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David L. Nickels
tierrasantiguas@gmail.com

C. Britt Bousman
bousman@txstate.edu

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By David L. Nickels and C. Britt Bousman

Principal Investigators: C. Britt Bousman and David L. Nickels

Archaeological Studies Report No. 13
Texas Antiquities Permit No. 2510

Center for Archaeological Studies
Texas State University-San Marcos
2010

Archaeological Testing at San Marcos Springs (41HY160) for the Texas River Center, Hays County, Texas

assembled by

David L. Nickels and C. Britt Bousman

with additional contributions by
Jimmy E. Barrera, J. Philip Dering, Wulf Gose, Lee C. Nordt,
and Brian Shaffer

Principal Investigator:
C. Britt Bousman

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CENTER FOR ARCHAEOLOGICAL STUDIES
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601 University Drive
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Management Summary

Management Objectives

This report describes the results of investigations undertaken to assess the archaeological resources at the Spring Lake Site, 41HY160, on the campus of Texas State University-San Marcos in Hays County, Texas. The Spring Lake Site, 41HY160, was recorded in the 1980s at the Aquarena Center, then a privately owned water park. In 1994 Texas State University-San Marcos purchased the Aquarena Center with the intention of converting it into an educational and research facility focused on rivers and springs in Texas. Eventually the University founded the River Systems Institute and it is now housed at the Texas River Center in the restored Hotel at the San Marcos Springs. In preparation for the construction planning for the Texas River Center, an archaeological testing project was undertaken in January 2001 and this report describes the results of that investigation. The primary goal of this project was to determine if intact and well-preserved archaeological materials were contained in the area planned for eventually construction.

Conclusions and Recommendations

The archaeological investigations were designed to assess the geological context and the nature of the preserved archaeological materials at the Spring Lake Site, 41HY160. An extensive geological coring effort extracted 22 cores from over 9 meters of alluvial sediments in the San Marcos River floodplain. These cores extended from the Hotel to beyond the football stadium. Five depositional units (A-E from older to younger) were identified, which dated from the Late Pleistocene to the Late Holocene, and all of these depositional units either contained preserved archaeological materials or were contemporary with know archaeological occupations in the immediate vicinity of Spring Lake. A single flake was recovered from geological Core E in Depostional Unit A channel gravels. Radiocarbon dates confirm sediment accumulation spanning the last ~12,000 radiocarbon years. Archaeological test units recovered a wide range of lithic tools, faunal remains, burned rock features and floral remains that have been identified as Middle and Late Archaic, and Late Prehistoric in age. Five intact burned rock features were excavated and documented. The careful excavation and archaeomagnetic analysis of burned rock from the cooking features demonstrates the presence of burned rock cooking pits and scattered burned rock hearths. These features were clearly constructed and used as cooking facilities by prehistoric inhabitants. The prehistoric inhabitants also actively hunted a number of large animals that consisted of bison, antelope and deer, and a variety of small species such as rabbits, turtle, fish, rodents, and snakes. The more limited floral remains demonstrate the use of cheno-ams for food, and oak, juniper and bald cypress for firewood. Better preserved plant remains were recovered from Depositional Unit A in the geological Core D and these demonstrate the potential for well preserved archaeological floral remains is great in the deeper portions of the site. A great diversity of chipped stone artifacts (projectile points, preforms and other bifaces, scrapers and other unifaces, groundstone tools) provide the most abundant evidence of technological activities, and production and procurement strategies at the site. The wealth of evidence and the secure geological context of these materials, clearly demonstrates that the potential for the recovery of significant archaeological materials at the Spring Lake Site, 41HY160, is great and it is recommended that any impacts of planned construction on archaeological resources be mitigated. All recovered materials are curated at the Archaeological Curation Facility, Texas State University.

Table of Contents

List of Figures

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

List of Tables

List of Tables (continued)

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The authors wish to thank Dr. Michael Abbott, Texas State University-San Marcos, who made this project possible and was extremely helpful throughout every phase. His insight and planning has lead to the founding of the Texas River Center. Mr. Ronald Coley and Ms. Debrah Lane, director and associate director of Aquarena Center, assisted the crew and investigations in numerous and diverse manners. Through the years Mr. Coley and Ms. Lane have taken great interest in and supported the archaeological investigations at the Texas River Center. The fieldwork was directed by Project Archaeologist David Nickels. Jimmy Barrera, Brandon (Charlie) Burton, Carrie Davis, Sheryl Gibbs, Linda Hodges, Ryan Kashanipour, Michael McCarthy, Colby Michefsky, Dale Norton, Antonio Padilla, Kevin Schubert, Shawn Soucie, James Taylor, and Nathan Todd served as crew members. Student volunteers Jennifer Cochran and Melissa Lehman assisted with the field and lab work. Elton Prewitt and Steve Tomka graciously volunteered their valuable time to help classify the projectile points and their assistance is greatly appreciated. The lithic analysis was conducted by Jimmy Barrera, Linda Hodges, Melissa Lehman, and Antonio Padilla under the supervision of David Nickels and Britt Bousman. Raphael Umsheid prepared the maps and illustrations. Jessica Hurley and Britt Bousman edited the final manuscript with the assistance of Karen Fuestes and Melissa Lehman. Artifacts, photographs, and written documents were prepared for curation by Jimmy Barrera, Antonio Padilla, and Shawn Soucie with the help of Connie Gibson.

Chapter 1

Introduction

David L. Nickels and C. Britt Bousman

Background

In June of 1691 the Domingo Terán de los Ríos expedition camped at the San Marcos Springs for a few days in route to East Texas and they recorded the Cantona Indian name for the San Marcos Springs. This name, *Canocanayestatetlo*, means "hot water." These were not the first people to be attracted to these hot waters. Archaeological evidence discussed below has demonstrated at least 12,000 years of use for these springs. In 1994 over 300 years after the Domingo Terán de los Ríos expedition camped at the springs, Texas State University-San Marcos (Texas State) purchased the San Marcos Springs. In the 1950s it had been converted into a amusement park known as Aquarena Springs, but in January 1998, Texas State and the Texas Parks and Wildlife Department (TPWD) executed a Memorandum of Understanding that formed a partnership with the goal of developing a public interpretive and educational center, the Texas Rivers Center at the San Marcos Springs (Figure 1-1). After a series of planning meetings, TPWD prepared a master plan for the project (Beckcom 1999). The master plan calls for two phases of development that will directly impact archaeological resources known to exist at the site.

The Phase 1 plan includes the renovation of Aquarena Springs Inn and restoration of the peninsula between the San Marcos River and Sink Creek. Peninsula restoration includes the demolition of buildings, roads, parking areas, and walkways. Two buildings are scheduled for relocation off-site and a third, a boat maintenance dock, will remain on site. Additionally, construction of two buildings (a pavilion and

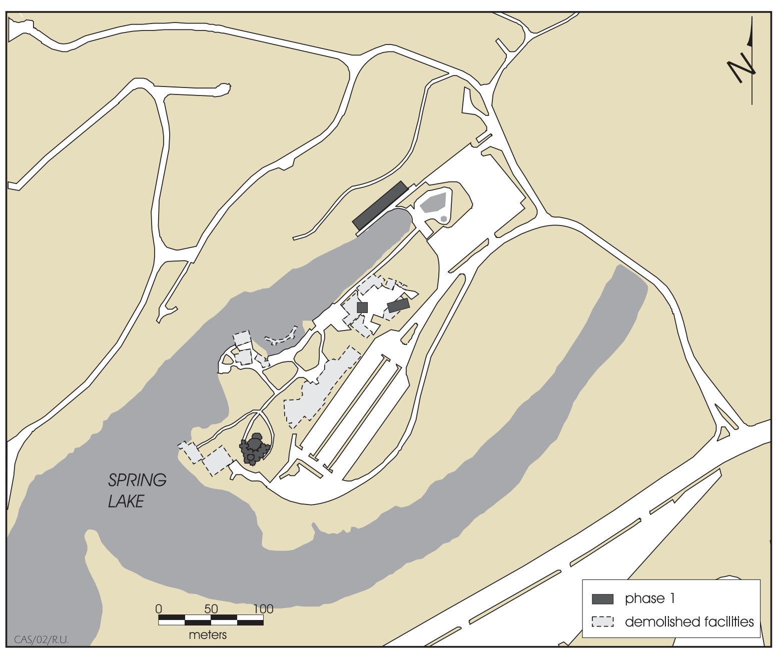

Figure 1-1. Project location and Texas Rivers Center master plan on peninsula at San Marcos Springs.

a restroom) and a parking lot were proposed. Archaeological investigations are included as part of the Phase 1 development. The Phase 2 plan consists of the construction of new buildings surrounding the existing swimming pool area.

Project Description

This report discusses the results of Phase I archaeological testing performed in January 2001 by the Center for Archaeological Studies (CAS), Texas State, at the Texas Rivers Center site (41HY160) in southern Hays County, Texas (Figure 1-2). This testing project was an element of the master plan and partnership between the TPWD and Texas State to develop a public interpretive and educational center.

The purposes of this project were 1) to determine the presence or absence of cultural remains in the areas to be impacted, and 2) to evaluate the integrity of any discovered cultural materials and determine their potential for providing significant archaeological information. Based on the excavation of six 1-x-1-m units, 22 new geological cores and previous investigations, this report documents the presence of intact and well-stratified archaeological deposits within the upper 1.7 m of a 8-9 meter thick intact alluvial terrace in the floodplain adjacent to the San Marcos Springs. These alluvial deposits contain human occupations dating from Paleoindian to Late Prehistoric times.

Because this is a testing project that focused on site integrity, issues related to site preservation and archaeological context are highlighted in this report. A more detailed analysis of cultural material and evidence of changing economics, technology, subsistence, and mobility through time will be included in a future data recovery report encompassing the archaeological investigations around San Marcos Springs.

CAS, in conjunction with the Texas Historical Commission (THC), acted as the agencies for oversight management of archaeological compliance-related activities during the duration of the testing. At the state level, the State Historic Preservation Officer (SHPO) at the Texas Historical Commission Department of Antiquities Protection (THC-DAP) evaluates the significance

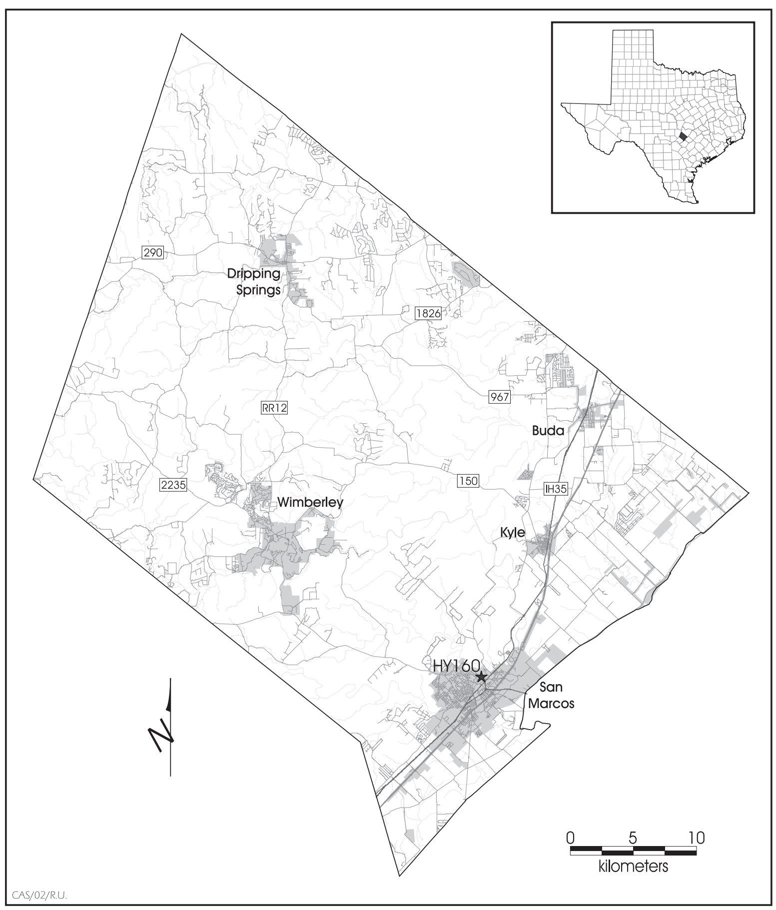

Figure 1-2. Project location in San Marcos, Texas, Hays County.

of cultural resources, and assists contractors and clients with preservation planning when those resources are threatened. Texas Antiquities Committee Permit Number 2510 was issued for the project.

The site is situated within silty clay terrace deposits surrounding the San Marcos Springs, at the headwaters of the San Marcos River. Several earlier projects by Southern Methodist University (SMU) and Texas State archaeologists at this site and five other sites within close proximity identified cultural resources ranging in age from approximately 11,500 years to 150 years ago. The purpose of this testing project was to evaluate the integrity of that portion of the site that was threatened by planned construction activities. Six 1-x-1-m units were excavated within the footprint of proposed new buildings. Test units were limited to the upper, approximately 1.7 meters, because of the high water table at the site. The archaeological investigations were accompanied and assisted by the geomorphological studies performed by Lee C. Nordt of Baylor University.

Fieldwork was conducted in January and February 2001. Britt Bousman served as principal investigator, and daily field operations were directed by the project archaeologist and Co-PI, David Nickels. CAS staff members who worked on the project in the field and lab included Jimmy Barrera, Brandon (Charlie) Burton, Carrie Davis, Sheryl Gibbs, Linda Hodges, Ryan Kashanipour, Michael McCarthy, Colby Michefsky, Dale Norton, Antonio Padilla, Kevin Schubert, Shawn Soucie, James Taylor, and Nathan Todd. Additionally, Texas State student volunteers Jennifer Cochran and Melissa Lehman assisted with the field and lab work. Field activities at the site included site mapping, geological coring, and hand excavating 1-x-1-m test units.

David Nickels conducted the overall lithic analysis with the assistance of Jimmy Barrera, Linda Hodges, Melissa Lehman, and Antonio Padilla. Elton Prewitt and Steve Tomka assisted with the diagnostic projectile point classification, Phil Dering analyzed the paleobotanical remains, Wulf Gose conducted the archaeomagnetic studies, Thomas Stafford conducted the radiocarbon assays, and Brian Shafer examined the faunal assemblage. The artifacts, records, and other materials recovered or generated during the fieldwork and subsequent laboratory analysis are curated at the CAS laboratory.

Report Organization

This report is divided into twelve chapters and five appendices. Chapter 2 provides a summary of the unique environmental setting within the Central Texas region, and more specifically, around the headwaters of the San Marcos River. The chronological context for the project area is also discussed in Chapter 2. Implications for buried sites derived from previous archaeological investigations conducted around the San Marcos Springs are synthesized in Chapter 3. Research questions addressed during this project, and the testing strategies employed to address them, are included in Chapter 4. Chapter 5 discusses the field and laboratory methodologies employed to address the specific research questions.

The results of geological coring and the potential for buried cultural deposits within the Pleistocene and Holocene sediments are presented in Chapter 6. The results of the excavations, site structure, and radiocarbon dates are discussed in Chapter 7. The analysis of vertebrate and plant remains are discussed in Chapters 8 and 9, respectively, followed by a description of chipped, ground, and hammered stone in Chapter 10. Chapter 11 provides a discussion of the cultural features and associated material recovered during the excavations. Finally, Chapter 12 presents a summary and conclusions.

Supporting data are included in the five appendices. Appendix A is a catalog of cultural remains. Appendix B lists faunal remains. Appendix C presents the results of archaeomagnetic analysis. Appendix D describes geologic cores, and Appendix E presents the results of radiocarbon dating. Appendix F presents the raw data on the non-diagnostic bifaces.

Chapter 2

Environment and Cultural Chronology

David L. Nickels and C. Britt Bousman

Environment

Introduction

The San Marcos Springs site (41HY160) at the Texas River Center lies in southern Hays County, and is situated in a deep alluvial terrace at the confluence of the headwaters of the San Marcos River and an intermittent tributary, Sink Creek (Figure 2-1). Clear cool waters emanate from approximately 200 small artesian springs and three large fissures to form the San Marcos Springs along the Balcones Fault Line. The area's diverse flora and fauna, rich lithic resources, and reliable spring waters have lured humans to the region the past 12,000 or more years (Beckcom 1999; San Marcos Springs 2002).

The location of San Marcos Springs makes it conducive to influences from more than one region. This chapter provides a synopsis of environmental and archaeological background information within an area encompassing the northern fringe of the South Texas Brush Country, the western portion of the Gulf Coastal Prairies and Marshes, the southeastern edge of the Edwards Plateau, and the southern tips of the Oak Woods and Prairies, and Blackland Prairie in east-central Texas (Figure 2-2).

Modern Environment

Two major landform regions conjoin at San Marcos Springs (see Figure 2-2). The

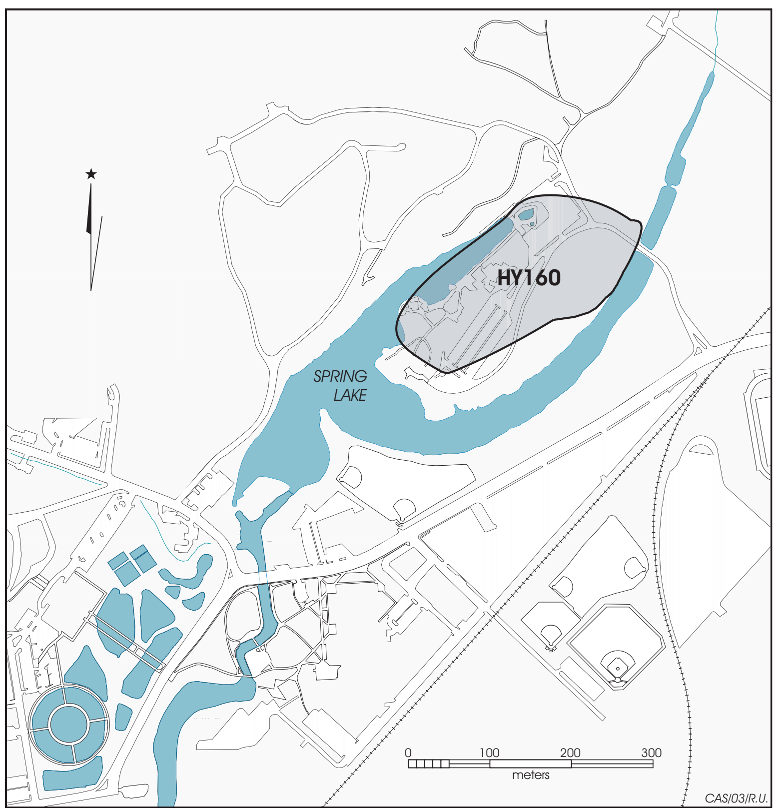

Figure 2-1. Site location on Sink Creek and the head of the San Marcos River.

Balcones Escarpment, which forms the edge of the Edwards Plateau, rises abruptly above the springs immediately to the west. The rolling Blackland Prairie stretches out to the east. Their abrupt boundaries at the escarpment result from faulting in the underlying bedrock.

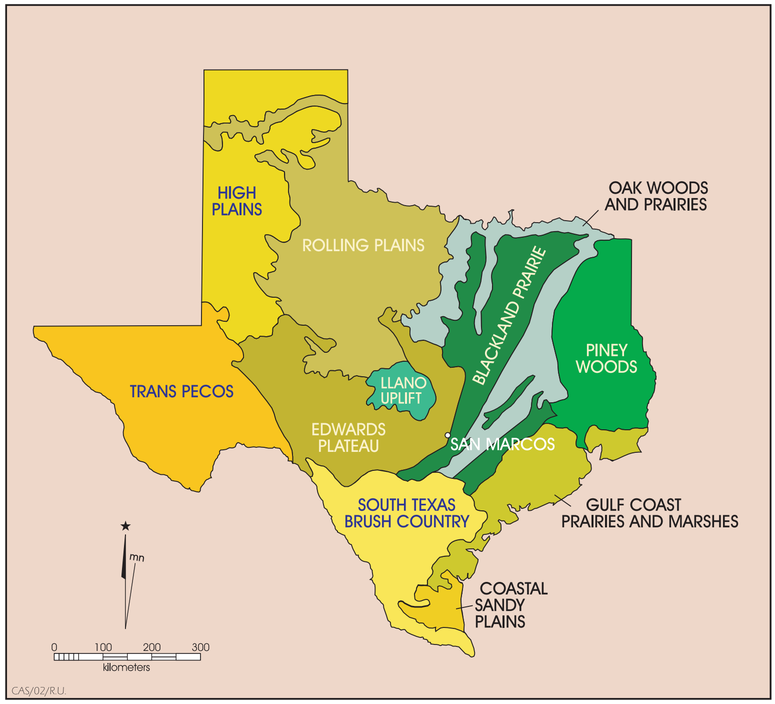

Figure 2-2. Physiographic regions of Texas (http://www.tpwd.state.tx.us/images/nature/wild/natrgbbg).

The Edwards Plateau, with elevations reaching over 1,400 feet above mean sea level (amsl) in northwestern Hays County (Hays County 2002), is a hilly region, gradually sloping to the southeast, and ending at the escarpment running across the middle of the region. It has otherwise been described as "a deeply dissected, rapidly drained stony plain having broad, flat to undulating divides" (Texas A&M BWG 2002). In the 1800s the plateau was predominantly covered with open savannah with trees and brush lining the drainages. Overgrazing by livestock and the absence of range fires in modern times have caused much of the plateau to be overtaken by juniper (Buechner 1944:703–704; Van Auken 1993:199–210; Texas A&M BWG 2002). The most characteristic flora today include juniper, plateau live oak, Texas persimmon, agarita, and tall and short grasses (Van Auken 1988:45; Texas A&M BWG 2002). In the drier, western part of the region, mesquite and live oak are the dominant woody species, with short and mid-grasses, along with various weeds and cacti resulting from overgrazing (Blair 1950:112; Texas A&M BWG 2002).

The Balcones Escarpment is a fault zone within fractured limestones, chalks, shales, and marls along the fault line. The escarpment slopes from an elevation of 1,000 feet amsl in the northwest to 700 feet amsl in the southeast (Taylor et al. 1991:119). The floral species are the same as those of the Edwards Plateau, with the addition of numerous riparian species in the river and creek bottoms (Van Auken 1988:55). The most economically important of these are nut trees, including oak, walnut, and pecan (Dalbey 1993:22). An intertwined diversity in biotic resources existing along the escarpment provides an ecotone which would allow humans to harvest a seasonal banquet of plants and animals (Collins 1995:366).

South and east of the escarpment is the Blackland Prairie, a rolling and well-dissected plain representing the southern extension of the true prairie running through the center of the United States. The prairie was once dominated by tallgrass species such as bluestem, indiangrass, tall dropseed, and silveus dropseed.

Much of this vegetation has been replaced by common invader species including mesquite, huisache, granjeno, and cenizo. Oaks, elms, cottonwoods, and native pecan are common along drainages (Gould 1975:11). Several major rivers dissect the plateau, escarpment, and prairies, providing not only food and water resources, but also east-west thoroughfares for Native Americans (see Figure 2-3).

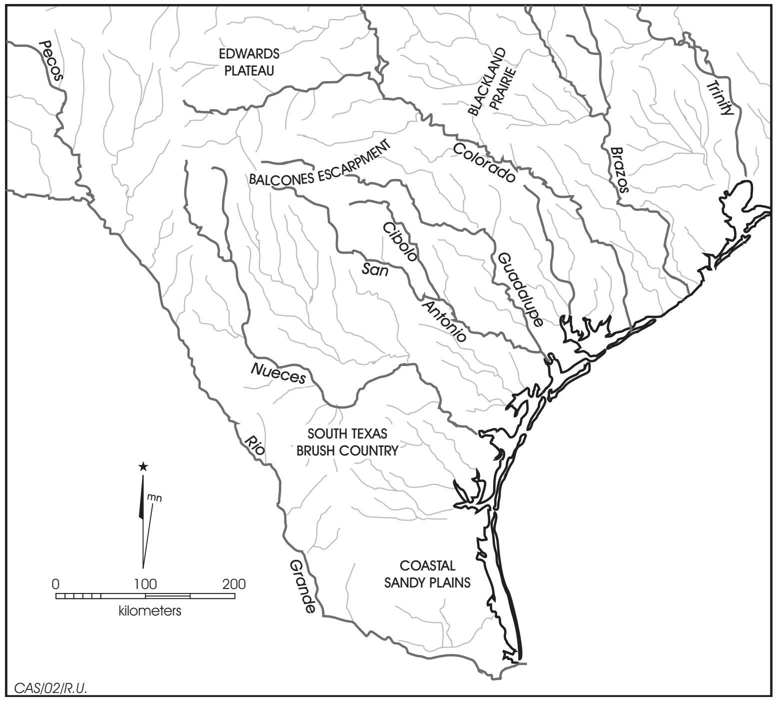

Figure 2-3. Southeasterly flowing rivers dissect the plateau, escarpment, and prairies of Texas.

Local Modern Environment

Climate and Hydrology

San Marcos has a modified subtropical climate, with cool winters and hot summers, primarily influenced by the low elevations and the Gulf of Mexico to the east. On average the coldest month is January (mean temperature: 40°F), and the hottest month is July (mean temperature: 96°F). Clear skies are prevalent throughout the year, and an average annual rainfall of 33.75 inches supplements an annual growing season of 254 days (Hays County 2002). The San Marcos River begins at the San Marcos Springs and joins the Blanco River approximately 8.5 km downstream of the springs. The San Marcos River is a tributary of the Guadalupe River, which empties into the Gulf of Mexico in San Antonio Bay approximately 120 km downstream.

Geology

During the Cretaceous Era, approximately 65 to 136 million years ago (Barnes 1974; Judson and Kauffman 1990:150), hard and massive limestone, chert, chalky dolomite, compacted shale, and silty clays began forming and now make up the bedrock underlying the Edwards Plateau. Faulted bedrock formations in the immediate area of 41HY160 are Upper Cretaceous Eagle Ford Group shale and limestone and Buda Limestone.

Soils

Fluviatile terrace deposits (Qal) composed of eroded gravel, sand, silt, and clay from the Edwards Plateau formed along the upper San Marcos River from the Late Pleistocene to Late Holocene (Fisher 1974; see also Chapter 8 and Appendix D). The frequently flooded alluvial terrace on which 41HY160 rests has weathered to form the Okallala clay loam and Tinn clay (Figure 2-4).

Okallala clay loam (Ok) soils are generally dark grayish brown in color, are moderately alkaline throughout, with approximately 60 percent calcium carbonate, and an extremely firm to very hard, moderate, fine subangular blocky clay structure (Batte 1984:34, 75). Their compact structure allows for less cracking and movement than in other clays with medium or massive blocky structure. Archaeological investigations in Okallala clay should thus be less hampered by the dynamics of cracking and movement because artifacts are more likely to be displaced to deeper sediments if cracking within archaeological deposits occurs (e.g. Villa 1982; Waters 1992:299-300; Nickels 2000:84-90).

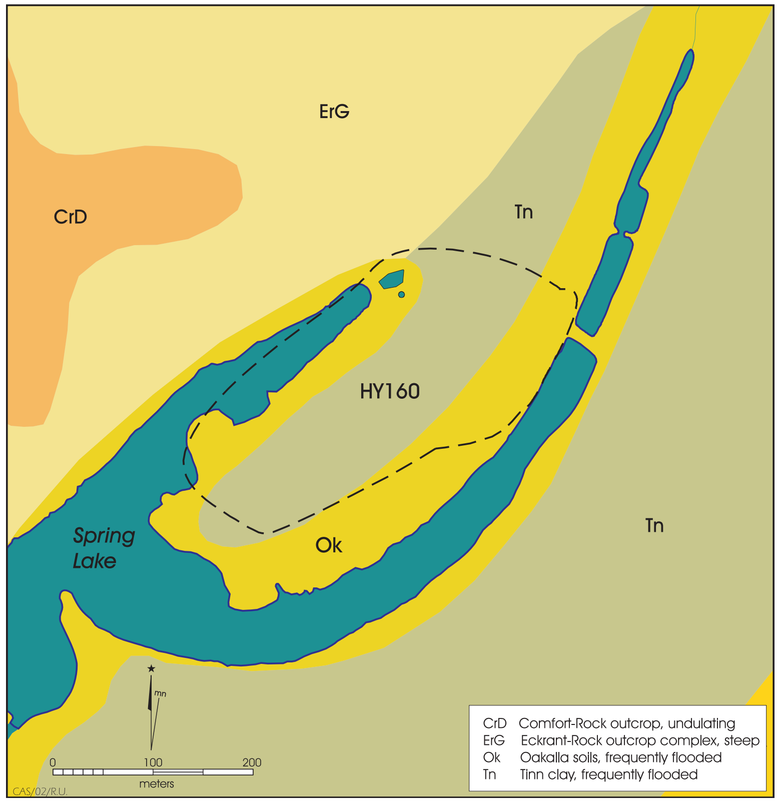

Figure 2-4. Archaeological deposits within the upper 1.7 m are encapsuled in Okallala clay loam and Tinn clay (adapted from Batte 1984).

Tinn clay (Tn) is generally dark gray to grayish brown, and like Okallala soils, is moderately alkaline and calcareous throughout. Because of its clayey texture, even roots are impeded from penetrating it. However, the structure of Tinn clay ranges from moderate, medium and subangular to weak, medium, blocky. It is generally very to extremely hard and firm, and especially hard and cloddy when dry (Batte 1984:41, 79). Because of its structure, it is more likely to crack, thus allowing for the possible vertical displacement of artifacts (e.g. Villa 1982; Waters 1992:299-300; Nickels 2000:84-90).

Lithic Resources

Immediately west of the site, rich sources of chert crop out in the Edwards Plateau region. Nodules and cobbles of good quality chert are commonly found eroding out of the limestone on the plateau itself, and in creek bed gravels originating on the plateau (Barnes 1974; Black and McGraw 1985; Potter et al. 1992). Evidence of gravel beds has been located in the bottoms of cores extracted from 41HY160 (see Chapter 8 and Appendix D). They were apparently deposited along the creek during the Late Pleistocene and Early Holocene. These resources suggest that raw materials for manufacturing stone tools and for use as limestone heating elements in hearths and ovens were readily available.

Biotic Resources Surrounding 41HY160

The area around 41HY160 is an ecotone incorporating an interface of diverse ecological communities. These include the Juniper-Oak-Mesquite Savanna, the Blackland Prairie, and Oak-Hickory forest (Figure 2-5).

Blair (1950:112) maps the joining of three biotic provinces: the Texan, the Balconian, and the Tamaulipan south of San Marcos in nearby Bexar County (Figure 2-6). The geographic location of San Marcos Springs, essentially on the periphery of these three biotic provinces, provides a dynamic setting for a greater diversity in riverine, uplands, and xeric vegetation and fauna.

Historic alterations to the landscape, especially in the Blackland Prairie, include plowing, overgrazing, stream channelization, controlled burning, and the over pumping of aquifers. These have lower water tables and have altered the plant and animal communities. Many springs feeding the streams draining the Hill Country are now either dry or do not discharge sufficient flows to reach the South Texas and Gulf Coastal plains before evaporating or seeping into sandy substrates (Brune 1981:75). However, the springs at the head of the San Marcos River are the second largest in Texas, producing about 4,300 liters (1,136 gallons) per second (Brune 1981; San Marcos Springs 2002).

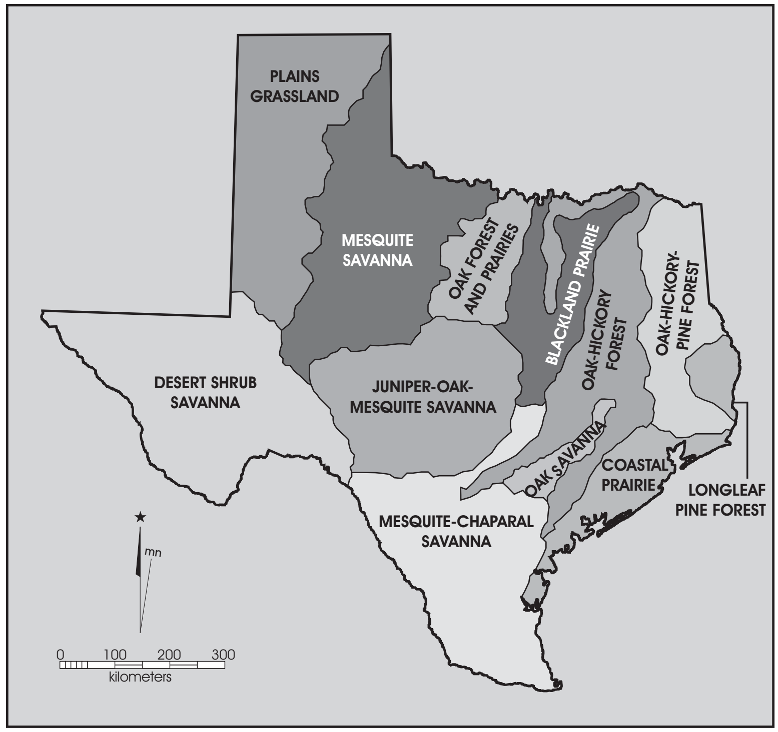

Figure 2-5. Vegetative regions of Texas (adapted from Arbingast et al. 1973).

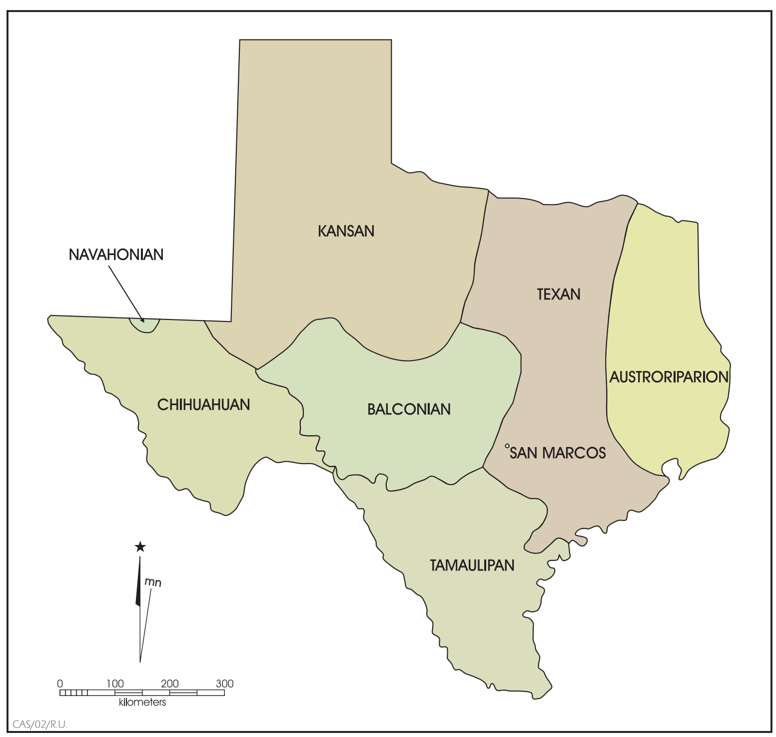

Figure 2-6. Biotic provinces of Texas (adapted from Blair 1950:98).

Regional Paleoenvironment

Introduction

Recent research, particularly during the past decade, has contributed a great deal toward the understanding paleoenvironments of Texas (e.g., Bousman 1998; Brown 1998; Caran 1998; Frederick 1998; Fredlund et al. 1998; Kibler 1998; Nordt et al. 2002; Ricklis and Cox 1998). However, the Texas paleoclimatic record contains significant gaps, primarily due to the scarcity of deep, finely stratified, and well-dated deposits (Stahle and Cleaveland 1995:51). Bousman (1998) suggests that Pleistocene biotic communities have a different structure from Holocene communities, caused by wetter winters and drier summers, in a cooler climate.

Essentially, the arguments over fluctuations in the environment can be based upon the relative percentages of grassland and arboreal pollen, C_3 versus C_4 opaline phytolith ratios, oxygen-isotope ratios in mollusca, noble gas in aquifer waters, and $\delta^{13}C$ ratios in buried soils. Six paleoenvironmental datasets within 240 kilometers (150 miles) of 41HY160, and from which relevant information is useful, are: 1) Wilson-Leonard in Williamson County, 2) Boriack Bog in Leon County, 3) Hall's Cave in Kerr County, 4) Fort Hood in Bell and Coryell Counties, 5) Weakly Bog in Leon County, and 6) the proposed Applewhite Reservoir in Medina County (see Figure 2-7). In the discussion that follows, all dates, unless otherwise stated, are approximate, and are given as radiocarbon years before present (B.P.), i.e., before A.D. 1950.

Late Pleistocene (10,000+ B.P.)

