schiffer 1987). The distribution of early PPNB sites is partly due to choices made to use key parts of the Cyprus landscape and partly due to natural processes working to preserve (or destroy) these sites. In this section, I discuss theoretical expectations site distribution and preservation that serve to guide the remainder of the thesis. One of the key principles of anthropology is its holistic approach to the study of humans. This has led archaeologists to pursue a multidisciplinary approach to the study of humans through their material remains. The landscape approach to understanding past cultures allows archaeologists to see the archaeological record as part of its geomorphic context (Binford 1982, Stafford and Hajic 1992, Zvelebil et al. 1992). This is, in essence, how we study both kinds of site formations processes: cultural and non-cultural (Schiffer 1987). Geoarchaeology is just one of the disciplines necessary to reconstruct a site and its environment. This approach aids in the understanding of the site as it relates to regional cultural patterns and how they change over time and space (Wells 2001). By examining the soils and geomorphology of Ayia Varvara Asprokremnos we can gain an understanding of the geological forces that shaped the record in this place (Waters and Kuehn 1996). We can then use this information to examine other areas of Cyprus that may have supported similar human activities and geomorphic processes.

When it comes to interpretation of the archaeological record, Binford (1982) stresses the role of formation processes as well as the role of place in the creation of the record. The artifact may be the basic unit of observation for the archaeologist (Binford 1992), but it is the context that gives the artifact meaning. Therefore, archaeological site
description and interpretation are not complete without a reconstruction of the physical and cultural landscape within which the site is located (Wells 2001). An important archaeological question is whether or not the patterns seen in the archaeological record reflect actual human activities or the differential preservation by geologic forces (Waters and Kuehn 1996). Landscapes are constantly changing. This results in the differential preservation and destruction of the archaeological record. The archaeological record can be no more complete than the stratigraphic sequence of the landscape (Waters and Kuehn 1996: 495).

The geologic interpretation of the site also lends credibility to the interpretation of the whether or not the artifact is in situ upon discovery. Furthermore, interpreting the geomorphological processes active both in the past and present at the site allows the archaeologist to more accurately interpret the presence or absence of artifacts in given areas (Wells 2001). A detailed understanding of the stratigraphic sequence of landscape can indicate whether or not settlement patterns observed in the present actually reflect past activities (Waters and Kuehn 1996).

The archaeological record should be examined based on an understanding of the factors that lead to the creation of the locus of cultural activity at the point of observation (Dunnell 1992: 27). If we must define “archaeological site” as a concept, I would loosely follow Binford’s definition because of its focus on the importance of context. To Binford, a site is defined by the artifacts and the artifact’s spatial relationship within and to different functional areas of a site (Binford 1964: 431). The biggest flaw with the site concept is that it ignores a large portion of the space potentially used by early peoples (Dunnell and Dancey 1983). Binford (1982) indicates that the idea of place may be more appropriate when attempting to describe human activities in the past.

One way to understand a past cultural system is through studying the relationships between “places” used by the culture in question (Binford 1982). To define “place” you must identify variables that have importance to a culture that would make the place a desirable location. The idea of “place” can be considered similar to the concept of environmental resource patch as described by landscape ecology. It is a location that
differs from its surroundings and contains desired elements (Gorman and Gordon 1986). Landscape archaeology interprets the relationship between “places”. An archaeological landscape is a past surface that existed within a defined span of time and has been subjected to modifications (Zvelebil et al. 1992). Landscapes are composed of landforms that can be defined by any assorted amount of properties (Stafford and Hajic 1992). Landforms may be considered a “place” or may contain several “places”. Therefore, we can look for archaeological landscapes that are comprised of an ideal set of elements. The geoarchaeological studies at Ayia Varvara Asprokremnos will help us define these elements.

If we are looking for traces of the early inhabitants of this island, then we must make some educated guesses about them to narrow our search. Since we have little archaeological evidence to guide our assumptions we have to start with the most parsimonious explanations. One of the key questions of the EENC research is in regards to what the toolkit of the early peoples was comprised of. Even if they came with the complete knowledge of and ability to perform early agricultural techniques, it would have taken time to establish self-sufficient communities. I assume that the earliest humans on the island practiced a mostly hunter-gatherer subsistence strategy. We see from the earliest known sites of Aetokremnos (Simmons 2001), Shillourokambos (Guilaine and Briois 2001) and Mylouthkia (Peltenburg et al. 2001b) that some level of foraging was practiced. By 8,000 BC, the transition from hunting and gathering to agriculture was not complete. Even with an agricultural toolkit and a semi-permanent settlement there were resources that required collection by way of periodic movements across a landscape. Therefore, the analysis of these early sites only includes a small portion of the area used and occupied by the early inhabitants of the island. We can then use this information to attempt to define ideal places that early Neolithic peoples would have sought out.

Hunter-gatherers are especially complex in their use of the landscape, so when studying these groups a landscape based approach is more appropriate (Stafford and Hajic 1992; Zvelebil et al. 1992). Humans, like all animals, are dependent on resources to survive. Human culture has allowed us to quickly adapt to new environments by
expanding the type and amount of resources we can utilize for survival. According to foraging theory, an animal will aim to maximize its energetic gain and minimize its energetic losses when looking for desired resources (Stephens and Krebs 1986). In this particular study, the animal is human and the resource to be analyzed is not food, rather it is its proxy - the raw material to make stone tools. Though chert does occur as cobbles throughout the landscape of Cyprus, its distribution in this form is not necessarily reliable or predictable. As river-worn cobbles, it may be obtained on an encounter basis, but perhaps not with enough frequency to keep up with demand. Therefore, learning to find patches of this resource in the form of bands or seams would be advantageous, if not optimal. Chert is not the only resource our hunter-gatherer must consider. Water, shelter, firewood and other resources are also necessities. A river corridor would provide protection, resources, and according to foraging theory would be the least-cost-path from the coast. A final aspect we must consider from landscape ecology is the matrix. Matrix is the element of landscape that is most extensive and connected. The matrix is the ecological system that the hunter-gatherer is operating in (Forman and Godron 1986). There are two elements of matrix that must be considered for this model. One is the landform. It must be old enough to have supported early Neolithic feet. The second is sediment. Cyprus is an eroding landscape. The landform must have either been saved from erosion or have been a place of deposition.

Ideal Free Distribution Theory posits that in an unrestricted landscape, humans have the freedom to choose places that are an ideal balance of resources (Cashdan 1992; Fretwell 1972). The early Neolithic landscape of Cyprus would have been unrestricted by competing groups of humans, so early hunter-gatherers would have had the opportunity to choose the best habitats without competition. This idea allows us to narrow our search for landscapes that provide the best possible combination of resources. The variables described above are considered by this researcher to represent an ideal combination. Though arguments can be made against these variables, some of which are presented in the discussion section below, this allows us to narrow our search to a more manageable area.
3 Objectives and Methods

The first goal of this thesis is to explain the site formation processes active at Ayia Varvara Asprokremnos. This includes describing the surficial geology of the site, the soil properties of the site and discussing alternative hypotheses to how the artifacts could have arrived at their present location. The second goal of the thesis is to make recommendations of where similar sites may be located on the landscape. The site of Ayia Varvara Asprokremnos will be used as a type-site for a predictive model that may be used to locate other sites of early Neolithic age. A combination of satellite imagery and Geographic Information Systems (GIS) data will be used to point out areas of the landscape that may have the potential to contain buried archaeological materials of Neolithic age with regards to the exploitation of chert resources at the contact between the Lefkara Formation and the Upper Pillow Basalts. This thesis focuses on defining the landscape of a specific site in order to better understand and define place.

This thesis is an outgrowth of my work with the Elaborating Early Neolithic Cyprus (EENC) team was to provide geoarchaeological support to the archaeological excavations at Ayia Varvara Asprokremnos and the archaeological survey at Agrokipia Paliokamina and Alambra Spelios. The primary goal of the EENC project in 2006 was to excavate at the site of Ayia Varvara Asprokremnos in order to find \textit{in situ} carbon material for radiocarbon dating. The project director, Dr. Sturt Manning, chose the site because it was almost exclusively comprised of lithic artifacts and appeared to have enough sediment accumulation indicating potential for buried materials. The work at this site aimed to address questions regarding Neolithic settlement patterns and resource exploitation. Data was collected from the site during the May 2006 field season. Methods I applied during that field season included reconnaissance and mapping and sampling.

3.1 Reconnaissance and Mapping
Prior to going into the field, 1:5,000 topographic maps, satellite images, and 1:30,000 geologic maps of the area were carefully examined. The names of the bedrock
types as well as the predominant geomorphic features were noted. The area was discussed in detail with Dr. Jay Noller, a soil scientist and geomorphologist familiar with the site and the island of Cyprus.