Nordt et al. (2002) correlate $^{12}C/^{13}C$ ratios in buried Applewhite soils with two episodes of glacial melting and C_4 plant production. They argue that the data demonstrate cooler conditions at the end of the Pleistocene, around 15,000 B.P. Using data from Hall's Cave in the Edwards Plateau in Central Texas, Toomey et al. (1993) argue that summer temperatures in the Late Pleistocene were 6° C cooler than present averages, and that by ~13,000 B.P. (Toomey and Stafford 1994), the wetter interval became warm and more arid. For the period between 12,500 and 11,800 B.P., the Boriack Bog data indicate that a drier episode stimulated a brief shift to grasslands, and are corroborated by oxygen-isotope ratios showing a cooler setting in South Texas (Bousman 1992; 1994:80). Nordt et al. (2002) also identify a cooler than modern period occurring around 12,000 B.P. in the sediments at Applewhite Reservoir. The Hall's Cave record indicates a wetter interval around 11,000 B.P. (Toomey and Stafford 1994), and micro-vertebrate fauna from Wilson-Leonard indicates that prior to about 12,000 B.P., conditions were relatively cooler and moister, followed by more xeric conditions from about 11,500 to 11,000 B.P. (Balinsky 1998).

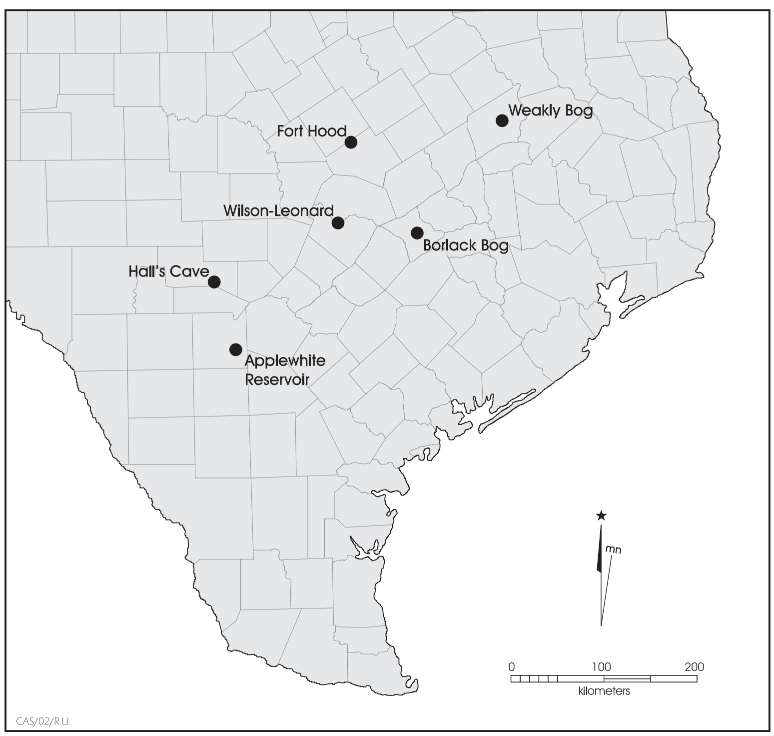

Figure 2-7.Study area and sites discussed in the text from which paleoenvironmental data was obtained, as well as the location of 41HY160.

Early Holocene (10,000–7500 B.P.)

$\delta^{13}C$ ratios from Applewhite soils (Nordt et al. 2002) indicate increasing temperatures between 11,000 and 10,000 B.P., toward the Pleistocene-Holocene boundary, followed by perhaps a stable climatic period between 10,000 and 9000 B.P. Arboreal species in the Boriack Bog spectra show a return of the woodlands between 9000 and 8000 B.P. As corroborating evidence, the Wilson-Leonard microfaunal data suggest a presumably moister period from about 9500–8750 B.P., followed by drier conditions (Balinsky 1998). Molluscan data from the same site indicate a shift from marshy to drier conditions around 9000 B.P. (Shaw 1998), and the phytolith data indicate a similar change in climate (Fredlund 1998). After 8000 B.P. woodlands rapidly declined, and by 7500 B.P., open grassland communities were predominant (Bryant 1977; Bousman 1998). Although the estimated percentages of grass cover have fluctuated from 7500 B.P. through the present, they appear to have remained predominate over woodland percentages until perhaps the past 350 years (Bousman 1994:80).

Middle Holocene (7500–4000 B.P.)

Although Nordt et al. (2002) demonstrate a marked cooling period around 7000 B.P. at Applewhite, the Middle Holocene is often seen as the beginning of the Altithermal drought, marked by reduced rainfall and higher temperatures substantially affecting subsistence and mobility (Nordt 1992; Nordt et al. 2002; see also Johnson and Goode 1994; Ellis et al. 1995; Bousman et al. 2002). At Boriack Bog, the continuous decline of the woodlands in the Early Holocene was briefly reversed around 6000 B.P., but nevertheless continued to decline until 5000 B.P. Around that time, a wetter climate caused a slow increase in arboreal pollen (Bousman 1994:80). This Mid-Holocene arid period indicated at Boriack Bog agrees with data presented by Nordt et al. (1994) from Fort Hood, in Bell and Coryell Counties, and from Applewhite Reservoir in Medina County, where a dry period for roughly the same time frame (6000 to 4800 B.P.) is indicated. A revised interpretation from Hall's Cave also argues for an arid episode, but between 7000 and 2500 B.P. (Toomey and Stafford 1994). Likewise, the phytolith and microfauna records from the Wilson-Leonard site in Central Texas (Balinsky 1998; Fredlund 1994) agree with increasing aridity in the Middle Holocene, indicated by spreading grasslands around 4400 B.P. and 4500 B.P., respectively. Finally, Johnson and Goode (1994) also report a dry period occurring in the Fort Hood area, but later still, between 5000 and 2500 B.P. (calibrated).

Late Holocene (4000 B.P.–Present)

Although the Wilson-Leonard phytolith data suggest that by 4000 B.P. the woodlands/grasslands mixture was very similar to today's (Fredlund 1998), there are indicators that the climate continued to fluctuate in the Late Holocene. Based on stable carbon ratios from deposits at Fort Hood, Nordt et al. (1994) suggest a warm and dry episode between 3000 and 1500 B.P. However, at Hall's Cave, Toomey and Stafford (1994) see a wet period appearing within this same time frame, at about 2500 B.P. In a more precise argument, Bousman suggests that the grass pollen frequencies found in the Weakly Bog pollen spectra and Applewhite $\delta^{13}C$ ratios indicate unique drying episodes and a slight cooling trend between approximately 1600 and 1500 B.P., and again between approximately 500 and 400 B.P. (Bousman 1994:80; Nordt et al. 2002).

Summary

The paleoenvironments of Texas are as varied as the landscape. The waning of the Pleistocene, or late-glacial period, marked a transition from a cooler, wetter environment to one that steadily grew warmer and drier, and more seasonal, with intermittent moist periods through about 6000 B.P. Most researchers generally agree that the period between 6000 and 3000 years ago was warm and dry. Over the past 3,000 years, intermittent moist and dry intervals have occurred (see Figure 2-8).

It is unlikely that the climate has changed significantly in the past few thousand years in the area surrounding San Marcos Springs as to induce marked vegetation changes. The greater changes have been induced by human intervention through the clearing of wooded areas along the rivers for construction purposes; pumping more water for irrigation, which has lowered water tables; and overgrazing by livestock. Although there are still many seeps, springs, and streams in the area, they probably flowed with greater abundance during wetter intervals than at the present time, which would have provided abundant resources for prehistoric occupants.

Cultural Chronology

Introduction

This section provides a brief synthesis of cultural time periods identified in Central Texas (see Figure 2-8). As in the previous section, all dates in the following discussion are approximate, and are given as radiocarbon years before present (B.P.), i.e., before A.D. 1950. Prewitt (1981, 1985), building on the work of Weir (1976), sorted through the mass of archaeological data from Central Texas and established a chronology defined by stages and phases. Collins (1995, 2004) reviewed the evidence for Central Texas and offered new temporal estimates for human occupations from the Paleoindian through Historic periods. Johnson and Goode (1994) accomplished the same for the Eastern Edwards Plateau. Based on the research by Joel Shiner and others it is clear that the San Marcos Springs have been occupied continually from Clovis times.

Paleoindian

This period or interval spans approximately 2,700 years, estimated at between ca. 11,500–8800 B.P. in Central Texas (Bousman et al. 2004; Collins 1995:381–383, 2004). The Paleoindian period begins before the close of the Pleistocene. Diagnostic artifacts of the early Paleoindian interval include Clovis and Folsom projectile points. Late Paleoindian period occupations begin with the first stemmed (as opposed to lanceolate) points known as Wilson (Bousman 1998; Bousman et al. 2002), and a variety of lanceolate forms such as Angostura, Golondrina, St. Mary's Hall, and Barber (among a few others). Within Texas' political boundaries, Meltzer and Bever (1995:47–81) have documented the presence of 406 Clovis points in 128 of 254 counties.

In general, Paleoindian adaptations have been considered to be one of small bands of nomadic, big-game hunters following herds of Late Pleistocene fauna, including mammoth, mastodon, bison, camel, and horse, across North America (Black 1989a). More recently, emphasis has been placed on the wide diversity of plants and animals used by these early Americans for subsistence, such as turtles and tortoises, alligators, mice, badgers, and raccoons (Black 1989a; Bousman et al. 2004; Collins 1995:381, 2004; Collins and Brown 2000), although they undoubtedly hunted large animals as well (Dibble and Lorraine 1968).

Known Clovis sites include killsites, quarries, caches, open campsites, ritual sites, and burials (Collins 1995:381–383, 2004). However, most Paleoindian finds in Central Texas have consisted of surface lithic scatters on upland terraces and ridges (Black 1989b:25, 1989c:48). A few Paleoindian components deeply buried in alluvium have been discovered, such as Berclair Terrace in Bee County (Sellards 1940), Berger Bluff in Goliad County (Brown 1987),

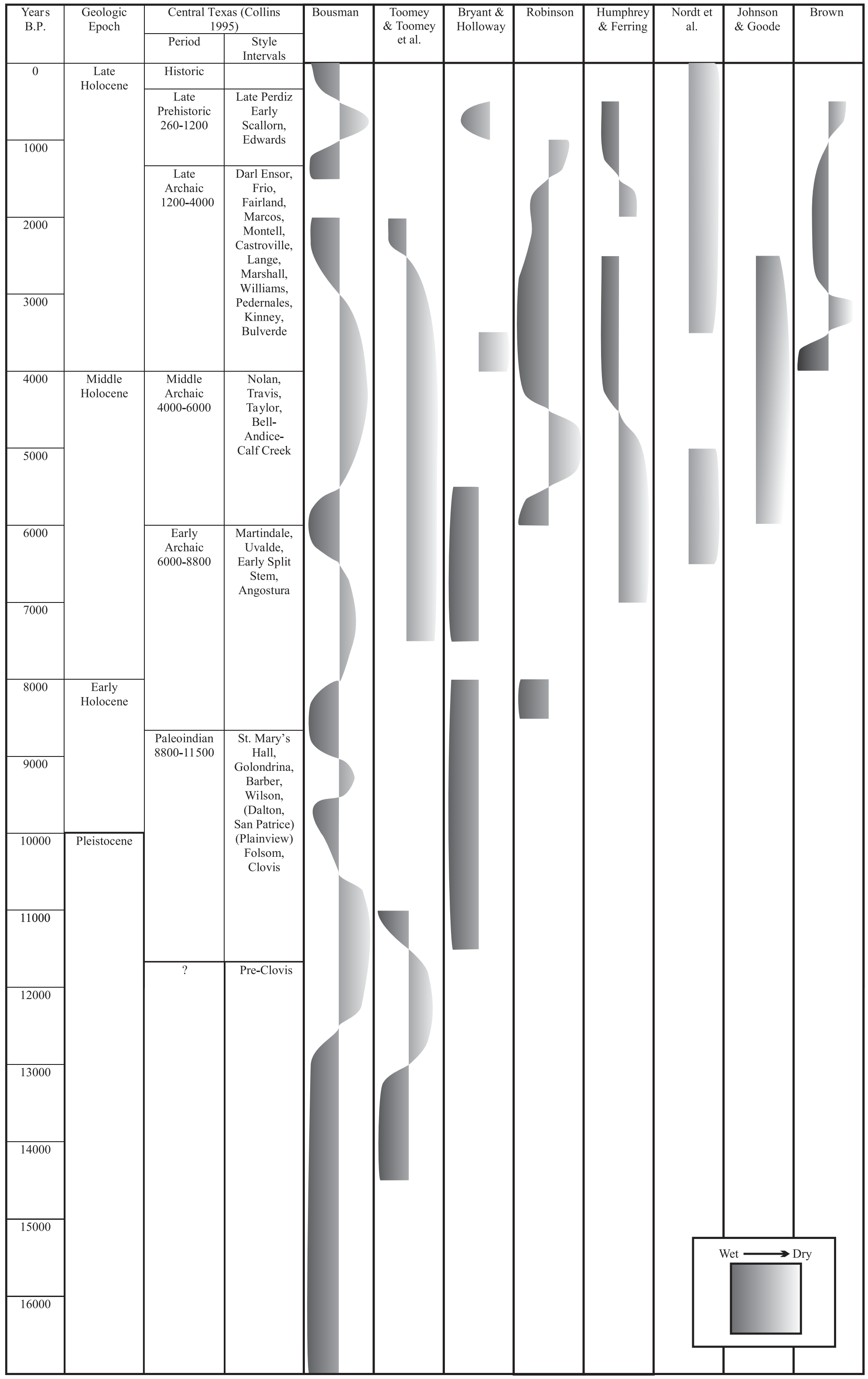

Figure 2-8. Climate and chronology of Central Texas (adapted in part from Collins 1995:376; Nickels et al. 2001:6, 13). References: Bousman 1998; Garber 1998; Bryant and Holloway 1985; Humphrey and Ferring 1994; Nordt et al. 1994, 2002; Robinson 1979, 1982; Toomey 1993; Toomey et al. 1992.

Kincaid Rockshelter in Uvalde County (Collins et al. 1989), Wilson-Leonard in Williamson County (Bousman et al. 2002; Collins et al. 1993; Collins 1998, 2004), and the Gault site in Williamson County (Collins and Brown 2000). As the warming that marks the transition from Pleistocene to Holocene climates began to take effect in Texas, prehistoric inhabitants adapted with changes in lifestyle (Bousman et al. 2002). This climatic shift is also marked by the population decline and eventual extinction of mammoth, mastodon, horse, and camel. The evolution of giant bison (Bison antiquus) into modern bison (Bison bison) apparently took place during the Late Paleoindian period well after the end of the Pleistocene (Lewis et al. 2007).

Archaeological evidence suggests that after 10,000 B.P., large gregarious game animals, except bison, were extinct in Texas. Human hunters were forced to concentrate on deer, antelope, and other medium-size or smaller game. Changes in the subsistence base required technological shifts that mark the beginning of a new cultural period known as the Archaic.

Early Archaic

Collins (1995:383, 2004) dates the Early Archaic from 8800 to 6000 B.P. in Central Texas. The extinction of large herds of megafauna and the changing climate at the beginning of the Holocene (ca. 10,000 B.P.) stimulated a behavioral change by the prehistoric inhabitants of North America. While the basic hunter-gatherer adaptation remained intact, an economic shift away from big game hunting was necessary. In general, more intensive exploitation of local and smaller resources in Central Texas—such as deer, fish, and plant bulbs—is indicated by greater densities of ground stone artifacts, fire-cracked rock cooking features, and more specialized tools. Weir (1976) speculates that Early Archaic groups were small and highly mobile, an inference based on the fact that Early Archaic sites are thinly distributed and that diagnostic projectile point types are seen across a wide area, including most of Texas and northern Mexico.

Story believes that population densities were low during the Early Archaic, and that groups consisted of related individuals in small bands with "few constraints on their mobility" (Story 1985:39). Their economy was based on the utilization of a wide range of resources, especially such year-round resources as prickly pear and lechugilla, as well as rodents, rabbits, and deer (Story 1985:38).

Middle Archaic

Collins (1995:383, 2004) defines this intermediate interval of the Archaic as lasting from about 6000–4000 B.P. in Central Texas. The Middle Archaic appears to have been a time of increased population in Central Texas, based on the large number of sites in the region from this period (Story 1985:40; Weir 1976:125, 128). Weir (1976:126) suggests that as the climate became more moist, deer and acorn-producing oaks thrived in Central Texas, attracting groups at least seasonally, from all other regions of Texas. The current understanding of the paleoenvironmental record conflicts with this interpretation. McKinney (1981:114) suggests that as the climate became drier during the Middle Holocene, Central Texas groups, as well as groups from other regions accustomed to arid conditions, would have moved into the Central Texas Hill Country (the Edwards Plateau). Perhaps not by coincidence, cemeteries make their first appearance during the later part of this period, suggesting a movement toward less mobility and perhaps territorialism.

A wide variation in projectile point styles suggests an increase in the diversity of game animals taken seasonally, along with a shift to concentrated, seasonal nut harvests in the riverine environments of the Balcones Escarpment (Black 1989a; Hall 1998). Weir (1976) believes that an expansion of oak on the Edwards Plateau and Balcones Escarpment led to intensive plant gathering and acorn processing. He also believes that the widely scattered bands prevalent in the Early Archaic now began to coalesce, at least during the acorn-gathering season, into larger groups who shared the intensive work of gathering and processing the acorn harvest (Weir 1976:126). Many researchers believe burned rock middens are a result of this endeavor (Creel 1986; Prewitt 1991; Weir 1976), but other investigators doubt this conclusion (Black et al. 1997; Goode 1991) Regardless, the exact processes which formed these middens are still a matter of controversy (Black 1989b:28; Black et al. 1997; Leach and Bousman 2001; Leach et al. 2005; Mauldin et al. 2003).

The common presence of deer remains in burned rock middens encourages the view that processing and cooking of deer took place at these sites (Nickels et al. 2001; Black and McGraw 1985:278; Weir 1976:125). Bison bone is encountered in archaeological sites in central Texas, at least occasionally, during all but the earliest part of the Middle Archaic (Dillehay 1974). There has been a tendency to equate the presence of burned rock middens with the absence of bison (Prewitt 1981); however, examinations of several recent faunal reports show that after about 4500 B.P., bison and burned rock middens are contemporaneous, at least in the southern Edwards Plateau and northern South Texas Plain (Meissner 1993).

Late Archaic

Collins (1995:384, 2004) dates the final interval of the Archaic in Central Texas to approximately 4000–1200 B.P. The most commonly found point types during the Late Archaic are Ensor and Frio, both of which are short, triangular points with side notches. The Frio point also has a notched base (Turner and Hester 1999:114, 122).

Some researchers believe populations increased throughout the Late Archaic (Prewitt 1985), while others feel populations remained the same or fell during this period (Black 1989b:30). Story (1985:44–45) believes the presence of cemeteries at sites such as Ernest Witte in Austin County (Hall 1981), and Hitzfelder Cave (Givens 1968) and Olmos Dam (Lukowski 1988) in Bexar County, indicates that Late Archaic populations in Central Texas were increasing and becoming more territorial.

Prewitt (1981:80–81) asserts that the accumulation of burned rock middens nearly ceased during the course of this period; however, excavations at the Blue Hole site in Uvalde County (Mueggenborg 1994:1–74), the Honey Creek midden at 41MS32 in Mason County (Black et al. 1997), the Mingo site in Bandera County (Houk and Lohse 1993:193–248), the Mustang Branch site in Hays County (Ricklis and Collins 1994), and multiple middens in Brown County (Mauldin et al. 2003) provide evidence that large cooking features up to 15 m in diameter were still very much in use (see also Black et al. 1997). In addition, recent research has documented a predominance of radiocarbon dates from Central Texas middens that fall within the latter part of the Late Archaic and into the early part of the Late Prehistoric (Mauldin et al. 2003). Subsistence is assumed to have become less specialized on acorns, in favor of a broad spectrum subsistence base (Black 1989b:30). By about 1450 B.P., bison populations had again declined (Dillehay 1974).

Late Prehistoric

The term “Late Prehistoric” is commonly used to designate the period following the Late Archaic period, and is generally thought of as spanning the period 1200–420 B.P. (Collins 1995, 2004). Although Collins (1995:385, 2004) contends that the commonly used date of 1200 B.P. for the end of the Archaic, and beginning of the Late Prehistoric in Central Texas is arbitrary, a series of distinctive traits marks the shift from the Archaic to the Late Prehistoric period, including the technological shift to the bow and arrow and the introduction of pottery (Black 1989b:32; Story 1985:45–47). Two distinct phases recognized within the Late Prehistoric period in Central Texas are the Austin and Toyah phases.

Austin Phase

Most researchers agree that the earlier Austin Phase of the Late Prehistoric period was a time of population decrease in Central Texas (Black 1989b:32). During the Austin phase, there appears to be a subtle transition period (Hester 1995, 2004) when expanding stem dart points may have been used as early arrow points (e.g. Edwards point). Nevertheless, the most prevalent point found in Austin phase sites is the Scallorn arrow point.

Even though small burned rock middens associated with Scallorn and Edwards points have been found (Goode 1991:71; Houk and Lohse 1993:193–248), they are rare. Settlement shifts into rock shelters have been noted during this time (e.g., Fox and Fox 1967; Shafer 1977; Skinner 1981). Cemeteries from this period often reveal evidence of conflict (Black 1989b:32). For example, an excavation of a burial just north of San Antonio (41BX952) revealed an Edwards point between two lumbar vertebra (Meissner 1991). Additionally, six human skeletons were exhumed from the Loeve-Fox site in Williamson County "with arrow points (all of the Scallorn type) in such a manner as to suggest that the penetration of projectiles was the cause of death" (Prewitt 1974:46).

Toyah Phase

Beginning rather abruptly at about 650 B.P. in Central Texas, a shift in technology occurred. This phase is characterized by the introduction of blade technology, the first ceramics in central Texas (bone-tempered plain wares known as Leon Plain), a shift from an expanding stem type to a narrow contracting stem type called "Perdiz," and alternately beveled bifaces (Black 1989b:32; Huebner 1991:346). The Perdiz arrow point may best represent the appearance of a distinct culture in south-central Texas lasting for about 300 years, which archaeologists have labeled the Toyah phase.

In the late 1940s, J. C. Kelley (1947a; 1947b) identified the Perdiz arrow point with what he termed the Toyah Foci. Six years later, Jelks (1953) demonstrated that in general, Austin Foci Scallorn were found underlying Toyah Foci Perdiz and Cliffton arrow points in the Blum Rockshelter. A few years after that, Suhm (1957) confirmed the predominance of Perdiz and Cliffton points as characteristic of the Toyah assemblage, vertically positioned over Austin Foci Scallorn points. Other apparently intrusive arrow points in Toyah assemblages include Fresno points from North Texas.

Jelks' Toyah traits include: Perdiz and Cliffton arrow points, double-pointed and beveled knives, gravers, small drills, stone side-scrapers, expedient scrapers, crude bifaces, bison bone scrapers, deer bone spatulates, bone awls, Leon Plain and possibly intrusive pottery, ground stone, hematite pigment, worked mussel shells, smoothed antler tines, pendants, tubular bone beads, fishhooks, and needles, along with perishable wood and grass/mat items (Jelks 1962: 86-90).

In Jelks' opinion,

> The Toyah Focus probably came to an end during the Late Prehistoric period, at which time it was replaced over much or all of central Texas by a short-lived complex of artifacts that included triangular arrow points, Goliad Plain pottery (described by Monger 1959:164-165), and probably other distinctive artifact styles. This hypothetical complex–if it actually exists–may represent the archaeological remains of the historic and protohistoric Tonkawa and/or Jumano Indians [1962:99].

Prewitt (1985) and Black (1989b) suggest Toyah technology encroached from north-central Texas. However, Patterson (1988) notes the Perdiz point was first seen in southeast Texas by about 1350 B.P. and was introduced to the west some 600–700 years later. In contrast, Johnson (1994; 1995) suggests that the Perdiz point seems to have had its origin along the western periphery of the Edwards Plateau and perhaps its advanced technology spread quickly. Although its style is unique, and some would argue that style is the indicator of social group identity and thus change (e.g. Sackett 1989, Weissner 1983), Johnson and Goode (1994) offer that it was functionally designed to hunt bison. Johnson believes the piercing point would have been ideal if shot in adequate numbers to make the bison slowly bleed to death. Perdiz projectile points are widely found throughout Texas, and often associated with bison kills (e.g. Ricklis and Collins 1994).

Huebner (1991:354-355) suggests that the sudden return of bison to Central Texas resulted from a more xeric climate in the plains north of Texas and increased grasses in the Cross-Timbers and Post Oak Savannah in North-Central Texas, forming a "bison corridor" into the South Texas Plain along the eastern edge of the Edwards Plateau. Sites from this period frequently have associated bison (Black 1986; Black and McGraw 1985; Henderson 1978;; Prewitt 1974).

Although bone-tempered pottery with stick-brushed exteriors is considered diagnostic to Toyah, intrusive wares are also present. Sometimes found are asphaltum-coated sherds, a Karankawan, Texas Gulf Coast tradition. Some of the vessels found at Toyah sites are identical in decoration to Northeast Texas Caddoan vessels. Others show a Jornada Mogollon influence, particularly ollas, while others appear very similar to the Los Angeles type found in Sierra de Tamalipas. In many cases, the jars found at Toyah sites contain residue, presumably from boiling bones for grease. The faunal assemblages would seem to support this presumption, as most are severely splintered, crushed, and broken. The fact that crushed bone appears in much of Toyah pottery may not be a coincidence (Hester 1995, 2004).

The only archaeological evidence that domesticated plants were ever introduced in Central Texas consists of a single corncob found in Late Prehistoric context in Timmeron Rockshelter in Hays County (Harris 1985), another found during excavations in Kyle Shelter in Hill County (Jelks 1962:113-114), and *Zea mays* remains at the Wild Turkey Midden (41MI8) in Mills County (Holloway 1988:4, 8). Not enough evidence exists to postulate there was ever a significant presence of maize in the area. The arrival of the Spanish during the later Protohistoric/Historic period brought significant cultivars to Central Texas.

Protohistoric and Historic Periods

The end of the Late Prehistoric and beginning of the Protohistoric period in Central Texas is characterized by written accounts of European contact with indigenous groups (Wade 2003). The Protohistoric period begins in 1528 when Spanish explorer Cabeza de Vaca traversed parts of Texas and left a diary of his five years spent among the hunter-gatherers of Texas and northern Mexico (see for example, Hallenbeck 1940; Covey 1961; Sauer 1971; Hickerson 1994). In 1541, Coronado entered the Texas Panhandle with hopes of finding riches (Winship 1896; Flint and Flint 1997); the same year, after assuming command from Hernando de Soto, Spanish explorer Luis de Moscoso Alvarado ventured into Texas and encountered Caddoan-speaking and other groups before turning back (Swanton 1985). In 1568 while returning to Nova Scotia from Mexico, Englishman David Graham passed inland along the Texas Gulf Coast (Cutrer 1985:7-12).

It is probable that the first Spanish explorers to reach Central Texas were a small contingency sent by Moscoso to scout west from the East Texas Caddo villages. The chronicler Elvan documents:

> There the [Caddo] Indians told them that ten days' journey thence toward the west was a river called Daycao where they sometimes went to hunt in the mountains and to kill deer; and that on the other side of it they had seen people, but did not know what village it was. ... After marching for ten days through an unpeopled region [they] reached the river of which the Indians had spoken. Ten of horse, whom they governor had sent on ahead, crossed over to the other side, and went along the road leading to the river. They came upon an encampment of Indians who were living in very small huts. As soon as they saw them, they took flight, abandoning their possessions, all of which were wretchedness and poverty. The land was so poor than among them all, they did not find a "alqueire" of maize" (Swanton 1985: 263).

Many historians believe that the Daycao River was the modern Trinity River, however the Caddo village was in the vicinity of modern-day Nacogdoches and the Trinity River is only 60 miles (~90 km) away. This is a very short distance to travel over ten days on horses. Also no "mountains' are found on the west side of the Trinity River. It is more likely that the mountains were probably the Edwards Plateau at the Balcones Escarpment and the river was probably either the Colorado or the Guadalupe. Austin is approximately 200 miles (~300 km) from Nacogdoches and this is a more reasonable distance. The people may have been the hunting and gathering Toyah. Obviously the Caddo did not know these people well and it is also obvious that Toyah sites have very few Caddo trade items (Collins 1995, 2004).

By the 1540s and 1550s, Spanish ranchers had established large ranches in northern Mexico, with several hundred thousand cattle and Native Americans used as slave labor. Large mining ventures in northern Mexico did the same. This encroachment from the south forced Native Americans to escape into the South-Central Texas region. In 1598 the Spanish pushed into New Mexico, and made Santa Fe the capital. Archaeological evidence from the Longhorn Site the Southern Plains demonstrates that horses and cattle were quickly adopted by Plains Indians in the early 17th Century (Boyd and Peck 1992). The harsh treatment of the Pueblo Indians in Northern New Mexico lead to the Pueblo Rebellion of 1680. The Spanish and a few loyal native groups fled to the El Paso area, establishing Isleta Pueblo, but left behind thousands of horses, dramatically increasing access to horses at this time.

When the Spanish missions were established in East Texas in the late 1600s, Spanish entradas became common in Central Texas. One of the first was Alonso de León's expedition of 1680 when the Camino Real (King's Road) was first established as a Spanish trail from Villa Santiago de la Monclova in Mexico to East Texas. This roadway followed established Native American trade routes. These expeditions provide the first detailed written observations on the original Native Americans and landscape in the San Marcos area.

Written records show that various groups lived near the San Marcos Springs during the Protohistoric period. Some of these groups probably lived permanently in the San Marcos area, e.g., Cantona, Muruam, Payaya, Sana and Yojuane, while others came to the region seasonally on bison hunts, e.g., Catqueza, Caynaaya, Chalome, Cibola and Jumano (Newcomb 1993; Johnson and Campbell 1992; Foster 1995:265-289). Later groups such as the Tonkawa, Lipan Apache and Comanche migrated south from Oklahoma and the Plains and replaced the former groups through warfare, diseases and settlement at the Spanish missions (Dunn 1911: Campbell and Campbell 1985; Newcomb 1961, 1993; Wade 2003).

The first Spanish fording of the San Marcos River was in 1690 by Alonso de León (Foster 1995). In 1691 the Domingo Terán de los Ríos expedition arrived at the Guadalupe and Comal Rivers from the south. At the Comal Springs they encounter a group of 2,000-3,000 mounted Choma, Cibola, Cantona, Cholome, Catqueza and Chaynaya Indians. Fray Massanet noted that "every year they come to the headwaters of the Guadalupe River and sometimes as far as the Tejas country. They come to kill buffaloes and carry away the skins because in their country, there are not buffaloes. When it gets cold they return to their own country" (Hatcher 1932: 58-59). Massanet also stated that the Choma, Cibola, Cantona, Cholome, Catqueza and Chaynaya Indians live in along the banks of the Rio del Norte and they also border with the Salineros Indians and the Apaches, with whom they are often at war. The Apaches live in a mountain range that runs from east to west (Hatcher 1932: 58). This mountain range is probably the southern side of the Balcones Escarpment between San Antonio and Del Rio, and the Rio del Norte is probably the Rio Grande.

On June 18, 1691 the Domingo Terán de los Ríos expedition camped at the Indians' rancheria near the Comal Springs at the headwaters of the Comal River. The Native American name of the Comal Springs was *Conaqueyadita*, which means "where the river rises." The large number of Native Americans at the Comal Springs worried the Spanish and they left for a nearby camping location that is now known as the San Marcos Springs. The Domingo Terán de los Ríos expedition camped there from June 20-25, 1691, and they saw many buffaloes and fish while at the San Marcos Springs. But during the first night their horses stampeded, and they spent the next few days recovering the horses. In the end only 35 horses were retrieved. Approximately 75 horses escaped. (Hatcher 1932:15). On June 23, 1691 approximately 60 Cantona Indians visited the Spanish camp at the San Marcos Springs and recorded their name for the springs as *Canocanayestatetlo,* which means "hot water" (Hatcher 1932:60). At this time the chroniclers for the Domingo Terán de los Ríos expedition noted that the Native Americans to the south and west of the San Marcos River all spoke the same language but the groups to the north spoke a different language (Foster 1995:58).

Over the 50 years from the first Spanish visit to San Marcos area in 1680 until 1730, nine Spanish expeditions traveled to San Marcos. In addition to the three expeditions discussed above, the Governor Gregoria de Salinas Varona visited the San Marcos area on June 27 in 1693 (Foster

1995: 77-93). On April 15, 1709 the Espinosa-Oliveres-Aguirre expedition was at the San Marcos Springs (Foster 1995:95-106). Captain Domingo Ramón, Espinosa and Saint-Denis were at the Springs on May 20, 1716 (Foster 1995:109-125). Governor Martín de Alarcón lead an expedition that reached the San Marcos River on May 9, 1718, and on May 13, 1718 on the return trip he named the San Marcos River the 'Rio de Inocentes" (Hoffman 1935:85; Foster 1995:169). In 1721 the Marqués de San Miguel de Aguayo visited the San Marcos Springs and in 1727 Brigadier Pedro de Rivera's inspection tour reached the San Marcos area (Santos 1981; Foster 1995:145-161, 163-175; Jackson 1995).

The first Spanish settlement in Central Texas was at San Antonio with the establishment of the Mission San Antonio de Valero (the Alamo) in 1718 and later with the founding of San Antonio de Béxar (Bolton 1970 [1915]; Habig 1968; de la Teja 1995). A number of Native American groups occupied the area around San Antonio, and these have been classified under the term Coahuiltecan, (Campbell and Campbell 1985) but at least by 1721 Apaches had begun to replace the native Coahuiltecans (Wade 2003:161). However the first Spanish settlement in San Marcos was not until 1755. In August of that year the San Francisco Xavier de Horcasitas, San Ildefonso, and Nuestra Señora de la Candelaria missions and the San Francisco Xavier de Gigedo Presidio were abandoned on the San Gabriel River near Rockdale and established temporarily at San Marcos. The San Francisco Xavier de Horcasitas Mission was originally established for the Tonkawan groups known as Yojuane, Mayeye and Ervipiame (Himmel 1999). San Ildefonso Mission was founded for the Atakapan groups called Akokisa, Bidai and Deadose. Mostly Karankawan groups such as the Coco, Top and Orocoquisa populated Nuestra Señora de la Candelaria Mission, but the Bidai, an Atakapan group, also was recorded at this mission (Bolton 1976).

Many factors led to the abandonment of the San Gabriel missions: drought, an epidemic, immoral behavior of the soldiers and commander, Apache attacks, neophyte desertions, and unhealthy conditions. Between 1755 and 1756 the San Xavier missions were temporarily located on the San Marcos River (Bolton 1970:263-278 [1915]), but the exact location in San Marcos is unknown.

While the missions were at San Marcos over 1,000 Lipan Apaches joined the missions. The Apaches convinced the Spanish missionaries to establish a mission and presidio for them in their own territory to protect them from Comanches. In 1756 the property from the San Xavier missions was assigned to the ill-fated Santa Cruz de San Sabá Mission, and in 1757 the presidio soldiers were assigned to the new San Luis de las Amarillas Presidio near the new Mission. Both were built near the present-day town of Menard on the San Saba River (Weddle 1964). The neophytes from the San Xavier missions at San Marcos were sent to the San Antonio missions, except for the *Mayeyes*. The Spanish built a separate mission for them on the Guadalupe River near New Braunfels, but it was abandoned in 1758.

After the missions at San Marcos were removed, the most complete record of Spanish visiting the San Marcos Springs comes from letters written by Athanase de Mézières to Teodoro de Croix. The first letter, dated September 25, 1779, states:

> "having halted near the head of the San Marcos River, a worthy rival of the San Xavier (Brushy Creek) in respect to the conveniences which it offers for settlement, I have seen with wonder that it owes its

origin to a huge rocky bluff, which emits from an ill-proportioned mount such a volume of water that it [at] once becomes a river. One sees in the neighborhood several caves, with wonderful formations, here are some steps, an altar, frontal candlesticks, and a font; there, curtains, festoons, flowers, images, and niches, all so clean that they appear to be in some one's charge. And there is no lack of benches, which invite the spectator to contemplate at leisure figures, some sacred, some profane, upon which nature has spent so much care that our Europe may well grieve at not being endowed with their equal. ... I have just dispatched an official communication to the chevalier governor of Bexar to notify him of a trail of ten or twelve men, which I saw at San Marcos, and which was seen again at Guadalupe in my opinion, they are coming with evil intent and to report to him the entrance of the Tancaques, so that if the first are Lipanes, their meeting may not have disastrous consequences. May God, etc. Salado, September 25, 1779. I kiss the hand of your Lordship, etc. Atanasio de Mesieres" [Bolton 1914: (II) 283-285].

In a summary of Athanase de Mézières' letters, on May 23, 1780, de Croix states "the San Marcos River rises in a large channel of water which springs from a great rock, in the neighborhood of which are wonderful crystallizations which represent various figures" (Bolton 1914: (II) 315).