In the field, in order to better understand the landscape surrounding the excavation site, different views of the area were drawn with paper and pencil with an eye towards the geomorphic processes at work on the landscape. Special attention was placed on the direction of water flow and areas of water pooling in the landscape. This allowed the researcher to see the landscape as a place of multiple functioning processes. The area was also extensively photographed using a digital camera. Based on the drawings, the area was mapped using ArcGIS and Global Positioning Systems (GPS) in Universal Transverse Mercator (UTM) coordinate system, Zone 36, WGS 1984 Datum. A Panasonic ToughBook with wireless GPS was used so that digital mapping could be preformed in real time on the landscape. Geologic, geomorphologic and anthropogenic features on the landscape were walked with the GPS in tracking mode thereby creating a map on a scale that was meaningful to that of the site. In order to see the landscape as an active place, Jenny’s (1941) five factors of soil formation: climate, organisms, relief, parent material and time were heavily relied upon during all phases of the fieldwork. These same factors proved useful when trying to understand archaeological site formation and preservation.

The process of constructing a soil map of a site is one way to gather information that can be used to answer many of the research questions. The utility of a soil map at an archaeological site is great. Sediments and soils are defined differently. Sediments are matter that has been transported and deposited or re-deposited by water, wind or gravity (Stein 2001; Waters 1992). The mode of deposition is limited by the size of the particle and the amount of energy within the depositional mode (Waters 1992: 16). By this definition, artifacts are part of the sedimentary record. Soils are physically, chemically or biologically altered earth materials that develop in place (Waters 1992: 40). Therefore, artifacts are also a component of the soil in archaeological sites. This alteration of sediments through addition, transformation, transfer, and removal processes requires
periods of relative stability in a landscape. If allowed by long periods of surface stability, the environmental factors will influence the development of soil horizons. Differences in the soil horizons and therefore types, arise as a function of the dominance of one or more of the soil forming factors: climate, organisms, relief, parent material and time (Jenny 1941). A soil map can indicate which soils are still intact and where materials yielded from eroded soils may have went. Documentation of the spatial changes in soils provides important information on the preservation potential for *in situ* artifacts.

### 3.2 Sampling

The aim of study at the site was to detect change in sediment or soil and depth in order to assess the possibility of buried archaeological deposits and to better understand soil development and site-formation processes. Transects were aligned both parallel and perpendicular to catenas, a sequence of soil profiles along a hillslope, in order to include the range of variation across the site. All notes had to be taken in the field as no soil samples could return to the United States due to permitting and importing regulations.

To assess the probability of intact subsurface deposits and any change in soils and/or sediments across the site, four transects of auger cores were drilled bisecting the area on several surfaces. These transects were placed both parallel and perpendicular to catenas in order to sample the range in variation. The cores within these transects were placed so that each position on the catena or each terrace was sampled with at least one core. The auger cores are shown overlaying the site map in Figure 3.1. The location of each core was recorded using GPS. Where depth or type of sediment made it impossible to drill with an auger, hand sampling and visual observation were used to determine map units.

At each core position, brief notes were made regarding the topography, landscape position, vegetation, bedrock type and parent material. A bucket auger with a 30-centimeter long and eight-centimeter diameter sand head was used to sample the soils. The depth of the auger was determined by measurement before the auger was removed from the hole. For each bucket, several characteristics were recorded based on the U.S.
Figure 3.1 Ayia Varvara Asprokremnos augers.
Department of Agriculture’s National Soil Survey Center 2002 guidelines. Descriptions include: 1) dry color, 2) texture, 3) structure, 4) fragments, 5) mottling, 6) concentrations and, if apparent, ped and void surface features. Color was determined using a Munsell soil color chart and texture was determined on hand samples. The presence or absence of any cultural material and carbon materials within the auger sample was also noted. If either were found, they were bagged for analysis by specialists. Each core was drilled until the sediment became impenetrable. This often was a large cobble at the bottom of the core. If a depth greater than 25 centimeters was not reached, up to five more tries were made within a one-meter square area.

After excavation was completed on the archaeological excavation units, one representative wall of each of these trenches was drawn and described by the researcher. These walls were based on the integrity of the profile and the inclusion of the range in variation within and among the profiles. Before drawing the profile, a level string line was placed at the surface to be a datum for measurements. The drawing was made on a 1:20 scale with measurements being taken at least every 20-centimeters along the wall. This drawing included soil horizon or sediment changes along with any artifacts, features, or rocks within the profile. The profile was examined and described using the U.S. Department of Agriculture’s National Resource Conservation Service’s 2002 soil pedon description form and guidelines. The profile was also documented using digital photography.

3.3 Predictive Mapping

After examining the site at Ayia Varvara Asprokremnos, I choose several variables to base my predictive maps upon. The first was the contact between the Lefkara Formation and the Upper Pillow Lavas. As discussed above, it is here that the chert is located. The second is the proximity to a 4th to 7th order stream. These streams of higher order are more likely to have persisted in some form from the early Holocene than the lower-order streams. Following a river from the coast would be the least cost path for access to inland resources. This corridor would also provide access to water,
shelter and other resources necessary to human survival (Forman and Godron 1986). The site is also located on an upland terrace. It is not clear how much downcutting has occurred since site occupation, but it is generally accepted that higher landforms are older than their lower counterparts (Waters 1992). Presumably, terraces below 10 meters above current river level or alluvial plains may not be old enough to contain sites of Neolithic age. The site at Ayia Varvara was preserved due to the stopping of sediment loss by checkdams. Cyprus is an eroding landscape and therefore we must take into consideration how much sediment loss, gain or disturbance a landform may have had since the early Holocene.

Creating the predictive maps based on these variables was a three-step process. First, I used the GIS data on Cyprus from the Geological Survey Department of the Republic of Cyprus to narrow down potential areas based on specific characteristics. Using the 1:250,000-scale geologic maps in GIS, I removed all but four of the geologic formations and sediments: Lefkara Formation, Upper Pillow Lavas, Perapedhi Formation, alluvium and colluvium. I then overlaid the 1:50,000-scale rivers map, removing the 1st through 3rd order streams leaving the 4th through 7th order streams visible. This allowed me to see the areas of the island where the contact between the Lefkara Formation and the Upper Pillow Lavas was within approximately 200 meters of a river (Figure 3.2). The second step was to overlay the 2003 Quickbird satellite images and zoom to a scale that would be useful for site prospection. The 1:5,000 scale or 1 inch equals 100 meters proved to be the best scale. It allowed the pixel size to be small enough for image clarity in examining the landscape while being small enough for on ground navigation. It is important to note that the 1:250,000 geologic maps and the 1:5000 satellite images are quite different in scale. The contacts represented by the lines from the geologic maps are only a close approximation of the contact. I used a digital elevation model of Cyprus to examine elevation and slope. Finally, I overlaid the projected WGS 1984 UTM Zone 36N gridlines so that the areas in question could be referenced on smaller-scale maps, and on the ground using GPS units.
Figure 3.2 Cyprus Map with geologic formations and rivers. The images vary in scale and the boxes with numbers indicate the predictive map.
Using the geologic and river maps, I was able to narrow the search area down to twenty-three 1:5,000 scale maps each fitting to an 8 ½ x 11 inch page. The third part was a visual examination of each of these maps to determine areas of potential preservation of archaeological materials. Once again, I considered all of the variables. As the contact represented in the 1:250,000-scale maps is not necessarily accurate to the 1:5,000-scale maps, I first examined if the contact was visible. I then considered the elevation above the river and the slope of the landform. Finally, I considered how much sediment loss, gain or disturbance each landform has undergone.
4 Results

My work at Ayia Varvara was three-fold in its approach. I made a soil map of the site, examined the surficial geology of the site and studied the soil profiles of the excavation units. I then took this information and used it to build predictive maps for areas across Cyprus where similar sites may potentially be found. Below I will discuss the findings from my work at Ayia Varvara Asprokremnos and the subsequent predictive mapping as a result of that work.

4.1 Ayia Varvara Asprokremnos

A total of four transects, 23 auger cores and numerous hand samples were studied across the site. After compiling all of the available information the research area was divided into 14 soil map units as seen in Figure 4.1. The transects and soil map units are described below. The representative auger core for each map unit is described in detail below. Based on my observations while making the soil map, I was able to create a surficial geology map of the study area (Figure 4.2).

4.1.1 Soil Map Units and Surficial Geology

The creation of the soil map based on augering across catenas yielded information on soil and sediment depth and type, areas of erosion and deposition, frequency of flooding and the differing types of land use and modification within the study area. Figure 4.1 shows the study area divided into soil map units. The soil map units are summarized in Table 4.1. Soil map units are just one way to delineate a landscape and discuss its features based on specific criteria. After the initial excavations at the site, it became clear that what the archaeologists had found was a task specific area dedicated to the reduction of lithic materials for tool making. This begged the question of whether or not there were other components of the site buried within the vicinity. The criteria used to determine soil map units became helpful in determining parts of the landscape where more buried archaeological materials may still remain.
Figure 4.1 Ayia Varvara Asprokremnos soil map units with dominant features noted.
Figure 4.2 Surficial geology of the study area at Ayia Varvara Asprokremnos. The darker formation is the Upper Pillow Basalt and the white is the Lefkara Formation. Base map courtesy of Google Earth.
Table 4.1 Ayia Varvara Asprokremnos soil map units.