The only archaeological evidence of Native American occupation at the Springs during the Protohistoric Period comes from the site of 41HY165 (Ringstaff 2000). A single Mission projectile point was excavated by Chris Ringstaff near the modern Spring Lake dam. No other evidence was recovered. There is also no archaeological evidence of the Spanish occupations or visits to the Springs.

During the Spanish period the Tonkawa tribe became associated with the San Marcos Springs. This was due partly to the missions moving there temporarily in the mid 1700s, but the abandonment of the area by the original inhabitants was certainly another factor. Much of what is known about the Tonkawa comes from the work of Newcomb (1961, 1993). Recent linguistic analysis shows that the original Native Americans in the San Marcos area, such as the Sana, were not Tonkawa and apparently the Tonkawa migrated south from Oklahoma in the 1700s (Johnson and Campbell 1992).

In the second half of the 18th century, the area north of the Guadalupe River was unsettled. The land was the King's Lands (realengas) and neither the missions nor ranchers from San Antonio could herd cattle there (Jackson 1986:59-60). A plan was developed to move the *Adaesanos* (displaced people from Los Adaes) between the San Marcos and Guadalupe rivers to alleviate the need for agricultural and grazing land near San Antonio (Jackson 1986:184-185). At that time there was much tension between the citizens of San Antonio de Béxar and the missions (de la Teja 1995). In 1772 the Baron de Ripperda suggested that a small fort and a settlement should be established at the San Marcos Springs, but this did not happen (Bolton 1914: [I] 335-336), and the *Adaesanos* were told that they could take over the agricultural lands of the Missions Valero , even though that never came to pass (Jackson 1986: 185).

It was not until 1808, when the village of San Marcos de Neve was established under the King's name on the San Marcos River, downstream from the modern town at the El Camino Real crossing, but it was abandoned in 1812 because of flooding and Indian raids (Horrell 1999). This was the last official Spanish community established in Texas.

In 1827, Mexico had gained its independence from Spain and European settlers were moving westward across the Coastal Plains and Blackland Prairies toward the Edwards Plateau. During the period of Mexican rule in 1831 Juan Martin de Veramendi, a native of San Antonio and the ninth governor of Coahuila y Texas under Mexican rule, received a land grant consisting of two leagues in the area that is now San Marcos. When Veramendi died of cholera in 1833 in Saltillo, portions of his holdings, including land at San Marcos were inherited by his daughter, Maria Josepha Veramendi Garza and her husband Rafael Garza.

By 1836, Texas had gained its independence from Mexico and Texas Rangers offered better protection from Native Americans resisting encroachment. After the war in 1840 the Republic of Texas passed "An Act to Provide for the Protection of the Northern and Western Frontier" (Texas Republic 1839). In the San Marcos area this resulted in the building of a road between Austin and San Antonio known as Post Road and a fort established at the headwaters of the San Marcos River known as Post San Marcos. William Lindsey surveyed and laid out the road from Austin to Post San Marcos. Adjunct General Hugh McLeod laid out the fort and Captain Josepha Wiehl's company, the First Infantry Regiment, garrisoned the fort in October 1840 (Pierce 1969:150-151). In March 1841 the Texas army was disbanded and the Post San Marcos troops marched to Austin where they were discharged (Pierce 1969:151). The fort has never been located or direct evidence recovered.

During this time William Lindsey began to purchase land from the Rafael and Maria Veramendi (Stovall et al. 1986). Some of this property is now within the town of San Marcos. On December 22, 1840 Nathaniel Lewis purchased 640 acres that included the headwarters of the San Marcos Springs from Rafael and Maria Veramendi (Hays County Deeds and Records [HCDR] Vol. A:10). On August 21, 1845 General Edward Burleson and Dr. Eli T. Merriman bought this 640 acres from Lewis (HCDR A:169) and the portion that Burleson acquired included the headwaters and springs of the San Marcos River.

A year after Burleson bought the San Marcos Springs, William McClintock, a volunteer with the Second Kentucky Regiment during the War with Mexico (he was killed in 1847 during the Battle of Buena Vista) wrote a detailed description of the San Marcos Springs and surrounding area:

> "2 miles north of St. Marks we crossed the Blanco, a mountain torrent of purest water, narrow and deep, there is the finest spring or springs (for they are not less than 50 in a distance of 200 yds.) I ever beheld. These springs gush from the foot of a high cliff and boil up as from a well in the middle of the channel. One of these, the first you see in going up the stream, is near the center, the channel is here 40 yds wide, the water 15 or 20 feet deep, yet so strong is the ebullition of the spring, that the water is thrown two or three feet above the surface of the stream. I am told that by approaching it in a canoe, you may see down in the chasm from whence the water issues. Large stones are thrown up, as you've seen grains of sand in small springs, it is unaffected by the dryest season. I am persuaded that the quantity of water which is carried off by this stream in the course of a year is greater than that by the South Licking, it is about 60 feet wide and 3 feet deep on an average, with a current of not less than ten

or fifteen miles per hour. Great numbers of the finest fish, and occasionally an alligator may be seen sporting in its chrystal waters. The town of St. Marks, (that is to be, for it is only born and christened, the first of the four houses, it contains having been put up four weeks since) stands on one of the loveliest spots in nature. Immediately in rear of it, to the north, a range of romantic woody hills extends away for many miles to the west, terminating at the north in an abrupt cliff from which issues the spring. The spring branch (St. Marks river) funds half round the place in a semi-circle forming the e[a]stern and southern boundary, at the west, the prairie rises in easy and regular swells for miles away. These swells are mostly cover'd with clumps of live oak, or groves of post, or pecan. The town site containing a mile square slopes from the center to the east, south, and west, a number of trees standing singly, or in groups cover this area, many of them hung with graceful festoons of Spanish moss. The margin of the stream, and sides of the hills are adorned with innumerable flowers and shrubs. In the eddies of the stream, water cresses and palmettos grow to a gigantic size. Great quantities of game in the neighborhood. It was a few months since, a favorite resort and camping ground for roving bands of Comanches" [McClintock 1931:32-33].

Edward Burleson built a two-roomed log house on the edge of the Balcones Escarpment overlooking the San Marcos Springs in 1848 (Bousman and Nickels 2003) and he lived there until died in 1851 of pneumonia in Austin while serving as a state senator (Jenks and Kesselus 1990). During his years in Texas Burleson became close friends with Placio, a Tonkawa chief, and Placio visited Burleson at his San Marcos home annually (Himmell 1999). After his death, Burleson's wife sold the property, known as the Homestead Tract, in 1855 (Bousman and Nickels 2003). Eventually the property was sold to A. B. Rogers in 1926 (HCDR 91:458), who in the 1940s began to develop the property as a theme park known as Aquarena Springs. The San Marcos Springs remained under private ownership until 1994 when Texas State University purchased the property (Bousman and Nickels 2003).

Chapter 3

Previous Research and Potential for Buried Sites

C. Britt Bousman

Potential for Buried Archaeological Deposits

The archaeological and geoarchaeological investigations described in the following two sections demonstrate the great potential for human occupation in and around the San Marcos Springs. Evidence for prehistoric occupation began at least by the Clovis period at approximately 11,500 years ago, and extends through the Late Prehistoric period, ending about 260 years ago. Historic documents record the use of the springs by Spanish and Native American groups in the eighteenth and nineteenth centuries, and in the mid-nineteenth century by early settlers such as General Edward Burleson.

Archaeology

According to the current construction plans, only 41HY160 will be directly impacted by construction at the Texas Rivers Center. However, because it is directly relevant to the archaeological resources at 41HY160, archaeological research in the surrounding area will be discussed in this section. Six archaeological sites are recorded in the vicinity of the Texas Rivers Center (Figure 3-1). These are 41HY37, 41HY147, 41HY160, 41HY161, 41HY165, and 41HY306 (Shiner 1981, 1983; Garber et al. 1983; Garber and Orloff 1984; Ford and Lyle 1998; Goelz 1999; Arnn et al. 1999; Lyle et al. 2000; Ringstaff 2001).

In 1978 Joel Shiner (1979, 1981, 1983) began underwater investigations at 41HY161 (the Ice House Site) below the dam at Spring Lake. This site

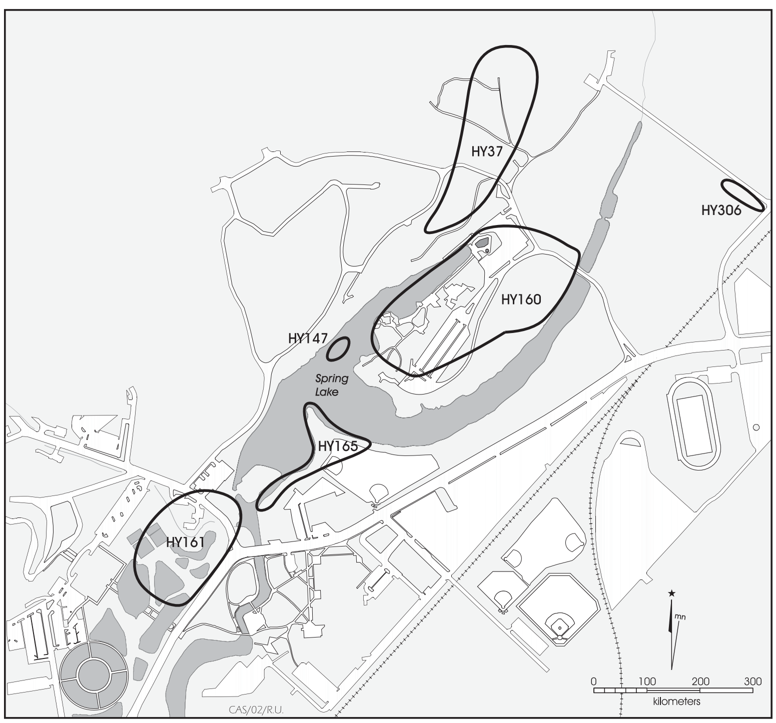

Figure 3-1. Recorded prehistoric sites near the San Marcos Springs.

appeared to be disturbed and contained a mixture of prehistoric, mostly Archaic, and historic artifacts. In 1979 Shiner shifted his attention to the underwater excavation of 41HY147 (known as the Terrace Locality) in Spring Lake adjacent to a large spring-eye. A mid-nineteenth century dam forms Spring Lake at Aquarena Springs and it flooded the once-dry alluvial terrace deposits. In his underwater excavations at 41HY147, Shiner recognized three strata on an eroded slope at the base of the escarpment. The top stratum was approximately 20-30 cm thick and consisted of a gray matrix with shouldered and notched Archaic projectile points. The middle stratum was a 10-20-cm-thick red sandy deposit with shouldered and lanceolate projectile points, clearly mixed deposits with Archaic and Paleoindian artifacts. The lowest layer was a 30-40-cm-thick red clay with Paleoindian lanceolate projectile points and numerous mega-faunal remains, including mammoth and mastodon teeth, and bison bone.

Shiner's underwater excavations at 41HY147 and 41HY161 produced abundant evidence of Archaic and Paleoindian occupations, including Clovis, but the remains were not found in sedimentary contexts that could be used to reconstruct detailed views of these past occupants' lifeways. Nevertheless, Shiner (1983) proposed that the Paleoindian inhabitants of 41HY147 probably were semi-sedentary and stayed at the springs for long periods of time. Shiner (1983) based his hypothesis on the apparent large number of Paleoindian projectile points and bones found in his excavations in contrast to well-known kill-sites in the Southern Plains with fewer points. In addition, he suggested that the presence of large springs with constant water temperatures would allow "edible flora and fauna [to] be available year-round" and the "green foliage near the temperate water would attract mega-fauna during the dry or cold seasons" (Shiner 1983:5-6). Johnson and Holliday (1983) contested this hypothesis, and suggested that the abundance of projectile points was related to the abundant supplies of Cretaceous cherts on the Edwards Plateau rather than a semi-sedentary mobility pattern.

In 1990 and 1991, Paul Takac, a graduate student at Southern Methodist University, continued Shiner's underwater excavations at 41HY147 (Takac 1990, 1991a, 1991b). His project was eventually abandoned because of the difficulty and costs involved in careful underwater excavations. Nevertheless, he documented a total of 46 Paleoindian projectile points collected by Shiner and himself at 41HY147, with most being Late Paleoindian in age.

Texas State field school participants, under the direction of James Garber, began to investigate sites near the San Marcos Springs, including 41HY37, 41HY160, 41HY161, and 41HY165 in 1982. Garber et al. (1983) reported on the 1982 field school at 41HY160. This site is on the peninsula between Spring Lake and Sink Creek at the Aquarena Center golf course. Thirty-four square meters were excavated in the vicinity of T-Box 6. The deepest excavation unit (XU1) extended to a depth of 2.4 meters below the surface. Intact Late Prehistoric through Early Archaic occupations were exposed. Garber et al. (1983) recovered over 35,600 lithic artifacts, including 504 lithic tools and 53 diagnostic projectile points. Late Prehistoric projectile points such as Perdiz, Scallorn, Cliffton, and Alba were found between 0-20 centimeters below the surface (cmbs), points characteristic of the Transitional Archaic Period (Darl, Fairland, and Edgewood) were recovered between 20-40 cmbs, Late Archaic projectile points (Ensor, Frio, Marshall, and Castroville) were excavated between 30-50 cmbs, early Late Archaic points (Pedernales) occurred primarily between 50-70 cmbs, and Nolan and Early Stemmed points representing the Middle and Early Archaic intervals were found between 70-

190 cmbs. Faunal remains consisted of bison, deer, and antelope. The thirteen documented features included two burned rock middens, five stone hearths, three stone alignments, one posthole, one trash pit, and a special activity area possibly associated with the production of ceramics. One stone alignment and an adjacent posthole might be the remains of a structure. The field school returned to 41HY160 in 1983, but these excavations have not been analyzed or reported.

In 1984, 41HY165 was recorded and briefly tested. Excavations were renewed in 1996 and continued through 1998. Jennifer Giesecke (1998), then a BA student at Texas State, analyzed the faunal remains for a class project. Chris Ringstaff (2001) presented this material for his MA Thesis; otherwise the excavations at this site have remained unanalyzed and have not been reported.

Texas State field school participants returned to 41HY160 under the direction of David Driver in 1991. Three units were excavated in the T-Box 6 area, three in the vicinity of the swimming pool in front of the hotel (Figure 3-2), and a seventh unit was excavated northeast of the anthropology field laboratory on the edge of the golf course. Most of the upper deposits near the swimming pool were believed to be mixed (James Garber, personal communication 1999), but some of the lower deposits appeared to be intact.

In 1998, under the direction of Kathy Brown, participants in the Texas State field school excavated six units at 41HY160 in the vicinity of the Aquarena Center offices (see Figure 3-2). Intact deposits were found immediately below the present surface in two of the units. Neither the 1991 nor the 1998 excavations have been analyzed and reported. In 1997, Dawn Ramsey (1997) conducted a pedestrian survey and shovel-testing project at Aquarena Center. She excavated 10 shovel tests on the east side (left bank) of Sink Creek and northeast of the entrance road immediately east of the escarpment. All but one shovel test produced prehistoric artifacts.

The Texas State field school participants excavated the Burleson homestead site (41HY37) on the ridge above the hotel in 2000 (Bousman and Nickels 2003). Britt Bousman conducted additional Texas State field school excavations in the pecan grove at 41HY160 in the summers of 2001-2003. This excavation recovered Late and

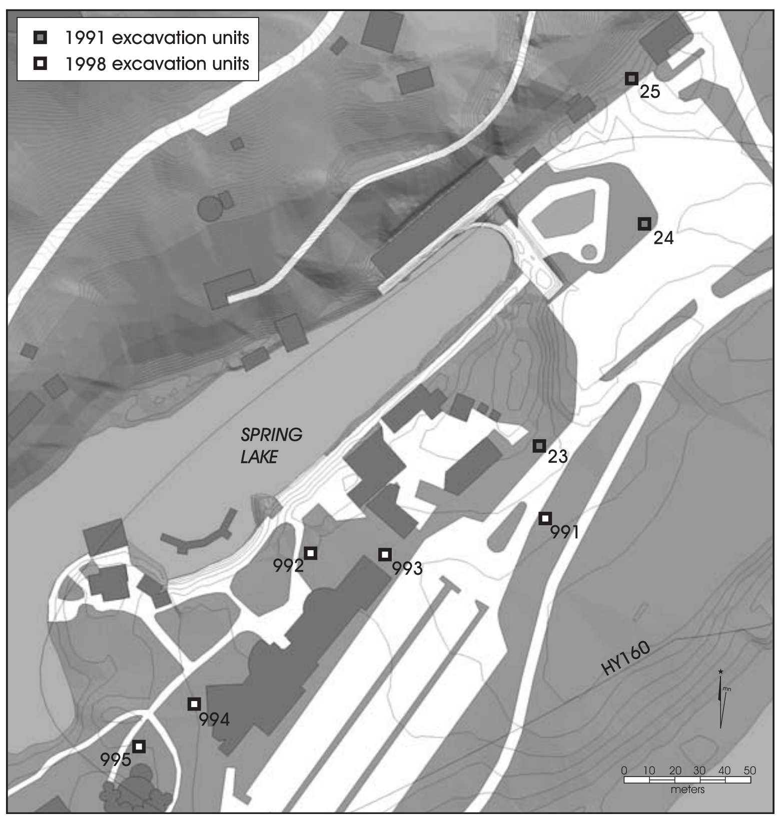

Figure 3-2. Locations of 1991 and 1998 excavation units.

Middle Archaic occupations with Nolan, Early Triangular and Calf Creek components in the upper 1.5 meters of deposits (Lohse in prep).

In 1997 Ford and Lyle (1998) conducted a limited shovel testing and backhoe testing operation at 41HY161, in the parking lot constructed for Joe's Crab Shack on the right bank of Spring Lake and immediately upstream from the dam. These investigations demonstrated the presence of extensively disturbed deposits. In 1998 Lyle et al. (2000) excavated backhoe trenches, shovel tests, and excavation units along the route of a water pipeline that went through 41HY161; the entire length of the pipeline route was monitored during construction. The route extended from the banks of the San Marcos River immediately downstream of the Ice House and Spring Lake Dam, ran adjacent to the Aquatic Biology Building, and then continued west. Test units west of the Aquatic Biology Building documented intact deposits with eight stratigraphic units. A Late Archaic (Williams) component in Zone 7 was found stratified above a Late Paleoindian (probably Angostura) component in the lower portion of Zone 7. Below the Angostura component was a buried soil in Zone 8. Organic matter from this soil was submitted for radiocarbon dating and the resulting estimate of 1060±70 B.P. (Beta-132889, $\delta^{13}C$= -20.1 ‰) reflects a serious contamination problem with modern organic matter. Dense subsurface roots from nearby bald cypress trees are the likely contaminant.

In 1999 Godwin et al. (2000) conducted test excavations at 41HY306 and data recovery excavations at a portion of 41HY37. The City of San Marcos installed a 24-inch water line at the base of the Balcones Escarpment and along Bert Brown Road. Diagnostic projectile points from the Early, Middle, and Late Archaic periods were associated with intact burned rock features at 41HY37, but little was found at 41HY306.

Geoarchaeological Assessment of Buried Site Potential

Before excavations were undertaken, the current geoarchaeological information at 41HY160 was assessed. Although not without problems, two recent studies (Goelz 1999; TETCO 1999), as well as a 1999 geotechnical analysis of the construction site (Gunter 1999), were used to determine the condition of the site as it pertains to archaeological resources.

In 1999 Prewitt & Associates conducted a geological assessment of seventeen 30-foot (9-m) cores (Goelz 1999). The primary result of this work was to provide an outline of the Late Quaternary geological history of the valley and the potential for prehistoric occupations. Goelz (1999:5-6) identified two stratigraphic units (I and II) and four depositional facies (I_g and $I\ell$ [my labels], and II_a and II_b).

Goelz (1999) argues that stratigraphic Unit I unconformably overlies Cretaceous bedrock (Person Formation of the Edwards Group). This unit is divided into a thick gravel facies (I_g) and a thin discontinuous loam facies ($I\ell$). The gravel facies represents deposition by a high-energy fluvial system such as a stream channel floor or a point bar. It was present in the lower portion of Cores 4, 7, 8, 14, and 15 (Figure 3-3), but unit designations are not clearly marked on the remainder of the core descriptions. The loam facies (Il) was present in only Cores 15 and 19. This facies is an organic-rich, fine-grained deposit that probably reflects the occurrence of a "backswamp" or marsh environment. A radiocarbon assay of 11,470±100 B.P. (Beta-132062, $\delta^{13}C$= -26.7 ‰; calibrated age 13,444 years B.P.) from 8.5 m below ground surface

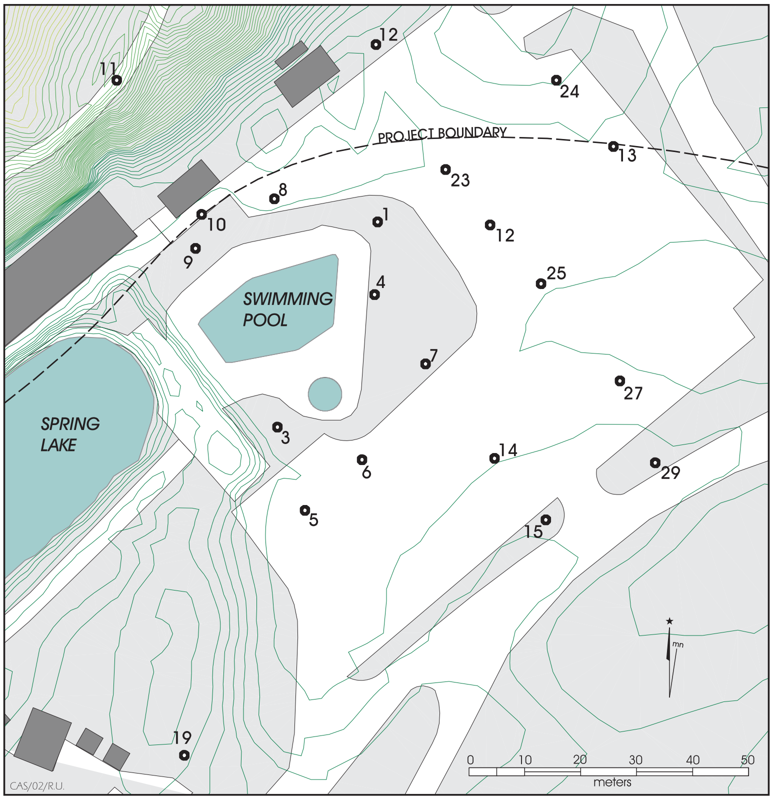

Figure 3-3. Numbered cores described in Goelz (1999).

in Core 15 supports the argument that most of the alluvial deposits in the valley accumulated during a temporal span that could potentially contain cultural materials.

Stratigraphic Unit II consists of two facies. Unit II*a* consists of fine-grained floodplain deposits, and Unit II*b* represents the accumulation of coarse-grained, poorly sorted colluvial deposits simultaneously accumulating at the base of the escarpment and interfingering with the alluvial deposits of Unit II*a*. A buried soil was observed in Core 3 and Core 9 at approximately 2 m below the surface. A radiocarbon date from Core 3 (3660±50 B.P., Beta-132061, $\delta^{13}C$= -21.7 ‰; calibrated age with multiple intercepts of 3979, 3936, 3933 years B.P.) is used to suggest that this soil formed during a brief period of surface stability during the Late Archaic period.

Thirty cores were extracted during this initial geotechnical and geoarchaeological study; twenty-one were in the immediate area of the Texas Rivers Center Phase 2 construction (see Figure 3-3), and the remaining cores were placed further to the southwest on the peninsula. Data collected during these two projects were used to construct the current site conditions; however, limitations existed and these are discussed below.

The thickness of alluvial sediments above bedrock are plotted on Figure 3-4. These plots show that deposits are shallow near the escarpment, but quickly thicken to an average depth of 8.4 meters in the central portion of the site. The south-easternmost core (Core 15) is 9.2 meters, and this may represent an incised channel in the underlying bedrock. It is possible that deposits become even thicker toward the middle of the valley.

Figure 3-5 illustrates the thickness of disturbed fill below the surface. Only cores near the swimming pool have deposits that have significant amounts of disturbed fill. Importantly, the cores immediately south of the swimming pool have no recorded disturbed fill, and this is an area where building construction is planned in Phase 2.

Figure 3-6 shows which cores produced prehistoric cultural materials and the maximum depths at which this material was observed. The recovery of cultural materials in such small cores is not common and recovery usually indicates reasonably dense occupation. In the area of the swimming pool, only one core (Core 4) did not produce prehistoric artifacts (see Figure 3-3). Cultural materials were recovered to a depth of 6.5 meters in core B-19 in the southern portion of the pecan grove, and similar depths could be expected nearer the swimming pool. As the radiocarbon date of 11,470 B.P. is from a 9.15-m depth in Core 15, all of the deposits above this level could potentially contain evidence of prehistoric occupations, and the estimated age for cultural materials at 6.5 m below the surface is 8850 B.P.

Figure 3-7 presents the depth of ground water. The most distinctive and expected pattern is that ground water is encountered at shallower depths in cores that are closer to standing water at the head of Spring Lake. Ground water depth can be expected to fluctuate with changes in rainfall. Garber et al. (1983) estimate that the water table is 12 feet (3.65 meters) higher because of Spring Lake. The most serious problem that ground water poses is instability of deposits. Hand excavation below ground water depths is not safe or logistically feasible without shoring and pumping.

Figure 3-8 illustrates the thickness of intact deposits. The most complete sections are south and east of the swimming pool.

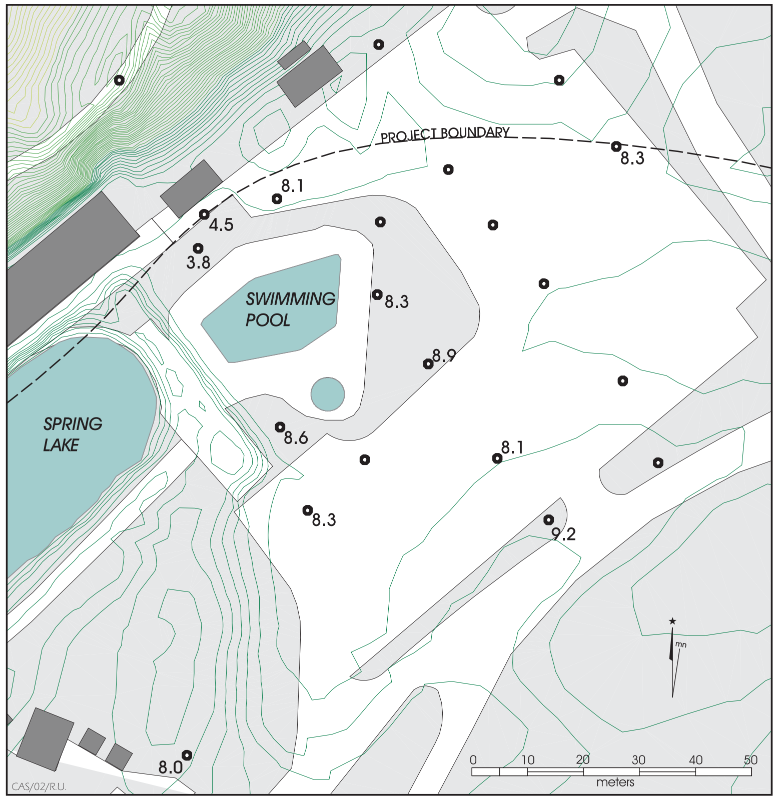

Figure 3-4. Depth of bedrock measured in cores (depths in meters- not recorded in all cores).

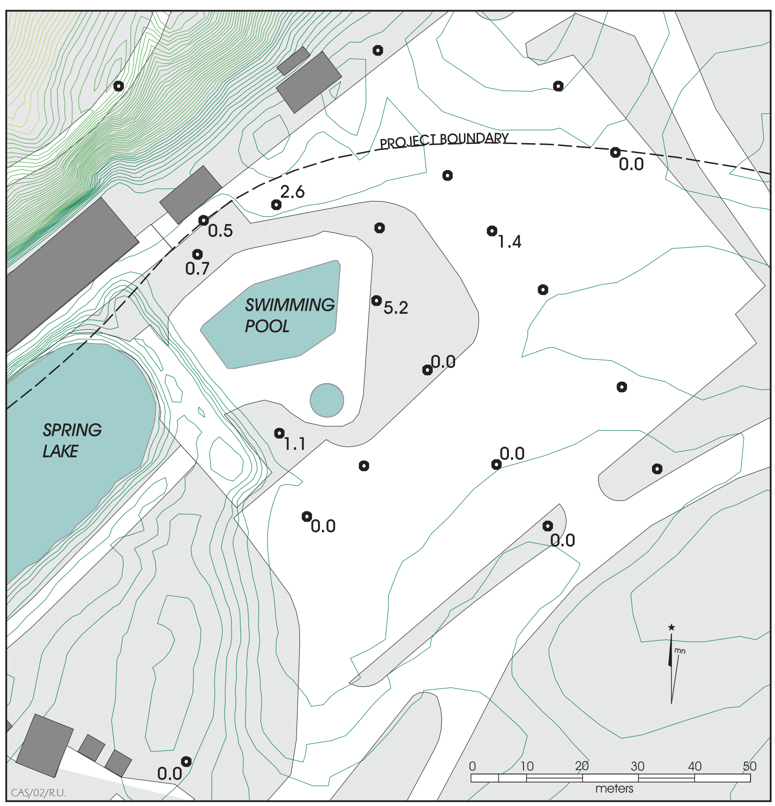

Figure 3-5. Thickness of disturbed fill (depths in meters).

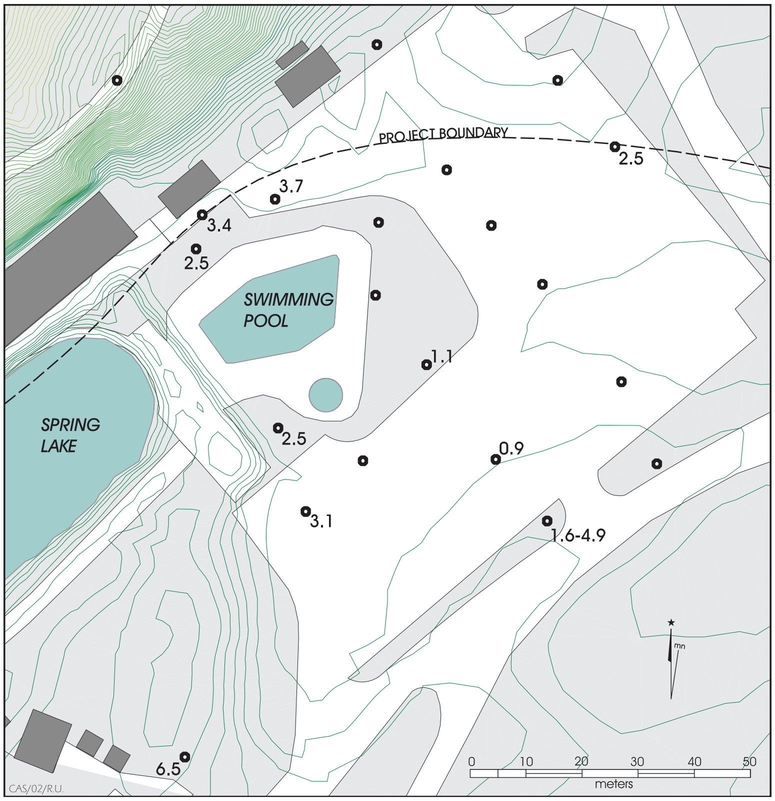

Figure 3-6. Depth of observed artifacts (depths in meters).

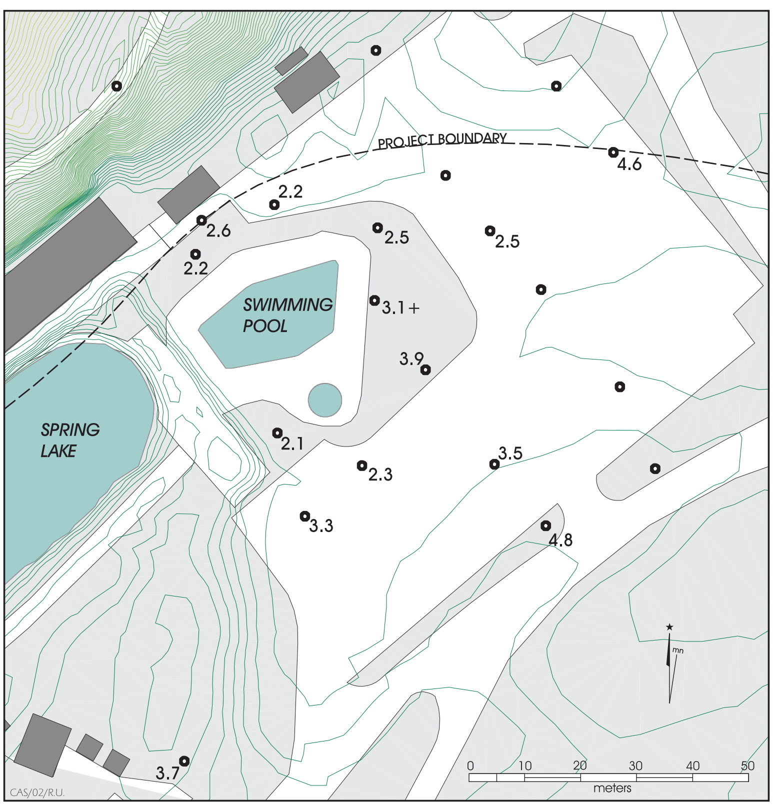

Figure3-7. Depth of water table (depths in meters-not recorded in all cores).

Cores near the swimming pool have thick mixed deposits near the surface, but the lower sections have apparently survived intact without obvious disturbance.

While the cores described by Goelz (1999) provide important information, there are problems with them that affect their usefulness in future investigations. Trinity Engineering Testing Corporation (TETCO) originally extracted their cores in May and June of 1999 for a geotechnical study of the construction site, although three cores were taken strictly for geoarchaeological purposes. TETCO removed nine 5-foot cores that did not sample the lower deposits and twenty-one 30-foot cores that reached bedrock. The cores were extracted with truck-mounted rotary and auger drill rigs. Three extraction strategies were used. First, cohesive soils (most of the Late Pleistocene and Holocene alluvial sediments are within this class) were continuously sampled with a hydraulically advanced 3-inch diameter steel push-tube sampler. This was implemented until "refusal." Secondly, granular soils were intermittently sampled with a split spoon sampler. Finally, rock-like materials were continuously cored with an NX size double walled core barrel equipped with a diamond or carbide cutting bit.

The push-tube sampler normally removed sections that

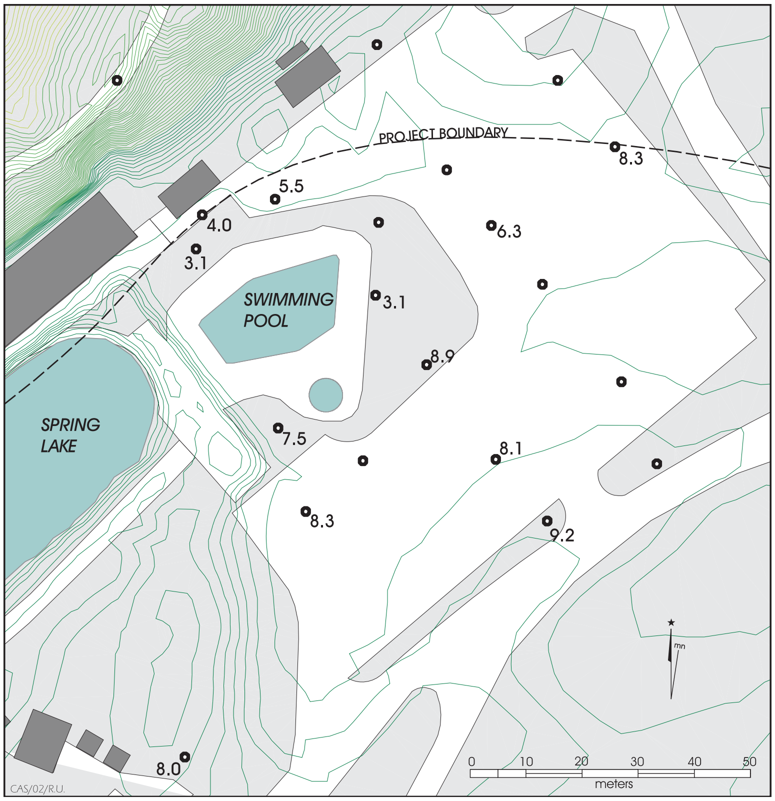

Figure 3-8. Thickness of intact Pleistocene and Holocene fill (depths in meters- not recorded in all cores).

and thus further inspection and analysis is impossible.