<table>
<thead>
<tr>
<th>Map Unit</th>
<th>Depth to C Horizon</th>
<th>Drainage</th>
<th>Total Area: Acres</th>
<th>Total Area: Hectares</th>
<th>Percent Area</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 cm</td>
<td>good</td>
<td>3.07</td>
<td>1.24</td>
<td>20%</td>
<td>Calcixerepts</td>
</tr>
<tr>
<td>2</td>
<td>55 cm</td>
<td>good</td>
<td>0.92</td>
<td>0.37</td>
<td>6%</td>
<td>Xerepts</td>
</tr>
<tr>
<td>3</td>
<td>--</td>
<td>poor</td>
<td>0.12</td>
<td>0.05</td>
<td>1%</td>
<td>Xerorthents</td>
</tr>
<tr>
<td>4</td>
<td>20 cm</td>
<td>moderate/poor</td>
<td>2.15</td>
<td>0.87</td>
<td>14%</td>
<td>Typic Xerorthents</td>
</tr>
<tr>
<td>5</td>
<td>40 cm</td>
<td>good</td>
<td>0.17</td>
<td>0.07</td>
<td>1%</td>
<td>Xerolls</td>
</tr>
<tr>
<td>6</td>
<td>0-25 cm</td>
<td>poor</td>
<td>2.4</td>
<td>0.97</td>
<td>15%</td>
<td>Xerorthents</td>
</tr>
<tr>
<td>7</td>
<td>0-25 cm</td>
<td>moderate/poor</td>
<td>1.35</td>
<td>0.55</td>
<td>9%</td>
<td>Fluvents</td>
</tr>
<tr>
<td>8</td>
<td>0.0 cm</td>
<td>poor</td>
<td>0.13</td>
<td>0.05</td>
<td>1%</td>
<td>Xerorthents</td>
</tr>
<tr>
<td>9</td>
<td>60 cm</td>
<td>good</td>
<td>0.79</td>
<td>0.32</td>
<td>5%</td>
<td>Calcixerolls</td>
</tr>
<tr>
<td>10</td>
<td>0-25 cm</td>
<td>moderate/poor</td>
<td>0.9</td>
<td>0.36</td>
<td>6%</td>
<td>Typic Xerorthents</td>
</tr>
<tr>
<td>11</td>
<td>28 cm</td>
<td>moderate</td>
<td>0.71</td>
<td>0.29</td>
<td>5%</td>
<td>Calcixerolls</td>
</tr>
<tr>
<td>12</td>
<td>48 cm</td>
<td>good</td>
<td>0.62</td>
<td>0.25</td>
<td>4%</td>
<td>Xerepts</td>
</tr>
<tr>
<td>13</td>
<td>--</td>
<td>moderate/poor</td>
<td>0.52</td>
<td>0.21</td>
<td>3%</td>
<td>Aquents</td>
</tr>
<tr>
<td>14</td>
<td>--</td>
<td>moderate/poor</td>
<td>1.79</td>
<td>0.72</td>
<td>11%</td>
<td>Xerepts</td>
</tr>
</tbody>
</table>

Map unit 1 is located on the first (lowest) and second river terraces on the northwest bank of the Gialias River. These terraces are composed of poorly sorted, rounded to sub-rounded alluvial gravels, pebbles and cobbles with fine colluvial and alluvial sands and silts. Dry-stacked terrace walls along various points of the risers have maintained the level surface of the terraces. Based on these results, the currently classified as Calcixerepts. Visual examination of the terrace edges indicates calcium carbonate accumulation within the soil. Further examination of the soil based on a soil pit, as opposed an auger core will reveal, a calcic horizon in more detail. The second river terrace is obviously older then the first, but at this time there is not enough evidence to separate them into separate soil map units. Flooding of these surfaces is rare due to their position above the river, lack of rainfall, and good drainage. The terraces are plowed and cultivated for domestic oat production. Current vegetation is mostly domestic oats. The likelihood of buried archaeological deposits within this map unit is poor. Map unit 1
composes 20% of the total study area (Table 4.1).

**Stratigraphic Profile Map Unit 1**

Ap-- 0-10 cm; brown (10YR 5/3) gravelly silty clay loam; moderate, very fine sub-angular blocky structure; 10% igneous, 5% sedimentary, 2% carbonaceous, sub-rounded to rounded gravels;

Ck -- 10 cm +; brown (10YR 5/3) gravelly silty clay loam; common, fine distinct, calcium carbonate threads in the matrix; >20% sub-rounded to rounded gravels with carbonate coats on bottom of rock fragments.

Map unit 2 encompasses the third terrace above the river on the southeast bank of the Gialias River. This terrace is bisected by drainages in several places, and the map unit encompasses those portions of the terrace at the toe of pillow basalt slopes. This terrace is composed of poorly sorted, rounded to sub-rounded alluvial gravels, pebbles and cobbles overlying pillow basalt. It receives colluvial deposits from the basalt slopes above and loses sediments on the southwest and northeast margins where the landform has been bisected by gullies. The soils in this map unit are Xerepts. Flooding in this unit is rare due its position above the river, lack of rainfall, and good drainage. This landform is dominated by domesticated oat and barley. The likelihood of buried archaeological deposits within this map unit is good. Map Unit 2 composes 6% of the total study area (Table 4.1).

**Stratigraphic Profile Map Unit 2**

Ap--0-22 cm; brown (10YR 4/3) clay loam; weak, very fine sub-angular blocky to granular structure; soft dry, very friable moist; 5% igneous and 5% sedimentary sub-angular to sub-rounded gravels;

Bw--22-55 cm; brown 10YR 4/3 clay loam; weak, very fine sub-angular blocky to weak, fine granular; soft dry, very friable moist; common, fine, prominent, white, dry, spherical, mottles in the matrix; 5% igneous and 5% sedimentary sub-rounded gravels;

C – 55 cm +; brown (10YR 4/3) clay loam; >20% sub-angular to sub-rounded gravels.
Map unit 3 is a low hill of the Lefkara Formation. Most of this map unit is saprolitic limestone with small pockets of Xerorthents. These pockets have accumulated enough sediment to allow for some low native vegetation including thyme and other small shrubs. Flooding is rare due to the sloping nature of the landform, though drainage is poor. The likelihood of finding buried archaeological deposits within this map unit is poor. Map unit 3 composes less than 1% of the total study area (Table 4.1).

Map unit 4 is located on the upland of weathering Lefkara Formation slopewash. It is generally flat with a very slight slope in places to the south and west. The soils in this unit are Typic Xerorthents. This area has been repeatedly plowed. Its bright white color is in sharp contrast to the other map units, except unit 3. Flooding is moderate to rare due to lack of rainfall, but may be possible due to the slower drainage and several low points within the map unit. Domesticated oats and barley dominate this area. The likelihood of finding buried archaeological deposits within this map unit are poor to moderate. Map unit 4 composes 14% of the total study area (Table 4.1).

Stratigraphic Profile Map Unit 4
Ap--0-20 cm; brown (10YR 5/3) clay loam; weak, very fine sub-angular blocky structure; very friable moist, brittle consistence; 5% combined igneous, sedimentary and carbonaceous sub-rounded gravels.
C1--20-32 cm; white (10YR 8/1) silty clay loam; massive; slightly hard dry, very friable moist, brittle.
C2--32-38 cm; white (10YR 8/1) silty clay loam; massive; slightly hard dry; very friable moist, brittle; concentrations of irregular shape very pale brown (10YR 7/4).
C3--38-64 cm; white (10YR 8/1) silty clay loam; massive; very friable, brittle; some cemented carbonate nodules.
R – 64 cm +; white (10YR 8/1); Lefkara Formation.

Map unit 5 is located upland at the base of the southeast side of a basalt hill and adjacent to the contact between the pillow basalts and Lefkara Formation. The soil in this
map unit is a Xerolls. This map unit is darker (10YR 4/4 to 10YR 5/6) than the surrounding units. This unit’s position at the base of a basalt slope is and flat surface means it likely receives more sediments then it loses. This unit is well drained and flooding is rare. The map unit description comes from the west wall of Trench 5 of the archaeological excavation site. The likelihood of finding buried archaeological deposits with this map unit is excellent. Map unit 5 composes 1% of the total study area (Table 4.1).

Stratigraphic Profile Map Unit 5
Ap-- 0-12 cm; brown (7.5YR 4/3) clay loam; moderate, very fine sub-angular blocky structure; moderately hard dry, firm moist, moderately sticky, moderately plastic; few very fine roots throughout; common very fine tubular pores; few, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 1% carbonaceous sub-rounded gravels; clear smooth boundary (11 to 13 cm thick);
AB—2-22 cm; brown (7.5YR 4/3) clay loam; moderate very fine sub-angular blocky structure; hard dry, firm moist, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; common, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 2% carbonaceous sub-rounded gravels; clear smooth boundary (20-23 cm thick);
Bt1—22-32 cm; very dark grayish brown (10YR 3/2) silty clay loam; strong very fine sub-angular blocky to granular structure; hard dry, friable moist, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; common, medium, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 4% carbonaceous sub-rounded gravels; common distinct clay films on all faces of peds; abrupt smooth boundary (10-11 cm thick);
Bt2 – 32-40 cm very dark grayish brown (10YR 3/2) silty clay loam; moderate very fine sub-angular blocky to granular structure; hard dry, friable moist, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; common, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 4% carbonaceous sub-rounded gravels; few, distinct clay films on all faces of peds;
40 cm very dark grayish brown (10YR 3/2) silty clay loam. This is the lowest extent of the excavation unit.