Summary of Site Potential and Limitations

Clearly, 41HY160 has a remarkable potential to provide significant new information to the prehistoric record of Texas. Every excavation unit that has been dug through undisturbed deposits has contained evidence of prehistoric occupations. Another measure of the site's potential can be gained by briefly inspecting sediment deposition rates. Even though the data are extremely limited, Figure 3-9 graphically depicts the radiocarbon age and depth of the two assays obtained by Goelz (1999), and indicates that the rate of deposition was greater between approximately 11,500 and 3700 B.P. than between 3700 B.P. and the present. This is consistent with

were 1.5 feet in length although recovered sections were often only 1.0 foot long. This resulted in 30% or greater compaction. Compaction erases the characteristics of pedogenesis. The tops and bottoms of each core were not clearly marked, only the top and bottom depths, thus making detailed stratigraphic divisions impossible. Fourteen of seventeen cores (82%) had portions that were missing, labeled as no recovery, or disturbed (three cores had less than 50% of the sampled sediment available for study). Overall, approximately 24.1% of the cores were not available for detailed analysis because of lack of recovery or disturbance. Finally, the cores were not saved or curated,

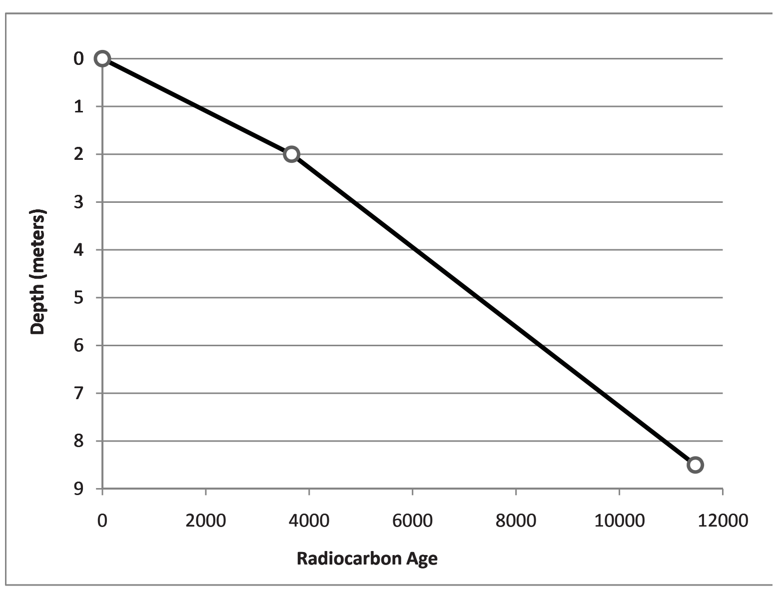

Figure 3-9. Radiocarbon assay age years BP and depth..

the geological evidence that documents a well-developed modern surface soil that probably reflects a long period of stability in the Late Holocene. Thus, the deeper and older components have a greater chance of being buried quicker and organic materials being better preserved.

A review of Figures 3-7 and 3-8 reveals that deep alluvial deposits exist throughout the area, except near the escarpment wall. It is also in this area where colluvial deposits are most likely. The distribution of disturbed fill and the distribution of intact fill suggest that the area surrounding the swimming pool will probably not include preserved Late Prehistoric and Late Archaic components. These will most likely be present immediately south of the pool. The distribution of water table depths shows that most excavations will be terminated between 2-3 m below the surface without some type of pumping. This means that testing the deeper deposits with Early Archaic and Paleoindian components would be very difficult.

Chapter 4

Research Questions and Testing Strategy

C. Britt Bousman and David L. Nickels

Research Questions

A number of major questions were addressed by the investigations at the Texas Rivers Center. However, as the reader may recall from the introductory chapter (Chapter 1), the purposes of this project were 1) to determine the presence or absence of cultural remains in the areas to be impacted, and 2) if cultural materials were found, to evaluate their integrity and potential for providing significant archaeological information.

Because this is a testing project, the issues of site integrity and preservation potential were the most important issues considered. Other issues that can be addressed with further analysis are related to how humans adapted to natural changes in the environment, as well as the availability or of fluctuating food resources. These issues are not dealt with in this testing report, but our methodology was designed with them in mind (see Chapter 5).

Economy

What economic changes occurred during the prehistoric period? The only nearby site that can compare to 41HY160 at Spring Lake is Wilson-Leonard (41WM235) in southern Williamson County (Collins 1998). Both sites have evidence of quasi-continuous occupation from the Early Paleoindian through the Late Prehistoric periods. The faunal record at Wilson-Leonard (Baker 1998, Balinsky 1998) suggests that dramatic changes in prehistoric faunal exploitation occurred during the same periods of occupation as represented at 41HY160, and that these changes were related to major environmental shifts. Giesecke (1998) tentatively identifies shifts between deer and bison at 41HY165, but these results must be confirmed with more detailed analysis. The use of plant foods can also be expected to change, but too little is known about what type of plants were used and how these were processed.

Environment

How has the local and regional environment changed? How have environmental changes influenced the exploitation of plants and animals in the area? Was the resource base stable during this 12,000-year period or did the prehistoric inhabitants respond to regional fluctuations in the plant and animal populations (Dillehay 1974; Bousman 1998)? Were the changes great enough that prehistoric Native Americans had to alter their economic, mobility, or technological exploitation patterns?

Technology

How have prehistoric technological strategies responded to changes in economic exploitation patterns? A shift from formal and curated lithic tools to a greater use of informal expedient tool using strategies is evident in the flake tools at

Wilson-Leonard (Prillman and Bousman 1998). Are changes in cooking technology a response to economic changes and availability of foodstuffs (Wandsnider 1997)? Are similar shifts present at 41HY160? Did the prehistoric inhabitants alter their technological strategies to match the exploitation patterns?

Mobility

How did changes in hunter-gatherer mobility influence technological patterns? According to Shiner (1983), we should expect to encounter evidence for semi-sedentary settlement patterns, even in the Paleoindian period. McKinney (1981) and others have remarked on the intensive exploitation and occupation of spring related sites along the Balcones escarpment, but does this occupation intensity translate to sedentary mobility patterns? Did shifts in mobility patterns influence the use of curated and expedient tools? How are non-local raw materials incorporated into the technological system? Are different resources from differing areas used in specific periods?

Habitation Structures

Two possible structures have been recovered from the Texas State excavations at 41HY160 and the nearby site of 41HY163 (Garber et al. 1983; Garber 1987). Other investigations in Texas demonstrate the construction of habitation structures; four structure types have been identified (Lintz et al. 1995). Ethnoarchaeological investigations of hunter-gatherer sites demonstrate the unorganized nature of sites occupied by highly mobile foragers and the more organized nature of sites occupied by semi-sedentary collectors (Binford 1986; Fisher and Strickland 1989; O'Connell 1987; Yellen 1976). Both foragers and collectors are known to construct habitations, but artifact distributions differ between these different hunter-gatherer adaptations. Recent intra-site spatial analysis of Late Archaic occupations at 41MV120 in Maverick County suggests a highly repetitive but informal use of space as would be expected on forager sites (Vierra 1998). Intra-site analysis of artifact distributions can be used to shed light on hunter-gatherer mobility patterns. If additional structures can be identified, then their use in detailed intra-site analyses of hunter-gatherer camps would be extremely informative, particularly if investigators can gain an understanding of how site structure relates to mobility patterns. Does the internal structure of prehistoric occupations at the springs support the argument for semi-sedentary occupation?

Site Preservation

This issue has been discussed in detail in the previous chapter, and in sum, three major questions related to site preservation are addressed. How has the nature of sediment accumulation affected the presence of archaeological evidence at 41HY160? Did erosion and different facies deposition inhibit the preservation of archaeological remains in specific periods? Could these different patterns of erosion and deposition account for the cultural historical record preserved at 41HY160?

Test Excavation Strategy

In order to address the research questions discussed in the previous section, the test excavation strategy was divided into two operations. The first was geoarchaeological coring, and the second was 1-x-1-m unit test excavations. The primary objective of this second phase of investigation was to obtain enough information to determine if a data recovery phase of investigations was warranted and, if so, how to best design the second phase of archaeological work.

Geoarchaeological Coring

New geoarchaeological cores are needed in order to better understand the geological history of the valley. The previous cores extracted by TETCO and described by Goelz (1999) were not retained and could not be examined, making further interpretations impossible. Furthermore, core recovery was too incomplete (see Chapter 3), and this led to a serious concern regarding the accurate interpretation of the geological context of the prehistoric occupations in the valley.

Additional coring was conducted by the Bureau of Economic Geology (UT-Austin) in order to document the Late Pleistocene and Holocene depositional history of the valley, including the exact depth of disturbed deposits in the swimming pool area. This produced another set of cores that were extracted in two valley cross-sections from east to west, but with a concentration in the swimming pool area where most of the Phase 2 construction will occur. One problem with the previous coring effort is that they were taken in a longitudinal pattern rather than on a cross-section, making reconstructing alluvial fill very difficult. Serious questions persisted concerning the depth of disturbed fill in the Phase 2 construction area, and these questions were to be answered as the first step in the archaeological investigations.

Test Excavations

Six 1-x-1-m test units were excavated to an average depth of 1.7 m before reaching the water table. Two units were placed in the footprint of the pavilion and the restrooms (Phase 1 Master Plan), and four units were placed in the area of the swimming pool and surrounding parking lot. These last four units were placed in areas where the geoarchaeological cores indicate that undisturbed deposits have survived. The primary purpose of these units was to determine the horizontal and vertical distribution of Late Prehistoric and Late Archaic occupations in these two construction areas. Older occupations could not be sampled by test units due to water table depth. Dr. Lee Nordt acted as the geoarchaeological consultant in order that the high resolution alluvial and colluvial stratigraphy obtained from the cores and these excavation units could be linked directly to the excavated samples. During the 1991 Texas State field school, a 1-x-1-m unit was excavated in the area of the swimming pool. This information was used to supplement the six planned units.

A number of special samples were collected from the test excavations, including radiocarbon, archaeomagnetic samples of burned rock from features, and macrobotanical samples. Archaeomagnetic burned rock samples provide information on the context of burned rock cooking features and the use parameters (temperature and heating interval) of these features. Macrobotanical samples offer information on past environments, as well as prehistoric plant use. Furthermore, Accelerated Mass Spectrometry (AMS) radiocarbon dating was used because AMS provides a much more precise and accurate assay, which is important for deposits of such great age. AMS also has the capability to date materials that are very small (charcoal) or contain very little contemporaneous carbon (bone). Recent dating efforts on similar sites have relied almost exclusively on AMS dating. Sediment textural analysis could be used to accurately assess the character of sediments and thus depositional environments. This information would be critical for a detailed understanding of the integrity of the archaeological remains. These would all be considered as feasibility tests, and the most productive could be used in the mitigation (data recovery) phase of investigations.

Data recording included level forms, feature forms, plan maps, profile descriptions, photographs, and elevation records. All excavated sediment was screened through ¼-inch mesh, and all artifacts, bone, and any other significant materials were collected.

Analysis of Artifacts and Features

The artifacts analysis was designed to provide information regarding the various research questions discussed in the previous section. The vast majority of materials to be analyzed were lithic artifacts. These were classified by class (tool, flake or core) and by raw material. More detailed analysis consists of fine-grained classifications into various tool types, e.g., projectile points. Other observations related to manufacturing strategies, intensity of use, and reuse could also be made (Bousman 1993). Faunal remains were also collected, and provisions were made for special analysis to the taxa level. It was expected that numerous burned rock features would be encountered. Radiocarbon and archaeobotanical samples were taken from these features. Furthermore, archaeomagnetic cores were collected and analyzed at Dr. Wulf Gose's Paleomagnetic Laboratory at the University of Texas at Austin. Archaeomagnetic analysis provides a reliable technique to determine the context of burned rock features and many of the use-parameters of these features, such as maximum heating temperature, reuse of burned rock, possible stone boiling, and approximate heating time. This information could be critical in the analysis of prehistoric subsistence and cooking strategies (Wandsnider 1997).

Chapter 5

Methods

David L Nickels

Introduction

This chapter provides a discussion of the field and laboratory methods used during the 2001 excavations, as well as subsequent analysis and curation of the cultural material recovered. The methods employed throughout the project were a direct result of those research questions and testing strategies discussed in the previous chapter. In total, six hand-dug 1-x-1-m units were excavated, and 22 geologic cores were extracted to investigate and evaluate 41HY160 during this project.

Field Methodology

During a four-week period beginning January 5, 2001, CAS conducted a Phase I testing project at 41HY160. Prefield operations included a thorough review of the data from previous testing projects at 41HY160. In addition to 1-x-1-m unit excavations, field investigations conducted by CAS included site mapping, the collection of macrobotanical, archaeomagnetic, and magnetic susceptibility samples, and geomorphological studies.

Mapping

A site datum was established in an area not projected to be disturbed by new construction, and was tied into a permanent benchmark using a Sokkia Total Station with a data collector. All test units and core boreholes were mapped using the Total Station, thus allowing for greater accuracy and speed in mapping (Figure 5-1). Mapping data were downloaded from the data collector to a database spreadsheet loaded onto a computer hard drive in the CAS laboratory. The data was checked for accuracy and maps were produced using Surfer and ArcView software.

Figure 5-1. Excavation units and bore holes were mapped using a Sokkia total data station.

Unit Excavations

Six units, assigned numerical designations 1–6, were excavated during the current testing project. All were 1-x-1-m, placed within the footprint, or immediate area of proposed new construction, and dug in 10-cm arbitrary levels using trowels. With the exception of special samples, all excavated material was screened through ¼-inch mesh. Initially, when work began on the fifth of January, all sediments were dry-screened. However, because of the wet, sticky clay, this method did not prove to be either time or cost effective. Therefore, on the twenty-third of January, all sediments were placed in 5-gallon bucket mixtures of water and baking soda. After stirring and allowing the combination to set for 30 minutes or longer, the sediments were then water screened (Figure 5-2).

Figure 5-2. Water screening at the Anthropology Field Laboratory.

Each unit was identified by the provenience of its southwest corner. Normally, two crew members were assigned to each unit. Unit datums were established at ground surface in the southwest corner of the unit. Feature numbers were assigned when identified, plan views were drawn, and photographs were taken. Twenty-one flotation samples were collected from 10 different features for further analysis. Additional samples were collected in and around features, or from soils that appeared to be organically enriched by human occupation.

Archaeomagnetic Samples

CAS drilled and collected 125 core samples for archaeomagnetic analysis from nine burned and fire-cracked rock features. Rocks from these features were drilled in place using an Echo E-Z Core rock drill, model D-2801, with a 1 1/8-inch diamond-tipped bit (Figure 5-3). The angle and dip were recorded using a Brunton compass mounted on a goniometer (Figure 5-4). The elevation of each sample relative to the unit datum was also recorded. A plan view was drawn of the drilled rocks with the archaeomagnetic sample number assigned. After each sample was scored and marked with a permanent marker to

Figure 5-3. Archaeomagnetic samples were collected from in situ Fire-cracked rocks using a rock drill.

ensure proper alignment during the laboratory processing phase, samples were removed and placed in separate labeled bags.

After reviewing their proveniences in relation to soil stratigraphy, available charcoal samples, diagnostic artifacts, and debitage patterning, 111 of the 125 samples were selected for analysis. In the CAS laboratory, the samples were cut to 2.3 cm in length. Following this, they were transported to Wulf Gose at the Paleomagnetic Laboratory, Department of Geological Sciences, The University of Texas at Austin. There they were labeled with pelican ink. Next they were placed in a helium-cooled cryogenic magnetometer to record their natural remnant magnetization signature. They were then subjected to thermal demagnetization to 600° C in increments of 50° C. After each heating event they were allowed to cool, their magnetic vectors were measured by the cryogenic magnetometer and then recorded on a computer database before being reheated to the next higher increment (see Appendix C).

Soil Susceptibility Samples

One hundred sixteen soil susceptibility samples were collected. Samples were removed in a miniature column fashion from the walls of Units 4, 5, and 6. First, the area of the wall to be sampled was scraped to insure a recent exposure to the atmosphere. An approximate 5-x-5-cm soil sample was taken vertically from top to bottom in three-centimeter increments. The samples were collected in labeled bags and their proveniences then recorded on a field form before being transported to the CAS laboratory. All samples were taken to the Center

Figure 5-4. After drilling a core in the fire-cracked rocks, measurements were taken using a brunton compass mounted on a goniometer.

for Archaeological Research, The University of Texas at San Antonio. Once there, the soils were removed from bags and placed in plastic two-centimeter cubes. The cubes were labeled alphabetically in order to provide a cross reference with their provenience at the site. Each sample was then placed at room temperature in a Bartington magnetic susceptibility MS2B sensor, its susceptibility was displayed on an MS2 meter, and the data were recorded in a computer database.

Figure 5-5. Cores were drilled by personnel from the Bureau of Economic Geology, The University of Texas at Austin.

Geoarchaeological Core Drilling

A total of 22 cores sampled in 5-foot sections to bedrock were drilled on and around the site using a core drilling rig from the Bureau of Economic Geology, The University of Texas at Austin (Figures 5-5, 5-6, and 5-7). Samples were logged by personnel from the Bureau of Economic Geology, with assistance from a CAS staff member. As the cores were removed, the project geomorphologist examined and made field notes on each section (Figure 5-8). They were then placed in plastic bags, labeled, and transported to Baylor University in Waco, Texas for further analysis. A discussion and description of cores can be found in Chapter 6 and Appendix D.

Photographs

CAS staff took 131 photographs using a Canon 35-mm camera with color slide film, and a Sony Digicam with diskettes. Photographs were recorded on standard CAS photo forms in the field. Several of the negatives were stored on color CDs during the time of development. In addition to photographing general excavation activities, particular attention was given to features, profiles, and plan views.

Figure 5-6. Core drilling on the edge of the Golf Course between Spring Lake and Sink Creek.

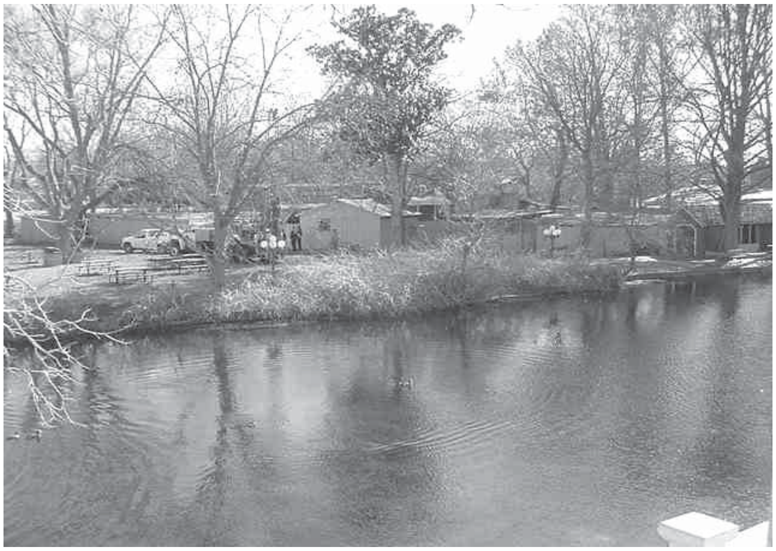

Figure 5-7. Core drilling in the pecan grove at Aquarena Springs.

Flotation Samples

Twenty-one samples were collected and processed for flotation at the Department of Anthropology Field Laboratory at the Texas Rivers Center. The sediments were poured into plastic buckets, clean water was added, and the mixture was gently stirred by hand to bring the light fraction to the water's surface. The floated material was then gently skimmed off the surface or poured through a tightly woven chiffon cloth fitted into a fine wire mesh kitchen colander. The cloth with the light fraction on it was then removed and allowed to dry indoors. After drying, the light fraction was poured from the chiffon cloth through graduated nested screen sizes of 2 mm, 1 mm, and 0.5 mm respectively. A catchment pan was placed on the very bottom to catch any remains finer than 0.5 mm. Any examination

Laboratory Methods

Artifacts collected in the field were brought to the laboratory on a daily basis where they were washed, sorted, and cataloged Figure 5-9).

Lithic Artifacts

The processing of lithic artifacts began with washing and sorting into debitage and tool categories during a preliminary analysis. A more complete form of analysis was made on all whole flakes recovered. This consisted of the identification of a flake type (e.g., core preparation, biface thinning, uniface, sequence). Individual tool categories were further analyzed by specific attributes designed for each tool type. Data were then entered on an Excel Spreadsheet. Chapter 10 presents further discussion of how lithic artifacts were analyzed for this project.

Figure 5-8. Lee Nordt examined the extracted cores in the field, while Charlie Burton helped section them for transport to the Department of Geology stratigraphy laboratory at Baylor University.

Figure 5-9. Artifacts were washed, sorted, and cataloged in the CAS Laboratory.

of the processed light fractions was done under clean conditions. The light fraction was then placed in paper letter envelopes and sent to Dr. Phil Dering of Texas Shumla Archaeobotanical Consulting for analysis (see Chapter 9).

Fire-cracked Rock

All fire-cracked rocks were collected for analysis. A total of 2,650 rocks from 12 features and other contexts were counted, size-sorted or weighed, and examined for material type (limestone, sandstone, quartz, etc.).

Carbon Dating

CAS collected 38 carbon samples. Ultimately, four wood charcoal samples were selected for radiocarbon analysis by Thomas Stafford. The selected samples were processed at the Stafford Research Laboratory in Boulder, Colorado. For a discussion of radiocarbon dates see Chapter 7 and Appendix E.

Faunal Remains

Faunal material was gently washed, air dried, and placed in individual bags with labels. Those pieces that were clearly too fragmented to be identifiable were weighed and kept in the CAS laboratory. The remaining pieces were transported to Brian Shaffer for further analysis (see Chapter 8 and Appendix B).

Snails

A total of 37,672 snails were collected. They were washed and sorted into two sizes: <1 cm or >1cm. No further analysis was conducted.

Curation

Artifacts processed in the CAS laboratory were washed, air-dried, and stored in archival-quality bags. Acid-free labels were placed in all artifact bags. Each bag was labeled with a provenience or corresponding lot number. Tools from all excavations were labeled with permanent ink and covered by a clear coat of acrylic. Artifacts from each investigation were separated by class and stored in acid-free boxes. Boxes were labeled with standard labels. Fire-cracked rock was discarded after analysis. Heavy fraction, light fraction, and other samples (i.e. ^{14}C, archaeomagnetic samples) were also placed in acid-free boxes.

Field notes, forms, photographs, and drawings were placed in labeled notebooks. Photographs, slides, and negatives were placed in archival-quality sleeves. All notebooks are stored in acid-free boxes. Documents and forms were printed on acid-free paper. A copy of the site report and all computer disks pertaining to the project are stored in an archival box and curated with the field notes and documents. All artifacts, photographs, and records are permanently housed at the Archaeological Curation Facility at Texas State University.

Chapter 6

Geology, Landscape Evolution, and Geoarchaeology at Spring Lake

Lee C. Nordt

Introduction

San Marcos Springs in San Marcos, Texas is an area rich in archaeological history. Six prehistoric sites with components ranging in age from the Paleoindian to Historic periods have been recorded in the Sink Creek valley, but none tested to depths of more than 2 to 3 m (Garber et al. 1983; Arnn and Kibler 1999; Lyle et al. 2000). The Paleoindian artifacts discovered at the bottom of Spring Lake greatly contribute to the archaeological importance to the area (Shiner 1983).

Two previous studies with a geoarchaeological focus have been conducted. Arnn and Kibler (1999) excavated backhoe trenches across the Sink Creek floodplain and along the northern valley escarpment. No datable, or time-diagnostic materials, were discovered in the floodplain down to depths of 3 m. However, along the valley escarpment radiocarbon ages from buried features indicated the presence of at least 2 m of Late Holocene colluvium. Goeltz (1999), in association with the Trinity Engineering Testing Corporation (TETCO), excavated cores in the immediate vicinity of the springs at Spring Lake. Two bulk humate radiocarbon ages were obtained. The oldest dated to Clovis time (11,470±100 B.P., Beta 132062), which came from the base of the alluvial valley fill at a depth of 8.6 m. A bulk humate date of 3660±50 B.P. (Beta 132061) was obtained from a depth of 2.4 m. Although these ages are only estimates, they demonstrate the importance of the Sink Creek valley as a reservoir for preserving a long-term prehistoric archaeological record of central Texas.

The purpose of this study is to investigate for the first time the complete alluvial stratigraphy of the Sink Creek valley in the vicinity of the San Marcos Springs. Results can be used to assess prehistoric site distribution, preservation potentials, and perhaps subsistence strategies and settlement patterns.

Methods

Stratigraphic data were collected from 22 cores taken with a truck-mounted drill rig provided by the Bureau of Economic Geology at The University of Texas, Austin. Undisturbed core samples were taken in 5-foot sections, and down to bedrock in most cases. With cores that suffered compaction or sample loss, thickness and depth adjustments were made. Core sections were transported to the Department of Geology Stratigraphy Laboratory at Baylor University and described following procedures of the Soil Survey Division Staff (1993). All cores and depths are graphically illustrated relative to Core A, the top of which was set at 0 meters elevation. Archaeological test units (TU) were described in the field. Radiocarbon dating for this project was performed by Stafford Research and Center for Accelerator Mass Spectrometry (Lawrence

Livermore) and reported in radiocarbon years before present. Beta Analytic, Inc. provided the two bulk humate ages reported in Goeltz (1999). All radiocarbon samples were performed by accelerator mass spectrometry.

Setting

Geology

The study area is located within the Balcones Fault Zone Physiographic Province bounded by the Edwards Plateau to the north and the Gulf Coastal Plain to the south (Vauter and Yelderman 1993). As shown in Figure 6-1, the local Cretaceous geological sequence includes limestones, shales, and clays from the Navarro/Taylor Group (youngest), Austin Formation, Eagle Ford Group, Buda Formation, Del Rio Formation, Georgetown Formation, Edwards Group (Person and Kainer Formations), Walnut Formation, and Glen Rose Formation (oldest). The Edwards Aquifer formed in fractured and displaced blocks of the Edwards Group, Georgetown and Walnut Formations, with the Del Rio Clay and Glen Rose Limestone serving as upper and lower confining beds. The steep escarpment northwest of Spring Lake is the San Marcos Fault line. San Marcos Springs issue from the vicinity of the fault line where Cretaceous beds are down thrust to the southeast. This displacement created fractures that serve as conduits for water flow. The aquifer is confined down dip by the Navarro/Taylor and Eagle Ford Groups, and the Buda, Del Rio, and Georgetown Formations (see Figure 6-1). Quaternary alluvium begins at Spring Lake at the base of the San Marcos Fault escarpment and extends across Sink Creek to the southeast beyond Interstate 35 to the San Marcos River and Blanco River confluence (see Figure 6-1).

The San Marcos Springs are the second largest along the Balcones Escarpment (Guyton and Associates, 1979). They issue from the Edwards Aquifer, which regionally flows in the subsurface from northwest to southeast (see Figure 6-1). Formation of the Balcones Escarpment began in the Miocene as soft coastal plain rocks subsided, creating a regional fault zone trending from the west to east in the study area. With subsequent dissolution, widening, and connecting of fissures, the Edwards Aquifer began to form (Vauter and Yelderman 1993).

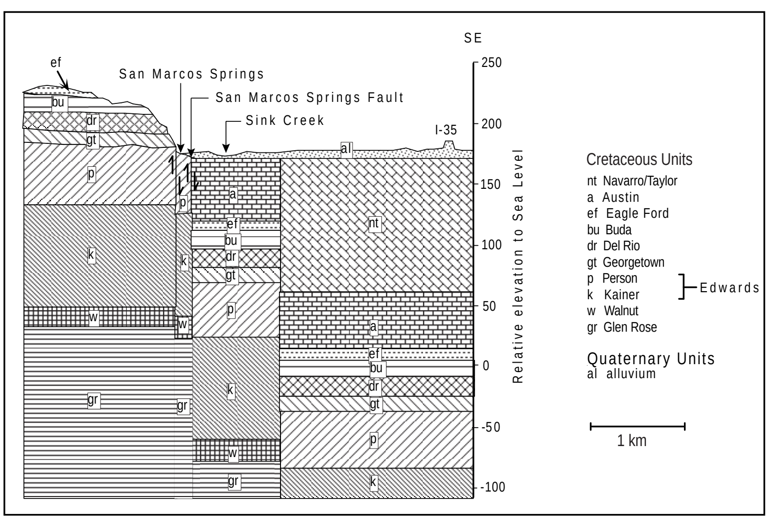

Figure 6-1. Cross section of the study area showing major geological units and fault structure in relation to San Marcos Springs and the Sink Creek valley (modified from Guyton and Associates 1979).

Most spring water emanates from five major limestone openings in the bottom of Spring Lake (Guyton and Associates 1979). Spring Lake was created in 1849 when a dam was constructed by Edward Burleson 300-m downstream from the main springs (Bousman and Nickels 2003). Before the dam was constructed, the spring bubbled out of a channel some 40 yards wide and 15 to 20 feet deep (McClintock 1930). Today, it is known that the springs are up to 12.2 m deep with 3.1 m of that contributed by Spring Lake dam. Average daily spring flow between 1956 and 1974 was 4.56 $m^3 s^{-1}$ with an average lake surface elevation of 175 m (Guyton and Associates 1979).

Geomorphology

Sink Creek is a low order tributary flowing into the head of the San Marcos River, which begins at the San Marcos Springs (Figure 6-2). Sink Creek begins in the uplands of the Edwards Plateau north of the study area. Just northeast of the study area the creek takes a sharp turn through a valley constriction before entering Spring Lake. This angle may be created in part where the creek encounters the southwest projecting San Marcos Springs Fault. Today, Sink Creek flows only during heavy rainfall events. The San Marcos River flows for about 8.5 km before joining the Blanco River. Base flow from the springs is the main water source for the San Marcos River.

The landscape surrounding the study area is subdivided into five geomorphic units: Upland Limestone Bedrock, Pleistocene/Upland complex, Pleistocene alluvium, Early Holocene alluvium, and Late Holocene alluvium (see Figure 6-2). The Upland Bedrock Unit is underlain by Cretaceous limestone, marl, and chalk and it is mantled by thin rocky soils. The Pleistocene/Upland complex consists mainly of a veneer (1 to 2 m) of gravelly alluvium with subsoil carbonate (Bk) and clay (Bt) development consistent with a late Pleistocene to early Holocene age (Denton, Krum, Lewisville, Rumple, and Anhalt series). Rock outcrops within the complex are mapped as Comfort, Tarpley, and Medlin series. This geomorphic surface is confined to the area above the major valley constriction north of the study area in the Spring Creek valley. The Pleistocene alluvium forms terraces situated from 3 to 12 m above the surface elevation of Spring Lake (175 m). The terraces contain deep soils of the Houston Black, Krum, and Lewisville series (Batte 1984). These soils formed in what was a large alluvial valley at the regional confluence of Sink Creek, and the San Marcos and Blanco Rivers. The degree of soil development is indicative of at

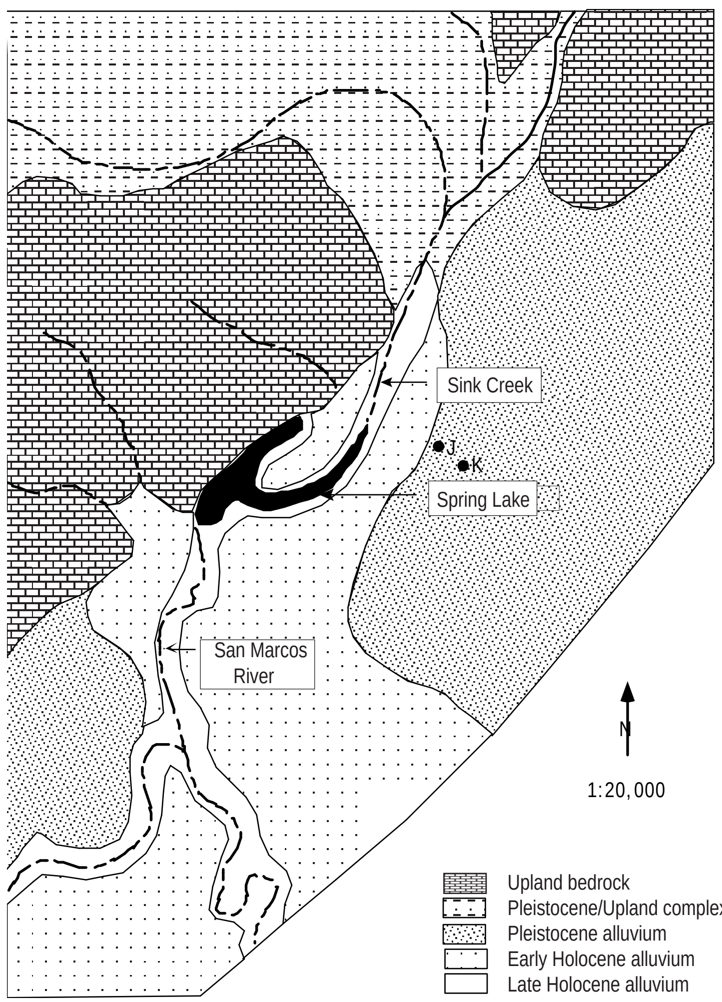

Figure 6-2. Geomorphic map of the study area based on core data from this study, topographic maps, and the Soil Survey of Comal and Hays County (Batte 1984).

least a Late Pleistocene age. Cores J and K from this study were excavated in the parking lot of the Texas State football stadium and both revealed truncated soils with numerous carbonate nodules indicative of a Pleistocene age. This area marks the Pleistocene/Holocene boundary on the southeast side of the Sink Creek valley.

The Holocene alluvium is subdivided into early and late (see Figure 6-2). The Early Holocene alluvium fills the broad Sink Creek and San Marcos River valleys just above the confluence with the Blanco River. In the study area, the Early Holocene terrace surface is about 2.5 m above the surface elevation of Spring Lake. The upstream section of this unit, including the Sink Creek valley, consists of fine-grained soils of the Tinn series, whereas the downstream section along the San Marcos valley consists of loamy soils of the Oakalla series. The Late Holocene alluvium is confined to the entrenched and modern floodplain of Sink Creek and the San Marcos River. Here, frequently flooded and weakly developed Oakalla soils are mapped. In the study area, Spring Lake marks the approximate elevation of the floodplain surface.

Stratigraphy

The alluvial stratigraphy of the Sink Creek valley is divided into five unconformably bound units labeled A through E from oldest to youngest, based on data from Cores A, B, U, G, H, and I (Figures 6-3 and 6-4), and from Cores F, M, N, O, P, and Q (Figures 6-3 and 6-5). Figures 6-4 and 6-5 show cores oriented in an across valley direction (see Figure 6-3) and Figures 6-6 and 6-7 show cores oriented in an up valley direction (see Figure 6-3).

The oldest stratigraphic unit in the study area is Unit A. It is located at the base of Cores A, B, H, I, P, Q, R, and C (Figures 6-4 through 6-7; Appendix D). Unit A is 2 to 2.5 m thick and consists of channel gravels deposited directly on the eroded bedrock floor of the Sink Creek valley. A veneer of yellowish brown to brownish yellow overbank deposits appear to cap the channel gravels in some areas. The gravels are also contained in a yellowish brown to brownish yellow mud matrix. In Core A, a brownish yellow to light yellowish brown colluvial wedge, containing clays and matrix supported limestone pebbles and cobbles, emanates from the northwest valley wall and interfingers with Unit A gravels in Core B (Figure 6-4). In two locations the gravels are capped by dark gray to black marsh deposits emanating from the springhead (Figure 6-7, Cores E and D). In Core E the marsh is subdivided into two horizons between depths of 666 and 706 cm. The upper layer is a very dark gray clay to clay-loam that is weakly calcareous with a lower layer that is black, calcareous, and with many more snail fragments. Both layers have well-preserved, fine to medium plant fragments. In Core D, the marsh consists of five layers between depths of 712 and 851 cm. The upper three layers are noncalcareous clay to clay-loams ranging from dark gray and gray in the upper two layers to black in the third layer. The lower two layers are calcareous (many snail fragments), very dark gray to dark gray silty clay-loams. Plant fragments occur mainly in the third and fourth layers. Iron depletions along channel voids indicate that roots were anchored in layers 2 and 3 during marsh development. Two radiocarbon ages indicate marsh accumulation at 9585±40 B.P. based on dating of plant fragments (Table 6-1), and to as old as 11,470±100 based on bulk humate dating (Goeltz 1999). Sediment humates tend to date older than charcoal in central Texas alluvium (Nordt 1992), thus the marsh deposits in Cores E and D are tentatively grouped together.

Unit B is inset to Unit A and confined to the area surrounding the springhead (Figures 6-

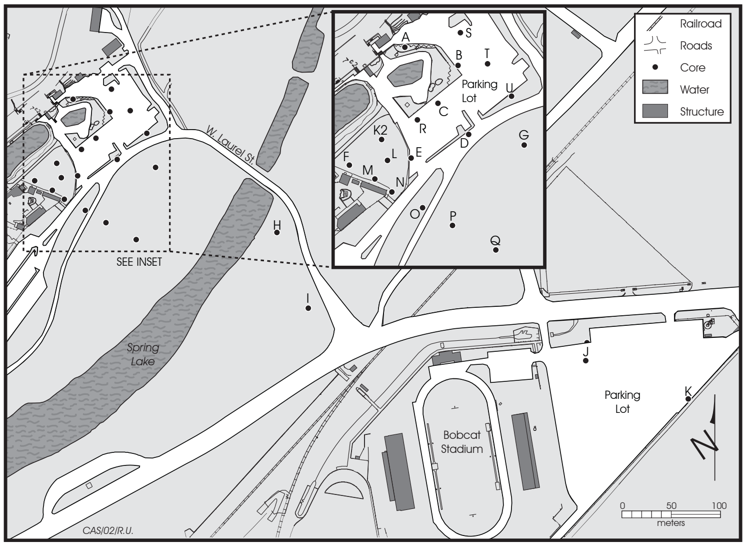

Figure 6-3. Location map showing distribution of geological cores extracted near the San Marcos Springs and Sink Creek Valley.

5 through 6-7, Appendix D; Cores F, M, N, O, and K2). Unit B also rests on the valley bedrock floor, but at a slightly lower elevation, suggesting that channel down cutting terminated floodplain stability and marsh formation associated with Unit A. Channel gravels at the base of Core O appear to mark the entrenchment point that preceded deposition of Unit B (Figure 6-5). In Core F, Unit B consists of a black, calcareous, clayey marsh deposit resting on the bedrock floor between depths of 654 and 724 cm (Figures 6-5 and 6-6). In Core M, the marsh is a black, calcareous silty clay between depths of 682 and 757 cm (Figures 6-5 and 6-7). Both marsh deposits in Unit B contain plant fragments and iron depletions along voids indicating the presence of in situ roots during formation. As with Unit A, mineral textures demonstrate that flooding was a component of marsh formation, although the presence of limestone fragments and proximity to the springhead indicate that spring deposits contributed more to the marsh sediments than in Unit A. Unit B at the base of Core N consists of 50% coarse fragments (chert and limestone) in the lower part, contained in a dark gray mud matrix where it transitions laterally to channel gravels (Figure 6-5). Channel entrenchment occurred sometime after 9585 B.P., and was followed by deposition of Unit B until around 7365±40 B.P. (see Table 6-1).

After a brief episode of erosion, Unit C marks a period of renewed channel activity as shown in Cores U, G, F, M, N, O, K2, and L (Figures 6-4 though 6-7; Appendix D). In Cores U and G, Unit C cuts through Unit A channel gravels and then traverses down valley through Core L (Figure 6-7) and then through Cores K2 and F (Figure 6-6). Because the channel did not cut through Unit B in Core F, the channel network at this time was aggrading near the springhead. Unit C is unique in that the channel gravels are encased in a reddish brown to strong brown mud matrix. In Cores U and G (Figure 6-4), the gravels appear to be capped by clays, up valley from associated marsh deposits. Marsh deposits cap Unit C in Cores F, M, N, O, and L in the vicinity of the springhead. Although higher in the section, the Unit C marsh does not appear to extend any further laterally away from the spring than in Unit B. Unit C marsh deposits are thicker and more complex than previous deposits. In Core F, the sequence consists of four layers between depths of 451 to 541 cm (Figure 6-5). Plant fragments occur throughout the very dark gray, calcareous, clay matrix, but this clay layer interrupted by a horizontally bedded zone in layer 2. The latter indicates that the spring elevation temporarily rose and spread carbonate clasts across the adjacent littoral zone, which may or may not have been associated with a flood surge. The first and third layers (darkest) also have evidence of root traces indicative of a shallow

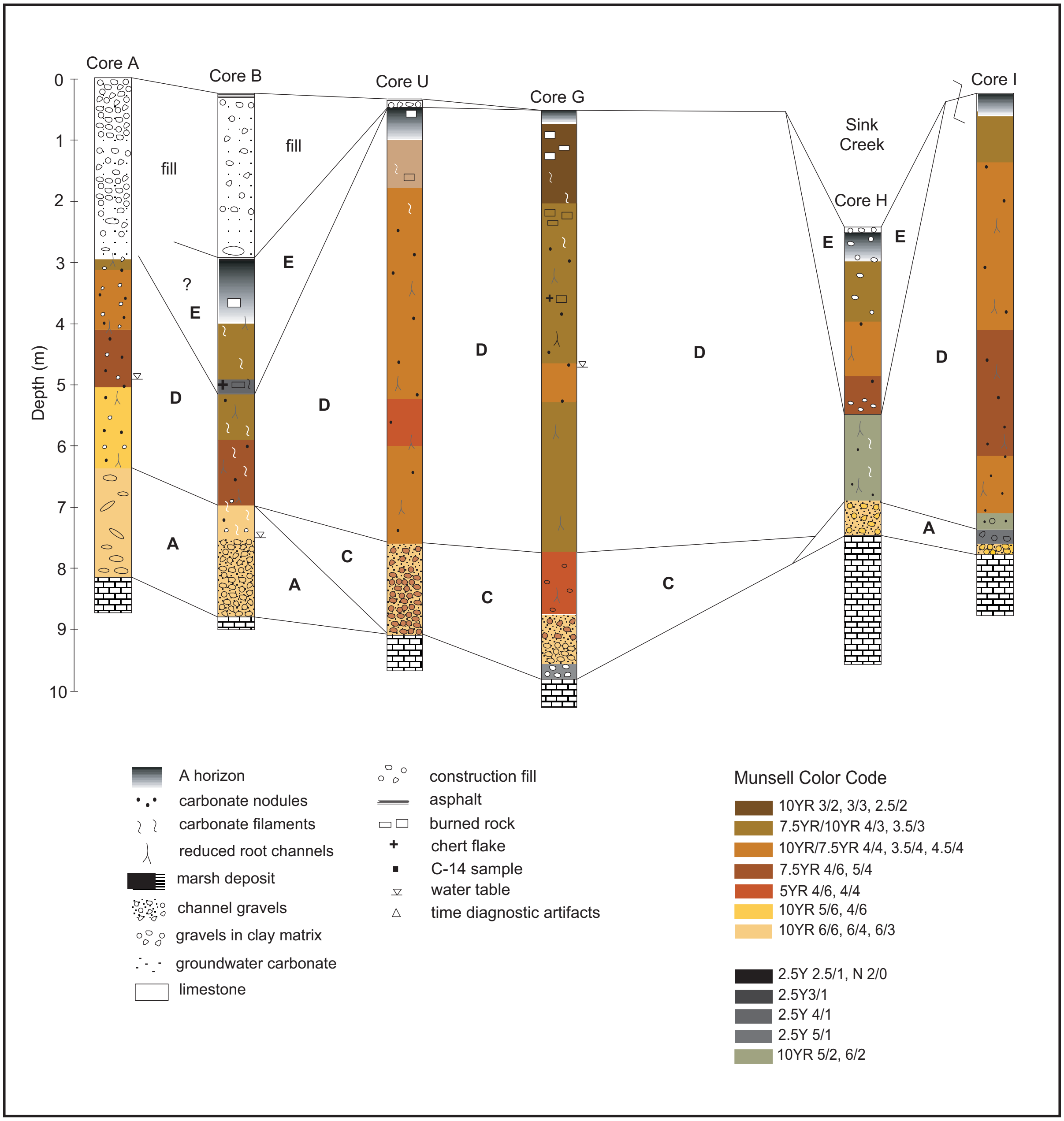

Figure 6-4 Stratigraphic cross-section from Core A to Core I (northwest to southeast) across Sink Creek Valley.

water littoral zone. Marsh deposits in Core M consist of three layers that appear somewhat out of sequence with those in Unit F (Figure 6-5). For example, the bedded zone in Core F occurs at the base of the sequence in Core M. In Core O, the marsh deposit is remarkably uniform consisting of a black, calcareous, mucky clay loam that is horizontally bedded throughout (Figure 6-5). Yet another variant is shown in Core L where marsh deposits consists of two thin layers (Figure 6-7). Radiocarbon ages from Core O indicate that Unit C marsh deposition terminated by 5975±40 B.P. (Table 6-1). A sample at the base of the marsh dated to the same age when including the one-sigma overlap. It is unclear whether fragments of the same, or similar, wood material were dated,

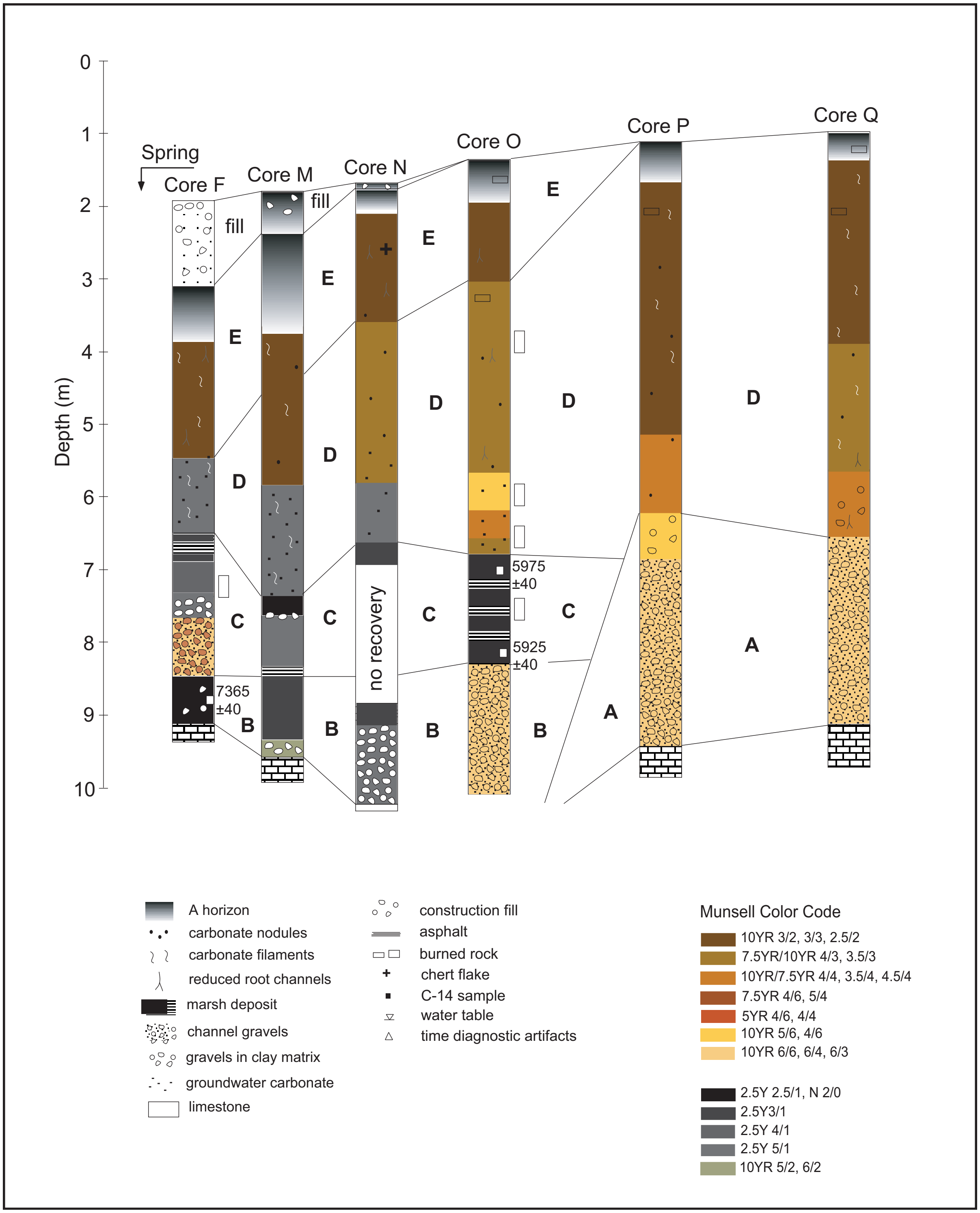

Figure 6-5 Stratigraphic cross-section from Core F to Core Q (northwest to southeast) from Spring Lake to Sink Creek.

or whether deposition was rapid at this time and in this area. Regardless, deposition of Unit C began no earlier than 7365 B.P.

Unit D was exposed in all cores (Figures 6-4 through 6-7). This unit unconformably buries Units A, B, and C and forms the constructional

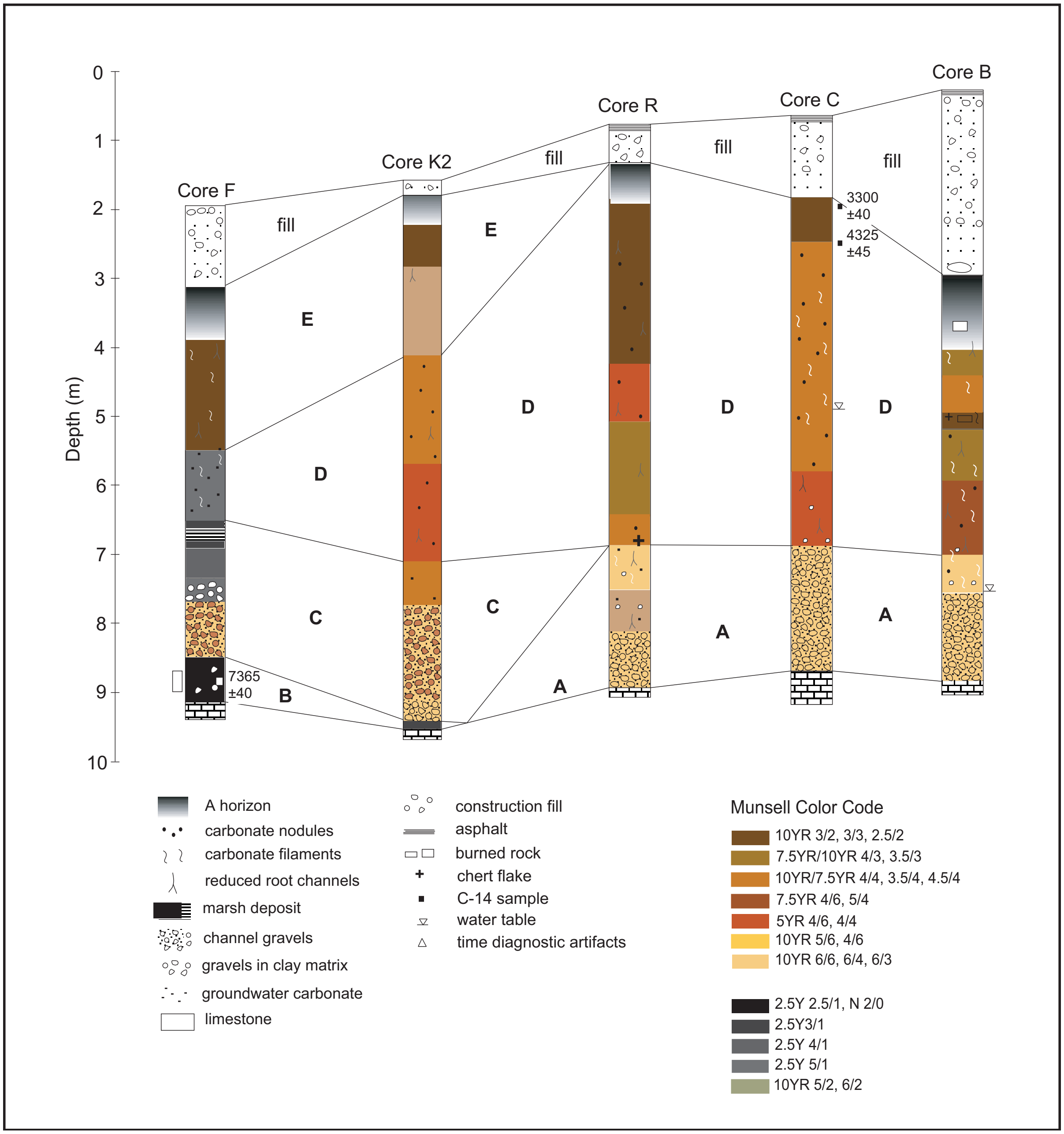

Figure 6-6 Stratigraphic cross-section from Core F to Core B (southwest to northeast) at Aquarena Center.

Early Holocene terrace surface across most of the Sink Creek valley (Figure 6-2). Unlike older units, Unit D consists of thick clayey deposits (6 to 7 m) with no apparent associated gravelly channel deposits. Surface horizons are typically weakly calcareous, black to dark brown clays grading down into thick, strong brown to reddish brown clayey Bk horizons with few to common carbonate filaments and nodules. Carbonate accumulation in the Bk horizons is consistent with decalcification of the surface horizons, indicating at least a few thousand years of pedogenesis. Unit D appears to interfinger with deposits in Cores F, M, and N near the springhead as flood deposits from Sink Creek draped across the floodplain and down into the littoral zone of the spring, eventually burying it (Figure 6-5 through 6-7). Deposition of Unit D began shortly after 5900 B.P.

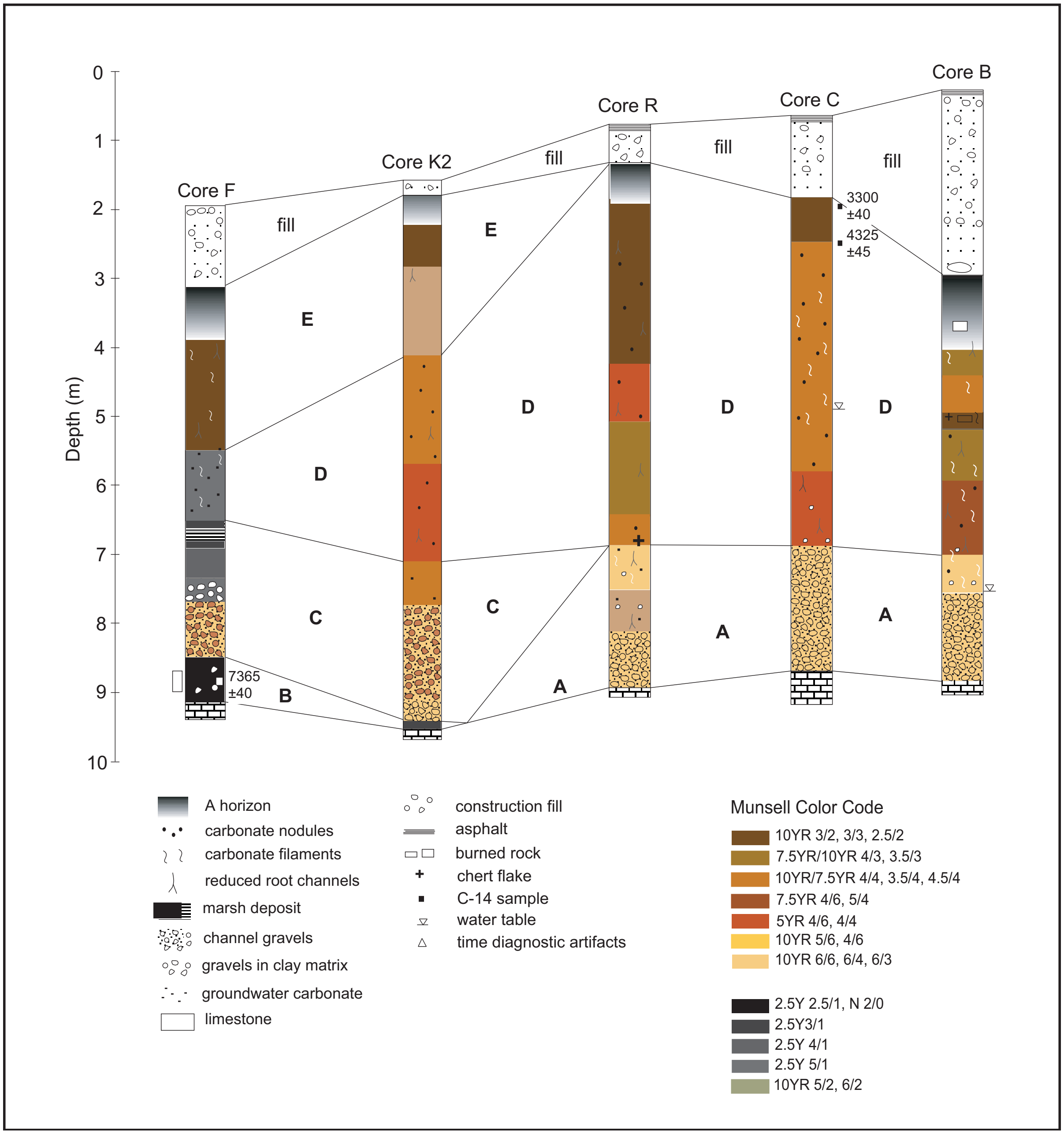

Figure 6-7 Stratigraphic cross-section from Core M to Core U (southwest to northeast) at Aquarena Center.

(Figure 6-5), and based on radiocarbon dating of charcoal from cultural features near the surface, it continued until at least 3300 B.P. (Figures 6-6 and 6-7; Table 6-1). Although the littoral zone of the spring may have contracted after 5900 B.P., the water table level was still sufficiently high that groundwater carbonate and anaerobic iron reduction occurred in lower Unit D deposits as exposed in Cores F, M, N, and L (Figures 6-5 through 6-7). After this time, deposition slowed as a cumulic A horizon began to form at the Unit D terrace surface. Although deposition across the Unit D surface may have continued after 3300 B.P., the rates were undoubtedly slow in that the surface horizons are nearly decalcified from landscape stability and pedogenesis. As noted in Core A, colluviation was still ongoing during this time (Figure 6-4).

Table 6-1. Radiocarbon ages from the stratigraphic cores and test units in the Sink Creek study area.

Table 6-1. Radiocarbon ages from the stratigraphic cores and test units in the Sink Creek study area.

Sample Number [1]	Stratigraphic Unit	Location [2]	Depth (cm)	Radiocarbon Years BP	Calendar Years BP [3]	Material
CAMS-85780	D	TU 4, Core C	107	3300±40	3470-3570	plant fragment
CAMS-85781	D	TU 6, Core E	70-80	3550±40	3720-3900	charcoal
CAMS-85782	D	TU 4, Core C	170-180	4325±40	4830-4970	charcoal
CAMS-85779	C	Core O	649-655	5925±40	6670-6800	plant fragment
CAMS-85778	C	Core O	585-597	5975±40	6740-6860	wood
CAMS-85776	B	Core F	700-724	7365±40	8050-8280	plant fragment
CAMS-85777	A	Core E	678-690	9585±40	10,750-11,100	plant fragment
Beta-132062	A	Core D	874-884	11,470±100	13,150-13,800	bulk humate

[1] CAMS - Stafford Laboratory and Center for Accelerator Mass Spectrometry (Lawrence Livermore); Beta - Beta Analytic, Inc. (taken from Goeltz 1999); all ages are AMS.

[2] TU - test units as correlated to the nearest stratigraphic core.

[3] Calibrations use the OxCal program from Oxford University.

Unit E occurs in two areas in the Sink Creek valley. Near the springhead in Cores F, M, N, O, K2, and L, surface horizons are calcareous and with less subsoil carbonate accumulation than in Unit D (Figures 6-5 through 6-7). It appears that Unit E in this area records deposition after formation of the Unit D surface soil, but the origin of the sediment is uncertain. It may be that the springhead area began to backfill with fine-grained slackwater sediments penetrating into the area from the Blanco River/San Marcos River confluence. Perhaps Late Holocene flood sediments from Sink Creek tended to preferentially collect around the spring area where the water table was nearer to the surface. Significant sedimentation, however, did not occur on the Unit D terrace surface during Unit E times. Unit E also fills a small channel in Core B and the narrowly confined, modern Sink Creek floodplain (Figure 6-4). Along Sink Creek in Core H, Unit E consists of a black to dark gray, calcareous and clayey surface horizon over a weakly developed brown and clayey Bw subsoil (Figure 6-4). At 303 cm, an abrupt contact separates Unit E from the underlying, truncated Unit D. In Core B, Unit E consists of an overthickened and black, calcareous, clay to clay-loam surface horizon grading down into a weakly developed Bk horizon with redoximorphic features indicative of poor drainage (Figure 6-4). At the base of the Unit E fill, a dark gray zone modified by prehistoric activity occurs. Here, Unit E also abruptly overlies Unit D.

Landscape Evolution

Regional work indicates that widespread channel entrenchment occurred sometime between 15,000 and 11,000 B.P. along central Texas streams (Blum and Valastro, 1989; Nordt, 1992). This is consistent with data from the San Marcos Springs because channel entrenchment must have occurred prior to 11,450 B.P. when Unit A marsh deposits began accumulating. Unit A was a bedload stream depositing a veneer of channel gravels across an eroded bedrock floor. The littoral zone from the springhead was expanding across the floodplain no later than 9585 B.P. as the water table was adjusting to the newly created base level from channel entrenchment. The marsh deposits in Unit A undoubtedly accumulated in shallow water of the littoral zone given the dark sediment colors and preservation of numerous plant fragments. The mineral textures of the deposits demonstrate that flooding from Sink Creek never terminated during marsh formation, but only slowed. Marsh deposits were largely noncalcareous at this time indicating somewhat acidic anaerobic conditions in the floodplain away from the springhead. One of two scenarios can explain the widespread occurrence of Unit A marsh deposits. First, the littoral zone of the spring spread out over a large, low lying area of the Sink Creek floodplain. The second possibility is that the marsh deposits accumulated in channel swales or cut-offs during an extended period of slow deposition. However, given the paucity of fine-grained overbank deposits, it seems unlikely that the channel network was sinuous at this time.

Between 9585 and 7365 B.P., an episode of channel entrenchment terminated marsh formation associated with Unit A. The spring and associated water table dropped by about 0.5 to 1 m, which may have been the cause of channel erosion. Channel B is of limited lateral extent and confined to the northwest part of the Sink Creek valley near the springhead. Deposition slowed, and marsh development began, by 7365 B.P. The Unit B marsh deposits also contain similar colors, textures, and preservation of plant fragments as in Unit A. However, Unit B contains a single thick marsh deposit, and Unit A has multiple episodes of marsh formation suggestive of more floodplain or spring instability.

Renewed channel aggradation occurred shortly after 7365 B.P., as the Unit B marsh deposits became buried by channel and overbank deposits of Unit C. Renewed aggradation may have occurred in response to elevated water tables and channel discharge. In fact, marsh deposits in Unit C reached the highest level during the Late Quaternary at some 1.5 to 2 m above those in Unit B. As with Unit A, multiple episodes of channel gravel capping marsh deposits occurred in Unit C, and persisted up until around 5900 B.P. Based on the location of Unit B in the cores, the associated channel deposits may have been more sinuous than during previous depositional episodes. The strong brown matrix mud may indicate an influx of eroded, oxidized upland soils from the surrounding drainage basin. The floodplain appears to have widened somewhat at this time and expanded further eastward toward the modern Sink Creek channel.

Profound fluvial geomorphic changes began shortly after 5900 B.P. in the Sink Creek valley. Fine-grained flood deposition began to overwhelm the littoral zone adjacent to the springhead, burying former spring deposits that never again appeared. There is no reason to believe that the spring ever went dry, but rather, after 5900 B.P. the littoral zone disappeared in response to rapid sediment influx from Sink Creek or from slackwater deposition emanating from the confluence of the San Marcos and Blanco River valleys some 8 to 9-km downstream. Given that the surface elevation of Core F is about 1.5 m below the adjacent Early Holocene terrace, the springhead was apparently carrying flood sediment out of its waters and down the San Marcos River after each flood event. Based on core data, there are no channel gravels associated with Unit D. If the lower gravels associated with Units A, B, and C were facies to Unit D, then buried paleosols would be present in floodplain alluvium associated in time with each of the marsh deposits. Perhaps climate conditions were becoming warmer or drier, creating erosion of oxidized Pleistocene soils from the uplands. It is possible that the valley was overwhelmed with fine-grained sediments deposited as a series of hyperconcentrated flows or from a fine-grained anastomozing stream network. Slackwater from the large floodplain just downstream near the Blanco and San Marcos Rivers may have also contributed to fine grained deposition up valley. Deposition of Unit D continued until at least 3300 B.P. Deposition slowed markedly afterward as evidenced by a nearly decalcified, cumulic, dark A horizon at the surface of the Early Holocene Unit D terrace.

The Sink Creek channel down cut and began creating the narrow, modern floodplain sometime after 3300 B.P. This event may have reduced depositional rates across the broader Unit D Early Holocene floodplain. As with Unit D, no channel gravels occur within the modern floodplain. It is also possible that the Unit D channel was in the location of the modern Sink Creek channel and simply filled in slowly during the Late Holocene as depositional rates slowed. Regardless, flood deposition in the Late Holocene was confined mainly to the Sink Creek floodplain, around the springhead, and up a small channel headward from the spring (Core B). Late Holocene alluvium is also confined to a narrow, frequently flooded meanderbelt downstream along the San Marcos River. Late Holocene colluviation continued in the study area where Late Archaic features were dated in colluvium a short distance upstream from the project area (Arnn and Kibler, 1999). Evidence of colluviation at this time in the vicinity of Core A was probably removed during construction of the Aquarena Springs resort.

Geoarchaeology

Alluvial, colluvial, and spring sediments dating to the past 11,500 years are contained within the Sink Creek valley in the study area (Figure 6-8). With current dating, Unit A is temporally bracketed in time to between 11,500 and 9500 B.P. These sediments have the potential to preserve Paleoindian features, including Clovis. This is consistent with discoveries of Clovis artifacts in Spring Lake (Shiner, 1983) and Early Archaic points at depths of only several meters in some parts of Unit D alluvium of Sink Creek (Garber 1983; see also this report). During initial deposition of Unit A, the valley was filled with a veneer of gravelly alluvium deposited from a bedload stream. Fluvial flooding then slowed as the littoral zone of the springhead expanded out into the floodplain, covering the channel gravels with organic rich marsh deposits. Although in a secondary context, a flake discovered in the channel gravels in Core E demonstrates cultural activity in the area prior to 9585 B.P. It seems unlikely that Paleoindians would have occupied the littoral zone now represented by the marsh deposits capping the Unit A gravels. However, environments immediately adjacent to these sediments in the floodplain, or perhaps on the nearby Pleistocene terraces or uplands, would have certainly been attractive occupation sites.

The Sink Creek floodplain became unstable shortly after 9500 B.P. as the channel down cut near the springhead prior to depositing Unit B (see Figure 6-8). The channel gravels at this time were apparently confined to the west side of the valley. The floodplain then stabilized no later than 7400 B.P. as the littoral zone of the springhead again expanded out on to the floodplain, although not as much as during deposition of the Unit A marsh. Late Paleoindian and Early Archaic artifacts may be buried within Unit B. Contextual integrity would be highest within the marsh zone, but as discussed previously, occupation may have been preferentially adjacent to the floodplain or on terraces or uplands.

During deposition of Unit C between 7400 and 5900 B.P., the Sink Creek valley began filling with channel gravels and thin fine-grained

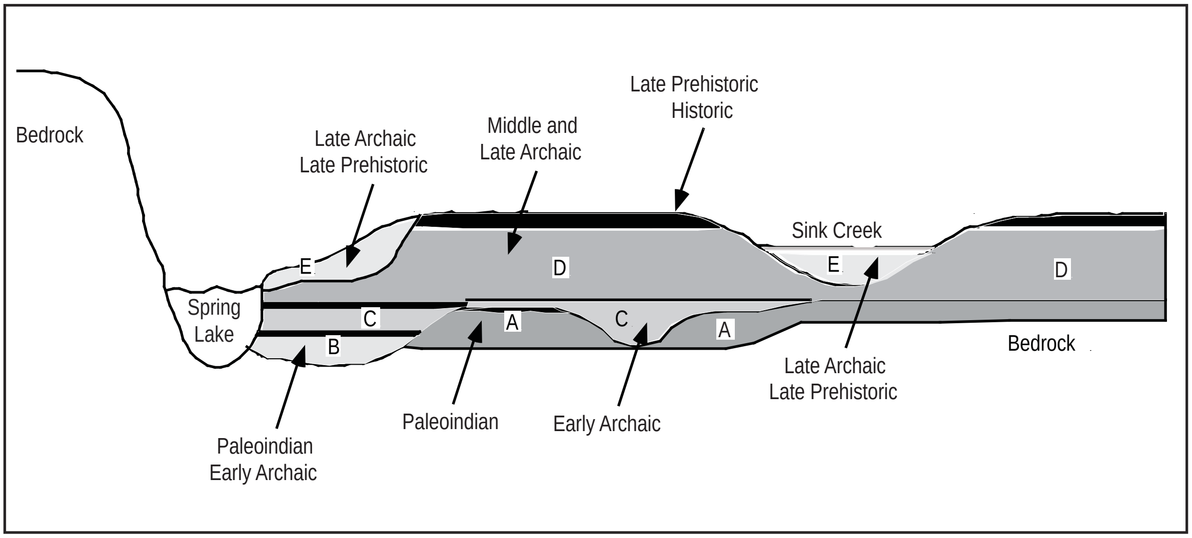

Figure 6-8. Schematic geologic cross section of the Sink Creek valley illustrating prehistoric preservation potentials.

overbank sediments representative of a sinuous stream (see Figure 6-8). Although channel activity was still confined to the western part of the valley, the floodplain widened somewhat. Only Early Archaic artifacts should be buried in Unit C. The highest potential for preservation in primary contexts would be in the thick marsh deposits of the expanding littoral zone or in the veneer of overbank clays adjacent to the marsh deposits.

Rapid valley filling began shortly after 5900 B.P. along Sink Creek creating Unit D. Fine-grained deposition continued until at least 3300 B.P., after which flooding and sedimentation began to slow, forming a thick cumulic surface soil. This depositional event created the bulk of the broad constructional Early Holocene terrace now bordering both sides of the modern Sink Creek channel. The channel at this time was an anastomozing, suspended load stream, with slackwater probably backing into the valley from the Blanco River/San Marcos River confluence. Even though deposition was from a suspended load stream, deposition was nevertheless rapid enough to prevent significant periods of landscape stability and paleosol formation. Early Archaic features may be preserved at the base of Unit D, and because of rapid depositional rates, vertically discrete Middle Archaic occupation zones may be preserved within the upper part of Unit D. Near the surface, Middle and early Late Archaic features may be preserved, but more compressed, as flood deposition was slowing.

The Sink Creek Channel migrated towards its modern position in the center of the valley after 3300 B.P. Deposition was probably preceded by an episode of down cutting as the former Unit D floodplain was abandoned and transformed into a terrace. Unit E near Core B apparently represents a side channel flowing towards the springhead from the trunk stream, and perhaps partially filled with slackwater deposits emanating up valley from the San Marcos River. A veneer of Late Holocene sediment covers only parts of the Unit D floodplain surface. Artifacts dating from the Late Archaic to Late Prehistoric may be preserved in discrete occupation zones in Unit E, but forming a palimpsest of occupation zones on the surface of the Early Holocene Unit D terrace.

The majority of sediments in the Sink Creek valley date to Paleoindian and Early Archaic times, with depths of preservation ranging from over 6 meters for the former and from several to 6 meters for the latter. Contextual integrity is moderate for Paleoindian and Early Archaic features because of the presence of a bedload stream and associated marsh deposits, whereas preservation in a primary context for Middle Archaic features is high because of the presence of thick, rapidly deposited overbank sediments. Middle and Late Archaic, and Late Prehistoric features will be preserved in discrete primary contexts in the modern Sink Creek floodplain or in an abandoned channel near the springhead, or compressed as a palimpsest near the surface of the Unit D terrace.

Chapter 7

Stratigraphy, Chronology, and Site Formation Processes

David L Nickels

Introduction

This chapter provides the results of the current investigations. It presents the findings of geomorphological studies in the upper 1.7 m of the site, as well as a review of the vertical distribution of artifacts. Only the six units excavated during this project are discussed here; for a discussion of the geomorphological investigation of the entire site, which includes the nearly seven meters of deposits lying below the depth of the six excavated units, see Chapter 6.

In examining the vertical distribution of artifacts and soil horizon stratigraphy, we argue that the upper, excavated portion of the site has a high degree of integrity. Next is a synthesis of the temporally diagnostic artifacts and radiocarbon dates. Finally, a description is given of the five features and the excavation units in which they were encountered. An analysis of the cultural remains follows in Chapters 8 through 11.

Natural and Cultural Stratigraphy

An understanding of the site's structure, including features, is contingent upon a thorough understanding of the site's geological context and stratigraphy. Flooding episodes along the Balcones Escarpment over the past several millennia have created deep alluvial terrace deposits (Appendix E). The 2001 test excavations were conducted within the upper 1.7 m, which is approximately 9 m above bedrock.