Map unit 6 is the summit, shoulder and backslope of complex pillow basalt slopes within the study area. Much of the area is exposed basalt with pockets of shallow Xerorthents supporting low growing plants, and shrubs such as thyme. Drainage is poor, but runoff is high and flooding is extremely rare on this map unit. The likelihood of finding buried archaeological deposits with this map unit is poor. Map unit 6 composes 15% of the total study area (Table 4.1).

Map unit 7 is a complex of soils and sediments along the current riverbed of the Gialias River. The more stable portions of this map unit support riparian vegetation from grasses to large Oleander bushes, whereas the other portions are unstable and support no vegetation. Soils in this map unit are considered Fluvents. Drainage in this map unit is moderate to poor and flooding is common during the wet season. The likelihood of finding buried archaeological deposits with this map unit is poor. Map unit 7 composes 9% of the total study area (Table 4.1).

Map unit 8 is exposed pillow basalt, with Xerorthents developing only cracks where sediments have been deposited by either aeolian processes or the very rare occasions of overland flow of the river. This exposure of basalt supports no vegetation. Drainage is poor, but runoff is high making flooding highly unlikely and only in extreme events. Map unit 8 composes less than 1% of the total study area (Table 4.1).

Map unit 9 is a west facing 10-degree slope. The lower portion of this map unit is the break in slope and the upper portion is bisected by two checkdams. This map unit is bordered to the north by a gully and to the south by a basalt hill. The surface has been recently plowed. It is covered by about 15% sub-angular to sub-rounded gravels and cobbles with rare angular cobbles of silicified umber. No vegetation is currently present on this map unit except at the checkdams where several trees and shrubs enjoy the deeper soil trapped by the checkdam. Presumably, the unit usually supports domestic oats as this is the dominant crop in the area. Soils on this map unit are Calcixerolls. Drainage in this
map unit is good, and flooding is rare due to the slope. The likelihood of finding buried archaeological deposits with this map unit is moderate. Map unit 9 composes 5% of the total study area (Table 4.1).

**Stratigraphic Profile Map Unit 9**

Ap-- 0-15 cm; brown (10YR 4/3) clay loam; moderate, very fine sub-angular blocky; soft dry, very friable moist; 10% combined carbonate, igneous, and sedimentary sub-angular to sub-rounded rock fragments.

Bw1--15-30 cm; brown (7.5YR 4/3) clay loam; moderate, very fine sub-angular blocky; soft dry, very friable moist; 10% combined carbonate, igneous, and sedimentary sub-angular to sub-rounded rock fragments.

Bk1--30-49 cm; yellowish brown matrix (10YR 5/6) silty clay loam; moderate, very fine sub-angular blocky; soft dry, very friable moist; common, medium, prominent, white, dry, spherical, carbonate masses in the matrix; 5% combined carbonate, igneous, sedimentary sub-angular to sub-rounded rock fragments.

Bk2-- 49-55 cm; yellowish brown (10YR 5/6) clay loam; moderate, very fine sub-angular blocky; soft dry, very friable moist; no fragments in auger; common (10%), medium, prominent, white (10YR 8/1) dry, spherical, carbonate masses in the matrix.

Bk3--55-60 cm; yellowish brown (10YR 5/4) clay; moderate, very fine sub-angular blocky; soft dry, very friable moist; common, fine, prominent, white, dry, spherical, carbonate masses in the matrix.

Ck-- 60-66 cm; yellowish brown (10YR 5/4) clay; moderate, very fine sub-angular blocky; soft dry, very friable moist; common, fine, prominent, white, dry, spherical, carbonate masses in the matrix.

Map unit 10 is a complex slope composed of two different bedrock types. The northeast and southeast portions of the slope are Lefkara Formation limestone and the west side is an outcrop of silicified umber of the Perapedhi Formation. The northeast and southeast sides hold the deepest soils, which are similar to the Typic Xerorthents of map unit 4 and are covered in domestic oats. The top of this slope has been artificially leveled
to create a road and bunker or berm. The soils here vary in depth and type depending on when they were last altered and the amount of each parent material. Many of the angular rock fragments within this unit have carbonate coats. The soils within this unit are likely Calcixerets. Drainage is moderate to poor in this map unit, and flooding is rare to moderate. The likelihood of finding buried archaeological deposits with this map unit is poor. Map unit 10 composes 6% of the total study area (Table 4.1).

Map unit 11 is an upland surface. It is positioned between the two pillow basalt slopes of map unit 6 and is adjacent to map unit 12 to the northeast and unit 4 to the west. A checkdam on the northeastern boundary of this unit retains the colluvial sediments eroded from unit 6. The boundary between unit 11 and unit 4 is the contact between the Upper Pillow Lavas and the Lefkara Formation. The underlying bedrock of map unit 11 is pillow basalt. The unit slopes very slightly to the west, and its surface is covered by about 15% with igneous, sedimentary and some carbonaceous sub-angular to sub-rounded gravels and cobbles. The soils of this unit are Calcixerolls. Map unit 11 is covered in cultivated oats and is plowed several times a year. Drainage in this unit is moderate and the likelihood of flooding is moderate to rare due to lack of rainfall, but may be possible due to the position of this unit on the landscape. The map unit description is from the west wall of Trench 2 of the archaeological excavation site. The likelihood of finding buried archaeological deposits with this map unit is excellent. Map unit 11 composes 5% of the total study area (Table 4.1).

Stratigraphic Profile Map Unit 11
Ap-- 0-6 cm; brown (10YR 5/3) dry; gravelly clay loam; moderate, very fine, sub-angular blocky; moderately hard dry, friable moist, moderately sticky, moderately plastic; few, very fine roots throughout; few, very fine tubular pores; few, fine, prominent, white, dry, spherical, mottles in the matrix; 5% igneous, sub-rounded gravels, 5% sub-rounded carbonaceous gravels; abrupt smooth boundary (6-8 cm thick);
Bt-- 6-18 cm; brown (10YR 4/3) dry; clay loam; moderate, very fine, subangular blocky; hard dry, friable moist, moderately sticky, moderately plastic; few, very fine roots throughout; common, very fine, tubular pores; few, fine, prominent, white, dry, spherical,
mottles in the matrix; few, faint, brown 10YR 4/3 (dry) discontinuous, clay films on all faces of peds; abrupt smooth boundary (12-13 cm thick);
2Ab-- 18-28 cm; brown (10YR 5/3) silty clay loam; moderate, very fine, granular; hard dry, friable moist, moderately sticky, moderately plastic; few, very fine roots throughout; few, very fine tubular pores; common, fine, prominent, white, dry, spherical, mottles in the matrix; common, coarse, prominent, white, dry, platy carbonates on bottom surfaces of rock fragments; moderately cemented sharp; few, faint, brown 10YR 4/3 (dry) discontinuous, clay films on all faces of peds; abrupt smooth boundary (10-12 cm thick);
2Btb-- 28-36 cm; light brownish gray (10YR 6/2); silty clay loam; weak, very fine subangular blocky; hard dry, friable moist, moderately sticky, moderately plastic; many, fine prominent white (10YR8/1) dry, spherical mottles in the matrix; common, coarse, prominent white (10YR8/1) dry, platy carbonate coats on bottom of rock fragments
3Bkb-- 36-56 cm; light brownish gray (10YR 6/2); silty clay loam; weak, very fine subangular blocky; common, coarse, prominent white (10YR 8/1) dry, platy carbonate coats on bottom of rock fragments.
4Ckb-- 56 cm + Lefkara Formation.

Map unit 12 is located on the first terrace on the east side of the river and between the second and third checkdams above the river. This unit slopes to the west between 10-12 degrees. The surface is covered by 20% by igneous, sedimentary and some carbonaceous sub-angular to sub-rounded gravels and cobbles. The soils in this unit are currently classified as Xerepts, but further examination could change their order to Mollisols. Drainage is good and flooding is rare. The unit has been recently plowed and currently does not support any vegetation. It is likely used for domestic oat production. The likelihood of finding buried archaeological deposits with this map unit is moderate. Map unit 12 composes 4% of the total study area (Table 4.1).

Stratigraphic Profile Map Unit 12
Ap--0-48 cm; brown (10YR 4/3) gravelly clay; very fine, moderate sub-angular blocky; soft dry, very friable moist, brittle; 10% igneous sub-rounded and sub-angular gravels,
5% sedimentary sub-rounded and sub-angular gravels;  
48 cm deepest extent of auger core. No further data is available.

Map unit 13 is the current riverbed of the Gialias River. The river originates in the Troodos Mountains to the west and drains to the east. This map unit is highly variable and is therefore composed of several soil types. Portions of this unit are currently saturated with water. Other portions of this map unit have large cracks from recent drying, while other parts are exposed river cobbles in-filled with fine alluvial sediments. Drainage is moderate to poor and flooding is frequent in this map unit. The soils in this map unit are Aquents. The likelihood of finding buried archaeological deposits with this map unit poor. Map unit 13 composes 3% of the total study area (Table 4.1).