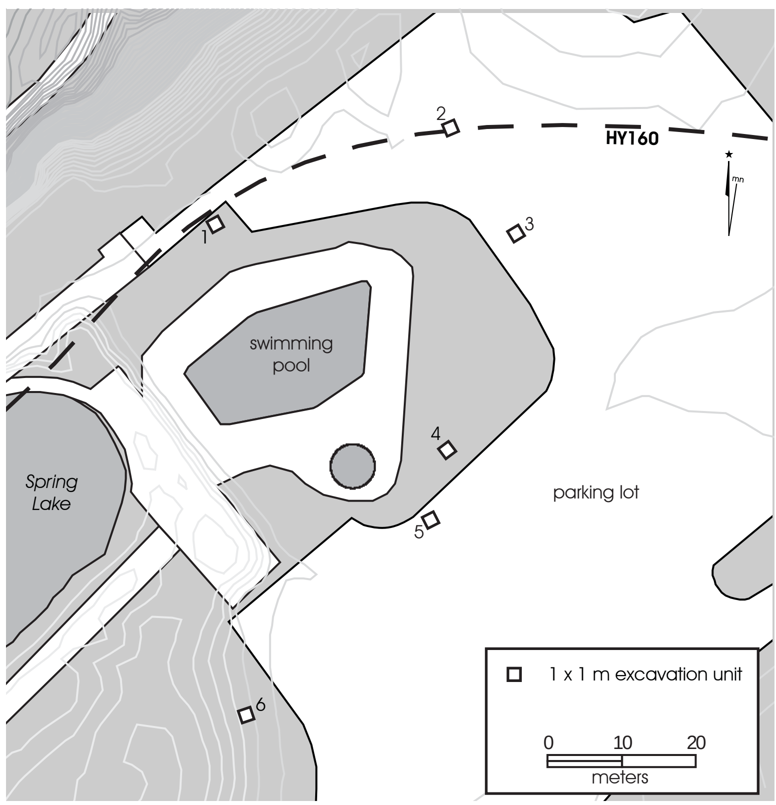

Figure 7-1. Site map showing six excavation units excavated during this project.

Excavation Units 1-3 were placed around the swimming pool (Figure 7-1). Because Units 1, 2, and 3 were excavated through intrusive pavement or landscaping overburden, and then into a continuum of disturbed fill to the depth of the water table, these three units will be discussed only briefly in this section, but will be synthesized in the final section of this chapter.

An examination of the profiles of Units 4–6 by Lee Nordt (see Chapter 9 and Appendix E) revealed seven zones separated either by changes in color, particle size, or structure, and representing A, AB, Bw, and Bk horizons (Figure 7-2). Significantly, these horizons typically represent stable depositional surfaces.

The geomorphological investigations complement the archaeological results, indicating that there are likely several gisements (Collins 1995:374), or well-defined cultural strata enveloped by gently-deposited alluvium sediments from sequential flooding events. The vertical distribution of chipped stone debitage and fire-cracked rock features within the various soil horizons are depicted in Figures 7-3 to 7-5.

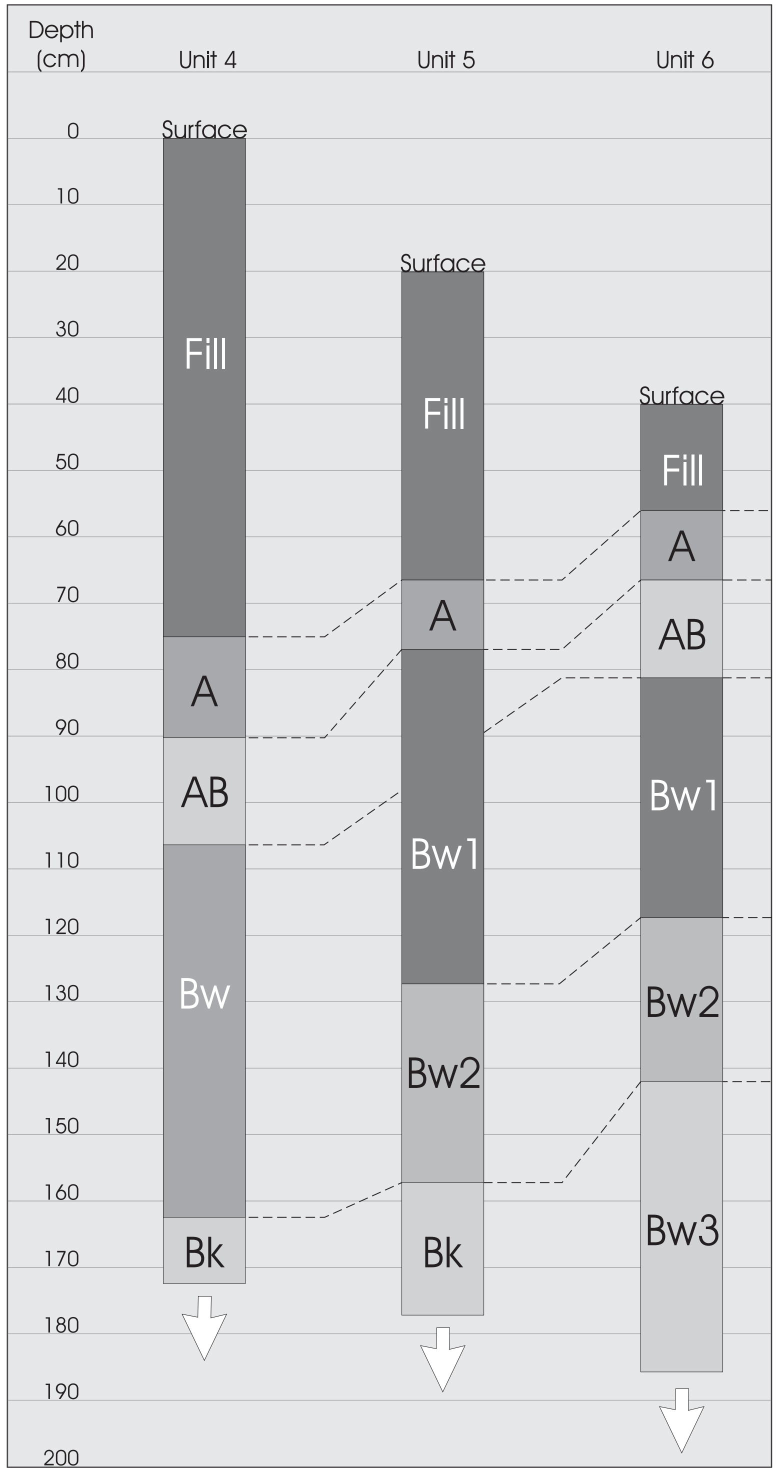

Figure 7-2. Depths (cm) at which soil horizons were documented.

Vertical Distribution of Cultural Remains

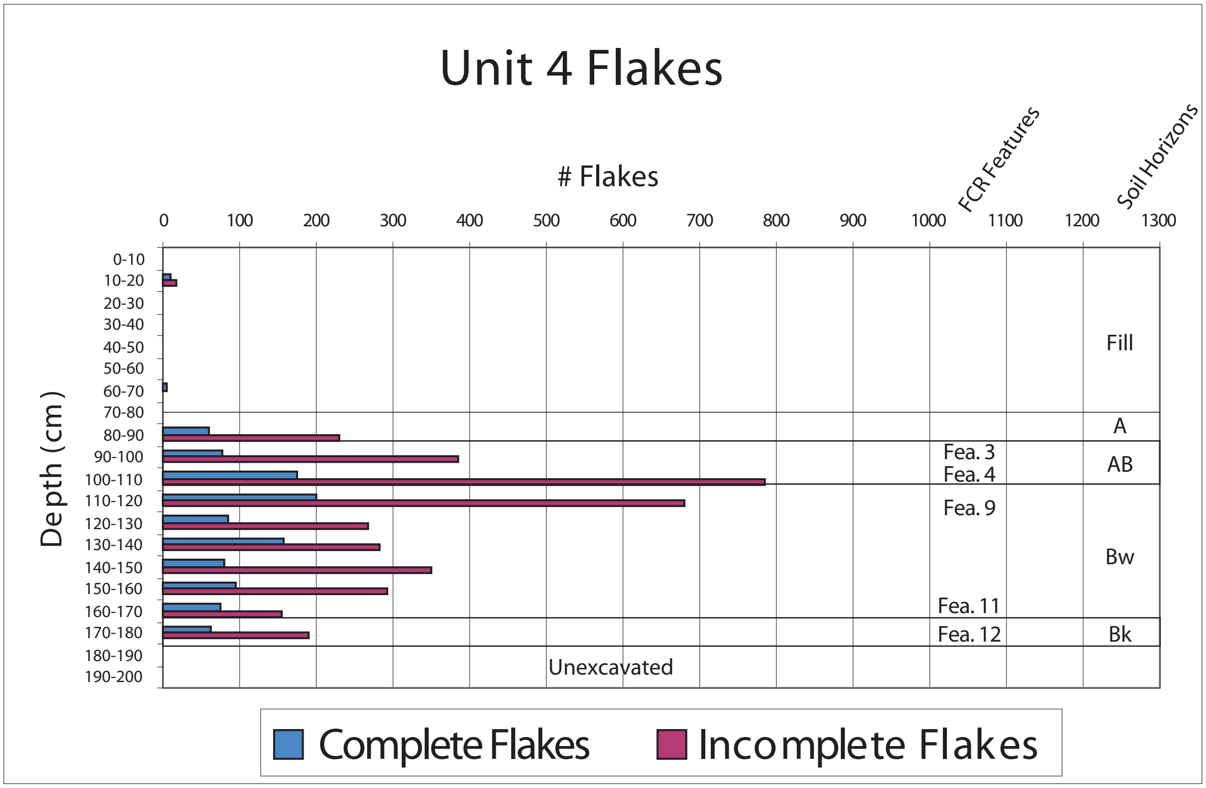

Figure 7-3. Flake counts, fire- cracked rock (FCR) features, and soil horizons in Unit 4.

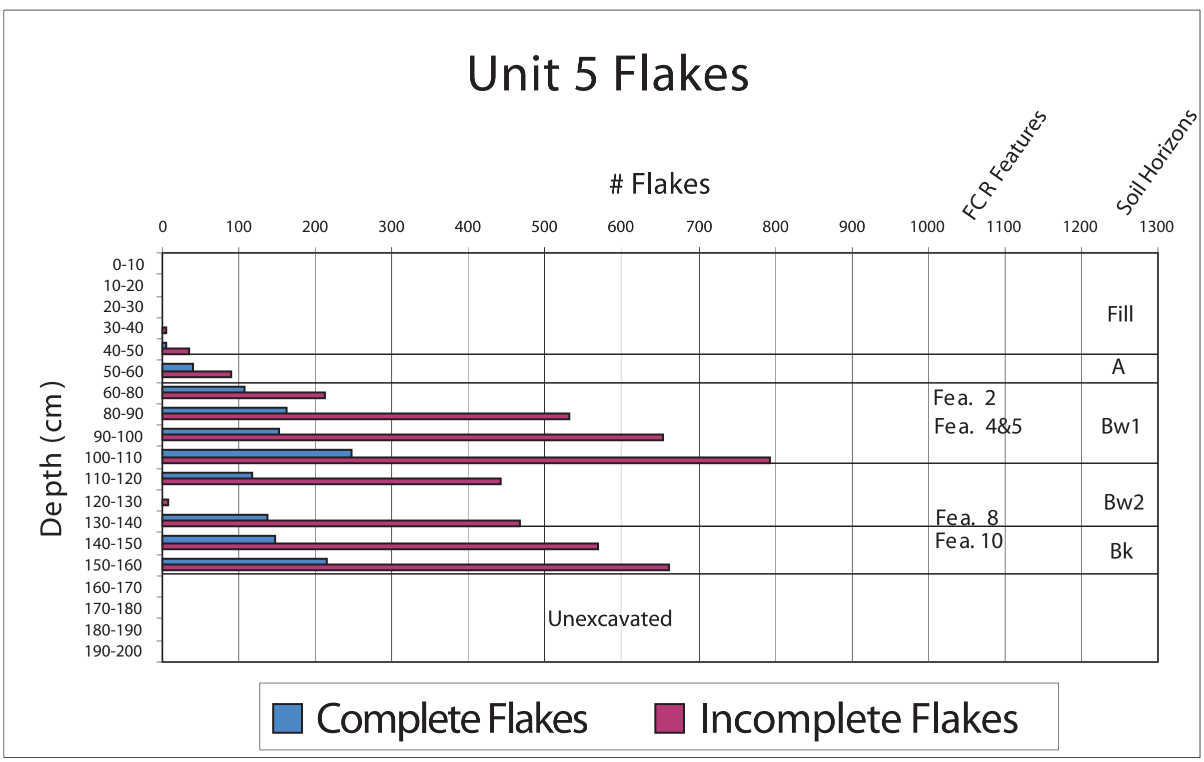

Figure 7-4. Flake counts, FCR features, and soil horizons in Unit 5.

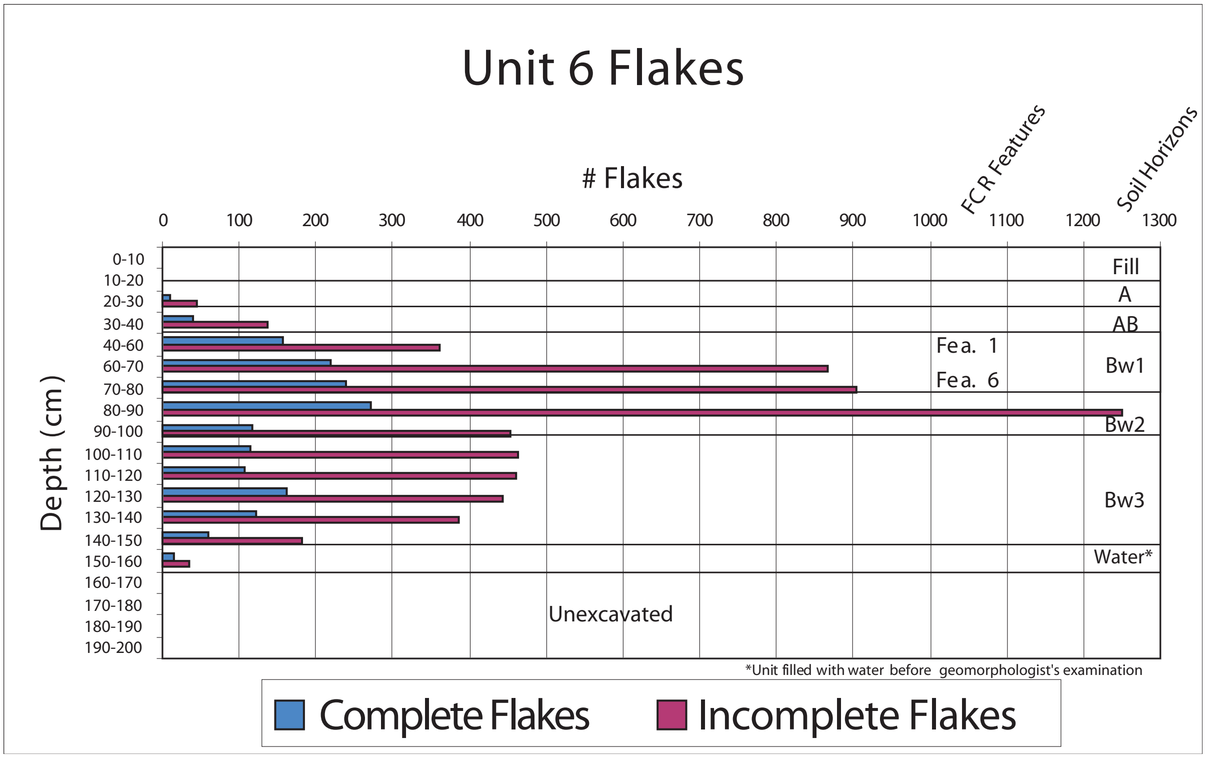

Figure 7-5. Flake counts, FCR features, and soil humates in Unit 6.

General Discussion

Villa (1982:277) points out that both Old World and New World archaeologists routinely observe clear breaks in sedimentary stratigraphy with associated cultural material, and accept these separations as isolatable components. As such, these discrete assemblages are suitable for constructing relative cultural chronologies. However, she argues that stratigraphic disturbances and the resulting movement of artifacts are not always obvious and detectable by even the most trained eye in the field. She cites "living floor" studies, which presume that layers that appear to be undisturbed "would yield discrete assemblages" but were sometimes criticized as being too coarse-grained (Villa 1982:277). Even thin floors may represent a palimpsest of occupations, and "considerable vertical displacement of artifacts (both upward and downward) may occur even when the matrix itself has not been disturbed or displaced." (Villa 1982:278).

Wood and Johnson (1978) note that sediments are not static mediums, and identify natural post-depositional processes affecting the vertical distribution of artifacts include frost heave, dry soil creep, solifluction (saturated soil creep), and subsidence (sinking) in cave deposits. Although in some cases these processes are easily identifiable in the field, in many other cases they are not. Another post-depositional disturbance often overlooked is biogenic perturbation, e.g., termites, earthworms, and other animal burrowing. Human post-depositional influences on artifacts may include trampling, tool reuse, the digging of postholes, storage pits, baking pits, or burial graves, and the borrowing of sediments for sealing cooking ovens or ceramic manufacture.

Yellen (1977:103), Gifford and Behrensmeyer (1977), and Stockton (1973) argue that trampling will cause the smaller artifacts to move downward, while generally leaving the larger artifacts on or very near their original surface. Periodic wetting and drying of soils due to percolating rainwater, and an oscillating water table will also cause artifacts to move downward (Cahen and Moeyersons 1977).

Unlike trampling, which causes artifacts to move downward, cryoturbation and argilliturbation cause artifacts to move upward. Cryoturbation results in the upward movement of larger artifacts, caused by freeze and thaw cycles. The San Marcos area is little affected by these cycles because of its temperate climate, although occasional freezes of short duration do occur. However, "the depth and rate of freezing are maximized in areas where (1) annual temperatures are below freezing for long periods, (2) the matrix is composed of fine-grained particles such as silt, and (3) abundant moisture is present in the soil to enhance ice lens formations" (Waters 1992:294). Basically, because of their thermal properties, stone artifacts freeze slower than the surrounding soil. When the soil around an artifact freezes, the ground heaves upward, carrying the artifact with it. As the artifact is lifted by the frozen soil, it leaves a cavity underneath it. Thus, immediately beneath the "warmer" stone artifact, the frost line dips into the cavity, filling it with an ice lens. As the soil and ice begin to thaw, the underlying cavity is partially filled with looser subsurface soil, thus not allowing the artifact to drop back into its original vertical position (Waters 1992:292-299).

Argilliturbation occurs when the wetting and drying of surficial layers of clays, called vertisols (Soil Survey Staff 1975), push artifacts toward the surface. Even before the Burleson Dam was constructed in 1849, the immediate area around San Marcos Springs was most certainly subjected to repeated episodes of wetting and drying, causing the clayey soils to expand and shrink. "When expansion occurs, an artifact is lifted slightly from its original position, leaving a small void or cavity under the artifact. As the soil dries, the matrix around the artifact shrinks. Because the cavity under the artifact also shrinks, the artifact cannot fall back into its original position, and fine-grained particles fill the void" (Waters 1992:299-300).

Soil types and textures certainly are a variable in that vertical movement of artifacts can occur, and Stockton (1973, 1977) argues that the phenomena can occur in all types of deposits, whether mostly sand, or a mixture of sand, silt, and clay. Experimental studies have demonstrated that 94 percent of artifacts recovered in loamy soils were vertically within 1 cm of their original placement after trampling, and the looser matrix caused by trampling "caught and held small- to medium-sized flakes" (Gifford-Gonzalez et al. 1985:808). Conversely, in sandy soils the majority of artifacts easily worked their way downward, at least until they encountered a moist layer of sand.

Regardless of soil conditions, Villa (1982:287-287) cautions against "over interpreting stratified sequences" without analyzing conjoinable pieces of stone, bone, and pottery relative to the total assemblage. Although we agree with Villa (1982) that the best method to evaluate the vertical movement of artifacts is by refitting or conjoining artifacts, using flake weights and lengths have also been demonstrated as effective alternative means of evaluating vertical displacement. Yellen (1977:103), Gifford and Behrensmeyer (1977), and Stockton (1973) argue that trampling will cause the smaller artifacts to move downward, while generally leaving the larger artifacts on or very near their original surface. Gifford-Gonzalez et al. (1985) concluded from their experiments and those of Villa and Courtin (1983) that length, weight, and volume are interrelated variables that affect the downward displacement of flakes caused by trampling, and thus statistically can be used interchangeably to evaluate their stratigraphic integrity.

In sum, these and other studies implicate that the integrity of occupation zones can be methodically tested by examining the vertical distribution of artifacts. There will be exceptions: animal burrowing, subsequent cracking in clayey soils, and some human intervention (e.g., borrowing and digging) may displace larger artifacts to lower levels and conversely, smaller artifacts upward; however, an overall mean size (or weight) should exhibit patterning by levels. Although we agree with Villa (1982) that the best method to evaluate the vertical movement of artifacts is by refitting or conjoining artifacts, refitting is very time consuming and not feasible in most contract situations. Flake weights and lengths can be used as an effective alternative means of evaluating vertical displacement.

Specifically, in clay soils one would expect to see a pattern similar to an inverted champagne glass, with larger flakes representing the zone of occupation, and smaller flakes representing the upward movement that has occurred. At other sites in South and Central Texas, archaeologists (Vierra 1998; Nickels et al. 1998:91-92; Nickels 2000) have examined the vertical movement of artifacts through soil horizons, and they have successfully correlated the data with occupation levels. In clay soils on an upper terrace along a major drainage in Wilson County, Nickels (2000:87) found that out of 4,341 unbroken flakes, 920 (21.2 %) smaller flakes may have moved upward as much as 10 cm, while 56 smaller flakes (1.3 %) may have moved downward as much as 10 cm; the downward movement most likely was due to vertical cracking.

Site Specific Discussion

We begin by briefly describing the excavations in Units 1, 2, and 3. These three units were excavated through construction fill to the depth of the water table; no intact sediments or soils were found. However, Units 4, 5, and 6 all contained intact soil horizons and cultural deposits. Thus, with the data from these three units we are able to provide beneficial archaeological results and inferences.

Unit Excavations in Fully Disturbed Deposits (Units 1, 2, 3)

Unit 1 was placed west of the swimming pool (Figure 7-6 and see Figure 7-1), and was excavated to the water table, 162 cmbs. Various matrixes of construction fill, ranging from rounded river gravels to mottled clays, were encountered throughout, along with modern trash (Appendix

Figure 7-6. Unit 1 was placed near the west edge of the swimming pool; facing northeast.

Figure 7-7. Various matrixes of construction fill, a buried palm tree, and a low concrete border surrounding the stump were encountered in Excavation Unit 1; facing north.

A). By chance, the unit was placed over a buried and rotting palm tree, surrounded at its base with a low concrete wall that formed a border around the tree stump (Figure 7-7). Although we did not recover prehistoric archaeological materials from this unit, we now know that the area around the swimming pool was built up instead of dredged. The base of the palm tree at 160+ cm below the modern surface apparently represents the 1929 initial elevation level of the hotel complex.

Unit 2 was placed in the parking lot northeast of the swimming pool (see Figure 7-1). After breaking through the pavement and excavating through various matrixes of construction fill and modern trash (Appendix A) to 165 cm, we encountered a second road base (Figure 7-8). Following a weekend, either the rising water table or possibly a leaky waterline nearby flooded the unit to about 1 m below the surface. Although we were unable to benefit archaeologically, this unit also contributed to our understanding that this area around the swimming pool had been filled in with more than 165 cm of sediment, and not dredged as initially believed..

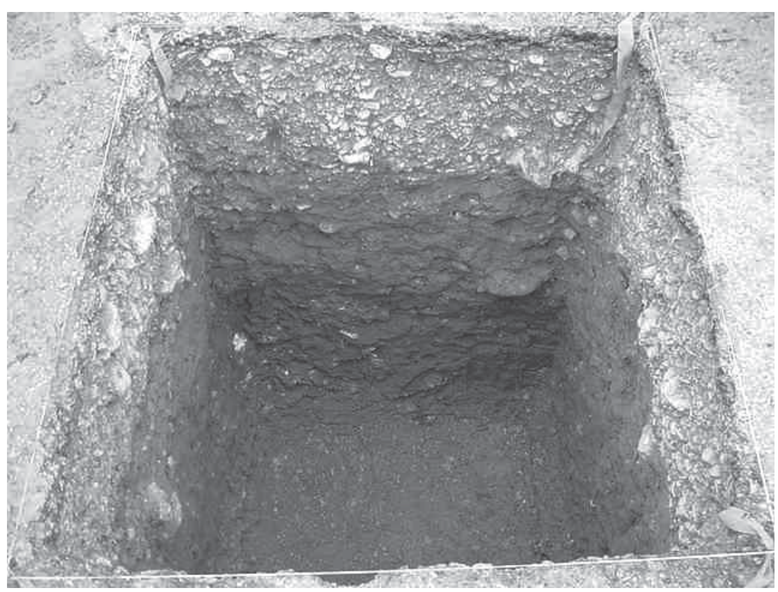

Figure 7-8. Parking lot and underlying construction fill in Excavation Unit 2; facing northwest.

Unit 3 was placed in a narrow grassy strip between the swimming pool and a parking lot (Figures 7-9 and 7-10; see Figure 7-1). As with Units 1 and 2, no intact soils were encountered in Unit 3; only various matrixes of construction fill and modern trash (Appendix A) to the water table, 218 cmbs. The excavation of Unit 3 also demonstrated that the accumulation of construction fill was on at least two sides of the pool.

Figure 7-9. Unit 3 (covered by plywood) in a grassy strip north of swimming pool. Spring Lake and hotel in background; facing south-southwest.

by zones of human occupation are what we would expect to observe in these clayey soils. However, the depositional context of sediment and clay soils around San Marcos Springs is such that vertical movement of artifacts through layered sediment and soil packages due to size sorting could be problematic (e.g., Stevenson 1991; Vierra 1998). To evaluate the vertical movement of debitage in layers below artificial fill at 41HY160, we compared the mean flake length of complete (unbroken) flakes with the soil horizons identified

Unit Excavations in Undisturbed Deposits (Units 4, 5, and 6)

Unit 4 was placed in a grassy area east of the swimming pool (Figure 7-11; see Figure 7-1). Intact sediments and soils were encountered after removing a sloping, 78-90 cm of fill. Unit 5 was placed in the parking lot east of the swimming pool (Figure 7-12; see Figure 7-1). Intact sediments and soils were encountered after removing 40 cm of fill from this unit. Unit 6 was placed in a grassy area within the pecan grove southwest of the swimming pool (Figure 7-13; see Figure 7-1). Here, intact sediments and soils were encountered after removing 15 cm of fill.

Repeated patterns of decreasing flake sizes interrupted

Figure 7-10. Construction fill was encountered to 218 cmbs before excavations were terminated at the water table in Excavation Unit 3.

Table 7-1. Mean maximum dimensions of complete flakes.

Unit 4			Unit 5			Unit 6		
Depth (cm)	Quantity	Mean Max Dimensions	Depth (cm)	Quantity	Mean Max Dimensions	Depth (cm)	Quantity	Mean Max Dimensions
80-90	59	2.97	50-60	30	2.07	20-30	8	2.38
90-100	75	2.67	60-80	99	2.60	30-40	37	2.08
100-110	172	2.94	80-90	149	2.15	40-60	149	2.17
110-120	202	2.65	90-100	152	2.46	60-70	208	2.36
120-130	118	2.44	100-110	243	2.26	70-80	224	2.13
130-140	151	2.34	110-120	115	2.50	80-90	261	2.30
140-150	83	2.17	120-130	0	0	90-100	121	2.26
150-160	91	2.20	130-140	136	2.53	100-110	114	2.34
160-170	73	1.95	140-150	149	2.30	110-120	103	2.43
170-180	61	2.73	150-160	94	2.05	120-130	168	2.38
						130-140	111	2.23
						140-150	61	2.61
						150-160	15	2.33

in the geomorphological study to examine the stratigraphic differences in size sorting. **Table** 7-1 presents the data, and Figures 7-14 through 7-16 illustrate the mean maximum dimensions of unbroken flakes correlated to the soil horizons identified.

Unit 4

The reader is reminded that the upper portion of this unit consisted of gravels backfilled during the construction of the swimming pool, and thus we are not able to evaluate neither the depth nor nature of the soils above 80 cm. However, a close examination of Figure 7-14 suggests there are three trends showing a decrease in flake dimensions from the bottom upward. These are between 180-160 cm, between 160-140 cm, and between 110-90 cm. If the upper portion had not been removed, we would expect to see another pattern of decreasing flake size.

These trends are followed by a sharp increase in flake dimensions between 170-180 cm; excavations were terminated at this depth because the water table level was reached at 171 cm, and the unit was repeatedly flooded. These patterns suggest discrete human occupation zones between 80-90 cm, 100-110 cm, 150-160 cm, and possibly 170-180 cm.

As stated above, we expect to see such decreasing patterns in clayey soils. Notably, the pattern between 150-110 cm shows a steady increase in flake size as we move upward.

Figure 7-11. Excavations in progress. Unit 4 is in the grassy area by the palm trees in the middle distance and Unit 5 is in the parking lot to the right.

Figure 7-12. Antonio Padilla at screen and Jimmy Barrera in Unit 5; Unit 6 is behind fence in background (between pickups); Facing South.

there are three trends showing a decrease in flake dimensions as we move from the bottom upward. They are between 120-100 cm, between 100-80 cm, and between 80-50 cm. These patterns suggest discrete human occupation zones between 60-80 cm, 90-100 cm, and 110-120 cm. The absence of any unbroken flakes recovered between 120-130 cm precludes any patterning for that level.

The patterns are as we would expect, except between 160-140 cm, which shows a trend toward an increase in flake length. As with Unit 4 above, based solely on this line of data, we may conclude that these levels are disturbed, or a change in lithic reduction strategy occurred.

Normally, without data to conclude otherwise, one assessment could be that these levels are possibly disturbed. However, other corroborating data such as soil susceptibility (discussed below) and a general increase in total flakes, fauna, and snails follow the same trends, thus indicating increasing intensity of occupation, peaking at the 120-110 cm levels. Of course, a general shift in lithic reduction strategy, such as from bifacial, late stage reduction to expediently utilized flakes, could influence the flake size also.

Unit 5

The reader is reminded that the upper portion of this unit was truncated during the construction of a parking lot, and the upper 40 cm was subsequently backfilled with gravels; thus we are not able to evaluate either the quantity or nature of natural deposition above 40 cm. However, a review of Figure 7-15 suggests

Figure 7-13. Unit 5 in front of blue pickup (left); Unit 6 in grassy pecan grove area, in front of Chevy Blazer; facing east northeast.

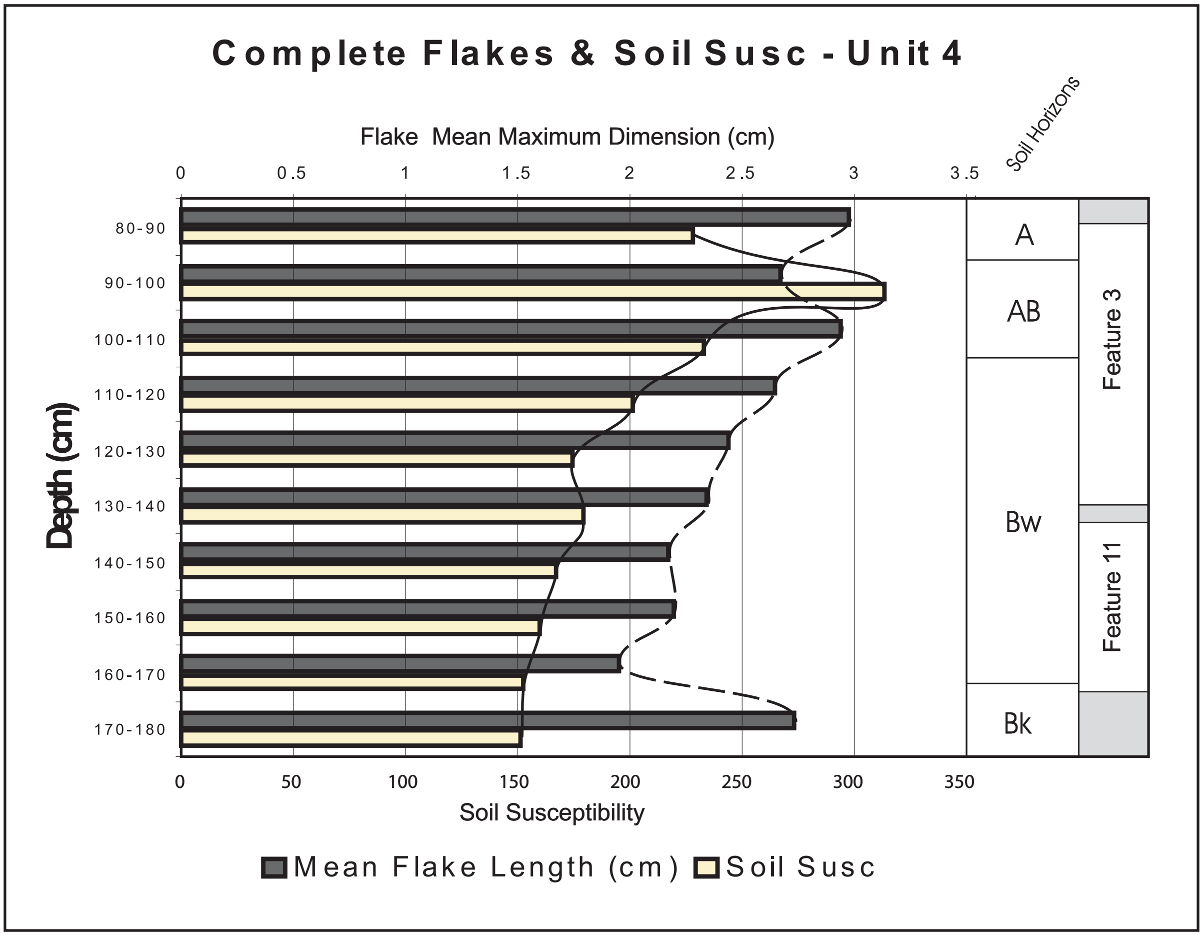

Figure 7-14. Vertical distribution of average complete (unbroken) flake lengths and soil susceptibility measurements within soil horizons and related to prehistoric features in Unit 4.

Unit 6

It is unclear whether or not the upper portion of this unit had been removed during landscaping activities in the area; only that the upper 15 cm consisted of pea gravels and intrusive clay loam. Figure 7-16 shows four trends with a decrease in flake dimensions as we move from the bottom upward; those being between 150-130 cm, between 120-90 cm, between 90-70 cm, and between 70-30 cm. The recovery of relatively longer flakes between 20-30 cm (compared to the three lower levels) suggests some removal of the upper portion of this unit.

The patterns in Figure 7-16 suggest discrete human occupation zones between 20-30 cm, 60-70 cm, 80-90 cm, 110-120 cm and 140-150 cm. Additionally, the recovery of relatively shorter flakes found between 150-160 cm (compared to the level above) suggests a probable sixth zone of occupation below 160 cm.