Map unit 14 is the eroding toe slope of the first terrace above the Gialias River on both sides of the river. It is composed of poorly sorted alluvial sands, pebbles, gravels and cobbles along with some colluvial sediments from the higher terraces. Some of the rock fragments within this map unit have carbonate coats. The lack of agricultural modifications and movement of herds of goats across this area have lead to slumping and erosion. Vegetation in this map unit is riparian including grasses and domestic species like oleander, oats and olive trees. The terrain in this map unit is variable and the soils are Xerepts. Drainage is moderate to poor. The lowest portions of this map unit may experience flooding on a semi-annual basis during heavy winter rains or flash floods. The likelihood of finding buried archaeological deposits with this map unit is poor. Map unit 14 composes 11% of the total study area (Table 4.1).

These map units were then used to compile a surficial geology map of the study area (Figure 4.2). The study area was divided into five main sediment types. The qaternary alluvium (Qal) is visible on the northwest side of the river and underlying the Holocene alluvium (Hal) and the Holocene alluvial fans. The Holocene colluvium (Hcv) that covers the eastern portion of the study area, which includes the excavation area, is a result of both colluvial and alluvial processes. There is a westward slope to this portion of the study area, which aids the gravitational movement of sediments. This movement is
expedited by infrequent but high-intensity rainfall. We know these sediments are of Holocene age because they overlay the archaeological site.

4.1.2 Excavation Profiles

A total of seven trenches were excavated at the site. Several of these trenches were combined during excavations, so that a total of four exposures represented all of the trenches. One trench did not contain buried archaeological materials. The site is buried by approximately 30 cm of Holocene colluvium; the depositional and pedogenic history of which is described in detail below. Artifacts are found within the Holocene colluvium, but this is likely due to several turbation processes active at the site including plowing, faunal and floral turbation, and erosion.

Figure 4.3 shows the largest excavation block. It is a combination of Trenches 2, 4, 6 and 7. This block will be referred to as Trench 2. Here you can see 2 large rounded pits cut into the Lefkara Formation slopewash and capped by fill. These pits were filled with lithic materials. You can see a cross section of the lithic fill in the Trench 2 profile (Figure 4.4). The lithic materials are largely clast supported. However, in the unexcavated baulks in we can see that non-artifact materials are also present in the form of sub-angular to sub-rounded pebbles and cobbles. EENC archaeologists hypothesize that the prehistoric inhabitants of the area dug these pits and filled them with lithic debitage. These pits represent a task specific site for the reduction of lithic materials. Some yet undiscovered location near by was a quarry for the chert and it was brought here to reduce and form into tools. The pits were dug to manage the potentially dangerous debris. The flakes, even after being in the ground for millennia, are still very sharp. The cross section in represents a more discrete event where the lithics were deposited at one time. Areas with more fill, such as the unexcavated baulks, may have been used and left open allowing some deposition of aeolian and colluvial sediments. An alternative hypothesis for the deposition of these artifacts is discussed below.

Examining the profiles of the excavation trenches, at least two depositional events occurred after the deposition of the artifacts. Excavation trench 5 clearly shows a discontinuity between the AB and 2Bt1 horizons. In the photograph, this is seen as a
Figure 4.3  A southwest facing view of the largest excavation block at Ayia Varvara Asprokremnos. This block combines Trenches 2, 4, 6, and 7. The excavation block measures approximately 10 meters by 5 meters.
Figure 4.4 Excavation Trench 2. The letters U-Z are used to help explain corresponding horizons. The red line is a discontinuity in the profile.
Figure 4.5 Excavation Trench 5. The letters U-Z are used to help explain corresponding horizons. The red line is a discontinuity in the profile.
Figure 4.6 Excavation Trench 3. The letters U-Z are used to help explain corresponding horizons. The red line is a discontinuity in the profile.
stone line and a sharp texture change (Figure 4.5). This is also present in Trenches 2 (Figure 4.4) and 3 (Figure 4.6). This type of discontinuity can be a result of an erosional event, a rapid depositional event or a combination of both. The similarities in texture, structure, color and depth in the 2Ab horizon of Trench 2, the 2Bt1 in Trench 5 and the 2Bt in Trench 3 may indicate that this may be a laterally continuous horizon. In Trench 2 this is expressed as a buried A horizon or a paleosol.

I have used the letters U-Z in Figure 4.4, Figure 4.5 and Figure 4.6 to help aid in my explanation of site formation processes. I hypothesize that at time Z1 and Z2 the pit was dug by prehistoric hands and the artifacts were deposited. During Y and X the artifacts were buried. Time X represents a stable period on the landscape where an A horizon was allowed to form. I believe X represents a buried A horizon. Line W represents an environmental change. It is unclear if or how much erosion occurred to X before it was rapidly buried by V and U. The construction of the checkdam may be the environmental change that stopped the erosion of and caused the burial of X. This hypothesis needs further testing.

Excavation trenches 2 and 3 have Bk (calcic) horizons as indicated by the accumulated calcium carbonate on the bottom faces of the rock fragments or artifacts. Calcic horizons are formed slowly through the translocation of calcium carbonates, and can persist for a long time. Calcic horizons (Bk) are characterized by layers of carbonate-coated rocks or thin filaments of carbonate (Schaetzl and Anderson 2005:403). When the soil is wetted by rainfall, carbonates are carried down through the profile until the wetting front stops, thereafter depositing the carbonates. The B and C horizons accumulate carbonate because the soil is rarely completely saturated thereby flushing out the carbonates (Schaetzl and Anderson 2005). Carbonate can come from soil parent material, water within which it is dissolved or outside sources, by depositing it onto the surface of the soil. In the research area, addition of carbonates from ground water is unlikely due to the depth of the water table. The Lefkara Formation is an obvious source of calcium carbonate both as a parent material and as an outside source.
4.2 Predictive Mapping

Twenty-three, 1:5000-scale maps fit the first two variables: proximity to the Lefkara Formation and Upper Pillow Lava contact and a 4th to 7th order stream. Notes on all 23 maps and the maps themselves can be found in Appendices B and C. The maps contain the UTM coordinate system (Zone 36, WGS 1984 Datum) gridlines for ease of viewing as well as the municipality within which the areas are located. Figure 4.7 shows the island of Cyprus with the locations of each of the 23 maps indicated with boxes and numbers. Figure 3.2 and Figure 4.7 indicate that the predictive maps reflect the ring of the Troodos Massif. The northeastern arm of the island is owned by Turkey, so data is not available for this part of the island and was therefore not included in the model. Figure 3.2 shows the island of Cyprus with the isolated geologic layers: green is the Lefkara Formation, blue is the Upper Pillow Lavas, pink is the alluvium and colluvium and yellow is the Perapedhi Formation. The contact of the Lefkara Formation and the Pillow Lavas is indicated where the blue and green meet. The contact is rather continuous on the northern half of the island indicating where the Troodos Ophiolite rises from the center of the island. Figure 3.2 also indicates the 4th through 7th order streams. This allowed me to narrow down the total amount of land analyzed in the predictive model to twenty-three 1:5,000 scale maps. These maps are indicated in the expanded views of the contact. The scale on this figure varies.

Map Thirteen includes the site of Ayia Varvara Asprokremnos. Maps 7, 8, 10 and 21 have extremely low probability and no areas were indicated. The areas indicated on the other 19 maps will need to be pedestrian surveyed by a team including archaeologists and geomorphologists. Together these specialists can further determine which areas are best for shovel testing.
Figure 4.7 Cyprus outline with the location of the predictive maps indicated with boxes and numbers. The predictive maps are presented in Appendix C.
5 Discussion

Deposition, erosion, and post-depositional alterations within and around alluvial systems are greatly affected by climate (Huckleberry 2001). The present day climate of Cyprus is considered temperate Mediterranean with hot, dry summers and cool, moist winters. With as few as 13 days of rainfall a year, this landscape has an aridic-xeric moisture regime. Past climatic information is more difficult to reconstruct due to the position of Cyprus between three large landmasses and within the Mediterranean Sea. Climatic reconstruction is further complicated by the fact that the climate is constantly fluctuating due to numerous factors. Generalizations can be made, but they are scale dependent. A compilation of climatic data from multiple sources (i.e. lacustrine sediments, palaeosols, palaeobotanical records, speleothems and sea cores) by Robinson et al. (2006) is an excellent summary of the climatic variation in the Levant and Eastern Mediterranean from 25,000 to 5,000 years BP. The last glacial maximum, between 23,000 years BP and 19,000 years BP, was cooler and more arid in the Eastern Mediterranean than today. Sea levels, lake levels and precipitation amounts were lower due to moisture being locked in glaciers in the northern and southern hemispheres. Sixteen thousand years BP was marked by Heinrich event 1, a period of intense cooling due to the addition of fresh water to the Northern Atlantic. Between 15,000 years and 13,000 years BP the Levant and Eastern Mediterranean experienced what is now called the Bølling-Allerød warm interval. Increased precipitation is seen in high lake levels during this time. The arid and cold period, known as the Younger Dryas, affected the area from approximately 12,700 years to 11,500 years BP. Pollen records, palaeosols, lake levels and oxygen-isotope records all indicate that the early and middle Holocene, between approximately 9,500 and 5,000 years BP, was the wettest period of the last 25,000 years in the Levant and Eastern Mediterranean. Finally, historic records dating back to the 14th century indicate that rainfall and flooding on Cyprus has been intermittent but intense as evident through written accounts of catastrophic floods (Butzer and Harris 2007). This review seems to indicate that the last period of consistent
deposition on the Cypriot landscape was the mid-Holocene.

There are two broad questions regarding time on this landscape and the current research. The first question regards the age of the river terraces. Of course, we can assume the higher terraces are older, but the actual ages of the river terraces and the timing of their abandonment are important. This question is important when it comes to archaeological prospection. If we are looking for 8,000 to 10,000 year-old sites, then we should be doing it on landforms that are at least 8,000 to 10,000 years old. The alluvial gravels that compose the terraces within the study area are consistent with lateral accretion deposits in that they are dominated by coarse sand and cobbles. This indicates that they were laid down by high energy-stream flow (Huckleberry 2001). The Gialias River is now in a period of downcutting. Initial examination of climatic fluctuations indicates that the last period of deposition may have been in the middle Holocene, but other evidence indicates that the upper terrace of map unit 1 (Figure 4.1) is older than middle Holocene.

In the absence of other dating techniques, carbonate development can be used as a relative dating tool. According to Gile et al. (1966). There are four phases of carbonate accumulation in profiles. In Stage I, gravelly profiles will have thin discontinuous coatings of carbonates and non-gravelly profiles carbonates will appear as filaments in pores. In Stage II, pebbles in gravelly profiles with have continuous coatings of carbonates with some of the interstitial spaces between the pebbles filled with carbonates. In non-gravelly profiles the carbonates with appear as more continuous filaments with few to common nodules. The lower terrace of map unit 1 (Figure 4.1) has developed a calcic horizon similar to Stage I or II (Gile et al. 1966). Using data from New Mexico as a correlate, we can hypothesize that the lowest terrace is of late Pleistocene to early Holocene in age (Schaetzl and Anderson 2005). I hypothesize that the Gialias River had already abandoned the upper terraces of map unit 1 and map unit 2 (Figure 4.1) at the time of site occupation. The river was likely down cutting through the lower terrace of map unit 1 at the time of at the time of site habitation. Further investigation is required to test this hypothesis.
The second question relates more closely to the archaeological site at Ayia Varvara. What is the age and sequence of the checkdams within the study area? These dry-stacked retaining walls were likely expanded and modified repeatedly as generations of farmers used the fields. Profiles from failed checkdams have revealed sequences of deposits as old as 1300 years (Noller and Wells 2003). Human activity on the landscape since the Chalcolithic period has aimed to limit soil erosion creating a stepped topography. However, this has lead marginal areas to experience increased human use perhaps making them more vulnerable to erosion (Noller and Wells 2003). This is not conducive to preservation of sites of Neolithic age. Whether the lowest checkdam was built first or the highest was built first is unknown. Construction of the highest checkdam at Ayia Varvara is, at this point in the research, the most significant as its construction has helped to preserve map unit 5, and created Map Unit 11 by trapping sediments. I have determined that map unit 5 may represent a remnant of an older soil. It stands apart from other map units in the vicinity with its darker soil chroma, illuviated clay horizons and its lack of a buried Ap horizon as in map unit 11. The darker color of map unit 5 is partly a function of the basalt parent material it receives from the slopes above, but is also an indication of what may have been lost prior to the construction of the highest checkdam. Map unit 11 is of particular interest because it contains the majority of the archaeological materials for the site. The features of the site were dug into the Lefkara slopewash on top of which sediments have accumulated in at least two separate phases. The soil present at the time of site habitation was likely eroded after site occupation and prior to the construction of the highest checkdam. Either through environmental change or construction of the checkdam, this erosion was stopped or slowed for a long enough period of time for sediments to accumulate and form into a soil. This period of relative stability is indicated by the Bt horizon directly below the modern plow zone. Much of the distribution of lithic artifacts in the upper horizons is more likely due to plowing as opposed to subsequent occupations.

5.1 Alternate Hypotheses

What is an alternate hypothesis for the deposition of such a dense concentration of
lithic materials? Water would be the most likely transport agent second to humans. The first problem with this hypothesis is the abundance and homogeneity of lithic materials at the site greatly outweighs their presence in the landscape. Especially when compared to other artifact types. It is not uncommon to find, for example, pottery ranging in age from Bronze Age to modern throughout the landscape of Cyprus. There was very little pottery found at this site and only in the plow zone. If a flash flood were to scour the surrounding landscape and leave its deposits here, we would expect to find a more diverse representation of artifacts. There is no evidence of chanellized flow at the excavation area. Being that the site is located on an upland terrace lacking a significant upland alluvial basin, there is also the problem of where water with enough energy to carry the lithic materials would have come from if not from flash floods. The area was more likely a place of erosion rather than deposition until the checkdams were constructed long after the lithic material was deposited.

5.2 Predictive Mapping

There are multiple ways a predictive map of this kind could have been generated. Using the GIS data, one can program variables, such as distance to geologic contact, elevation, slope into a software program and use it to locate areas with specific characteristics with a statistically significant accuracy level. Utilizing such software to create predictive maps was the initial proposal of my research. This researcher found the technology very complex, preparation of the data extremely time consuming and the results to be incomprehensible. A second problem was one of scale. For instance, the DEM (digital elevation models) have a raster size of 25 meters. In the case of Ayia Varvara Asprokremnos, the excavation area was less than 25 meters wide. Had I been able to successfully understand and implement the software, I still would have been required to review the maps and modify them to a format that was useful to a field archaeologist wanting to test this hypothesis. If you program a computer to find landforms within 200 meters of a stream, it will ignore all landforms outside 200 meters. It is possible that the “perfect” landform is just outside your programmed criteria. Having worked as a field archaeologist, I propose that a satellite image with UTM grids
and areas signified as potential places of interest is more useful than a set of statistics. Using the GIS geologic map and river map as a way to narrow the search down was a very productive use of technology. Luckily, the island of Cyprus and the number of contacts was few enough that the task was manageable for one person.

A problem with removing the human element in decision-making is that humans make decisions based on a multitude of factors that are not always easily quantifiable. There are many costs and trade-offs to human foraging that need to be considered in an analysis of a population that no longer exists. However, this same argument can be said for predictive models as a whole. It would be nearly impossible to predict and factor in every variable in every human decision. Every variable has a set of arguments for and against it as being a limiting factor – are rivers truly the least cost route inland or was chert a valuable enough resource to be called a patch? We’ll leave these arguments for others. The point is we have to start somewhere. Furthermore, building an understanding of early PPNB site formation from the Ayia Varvara Asprokremnos site, which constitutes a sample size of one is problematic for creating a predictive model. However, the predictive model presented here bases its finding on the entire Cyprus PPNB data set. Ultimately, this predictive model attempts to define the ideal place for early Neolithic peoples on Cyprus in order to narrow down the search for their remains.
6 Conclusion

The study area at Ayia Varvara Asprokremnos is a complex of terraces, slopes, erosional and depositional features. The upland portion of the study area consists primarily of eroded Lefkara Formation. With little run off and little deposition from surrounding slopes, the uplands have developed weakly formed and relatively heterogeneous soils. The pillow basalt hills support shallow soils, but erosion and runoff from the slopes have created pockets of deeper soils at the toe slopes. Much of the study area is now slowly eroding towards the river. A number of checkdams have slowed this erosion and have trapped sediments to form deeper soils on these abandoned terraces. One of these checkdams appears to have helped preserve the site of Ayia Varvara Asprokremnos.

There are a number of questions left to be answered regarding the site of Ayia Varvara Asprokremnos. Some will require further archaeological excavations and others more extensive geomorphological investigations by other researchers. The site still has yet to be conclusively dated as Neolithic in age. Preserved organic matter for carbon dating has been difficult to acquire from the excavation. The site appears to be a task specific area. Is there a habitation site near by? Dating the river terraces and completing a more comprehensive geomorphologic investigation of the area would allow us to paint a clearer picture of what the site looked like at the time of occupation, and may also help pinpoint the potential areas for a habitation site.

The predictive model presented in this thesis is not yet tested with field data. The areas indicated on the predictive maps are merely places of potential preservation derived from an examination of satellite imagery and geological map units combined with a consideration of settlement patterns for early hunter-gatherers on Cyprus. The human element is only one factor in site formation. The second factor is the geomorphic processes that help preserve or destroy sites (Schiffer 1987). One of the key assumptions that this model makes is that in order for a site to have persisted since the early Neolithic,
it must be buried by sediments. Subsurface testing will be required to test this predictive model.

Landscape scale geomorphic mapping of all landforms would further help to answer questions regarding areas of potential preservation. The places indicated on my predictive maps will need to be ground verified, pedestrian surveyed and, most importantly, tested by excavation. The possibility does remain that Ayia Varvara Asprokremnos is a unique phenomenon. Further investigations are required before we can place Ayia Varvara Asprokremnos into a wider discussion regarding early Neolithic settlement patterns. The site was a task specific area for the reduction of lithic materials. Without further information we cannot say if it was deposited by the earliest hunter-gatherers inhabiting the island or a resource extraction area of one of the more established groups like those of Mylouthkia or Shillourokambos. The lack of obsidian and the presence of a fragment of a shaft straightener are tantalizing clues to who the inhabitants were and where they were from. The best way to answer these questions is to find more early sites. One way to find more sites is to test predictive models like the one presented in this thesis. With a combination of knowledge, skill and luck researchers may be able to elaborate on the story of early Neolithic Cyprus.
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Waters, M. R.