Soil Magnetic Susceptibility

General Discussion

Soils and sediments acquire magnetism from the Earth's ambient magnetic field. The amount of the magnetic force acquired by a sediment or soil is called its magnetic susceptibility. Susceptibility is proportional to the concentration of ferro- and ferromagnetic minerals in the soil. The magnetic susceptibility of soils can be altered by both pedogenic and cultural processes. In both cases,

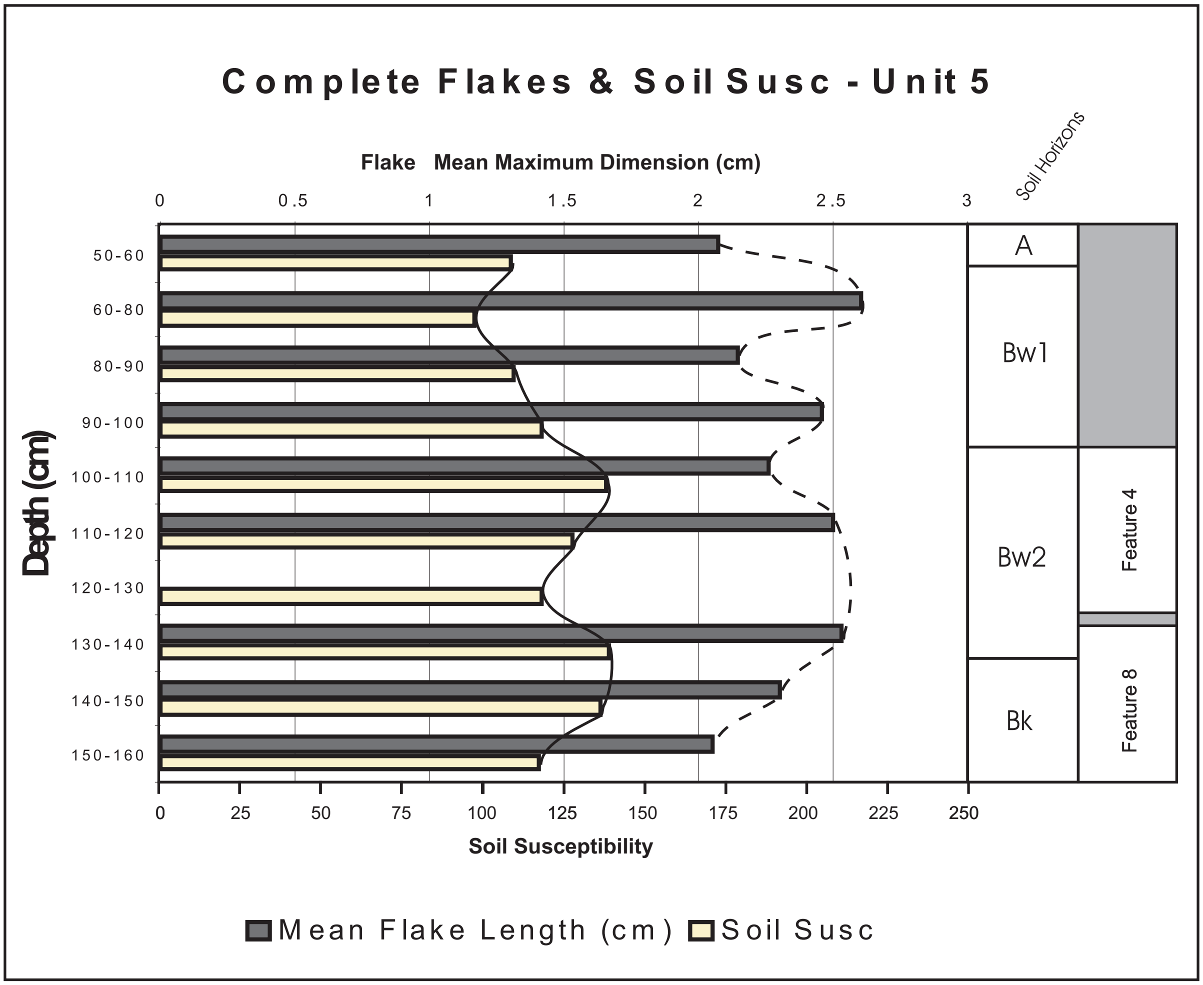

Figure 7-15. Vertical distribution of average complete (unbroken) flake lengths and soil susceptibility measurements within soil horizons and related to prehistoric features in Unit 5.

the organically induced pedogenic and cultural processes enhance (increase) susceptibility values. In pedogenic studies, a significant increase in soil susceptibility values has been observed in the A horizon of soil profiles, probably as a result of organic activities, which creates maghemite, a ferromagnetic mineral (see for example, Singer and Fine 1989). Other research (e.g., Heller and Evans 1995) indicates that the susceptibility values can also be altered by changes in climate.

Even though the pedogenic and climatic processes that may alter the magnetic susceptibility of soils are important and beg further research on and around archaeological sites, thus far the most significant variability in susceptibility noted by archaeologists and paleomagnetists, has been derived from the presence of wood ash and charcoal (Gose 2000). Granted, wood ash also can be present due to past range and forest fires. However, horizontal studies within distinct strata indicate that the increase in values around prehistoric hearths is remarkably distinct, as is the vertical separation of clearly distinguishable cultural strata from natural strata (see for example, Gose and Nickels 1998). This is particularly true if multiple heating events are distinguishable in the archaeological record (e.g., Heller and Evans 1995). In Central Texas, where many of the soils are particularly carbonaceous and have high ferromineral contents, the increase in magnetic susceptibility values on archaeological sites is

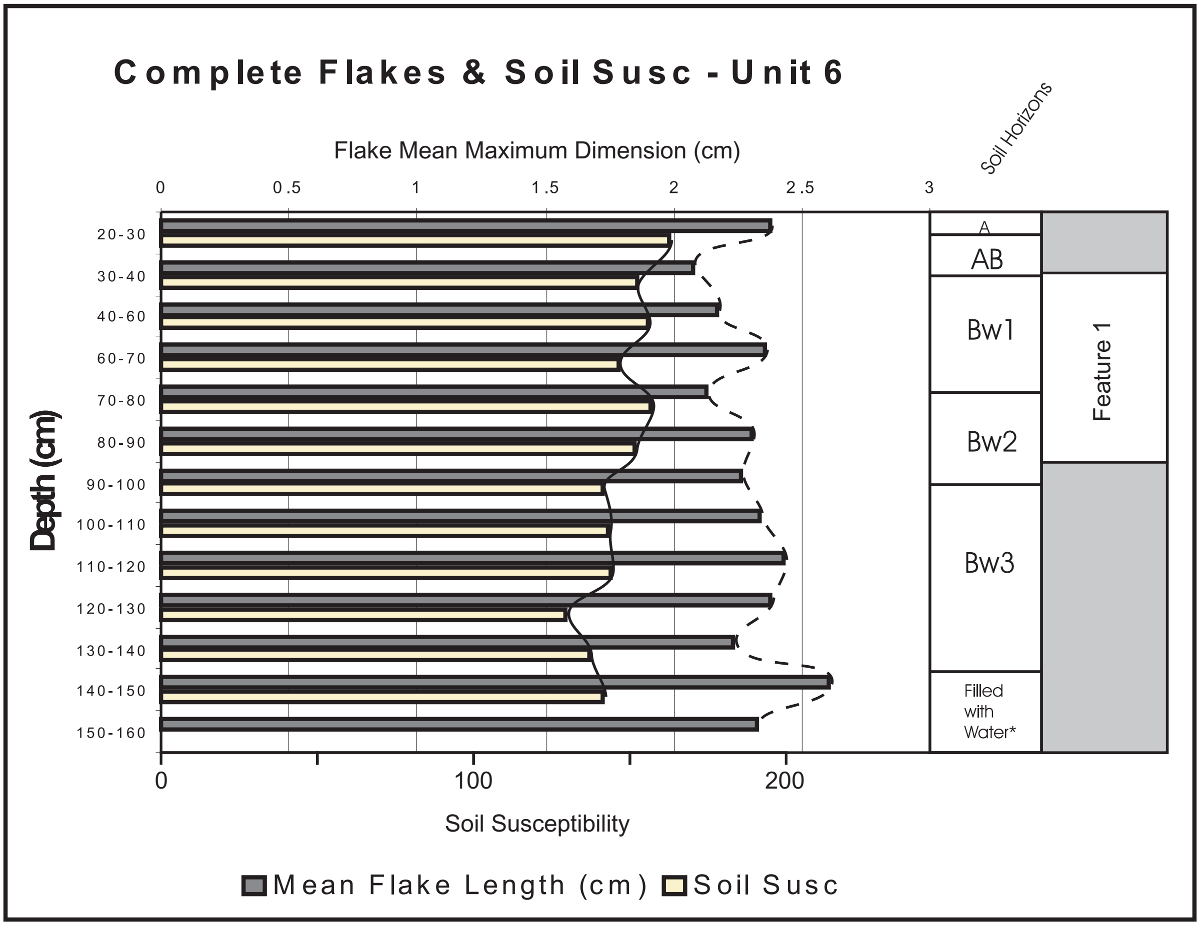

Figure 7-16. Vertical distribution of average complete (unbroken) flake lengths and soil susceptibility measurements within soil horizons and related to prehistoric features in Unit 6.

notable compared to the culturally unaltered surrounding soils (Collins et al. 1994).

Site Specific Discussion

During this project, we collected soil columns in Units 4, 5, and 6. The methods for collection and processing are discussed in Chapter 4. Figures 7-14 through 7-16 depict the soil susceptibility values relative to fire-cracked rock features in each unit. Peaks in magnetic susceptibility reflecting more intense human occupation occur as follows: in Unit 4 between 90-100 cm and 130-140 cm; in Unit 5 between 50-60 cm, 100-110 cm, and 130-140 cm; and in Unit 6 between 40-60 cm, 70-80 cm, 110-120 cm, and 140-150 cm.

Soil Susceptibility Relative to Complete Flake Length

In the two previous sections, we have separately examined the vertical distribution of complete flake length and magnetic soil susceptibility. We, in turn, interpreted the data as corroborating evidence to suggest that human occupation levels should be present between certain levels. Table 7-2 presents those levels where peaks in soils susceptibility and flake length are observed (see Figures 7-14 through 7-16), and from which we argued that these levels have a high potential for containing intact cultural deposits. These data reveal that generally, the susceptibility values and mean flake length follow correlating trends, with susceptibility values generally reaching

Table 7-2. Levels where noted peaks in soils susceptibility and flake length suggested that these levels have a high potential for containing intact cultural deposits.

Unit 4		Unit 5		Unit 6	
Soil Susceptibility Peaks	**Mean Flake Length Peaks**	**Soil Susceptibility Peaks**	**Mean Flake Length Peaks**	**Soil Susceptibility Peaks**	**Mean Flake Length Peaks**
	80-90	50-60	60-80		20-30
90-100	100-110		90-100	40-60	60-70
130-140	150-160	100-110	110-120	70-80	80-90
		130-140		110-120	110-120
				140-150	140-150

their peak values just below the peaks in mean flake lengths.

Snails

Why are snails (particularly *Rabdotus*) so prevalent on archaeological sites? Although some researchers (e.g., Matteson 1959; Neck 1987c) assert that they are drawn by calcium-rich mussel shells also commonly found in abundance and in association with large quantities of *Rabdotus* (e.g., Nickels 2000), this is not the case at 41HY160; only 2 umbos were recovered during this project. Although it is inconclusive whether snails feast and thrive on living or dead organisms (both plant and animal), many researchers (e.g., Mueggenborg 1994; Neck 1994b; Wright 1997) believe snails are attracted in large quantities to the decomposing organics left behind in prehistoric cultural middens. On the other hand, Brown (2002:248) points out that the snails may be attracted not to the human organic garbage, but rather to the lush, moist vegetation that springs up in the enriched soils soon after a site is abandoned, but before it is entirely covered over. This would account for the direct association of snails with middens. A problem with this argument is that if middens accumulate with repeated and continuous use, then snails should only be present in the uppermost portion of the midden (Brown 2002:248). Such is not the case in most midden deposits, where snails are prevalent throughout (e.g., Mueggenborg 1994).

Several archaeologists (e.g., Simmons 1956; Allen and Cheatum 1960; Jelks 1962; Johnson 1964; Hester 1995) have long believed that snails, specifically *Rabdotus*, were a part of prehistoric diets. Brown (2002:248) suggests that it is very doubtful that snails would naturally be attracted to, or survive on an archaeological site while it was occupied for several reasons: 1) the intended and unintended clearing of vegetation would remove both the vegetal nutrients presumably consumed by snails; 2) cleared areas allow for the moisture to evaporate quickly and snails need this moisture; 3) the compacted soils from human use would contribute to a significant decrease in the moisture needed for snails to survive, and 4) the mere trampling by humans would kill the snails. In sum, at the Smith Creek Bridge site (41DW270), Brown (2002:265) believes *Rabdotus* were most likely gathered as a food source while the site was occupied, and they then were attracted to the site during periods of human abandonment.

Brown's (2002) analysis of several species of snails at 41DW270, as well as a Master's Thesis by Andy Maloff (2001), provide both theoretical and innovative methodological approaches to answering the question of why there are so many snails on archaeological sites. Regardless of the reason the snails are present, a general consensus seems to be that snail densities increase and decrease commensurate with increases and decreases in cultural remains densities, such as flakes (e.g., see Brown 2002; Nickels 2000).

Table 7-3. Vertical distribution of cultural remains and soil horizons in Unit 4. Values highlighted indicate a high node in vertical distribution.

Unit 4

Depth (cm)	Total No. Flakes	Mean Flake Length	No. FCR >1"	Fauna (gms)	Snails	Highest Soil Susc.	Average Soil Susc.	Feature No.	Soil Horizon	Diagnostic Artifacts	C14 Dates
80-90	290	**2.97**	258	**82.7**	42	227.87	225	3	A		
90-100	459	2.67	**268**	81.5	539	**312.86**	**275**	3	AB	Pedernales-Marshall	
100-110	**958**	**2.94**	234	86.3	799	232.74	217	7	AB/Bw	Marshall	3300 BP
110-120	883	2.65	**308**	**190.8**	**1403**	200.96	189	7	Bw	Pedernales, Travis	
120-130	385	2.44	51	43.1	830	174.04	172	9	Bw	Pedernales	
130-140	**444**	2.34	**82**	52.0	364	**178.94**	172		Bw		
140-150	433	2.17	26	**104.9**	**409**	166.56	165		Bw		
150-160	384	**2.20**	**68**	33.8	275	159.80	159	11	Bw		
160-170	228	1.95	64	0.6	524	153.10	152	12	Bw/Bk		
170-180	**253**	**2.73**	19	**16.2**	**908**	150.75	148		Bk		4325 BP
Totals	4717	691.90	6093	1378.0							

Table 7-4. Vertical distribution of cultural remains and soil horizons in Unit 5. Values highlighted indicate a high node in vertical distribution.

Unit 5

Depth (cm)	Total No. Flakes	Mean Flake Length	No. FCR >1"	Fauna (gms)	Snails	Highest Soil Susc.	Average Soil Susc.	Feature No.	Soil Horizon	Diagnostic Artifacts
46-50	39	2.20	0	0	A					
50-60	126	2.07	0	16	5	**130**	92		A/Bw1	Perdiz
60-80	314	**2.60**	33	**167.4**	15	117	104	2	Bw1	
80-90	681	2.15	55	80.5	**318**	131	128	4	Bw1	
90-100	806	**2.46**	72	78.4	205	142	135	5	Bw1	
100-110	**1036**	2.26	95	95.3	471	**166**	**155**		Bw1/Bw2	Pedernales
110-120	621	2.50	**103**	**102**	**888**	153	148		Bw2	Marshall
120-130	8	0.00	72	0	6	142	133	8	Bw2	
130-140	602	**2.53**	**80**	81.2	**509**	**167**	**154**	10	Bw2/Bk	
140-150	719	2.30	38	**114.5**	434	164	146		Bk	
150-160	**758**	2.05	24	38.7	**890**	141	132		Bk	
Totals	5710		572	776.2	3741					

Table 7-5. Vertical distribution of cultural remains and soil horizons in Unit 6. Values highlighted indicate a high node in vertical distribution.

Unit 6

Depth (cm)	Total No. Flakes	Mean Flake Length	No. FCR >1"	Fauna (gms)	Snails	Highest Soil Susc.	Average Soil Susc.	Feature No.	Soil Horizon	Diagnostic Artifacts	C14 Dates
20-30	52	**2.38**	0	2.9		**198**	169		A		
30-40	176	2.08	25	39.4	12	189	186	1	A/AB		
40-60	512	2.17	49	59.4	161	**218**	190	1	AB/Bw1		
60-70	1077	**2.36**	**103**	**89.6**	842	182	179		Bw1		
70-80	1127	2.13	52	83.0	572	**199**	191	6	Bw1/Bw2	Pedernales	3550 BP
80-90	**1529**	2.3	3	**86.5**	1214	191	185		Bw2	Marshall	
90-100	574	2.26	44	49.5	**2271**	180	172		Bw2		
100-110	583	2.34	**175**	**86.0**	1172	176	174		Bw2/Bw3		
110-120	564	**2.43**	61	68.1	525	**185**	175		Bw3		
120-130	**609**	2.38	57	68.5	**691**	161	158		Bw3		
130-140	498	2.23	**65**	61.9	601	173	167		Bw3		
140-150	243	**2.61**	35	**93.8**	**645**	**200**	172		Bw3/water	Pedernales	
150-160	50	2.33	10	25.5	193	water	water	water			
Totals	7594		679	814.1	8899						

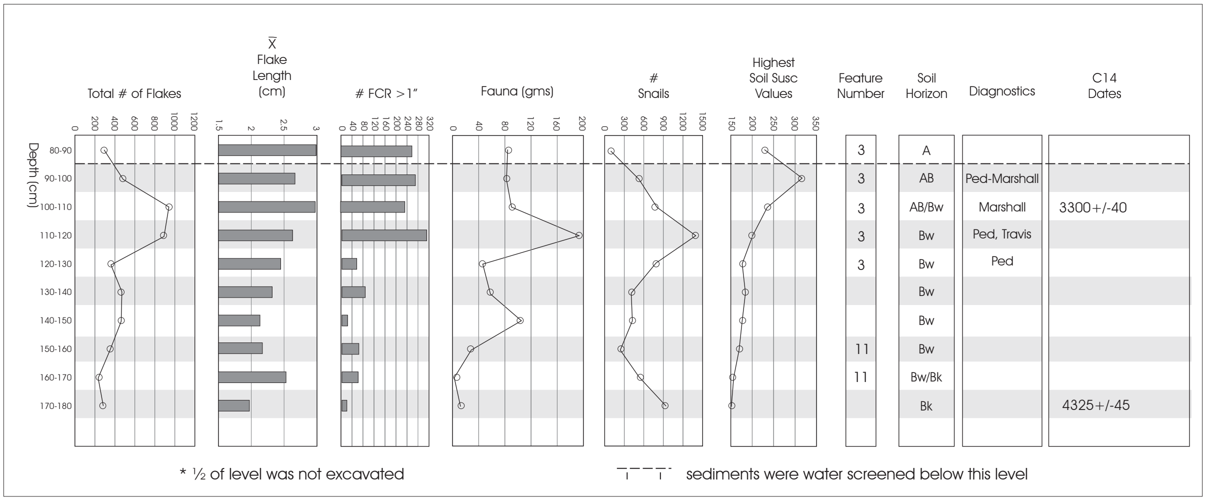

Figure7-17 Volumetic distributions of cultural and noncultural and soil variablesin Unit 4.

Although we did not undertake the intensive examination and classification for the 37,672 snails we collected during this project, we do feel justified in using snail densities as corroborating evidence for human occupation.

High Value Nodes in the Vertical Distribution of Materials

Tables 7-3 through 7-5 present synthesized data from the accompanying appendices, and Figures 7-17 through 7-19 summarize the vertical volumetric distribution of flakes, faunal remains, fire cracked rocks, snails, cultural features, and soil horizons below the fill in Excavation Units 4, 5 and 6. The highlighted numbers in Tables 7-3 though 7-5 represent high value nodes in the vertical distribution of each category.

The high nodes represent peaks in either volume or intensity of human use. It is understood that these nodes can be influenced by many factors: the type of lithic technology practiced, lithic resources available, food resources, flooding events, etc. Nevertheless, when we understand and accept those problematic conditions we

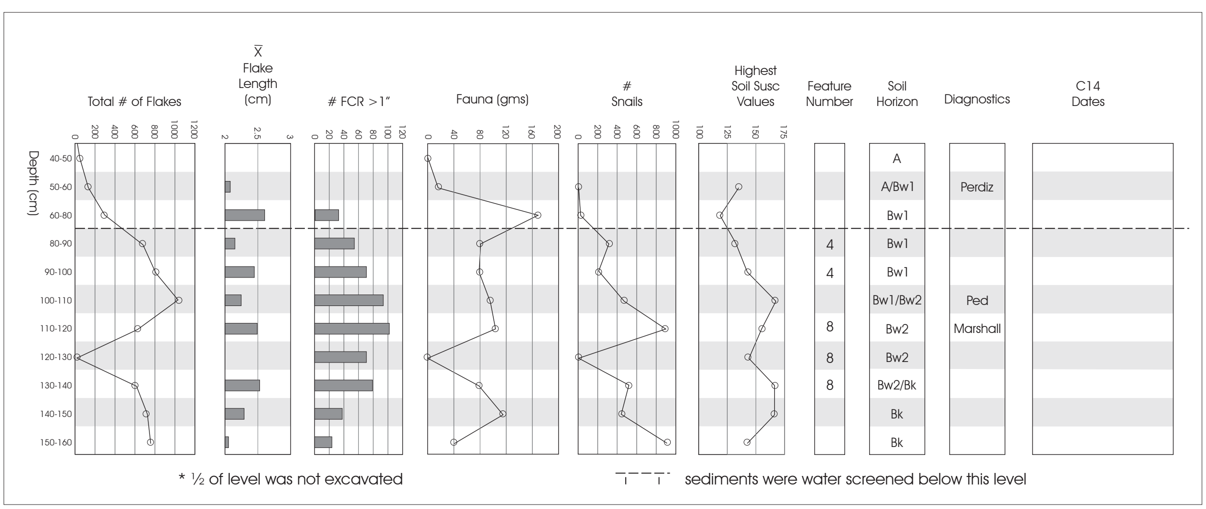

Figure 7-18. Volumetic distributions of cultural and noncultural and soil variablesin Unit 5.

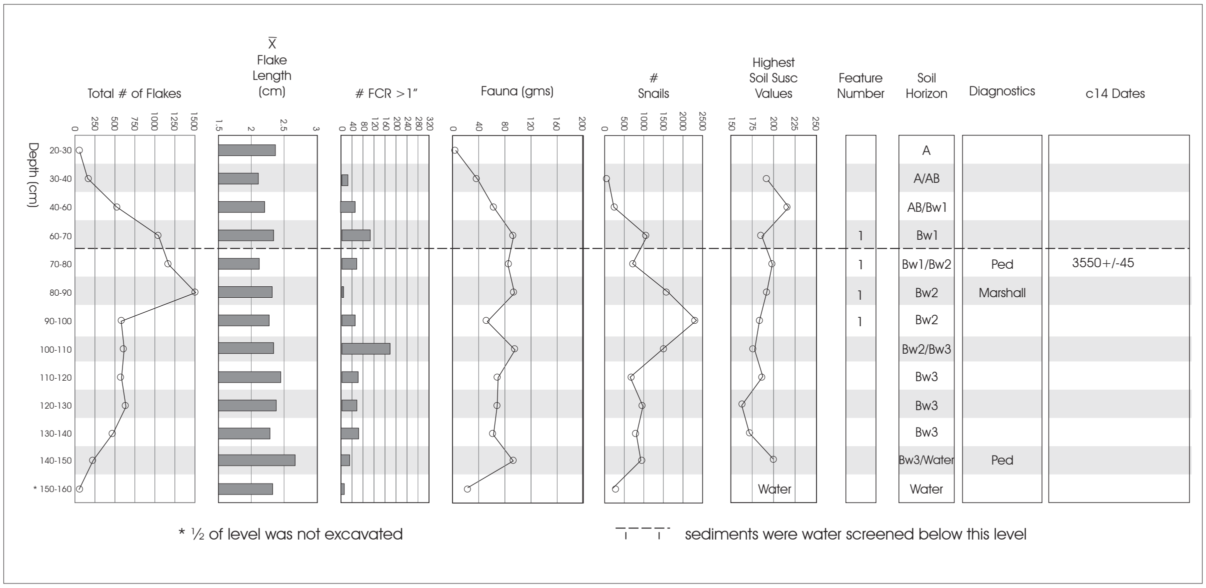

Figure 7-19. Volumetic distributions of cultural and noncultural and soil variablesin Unit 6.

are able to begin to tease out discrete buried components. Figure 7-20 is presented to show the number of high nodes in each level that occur in six categories: Total Number of flakes, Mean Flake Length, Fauna (gms), Number of FCR > 1 inch, Number of Snails, and Highest Soil Susceptibility values for each level. Notably, in Unit 4 there appears to be a discrete separation of intensive human occupation between 120-130 cm and again between 160-170 cm. In Unit 5 we see the same phenomena between 120-130 cm; however, in Unit 6 we see no such distinct pattern, suggesting that area was occupied with a relative constant intensity through time.

Intrusive Modern Trash

In the 1960s, a swimming pool and parking lot were constructed in the area of the site where Units 1 through 5 were excavated, and the Unit 6 area was and is still being used as a family picnic area. As such, modern trash was found in five of the six units (1, 3-6). Attesting to the prehistoric components' stratigraphic integrity, all 72 fragmented pieces of modern trash (Appendix A) were confined to the construction fill zones, except for a small (182 mm) clear glass sherd found between 50-60 cm in Unit 5 (4-14 cm below fill zone), and a second small (79 mm) glass sherd found between 60-70 cm in Unit 6 (45-55 cm below fill zone). Although the tiny glass sherd found in the screen from Unit 6 could be troubling, all other data indicate no evidence of disturbance to that depth and whatever process introduced the glass had only a minor affect.

Summary

In sum, the vertical distribution and clustering of artifacts within distinct soil zones indicates discrete levels of occupation, and strongly suggests different periods of occupation at the site. Diagnostic artifacts and radiocarbon dates indicate Late Prehistoric, Late Archaic, and Middle Archaic components are present. This evidence is discussed in the following section.

Chronology

The previous section discussed the sediment deposition and soil formation processes that have occurred at the site. Specifically, seven horizons with cultural material were identified. The purpose of this section is to build on the soil horizon findings and the archaeological excavation results in order to synthesize the chronometric information in a coherent and evidential manner.

Three lines of evidence are available for dating deposits at 41HY160. The first is from time-diagnostic projectile points. The second involves absolute dating techniques and includes radiocarbon dating of three wood charcoal samples. The final technique involves stratigraphy. This includes, at its broadest level, the depositional sequences identified by Nordt (Appendix E). Although no humate dates were obtained, the soil horizons are relevant to this discussion because they encompass the stratigraphic ordering or superposition of depositional units, and the artifacts within these units, correlated previously in this chapter.

Projectile Points

Although a review of point types associated with Texas chronologies has been provided in Chapter 2, and a detailed description and analysis of each of the points recovered during this project follows in Chapter 10, a brief synthesis is in order. Table 7-6 presents the temporal affiliations of points recovered.

Radiocarbon Dates

Three radiocarbon dates obtained from wood charcoal samples validate early Late Archaic and late Middle Archaic occupations (Table 7-7). The samples were processed by Stafford Research Laboratory using AMS (Appendix E). Stafford Laboratory Sample SR-6099 came from Unit 4, Level 3, 107 cmbs within Feature 7, a slab-lined hearth, with an associated Marshall point. Stafford Laboratory Sample SR-6102 also came from Unit 4, but

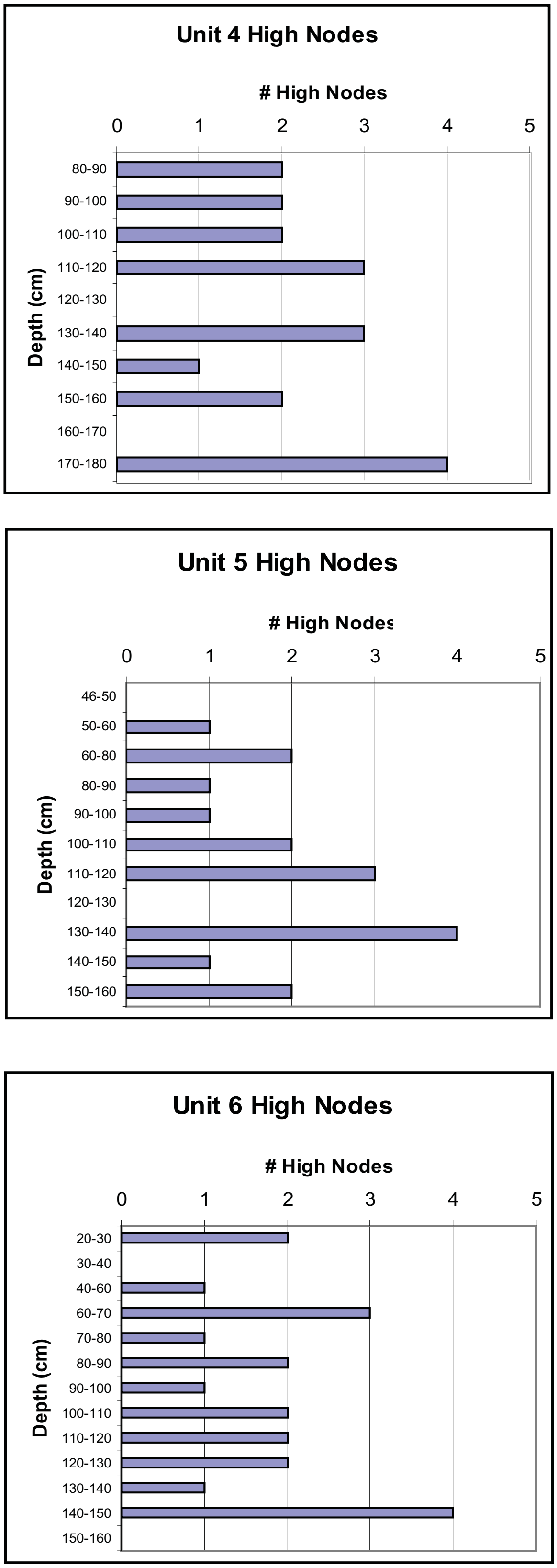

Figure 7-20. High nodes represent peaks in human occupation.

Table 7-6. Projectile points and preforms from excavated units, with periods and phases of manufacture/use (Black and McGraw 1985; Collins 1995; Johnson and Goode 1994).

Unit	Depth (cm)	Point Type	Interval/Phase	Age (Years B.P.)
4	90-100	Pedernales→Marshall	Late Archaic	Ca. 2700-2100
4	100-110	Marshall preform	Late Archaic	2300-2100
4	119	Pedernales	Late Archaic	4250-2300
4	120	Travis	Middle Archaic	4450-4000
4	120-130	Pedernales	Late Archaic	4250-2300
4	140-150	untypable	Unknown	Unknown
5	50-60	Perdiz	Late Prehistoric/Toyah	700-250
5	83	untypable	Unknown	Unknown
5	90-100	untypable	Unknown	Unknown
5	100-110	Pedernales	Late Archaic	4250-2300
5	110-120	Marshall-like	Late Archaic	2300-2100
5	150-160	untypable	Unknown	Unknown
6	70-80	Pedernales	Late Archaic	4250-2300
6	80-90	Marshall	Late Archaic	2300-2100
6	110-120	untypable	Unknown	Unknown
6	120-130	Pedernales→Marshall	Late Archaic	Ca. 2700-2100
6	140-150	untyped	Unknown	Unknown
Core C	Unknown	Marshall	Late Archaic	2300-2100

from Level 10, 170-180 cmbs, at the base of Feature 12, a fire-cracked rock hearth. Stafford Laboratory Sample SR-6101 was collected from Unit 6, Level 5, 70-80 cmbs within Feature 6, a concentration of fire-cracked rock, and with an associated Pedernales point.

Evidence for Dating the Occupations Within the Upper 1.7 Meters at 41HY160

Without associated absolute radiocarbon dates, the Late Prehistoric Toyah phase component can be only relatively dated. The recovery of a single Perdiz point buried between 50-60 cm below the modern surface in well-stratified deposits is considered to reliably represent an approximated period of occupation ca. 700-250 B.P. (Collins 1995). Although bone-tempered pottery is often associated with Perdiz points, none was found during this project.

Projectile point types and radiocarbon dates suggest that the site was also occupied as early as 4450 B.P., during the Middle Archaic interval, and into the Late Archaic interval. Evidence for dating these occupations at the site is presented in Table 7-7. An analysis of cultural remains discussed in Chapters 8 and 9 suggests that the site was occupied seasonally; whether or not it was occupied year-after-year or periodically through several millennia is unknown.

A view of Figure 7-21 indicates that the radiocarbon dates do not progressively get older with depth. However, depths below the modern surface become less significant when the three dates are plotted against the sloping soil horizons identified by Lee Nordt (Figure 7-22). The dates are in a rough stratigraphic sequence when considering the soil horizon stratigraphy: near the bottom of the AB Horizon. (3300±40 B.P.),

Table 7-7. Results of wood charcoal assays from the Late Archaic component.

Provenience	Laboratory Number	Radiocarbon Age Years BP	Calibration Intercepts Years BP	1 Sigma Range Years BP	2 Sigma Range Years BP
Unit 4, 107cm	SR-6099	3300±40	3548, 3535, 3531, 3519, 3479	3627-3469	3635-3411
Unit 4, 170-180cm	SR-6102	4325±45	4863	4955-4841	5030-4829
Unit 6, 70-80cm	SR-6101	3550±45	3833	3890-3728	3974-3692

near the bottom of the Bw1 Horizon (3550±45 B.P.) and bottom of Bw Horizon (4325±45 B.P.).

Interestingly, no diagnostic artifacts dating to the latter half of the Late Archaic were recovered from Units 4, 5, and 6. Whether the area was truncated naturally or artificially, or whether the area was simply not occupied during the latter half of the Late Archaic, is unknown. In the previous chapter, Nordt depicted this slope in Figure 6-8, which shows the probable locations and depths of Late Archaic occupations in close proximity to Spring Lake (west of Units 4, 5, and 6). The sloping surface can also be seen in a historic photograph taken before construction of Aquarena Center and the swimming pool (Figure 7-23), suggesting that the slope was not caused (and by implication, truncated) by artificial causes.

Summary

Several lines of data have been used to evaluate the vertical integrity of the site. These data validate the presence of intact buried cultural deposits, and thus the overall high integrity in the portion of 41HY160 tested by Units 4, 5 and 6 during this project. Specifically, we used mean flake length as a basis for evaluating the potential natural disturbances that can occur around the springs. The pattern we observed is generally that expected on a site that has been periodically inundated and exposed through flooding, layering it with silty clay vertisols, and is in a climatic region of periodic wetting and drying. It is a distinct pattern repeated in Units 4, 5 and 6 that suggests the presence of human occupations within discrete zones, as corroborated by the presence of non-diagnostic artifactual remains, fire-cracked rock cooking features, radiocarbon dates, diagnostic artifacts, and soil susceptibility variations.

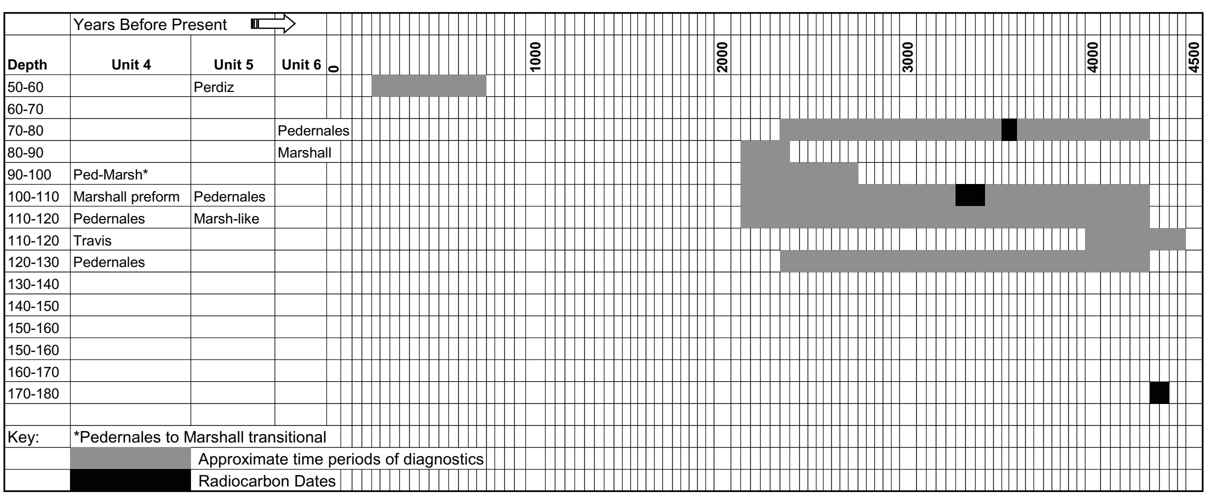

Figure 7-21. Evidence for dating the occupations at 41HY160.