Wells, L. E.

Wilkinson, K. N., A. R. Beck, and G. Philip

Zvelebil, M., S. W. Green, and M. G. Macklin
Appendices
Appendix A Ayia Varvara Asprokremnos Profile Descriptions

Trench 1 East Wall
Ap – 0-8 cm; pale brown (10YR 6/3); clay loam; moderate, very fine, sub-angular blocky structure; hard, brittle, firm dry; semi-deformable moist, moderately sticky, very plastic; few, medium, prominent white (10YR 8/1) spherical mottles in the matrix, common, faint discontinuous, white (10YR 8/1) carbonate coats on all faces of peds, and rock fragments; few, very fine roots throughout; few very fine tubular pores; 5% igneous, sub-angular and sub-rounded gravels and 2% carbonate subrounded gravels clear smooth boundary (6 to 10 cm thick).

AB -- 8-20 cm; brown (10YR 5/3) clay loam; fine sub-angular blocky structure; hard, brittle dry and firm semi-deformable moist, moderately sticky and very plastic; common, medium, prominent white (10YR 8/1) dry, spherical mottles in the matrix; common, faint, discontinuous, (10YR 8/1) white carbonate coats on all faces of peds and rock fragments, few very fine roots throughout; common, very fine, tubular pores; 2% igneous, sub-angular and sub-rounded gravels and 5% carbonate subrounded gravels; abrupt smooth boundary (12 to 13 cm thick).

BC1 -- 20-40 cm; light yellowish brown (10YR 6/4); silty clay loam; fine sub-angular blocky structure; hard, brittle dry, firm semi-deformable moist, moderately sticky, moderately plastic; many, medium, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; many, faint, discontinuous, white (10YR 8/1) carbonate coats on all faces of the peds; few very fine roots throughout; common, fine, tubular pores; gradual boundary. (19 to 23 cm thick).

BC2 – 20-40 cm; brown (10YR 5/3); silty clay loam; fine sub-angular blocky structure; hard, brittle dry, firm semi-deformable moist, moderately sticky, moderately plastic; common, medium, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; many, faint, discontinuous, white (10YR 8/1) carbonate coats on all faces of the peds; few very fine roots throughout; many, fine, tubular pores; gradual boundary

C -- 40 cm +; Lefkara Formation

Trench 2 West Wall
Ap – 0-6 cm; brown (10YR 5/3); gravely clay loam; moderate, very fine subangular blocky structure; moderately hard dry, friable moist, moderately sticky, moderately plastic; few, fine, prominent, white (10YR 8/1) dry, spherical mottles in the matrix; few, very fine roots throughout; few, very fine, tubular pores; 5% igneous subrounded gravels, 5% carbonate subrounded gravels; abrupt smooth boundary. (0-6 cm thick).

Bt – 6-18 cm; brown (10YR 5/3); clay loam; moderate, very fine subangular blocky structure; hard dry, friable moist, moderately sticky, moderately plastic; common, fine,
Appendix A Ayia Varvara Asprokremnos Profile Descriptions (Continued)

prominent, white (10YR8/1) dry, spherical mottles in the matrix; few, faint, discontinuous, brown (10YR 4/3) clay films on ped faces; few, very fine roots throughout; common very fine tubular pores; 5% igneous, subrounded gravels, 5% carbonate, subrounded gravels; abrupt smooth boundary. (12 to 13 cm thick.)

2Ab – 18-28 cm; brown (10YR 5/3); silty clay loam; moderate, fine granular structure; hard dry, friable moist, moderately sticky, moderately plastic; many, fine prominent white (10YR 8/1) dry, spherical mottles in the matrix; common, coarse, prominent white (10YR 8/1) dry, platy, carbonate coats on bottom of rock fragments; few, faint, discontinuous, brown (10YR 4/3) clay films on ped faces; few, very fine roots throughout; common very fine tubular pores; abrupt smooth boundary. (10 to 11 cm thick).

2Btb – 28-36 cm; light brownish gray (10YR 6/2); silty clay loam; weak, very fine subangular blocky; hard dry, friable moist, moderately sticky, moderately plastic; many, fine prominent white (10YR8/1) dry, spherical mottles in the matrix; common, coarse, prominent white (10YR8/1) dry, platy carbonate coats on bottom of rock fragments.

3Bkb –36-56 cm; light brownish gray (10YR 6/2); silty clay loam; weak, very fine subangular blocky; common, coarse, prominent white (10YR 8/1) dry, platy carbonate coats on bottom of rock fragments.

Trench 5 West Wall

Ap-- 0-12cm; brown (7.5YR 4/3) clay loam; moderate, very fine sub-angular blocky structure; moderately hard dry, firm moist, moderately sticky, moderately plastic; few very fine roots throughout; common very fine tubular pores; few, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 1% carbonaceous sub-rounded gravels; clear smooth boundary. (11 to 13 cm thick).

AB—1-22 cm; brown (7.5YR 4/3) clay loam; moderate very fine sub-angular blocky structure; hard dry, firm moist, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; common, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 2% carbonaceous sub-rounded gravels; clear smooth boundary. (20-23 cm thick).

2Bt1—22-32 cm; very dark grayish brown (10YR 3/2) silty clay loam; strong very fine sub-angular blocky to granular structure; hard dry, friable moist, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; common, medium, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 4% carbonaceous sub-rounded gravels; common distinct clay films on all faces of peds; abrupt smooth boundary. (10-11 cm thick).
Appendix A Ayia Varvara Asprokremnos Profile Descriptions (Continued)

2Bt2 – 32-40 cm very dark grayish brown (10YR 3/2) silty clay loam; moderate very fine sub-angular blocky to granular structure; hard dry, friable moist, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; common, fine, prominent, white, dry, spherical, mottles in the matrix; 2% igneous, sub-rounded, gravels and 4% carbonaceous sub-rounded gravels; few, distinct clay films on all faces of peds.
C-- 40cm +

Trench 3 West Wall

Ap – 0-14 cm; brown (10YR 5/3); clay loam; moderate, very fine subangular blocky; hard, brittle dry, friable semi-deformable moist, moderately sticky, moderately plastic; few fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; few, very fine roots throughout; few, very fine tubular pores; 2% igneous subrounded gravels, 2% sedimentary subrounded gravels; clear smooth boundary. (1-15 cm thick.)

B – 14-22 cm; brown (10YR 5/3); clay loam; moderate, very fine subangular blocky; hard, brittle dry, friable, semi-deformable moist, moderately sticky, moderately plastic; common, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; few very fine roots throughout; few, very fine tubular pores; 2% igneous subrounded gravels, 2% sedimentary subrounded gravels; clear smooth boundary (8 to 10 cm thick).

2Bt – 22-32 cm; dark brown (7.5YR 3/2); silty clay loam; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, very plastic; common, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; common, coarse, prominent white (10YR 8/1) dry, platy carbonate coats on bottom of rock fragments; common, distinct, discontinuous, clay films, dark brown (7/5YR 3/2) on ped face; common very fines roots throughout; common, very fine tubular pores; 2% igneous subrounded gravels, 2% sedimentary subrounded gravels, 2% carbonate subrounded gravels; gradual wavy boundary (9 to 15 cm thick).

2Bk – 32-48 cm; light brown (7.5YR 6/3); clay loam; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; common, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; common, coarse, prominent white (10YR 8/1) dry, platy carbonate coats on bottom of rock fragments common very fines roots throughout; common, very fine tubular pores; 2% igneous subrounded gravels, 2% sedimentary subrounded gravels, 2% carbonate subrounded gravels; gradual smooth boundary (15 – 17 cm thick).

2BC1 – 48 – 104 cm; light yellowish brown(10YR 6/4); clay loam; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; many, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; few, very fine roots throughout; many very fine tubular
Appendix A Ayia Varvara Asprokremnos Profile Descriptions (Continued)

pores; 2% igneous subrounded gravels, 2% sedimentary subrounded gravels, 2% carbonate subrounded gravels; gradual smooth boundary (52 to 58 cm thick).

2BC2 – stain ~104 -144 cm; pale brown (10YR 6/3); clay loam; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; common, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; many very fine and fine tubular pores.

2BC3 – stain ~ 90 – 100 cm; light yellowish brown (10YR 6/4); clay loam; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; common, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; many very fine and fine tubular pores; gradual broken boundary (4 to 14 cm thick).

2BC4 – stain ~ 100 – 120 cm; brown (7.5YR 5/4); clay; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; few, fine, distinct, white (10YR8/1) dry, spherical mottles in the matrix; many very fine and fine tubular pores; gradual broken boundary (4 to 18 cm thick).

2BC5 – stain ~ 100 – 140 cm; grayish brown (10YR 5/2); clay; moderate, very fine subangular blocky; moderately hard, brittle moist, friable, semi-deformable moist, moderately sticky, moderately plastic; few, fine, distinct, white (10YR 8/1) dry, spherical mottles in the matrix; 25%, discontinuous, distinct, grayish brown (10YR 5/2) dry, burn stain, on vertical faces of peds; many very fine and fine tubular pores; gradual broken boundary (10 – 40 cm thick).
<table>
<thead>
<tr>
<th>Map Number</th>
<th>Municipality</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pegeia</td>
<td>Adjacent to the contact and sediments may have been trapped by terracing. River Elevation: 51 m Area Elevtion: 64 m</td>
<td>Upland terrace and change in color may indicate depth of sediments. River Elevation: 68 m Area Elevation: 86 m</td>
<td>Adjacent to the contact and dark sediments my indicate older soil. River Elevation: 42 m Area Elevation: 58 m</td>
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<tr>
<td>2</td>
<td>Pegeia</td>
<td>Upland terrace, contact is clear, trees may indicate depth of sediment. River Elevation: 102 m Area Elevtion: 134 m</td>
<td>Upland terrace, contact is clear, trees may indicate depth of sediment. River Elevation:102 m Area Elevation: 116-145 m</td>
<td></td>
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<tr>
<td>3</td>
<td>Marathounta</td>
<td>Pillow basalt hills with accumulated sediments adjacent to the contact. Age of landform is in question River Elevation: 92 m Area Elevtion: 102 m</td>
<td>Pillow basalt hills with accumulated sediments adjacent to the contact. Age of landform is in question. River Elevation: 92 m Area Elevtion: 125 m</td>
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<tr>
<td>4</td>
<td>Marathounta</td>
<td>Contact is clear and checkdams have stopped sediments. River Elevation: 114 m Area Elevtion: 127 m</td>
<td>Contact is clear and checkdams have stopped sediments. River Elevation: 114 m Area Elevtion: 164 m</td>
<td>Contact is clear and checkdams have stopped sediments. River Elevation: 114 m Area Elevtion: 173 m</td>
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<tr>
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<td>Aradippou</td>
<td>Contact is clear, but landscape looks eroded. Moderate probability.</td>
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<td></td>
<td></td>
<td>River Elevation: 57 m</td>
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<td></td>
<td></td>
<td>Area Elevation: 79 m</td>
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<td>Aradippou, Avdellero</td>
<td>Lefkara/Lava contact is not on 250k scale, but it appears present.</td>
<td>Lefkara/Lava contact is not on 250k scale, but it appears present.</td>
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<tr>
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<td></td>
<td>Pillow lava hills and accumulated sediments. River Elevation: 72 m</td>
<td>Pillow lava hills and accumulated sediments. River Elevation: 72 m</td>
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<tr>
<td></td>
<td></td>
<td>Area Elevation: 89 m</td>
<td>Area Elevation: 89 m</td>
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<tr>
<td>7</td>
<td>Troulloi, Voroklini</td>
<td>Low Probability. Landscape appears eroded.</td>
<td></td>
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<td>8</td>
<td>Kofinou</td>
<td>Low Probability. Contact is unclear and sediment deposition seems minimal.</td>
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<td>9</td>
<td>Alethriko</td>
<td>Low probability. River Elevation: 150 m</td>
<td>Contact not present. Alluvium/Colluvium</td>
<td>Contact is clear and checkdams have trapped sediments. River Elevation: 289 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area Elevation: 167 m</td>
<td>overlays Lefkara Formation.</td>
<td>Area Elevation: 309 m</td>
</tr>
<tr>
<td>10</td>
<td>Pyrga Larnakas</td>
<td>Low Probability. Contact not present.</td>
<td></td>
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<td></td>
<td></td>
<td>Alluvium/Colluvium overlays Lefkara Formation.</td>
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<tr>
<td>11</td>
<td>Pyrga Larnakas</td>
<td>Contact may be covered by Alluvium/Colluvium</td>
<td></td>
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<td></td>
<td></td>
<td>River Elevation: 211 m</td>
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<td></td>
<td></td>
<td>Area Elevation: 220 m</td>
<td></td>
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<td>12</td>
<td>Agia Anna</td>
<td>High terrace, near contact, may have sediment accumulation. River Elevation: 127 m</td>
<td>High terrace, near contact, may have sediment accumulation. River Elevation: 127 m</td>
<td>Low probability due to slope, but contact is clear and checkdams have stopped sediments. River Elevation: 289 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area Elevation: 139 m</td>
<td>Area Elevation: 140 m</td>
<td>Area Elevation: 317 m</td>
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<tr>
<td>13</td>
<td>Agia Varvara</td>
<td></td>
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<td></td>
<td>Lefkosias</td>
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<td>Low probability due to slope, but contact is clear and checkdams have stopped sediments. River Elevation: 289 m</td>
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<td></td>
<td></td>
<td>Area Elevation: 309 m</td>
<td>Area Elevation: 317 m</td>
<td></td>
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<tr>
<td>Map Number</td>
<td>Municipality</td>
<td>A</td>
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<tr>
<td>14</td>
<td>Margi</td>
<td>Contact is clear and checkdams may have trapped sediments. River Elevation: 284 m Area Elevation: 294 m</td>
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</tr>
<tr>
<td>15</td>
<td>Margi</td>
<td>Contact is clear, but may not have deposition. River Elevation: 290 m Area Elevation: 298 m</td>
<td>Contact is clear, but may not have deposition. River Elevation: 290 m Area Elevation: 304 m</td>
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<tr>
<td>16</td>
<td>Analiontas</td>
<td>Contact is clear. Checkdams and terraces may have trapped sediments. River Elevation: 312 m Area Elevation: 328 m</td>
<td>Contact is clear, but amount of deposition is unknown. River Elevation: 312 m Area Elevation: 319 m</td>
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<tr>
<td>17</td>
<td>Kampia</td>
<td>May be remnant of older landform. River Elevation: 395 m Area Elevation: 408 m</td>
<td>Upland near contact. River Elevation: 395 m Area Elevation: 426 m</td>
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<tr>
<td>Map Number</td>
<td>Municipality</td>
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<tr>
<td>18</td>
<td>Politiko</td>
<td>Contact is near and checkdams may have stopped sediment.</td>
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<td>River Elevation: 381 m</td>
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<td></td>
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<td>Area Elevation: 397 m</td>
<td></td>
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<td>19</td>
<td>Arediou</td>
<td>Low probability. These look like leveled hill tops pedestrian</td>
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<td></td>
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<td>survey recommended.</td>
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<td></td>
<td></td>
<td>River Elevation: 353 m</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Area Elevation: 362 m</td>
<td></td>
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<td>20</td>
<td>Malounta</td>
<td>Alluvium/Colluvium my overlay contact.</td>
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<td></td>
<td></td>
<td>River Elevation: 355 m</td>
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<td></td>
<td></td>
<td>Area Elevation: 375 m</td>
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<tr>
<td>Map Number</td>
<td>Municipality</td>
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<td>B</td>
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<tr>
<td>21</td>
<td>Mitsero</td>
<td>Low Probability. Highly sloped and eroded.</td>
<td></td>
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</tr>
<tr>
<td>22</td>
<td>Sarama</td>
<td>May be remnant of older terrace. Shelter from three sides. River Elevation: 217 m Area Elevation: 236 m</td>
<td>Adjacent to contact. Sediments may have been trapped by terracing or checkdams. River Elevation: 217 m Area Elevation: 224 m</td>
<td>Contact may be buried under alluvium. Moderate probability. River Elevation: 217 m Area Elevation: 229 m</td>
</tr>
<tr>
<td>23</td>
<td>Pegeia</td>
<td>Contact is clear. Second order stream drains to ocean 2.5 km southwest. River Elevation: 81 m Area Elevation: 100 m</td>
<td>Contact is clear. Second order stream drains to ocean 2.5 km southwest. River Elevation: 81 m Area Elevation: 100 m</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C Predictive Maps

Map One

Legend
- Alluvium/Colluvium
- Lefkara Formation
- Perapedhi Formation
- Upper Pillow Lavas
- Area of Potential
- Lefkara/Lava Contact
- Elevation point

C.1 Predictive Map One
C.2 Predictive Map Two.
C.3 Predictive Map Three.
C.4 Predictive Map Four.
C.5 Predictive Map Five.
C.6 Predictive Map Six.
C.7 Predictive Map Seven.
C.8 Predictive Map Eight.
C.9 Predictive Map Nine.
C.10 Predictive Map Ten.
C.11 Predictive Map Eleven.
C.12 Predictive Map Twelve.
C.13 Predictive Map Thirteen.
C.14 Predictive Map Fourteen.
C.15 Predictive Map Fifteen.
C.16 Predictive Map Sixteen.
C.17 Predictive Map Seventeen.
C.18 Predictive Map Eighteen.
Map Nineteen

A

Upper Pillow Lavas

Lefkara Formation

Other Formation(s)

Municipality: Arediou

353 m

362 m

Legend

Alluvium/Colluvium

Lefkara Formation

Perapedhi Formation

Upper Pillow Lavas

Area of Potential or Lefkara/Lava Contact

Elevation point

C.19 Predictive Map Nineteen.
C.20 Predictive Map Twenty.
C.12 Predictive Map Twenty-One.
C.22 Predictive Map Twenty-Two.
C.23 Predictive Map Twenty-Three.