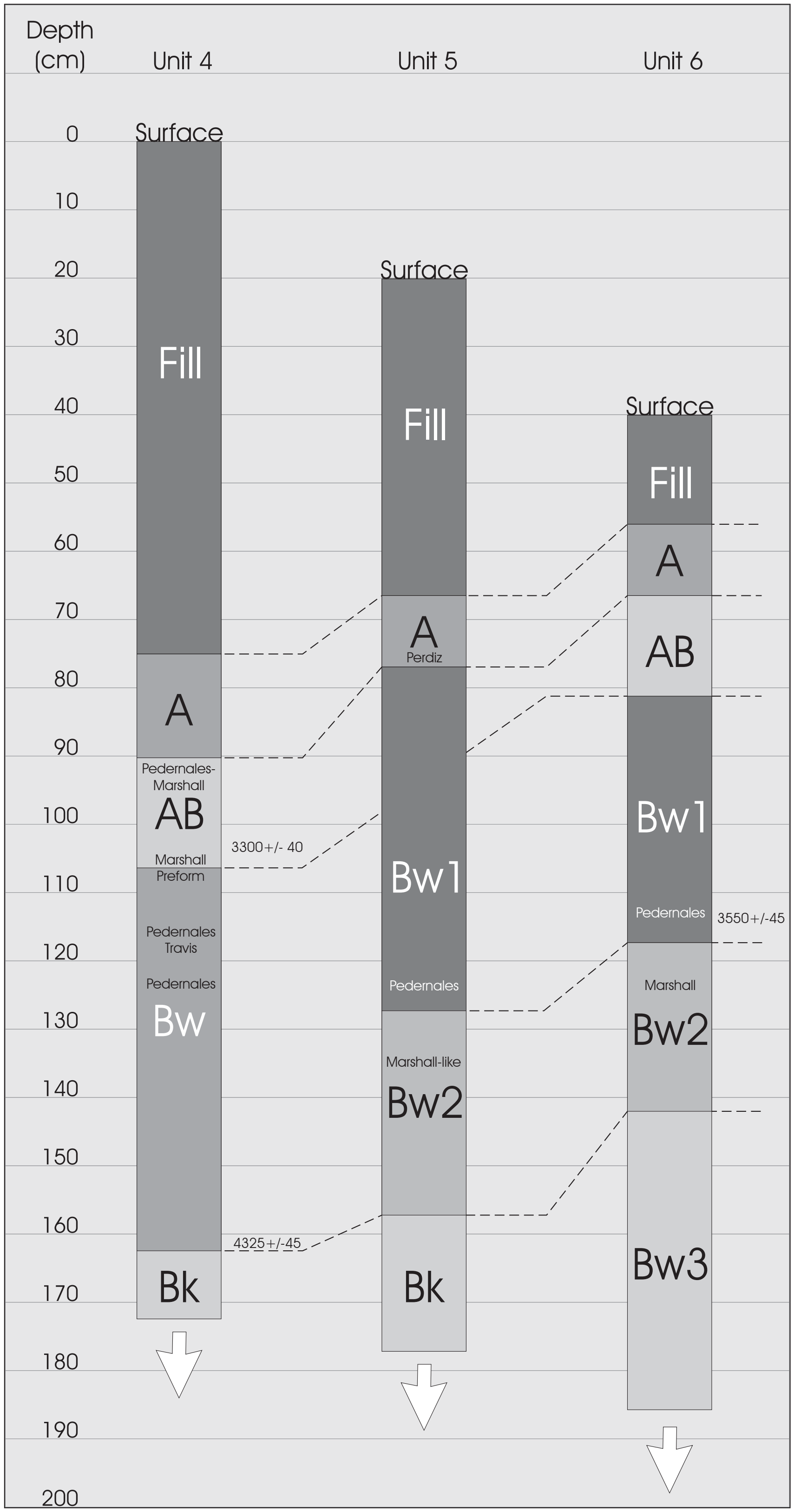

Figure 7-22. Depths (cm) at which soil horizons were documented by Nordt, with correlated radiocarbon dates.

Figure 7-23. Postcard of the headwaters of the San Marcos Springs circa 1910 before the hotel and swimming pool were constructed; note that the gradual slope on the right is where Excavation Units 4, 5, and 6 were placed and the steeper slope on the left suggests the accumulation of colluvial deposits at the foot of the escarpment. Between the slopes is low swell showing possible infilled channel at the head of the springs. Postcard courtesy of the San Marcos-Hays County Collection, San Marcos Public Library, Photograph Number 1326.

Chapter 8

Analysis of the Vertebrate Faunal Remains

Brian Shaffer

Introduction

Faunal remains recovered from excavation of four units at 41HY160 revealed the presence all five classes of vertebrates from a total sample consisting of 4,388 specimens. Analysis was undertaken to identify the taxa represented, the taphonomic condition of the remains, and any unique aspects, such as specific forms of cultural modification. This was accomplished using the comparative specimens housed at the Institute of Applied Sciences Zooarchaeology Laboratory at the University of North Texas (UNT). Identifications were made based primarily on morphology and comparison with specimens from the UNT collection. The one exception to this was the identification of cf. *Bison* sp. from tooth specimens. The context and depth of the specimens indicated they were prehistoric and hence could not be domestic cattle. Since the specimens were not readily separable from domestic cattle, the identification was left as "cf." This denotes that the specimens compare favorably with the identification as bison but that the identification is not definite. Data were recorded using the vertebrate Faunal Analysis Coding System (Shaffer and Baker 1992) with the data transferred into Microsoft Excel as a spreadsheet.

Results of Analysis

No unusual or unexpected taxa were identified. All taxa identified were within expected normal geographical distributions. Faunal remains were tabulated using the number of identified specimens (NISP). This is simply the number of specimens identified to each taxonomic category (Table 8-1). Commonly used in conjunction with NISP, the minimum number of individuals (MNI) was also calculated (Table 8-2). The skeletal representation of each taxon was examined to determine the minimum number of animals that could be represented. The entire assemblage was treated as a single aggregate, so MNI was determined primarily on the basis of element duplication. Animal age was also taken into consideration, but in no case when approximate age at death could be determined did the number of aged specimens indicate a greater number of individuals than represented by element duplication.

Table 8-3 presents the taphonomic findings by category. Table 8-4 provides a more in-depth breakdown of taphonomy by taxon. A detailed listing of faunal remains recovered from each unit and level is provided in Appendix B. In terms of natural processes affecting the assemblage, with the exception of breakage, the assemblage does not appear to have been greatly affected. Weathering, or exposure to the weather-related elements (sun, rain, etc.), was not a significant factor in the deterioration of the assemblage.

Table 8-1. Number of identified specimens by taxon.

TAXON	***COMMON NAME***	***NISP***	***TAXON***	***COMMON NAME***	***NISP***
Vertebrata	Vertebrates	2,431	Mammalia (Small/medium)	Rabbit/canid-sized mammals	15
Osteichthyes (Small)	Small bony fish	2	Mammalia (Medium/large)	Canid/deer-sized mammals	1,211
Osteichthyes (Medium)	Medium bony fish	13	Mammalia (Large/very large)	Deer/bison-sized mammals	6
Osteichthyes (Large)	Large bony fish	2	Leporidae	Rabbits and hares	1
Lepisosteidae	Gars	7	*Lepus* sp.	Jackrabbits	17
Ictalurus sp.	Catfish	2	*Sylvilagus* sp.	Cottontail rabbits	95
Anura	Toads and frogs	2	Rodentia (Small)	Mouse-sized rodent	2
Testudinata	Turtles	194	Rodentia (Medium)	Rat/squirrel-sized rodent	23
Kinosternidae	Mud and musk turtles	20	Geomyidae	Pocket gophers	10
Emydidae	Water and box turtles	2	*Sigmodon* sp.	Cotton rats	13
Chrysemys sensu lato	Painted turtles, cooters, etc.	3	*Neotoma* sp.	Wood rats	3
Trionyx sp.	Softshell turtle	3	*Procyon lotor*	Raccoon	4
Squamata	Lizards and snakes	1	Canidae	Dogs and relatives	1
Lacertilia	Lizards	1	cf. *Vulpes* sp.	Foxes	3
Serpentes	Snakes	16	cf. *Canis latrans*	Coyote	4
Colubridae	Colubrid snakes	31	Artiodactyla (Medium)	Deer/pronghorn-size d ungulates	129
Viperidae	Pitviper snakes	32	Artiodactyla (Large)	Bison/cow-sized ungulates	3
Aves (Large)	Hawk-turkey-sized birds	12	*Odocoileus* sp.	Deer	64
Phasianidae	Chicken-sized	1	*Antilocapra americana*	Pronghorn antelope	1
Mammalia (Micro)	Shrew/mouse-sized mammals	2	cf. *Antilocapra americana*	Pronghorn antelope	1
Mammalia (Micro/small)	Shrew/rabbit-sized mammals	1	cf. *Bison* sp.	Bison	4
			Total Specimens Analyzed		***4,388***

Chemical etching of the bone was noticed on a few specimens from several proveniences, but also was not significant. This etching was limited to random and irregular pitting along the bones' surfaces. Given the presence of calcium carbonate root casts found co-mingled with the faunal sample, it is quite likely that the chemical etching is the result of pH conditions within the ground as opposed to carnivore or raptor stomach acid. Rodent gnawing was also present on several specimens but was generally limited to only a few marks. There were exceptions. A few of the specimens exhibited marked rodent gnawing where much of the surface of the bone was damaged. Although rodent damage seems to be limited in the assemblage, the possibility exists for rodent damage to specific specimens to have been extremely destructive. It is also possible other such examples were not recovered because the specimens were reduced to a size smaller than the screens would recover.

Broken bones were recorded as having angular or spiral fractures. Angular fracturing occurs in skeletal elements, such as flat bones of the pelvis blades, flat sides of ribs, sternum, scapula, or cranium of mammals and birds, as well as in elements such as turtle shell. These may occur either when the bone is still fresh or contains collagen, or after the bone has lost its collagen. Spiral fractures can occur in most tubular bones or thick-walled portions of bones, such as parts of the pelvis particularly around the acetabulum, the scapula in the area of the neck and spine of the blade, and other such elements, when they are fresh or contain collagen. Spiral fractures may be associated with the processing of bone for marrow or grease, but also may be caused by other processes such as by carnivore gnawing. No definitive carnivore bone breaking evidence was observed. However, impact points were noted on six specimens. Impact points represent the points of percussion where bone is struck by a hard object such as a hammerstone. The result is a conical fracture that can be identified on the interior of the bone. While most of the identified impact points occurred singularly, one deer-sized artiodactyl tibia shaft fragment was identified with three impacts located along the same plane down the shaft. Such impacts are indicative of intentional attempts to open the bone as might be done for the removal of marrow.

Table 8-2. Minimum number of individuals by taxon.

TAXON	***COMMON NAME***	***MNI***	***TAXON***	***COMMON NAME***	***MNI***
Osteichthyes (Small)	Small bony fish	1	Phasianidae	Chicken-sized.	1
Osteichthyes (Medium)	Medium bony fish	1	*Lepus* sp.	Jackrabbits	1
Osteichthyes (Large)	Large bony fish	1	*Sylvilagus* sp.	Cottontail rabbits	7
Lepisosteidae	Gars	1	Geomyidae	Pocket gophers	2
Ictalurus sp.	Catfish	1	*Sigmodon* sp.	Cotton rats	1
Anura	Toads and frogs	1	*Neotoma* sp.	Wood rats	1
Kinosternidae	Mud and musk turtles	2	*Procyon lotor*	Raccoon	1
Chrysemys sensu lato	Painted turtles, cooters, etc.	2	cf. *Vulpes* sp.	Foxes	1
Trionyx sp.	Softshell turtle	1	cf. *Canis latrans*	Coyote	1
Lacertilia	Lizards	1	*Odocoileus* sp.	Deer	1
Colubridae	Colubrid snakes	2	*Antilocapra americana*	Pronghorn antelope	1
Viperidae	Pitviper snakes	2	cf. *Bison* sp.	Bison	1

Burning represented another significant contribution to the taphonomy of the assemblage with 944 specimens identified as burned. Two forms of burning were identified. The first is that of charred bone. Charred bone represents bone that is only partially combusted. This results in the bone taking on a dark brown or black appearance. Charred bone is still very stable and usually retains surface integrity very well, such that identifications are not significantly hampered. Calcined bone, on the other hand, is bone that is more completely combusted. Most often, calcined bone is white in color, although it may be light grey or even have a blue color to it. Calcination represents the last stage of bone integrity before bone starts to break down and disintegrate, and some calcined bone will take on a chalky composition as it loses integrity. Calcined bone can be damaged to the extent that surface features necessary for proper identification have been obliterated. Not surprisingly, burned bone follows a similar pattern to spirally fractured bone with concentrations in the Vertebrata, medium/large mammal, and deer-sized artiodactyl. Where this pattern diverges is with turtles. Approximately one-quarter of the turtle shell elements recovered were burned and the majority of those were only charred. Based on the lack of significant amounts of calcination on turtle shell elements, it seems likely that turtles may have been cooked or roasted in their shells.

The only other cultural modification observed was cutting. Cut marks were present on two specimens. The first is a cranial fragment that based on bone size and suture shape, appears to be from a deer; although the specimen could not be specifically correlated with a comparative specimen to confirm such identification. This specimen is from Unit 4, Level 11 and exhibits eight or more shallow cut marks. The other specimen is from Unit 6, Level 9. This specimen is spirally fractured, and exhibits four or more shallow cut marks. The ambiguity in the number of cut marks stems from the presence of several additional marks that resemble cut marks, but could not specifically be identified based on their morphology. Neither set of cut marks is associated with a joint. While shallow, the cut marks enter at a perpendicular angle to the bone and therefore do not appear to be associated with filleting for meat or hide removal.

In looking at the taxa represented from the site, mammals dominate the assemblage, followed

Table 8-3. Summary of site taphonomy.

TAPHONOMY			***NISP***
Surface Alteration	Weathering	Light	4,381
		Marked	7
	Chemical Etch		5
	Rodent Gnaw		31
	Cut Marks		2
Breakage		Unbroken	63
		Angular	2,764
		Spiral	1,561
		Impact	6
Burning		Unburned	3,444
		Charred	736
		Calcined	208

Table 8-4. Taphonomy by taxon.

TAXON	***TAPHONOMY***											
	Surface Alteration					***Fractures***				***Burning***		
	Weathering											
	Light	Marked	Chemical	Gnaw	Cut Marks	Unbroken	Angular	Spiral	Impact	Unburned	Charred	Calcined
Vertebrata	2431	-	-	3	-	-	1657	774	-	2004	323	104
Osteichthyes (Small)	2	-	-	-	-	-	2	-	-	2	-	-
Osteichthyes (Medium)	13	-	-	-	-	-	13	-	-	13	-	-
Osteichthyes (Large)	2	-	-	-	-	-	2	-	-	2	-	-
Lepisosteidae	7	-	-	-	-	-	7	-	-	7	-	-
Ictalurus sp.	2	-	-	-	-	-	2	-	-	2	-	-
Anura	2	-	-	-	-	-	2	-	-	2	-	-
Testudinata	194	-	-	-	-	-	194	-	-	150	43	1
Kinosternidae	20	-	-	-	-	-	20	-	-	16	4	-
Emydidae	2	-	-	-	-	-	2	-	-	1	1	-
Chrysemys sensu lato	3	-	-	-	-	-	3	-	-	3	-	-
Trionyx sp.	3	-	-	-	-	-	3	-	-	2	1	-
Squamata	1	-	-	-	-	-	1	-	-	1	-	-
Lacertilia	1	-	-	-	-	-	1	-	-	1	-	-
Serpentes	16	-	-	-	-	-	16	-	-	16	-	-
Colubridae	31	-	-	-	-	6	25	-	-	30	1	-
Viperidae	32	-	-	-	-	2	30	-	-	29	3	-
Aves (Large)	12	-	-	-	-	1	7	4	-	9	3	-
Phasianidae	1	-	-	-	-	-		1	-	1	-	-
Mammalia (Micro)	2	-	-	-	-	-	2	-	-	2	-	-
Mammalia (Micro/small)	1	-	-	-	-	-	1	-	-	1	-	-
Mammalia (Small/medium)	15	-	-	-	-	1	13	1	-	15	-	-
Mammalia (Medium/large)	1207	5	3	21	2	1	533	677	3	791	326	94
Mammalia (Large/very large)	6	-	-	-	-	-		6	-	5	1	-
Leporidae	1	-	-	-	-	-	1	-	-	1	-	-

Table 8-4. Continued.

TAXON	***TAPHONOMY***											
	Surface Alteration					***Fractures***				***Burning***		
	Weathering		Chemical	Gnaw	Cut	Unbroken	Angular	Spiral	Impact	Unburned	Charred	Calcined
	Light	Marked										
Rodentia (Small)	2	-	-	-	-	-	2	-	-	2	-	-
Rodentia (Medium)	23	-	-	-	-	-	20	3	-	21	1	1
Geomyidae	10	-	-	-	-	2	8	-	-	10	-	-
Sigmodon sp.	13	-	-	-	-	10	3	-	-	13	-	-
Neotoma sp.	3	-	-	-	-	1	2	-	-	3	-	-
Procyon lotor	4	-	-	-	-	1	3	-	-	4	-	-
Canidae	1	-	-	-	-	-	1	-	-	1	-	-
cf. *Vulpes* sp.	3	-	-	-	-	1	2	-	-	2	1	-
cf. *Canis latrans*	4	-	-	-	-	2	2	-	-	4	-	-
Artiodactyla (Medium)	127	2	2	6	-	15	33	81	3	104	18	7
Artiodactyla (Large)	3	-	-	-	-	-	3	-	-	1	2	-
Odocoileus sp.	63	-	-	1	-	2	58	4	-	60	4	-
Antilocapra americana	1	-	-	-	-	-	1	-	-	1	-	-
cf. *Antilocapra americana*	1	-	-	-	-	-	1	-	-	1	-	-
cf. *Bison* sp.	4	-	-	-	-	-	4	-	-	4	-	-
Totals	4381	7	5	31	2	63	2764	1561	6	3444	736	208

by reptiles, birds, fish, and amphibians. While it is expected that mammals would likely represent the largest portion of the assemblage, the lack of more aquatic species is surprising given the proximity of the site to water. All of the identified turtle remains include taxa that favor aquatic habitats, however. The only possible exceptions are the two specimens identified as Emydidae, which includes box turtles; all other members of the family, such as the painted turtles, sliders, and cooters, are aquatic. Turtle shell elements are easy to recognize as turtle, even from small fragments. The presence of a relatively large number of identified shell fragments may be due to the combination of fragmentation and ease of identification. Of the identified turtles, an MNI of two was assigned to the Kinosternid and Chrysemid turtles based on disparity of element sizes. At least one larger and one smaller individual were present in both groups.

The lack of fish in the assemblage could be attributed to the poor preservation typical of fish remains due to their generally more fragile composition, which makes them more susceptible to taphonomic factors. However, there is no evidence to suggest that osseous fish elements would necessarily decompose more quickly at the site. For example, four of the gar elements recovered were scales. Gar scales tend to preserve very well even when other elements do not, and each individual fish will have hundreds of scales. It is therefore plausible to assume that fish did not make up a large portion of the diet of the inhabitants at this site.

After turtle, the next most commonly recovered reptile was snake. Snakes were identified as Colubrid (non-poisonous) and Viperid (poisonous) based on the presence and size of the ventral spine on the dorsal vertebrae recovered. Once again, based on size, at least two individuals were present in each group.

Birds comprised a small portion of the assemblage. All avian specimens, however, were from larger-sized birds. Most of the elements were too fragmented for more specific identification, but they undoubtedly came from birds ranging in size from duck to turkey.

Within the mammal component of the assemblage, specimens from medium/large and large/very large mammals dominate. Part of the reason for this is that fragmented remains from these larger taxa still can be identified to class and approximate animal size. Fragmented remains from smaller taxa, such as rabbits and rodents, are difficult to discern from non-mammalian fragmented remains, such as from birds. Therefore, these specimens can only be identified as Vertebrata. The higher level of larger-sized mammal remains compares well with the presence of deer-sized artiodactyl that dominate the identified mammalian assemblage, plus the additional bison-sized artiodactyl specimens. These match the more specifically identified deer, pronghorn, and bison remains.

While a large proportion of the assemblage comes specifically from larger-sized mammals, there is an interesting disparity that occurs when compared to the smaller taxa, such as the cottontail rabbits and the rodents. Based on MNI, no more than one deer, one pronghorn, and one bison can be attributed to representing the assemblage. Represented by many fewer fragments, gophers are represented by two individuals, cotton rats by three, and cottontail rabbits by seven. Given the generally poor representation of these smaller taxa and lack of recovery of a significant number of elements from any one location, there is no reason to assume they represent individuals that died in burrows. The lack of chemical etching indicates that they likely were not deposited as a result of carnivore or raptor activity. There are no cut marks or other direct evidence to conclusively identify that they are the result of cultural activity either. By the same reasoning, there is no direct evidence that the pronghorn or the bison were at the site as a result of cultural activity.

So what can account for this disparity in NISP and MNI representation amongst the mammals? It is my feeling that the MNI representation is likely more accurate in terms of the number of individuals at the site. Smaller taxa are more susceptible to recovery bias and to taphonomic degradation than larger taxa. Specimens from the smaller taxa may have been missed in the recovery process or were recovered as fragments that could not be identified as anything other than Vertebrata. The recovered and more intact specimens were identified and tallied.

For the larger taxa, there is a greater likelihood of being able to identify particular elements. Even small pieces can be identified because in relative terms, a small portion of a big element from a deer is still considerably larger than a big portion of a small element from a cottontail rabbit. Landmarks and other features are more easily identified. As such, the resulting large mammal assemblage may be composed of a high number of heavily fragmented remains that can be attributed to only a few individuals (see Table 8-4). In this case, a good portion of the fragmentation of the larger mammals (such as deer) undoubtedly was the result of human activity based on the large number of spiral fractures and impact points.

Of note, quite a bit of the expected artiodactyl skeletons was not well represented although fragments should have been quite visible and identifiable. Only six specimens were identified as rib fragments from medium/large mammals and artiodactyls. Only three vertebral and one pelvic specimen were identified. This indicates that these portions most likely were not transported to the site or were not processed in the areas of the site excavated. Only one hoof was recovered even though numerous foot and leg elements were recovered. This may indicate that hooves were taken with skins from the site.

The large artiodactyl specimens from the site are problematic. Bison is represented specifically by teeth only. Large artiodactyl is represented by long bone specimens but these were not of sufficient size to positively distinguish bison from elk and so the identifications were left at the more general level. It is likely that the long bone specimens are also from bison.

More troubling are the remains of carnivores at the site, including raccoon, fox, and coyote. These are almost entirely represented by teeth and associated dental elements. What roles these taxa played in relation to the human occupants of the sight are not certain.

Discussion

Analysis of the 4,388 specimens recovered from 41HY160 produced some interesting results. The assemblage is dominated by a large number of fragments from larger taxa, but most of the taxa recovered are smaller taxa, such as rabbits, rodents, turtles, and snakes. Extrapolating from the data available, the assemblage gives the impression of large game exploited in low frequency and small game exploited in a higher frequency. This is not an unreasonable hypothetical perspective as smaller game most likely was more readily and locally available. The lack of key elements for the larger artiodactyls indicates that these animals may not have been killed locally and that they have been butchered elsewhere with only portions of the carcass returned to the site. Of the skeletal elements that did make it to the site, many were processed for marrow.

Chapter 9

Plant Remains from 41HY160

J. Philip Dering

Introduction

CAS submitted 22 flotation samples for botanical analysis. This chapter presents a description of the plant materials from the site, and examines the archaeobotanical assemblage in the context of other assemblages recovered from sites in the region. Included in this data are the identification of seeds and wood fragments.

Methods

The analysis follows standard archaeobotanical laboratory procedures. Each flotation sample is passed through a nested set of screens of 4 mm, 2 mm, and 0.45 mm mesh and examined for charred material and separated for identification. Because of the high rates of deterioration at most open archaeological sites in North America, including those located in arid regions, only carbonized plant materials are considered to be part of the archaeological record. Charred wood caught on the 4mm and 2 mm mesh screens is separated for weighing, counting, and identification. Carbonized wood from the 4 mm and 2 mm screens (smaller pieces are seldom identifiable) were separated in a grab sample and identified. The material caught on all of the sieve levels, including the bottom pan, was scanned for floral parts, fruits, and seeds. Identification of carbonized wood samples was accomplished by using the snap technique, examining them at 8 to 45 magnifications with a hand lens or a binocular dissecting microscope, and comparing them to references in the archaeobotanical herbarium.

The anatomy of some woods is so similar that it is very difficult to identify to the genus level. In other cases, genera within a plant family are usually distinguishable, but some of the archaeological material is often too fragmented or deteriorated to allow identification to the genus level. For these reasons, I combine some taxa into wood types. All identifications in the "type" category represent identifications to the taxon level indicated by the name of the type. The following wood types or categories are used:

Willow/Cottonwood Wood Type (Salicaceae)—Includes members of the Salicaceae, willow and cottonwood, which are difficult to distinguish by genus.

Juniper/Cypress Wood Type (Taxodiaceae)—Includes hawthorns, wild plums, and wild peaches. Small fragments of the wood when charred are difficult to distinguish.

Indeterminate Hardwood—Refers to any woody seed-bearing plant, i.e., not a cone-bearing tree such as pine, cypress, or juniper.

Results

Archaeobotanical Assemblage

The samples were recovered from two areas of the site. Fifteen samples came from Core D, from about 6.6 meters below surface to a depth of 8.7 meters below surface. Excavation Unit 4 contained several features from which seven flotation samples were analyzed. The botanical materials from these two sampling areas were quite different both in a qualitative and a quantitative sense.

Most of the plant material in Core D is not carbonized. Usually, uncarbonized plant material is not considered part of the archaeological record because deterioration occurs within a few years of deposition. However, because of the depth of the core and the presence of waterlogged sediments, there is a possibility that this material is contemporaneous with the archaeological deposits at the site. The samples in Core D contained 105 seeds and 24 seed fragments, none of which were charred. In addition, acorn fragments (n=3) were noted from FS 9 and 12. Twelve carbonized wood fragments weighing .3 gram occurred in the core. By contrast, most of the small amount of material identified from Unit 4 was carbonized. Identified botanical material from Unit 4 included one charred cheno-am seed and seven charred wood fragments.

Core D

Results from Core D samples are presented in Table 9-1. These are correlated to Depositional Unit A (see Chapter 6) and date to 9585±40 B.P. (10,940 cal. B.P.) or older. Eleven different taxa are represented in the samples, including potentially economic seeds of goosefoot, hackberry, prickly pear, grape, and acorn fragments. None of the seeds were carbonized. A few fragments of charred wood were recovered from Samples 8 and 9. There are seeds present throughout the core, but these are not distributed evenly. The analyzed portion of the core measures approximately 212 cm. If we divide it into four roughly 50 cm sections, we can see that the majority of the seeds are concentrated in the middle portions of the core. There are only two seeds in the top 50 cm, but below that level seed abundance rises significantly. In the second 49 cm (712-761 cm) there are 42 seeds, and in the third 58 cm section (761-819 cm) the number of seeds rises to 87. Only 25 seeds were noted in the bottom section of the core below the 819 cm level.

Unit 4

Table 9-2 contains the results of the analysis from Unit 4. The seven samples contained a single Cheno-am seed and seven fragments of wood charcoal. One of the fragments was oak, and two were of the juniper/cypress wood type. All of the identified plant material from Unit 4 was carbonized.

Analysis and interpretation of field notes has indicated that Features 3, 7, and 9 are all part of a slab-lined hearth that has been re-designated Feature 3; hence samples U4 1–5 are from the same feature. This is a nearly intact fire-cracked limestone cobble feature, with tabular limestone lining the base of a 50-cm deep pit. A radiocarbon assay yielded an age of 3300±40 B.P. This is the feature from which we recovered the single cheno-am seed. Although a single cheno-am seed does not constitute very hard evidence for bulk processing of this resource, it suggests that some cheno-am processing occurred in the slab-lined feature.

Feature 11 (combined from Features 11 and 12) was a fire-cracked limestone cobble concentration. A single radiocarbon assay from the feature produced a Middle Archaic age (4325±45 B.P.). Carbonized wood recovered from

Table 9-1. Plant materials from Core D.

FS No.	Depth	Taxon	Name	Part	Count	Wt (g)	Carbonized
1	661-688	*Celtis* sp.	Hackberry	Nutlet	2		no
2	688-700	No Plant Remains					no
3	700-712	No Plant Remains					no
4	712-722	Cheno-am	Goosefoot/Pigweed	Seed	1		no
5	722-729	No Plant Remains					no
6	729-739	No Plant Remains					no
7	739-749	*Vitis* sp.	Grape	Seed	2		no
7	739-749	Indeterminate		Root fragments		0.3	no
8	749-761	Indeterminate		Wood	5	0.1	yes
8	749-761	Indeterminate		Vesicular material		0.7	no
8	749-761	*Vitis* sp.	Grape	Seed	4		no
8	749-761	Cheno-am	Goosefoot/Pigweed	Seed	20		no
8	749-761	*Verbesina* sp.	Crownbeard	Seed	1		no
8	749-761	Compositae	Sunflower family	Seed	1		no
8	749-761	*Potamogeton* sp.	Pondweed	Seed	1		no
8	749-761	Poaceae	Grass Family	Culm	1		no
8	749-761	Cyperaceae	Sedge Family	Seed	6		no
9	761-774	*Quercus* sp.	Oak	Wood	7	0.2	yes
9	761-774	*Quercus* sp.	Oak	Acorn fragment	1		no
9	761-774	Indeterminate		Root fragments		0.8	no
9	761-774	Indeterminate		Leaf fragments		0.1	no
9	761-774	Cyperaceae	Sedge	Seed	1		no
9	761-774	Cheno-am	Goosefoot/Pigweed	Seed	12		no
9	761-774	*Vitis* sp.	Grape	Fragment (seed)	3		no
10	774-785	Cheno-am	Goosefoot/Pigweed	Seed	6		no
10	774-785	*Vitis* sp.	Grape	Seed	5		no
10	774-785	Indeterminate		Leaf fragments		0.3	no
10	774-785	Indeterminate		Root fragments		0.1	no
11	785-797	Indeterminate		Fragment (seed)	12		no
11	785-797	*Vitis* sp.	Grape	Seed	7		no
11	785-797	*Acalypha* sp.	Copper leaf	Seed	3		no
11	785-797	Cheno-am	Goosefoot/Pigweed	Seed	4		no
11	785-797	Cyperaceae	Sedge	Seed	5		no
11	785-797	Indeterminate		Root fragments	0.3		no
12	797-819	*Quercus* sp.	Oak	Acorn	2		no
12	797-819	*Quercus* sp.	Oak	Leaf fragment	5		no
12	797-819	*Paspalum* sp.	Grass	Seed	1		no
12	797-819	*Opuntia* sp.	Prickly Pear	Seed	1		no
12	797-819	Cheno-am	Goosefoot/Pigweed	Seed	12		no
13	819-837	Cyperaceae	Sedge	Seed	6		no
13	819-837	Indeterminate		Vesicular material		0.5	no
13	819-837	Indeterminate		Root fragments		0.4	no
13	819-837	Indeterminate		Leaf fragment		0.1	no
14	837-851	Cheno-am	Goosefoot/Pigweed	Seed	4		no
14	837-851	Cyperaceae	Sedge	Seed	2		no
15	851-873	Indeterminate		Vesicular material	4		no
15	851-873	Poaceae	Grass Family	Fragment (seed)	9		no

Table 9-2. Plant materials from Unit 4.

Sample No.	Feature	Level	Depth	Taxon	Name	Part	Count	Wt (g)
U4-1	3	9	90-94	No Plant Remains				
U4-2	3	9	90-100	No Plant Remains				
U4-3	7	--	105-110	Cheno/Am	Goosefoot or Pigweed	Seed	1	
U4-4	9	12	--	No Plant Remains				
U4-5	7	12	115-120	Indeterminate		Wood	4	0.1
U4-6	11	15	150-160	*Juniperus*/*Taxodium*	Juniper/cypress	Wood	2	<.1
U4-6	11	15	150-160	*Quercus* sp.	Oak	Wood	1	<.1
U4-7	12	16	160-170	No Plant Remains				

this context indicated that either juniper or bald cypress and oak were utilized as firewood.

Discussion and Ethnobotanical Overview

If the Core D plant materials are indeed contemporaneous with the cultural materials from 41HY160, then these materials present significant information regarding subsistence patterns of the region. There are five economically important plants recovered from the core, including goosefoot, hackberry and grape, prickly pear, and acorn fragments. In addition, a single carbonized cheno-am seed was recovered from Unit 4.

Acorns

The presence of pericarp fragments at 41HY160 suggests that acorns may have been utilized as a food source at the site. A total of three acorn fragments were recovered from two samples, FS 9 and 12. It is quite possible that acorns played an important part in Archaic and Late Prehistoric subsistence in the region (e.g., Creel 1986) but direct evidence is not overwhelming. Acorns have been recovered from some other sites on the Edwards Plateau, including the Honey Creek site (41MS32), and 41BN63 in Bandera County (Dering 1997; 2002). The extensive literature that exists for the utilization of acorns in California suggests that oak processing often may not have encouraged accidental charring of acorns (see Gifford 1936 for summary of processing), one possible reason why acorn fragments are not often encountered in open sites.

In addition, there is not much evidence for baking acorns in earth ovens, perhaps the most common cooking feature in the region. Several references mention roasting either whole acorns or flour (Gifford 1936; Dixon 1907). However, most of the ethnographic observations note that heat or fire is often not used until the acorns are reduced to flour (Gifford 1936; Kroeber 1953).

Initial processing centered around the removal of tannic acid from the acorns. The process usually followed two procedural pathways, either burial of the whole acorn or leaching the flour (Gifford 1936:86). In one method mentioned specifically for live oaks, entire acorns were buried in the ground or in mud until they molded (Dixon 1907:426). In the other method, the meat was separated from the shell and then pounded into flour (Gifford 1936:86; Jackson 1991). Leaching of either whole acorns or the flour often would occur on the bank of a stream or other body of water, making the location of 41HY160 an ideal place to process acorns.

Cheno-am or Goosefoot

Cheno-am refers to the seed-like fruit (achene) of either Chenopodium (Goosefoot) or Amaranthus (Pigweed). The term is used when a seed is modified by carbonization, a process that often obscures some of the shape and surface sculpturing of the achene. The material from Unit 4, which is charred, has been assigned to the category cheno-am. The uncharred material from Core D can be assigned to the genus Chenopodium. For practical purposes, however, both plants serve roughly the same functions in the regime of a forager in the Edwards Plateau region. Both goosefoot and pigweed were utilized throughout their range in North America as a potherb (Bye 1981). The seeds of both genera, which are parched and ground into flour, have been important to many groups throughout the southwest, including the Zuni, Navajo, and the Papago (Russell 1908; Stevenson 1915; Vestal 1952). Some species of goosefoot are cool-season plants, setting seed in the spring after winter growth (Bohrer 1991).

Prickly Pear

A single prickly pear seed was recovered from Core D. This tremendously important economic plant was utilized by Native Americans throughout its range. In Texas, prickly pear has been noted in archeological deposits in the northern, central, southern, and western reaches of the Edwards Plateau, including the Honey Creek site (41MS32), 41MK8 in McCullough County, 41VV1897 in northern Val Verde County (Dering 2002), and dozens of rock shelter sites in southern Val Verde County (Dering 1999; Irvin 1966).

Although prickly pear was considered to be of utmost importance to many groups throughout the Southwest and Mesoamerica, there are very few ethnohistoric notations of its use in Texas. Cabeza de Vaca describes how the Mariames preserved prickly pear fruit by squeezing, splitting, and drying the fruit. The same source describes roasting prickly pear pads and green tunas (fruit) without describing how the oven was constructed (Favata and Fernandez 1993 [1555:72, 84]). My experiments demonstrate that green prickly pear fruit requires earth oven baking for at least 12-15 hours, so the term "roast" is probably not functionally accurate.

Hackberry and Grape

Both hackberry and grape are mid-to-late summer fruits that were utilized by most Native American groups. Although neither made a major contribution to the diet, they were added to many meals. Unlike acorns or prickly pear, there are no references to the mass processing of grapes and hackberry into a storable long-term carbohydrate source. Grapes were eaten fresh or dried for temporary storage by several groups throughout the Southwest (Palmer 1878:616; Havard 1884:104; Hedrick 1919:599). Hackberry fruits/nutlets were pounded into powder and added to other foods by several Plains groups (Gilmore 1977:24).

Conclusions

The carbonized material from Unit 4 is unquestionably archeological in nature. The cheno-am seed and the wood charcoal from Feature 3 suggests seed parching or processing using hot coals. The juniper/cypress and oak wood from Feature 11 also indicates utilization of both oak and juniper or bald cypress wood as fuel. The antiquity of the botanical material from both Features 3 and 11 is suggested by radiocarbon ages from these contexts that places Feature 3 in the latter part of the Middle Archaic Period and Feature 11 in the Late Archaic Period.

The uncarbonized archaeobotanical assemblage from 41HY160 presents a special case. At open sites throughout North America it is normal procedure to consider only carbonized plant material to be part of the archeological record (Miksicek 1987). The only exceptions to this "open site" rule are plants that are kept in anaerobic conditions, especially waterlogged conditions. The deeply buried nature of the site and the presence of springs suggests that 41HY160 may meet these conditions. If this is the case, then the archeological record indicates that the area was occupied periodically during the late spring/early summer and later in the late summer/early fall seasons. The goosefoot seeds could come available earlier in the growing season, and prickly pear and acorns are ready to eat later in the growing season.

Chapter 10

Chipped, Ground and Hammered Stone, and other Materials Recovered

David L. Nickels and Jimmy E. Barrera

Introduction

This chapter describes the culturally altered lithic material collected from hand excavated units during this project. The purpose of this chapter is to highlight the overall tool assemblage; selected pieces found in association with features will be discussed in Chapter 11: Analysis of Cultural Features. A total of 18,378 pieces of chipped stone, 2 pieces of ground stone, 1 hammerstone, and varia (miscellaneous) items were recovered during the excavations (Appendix A).

Chipped Stone

During the analysis, the chipped stone artifacts were subdivided into the following classes: projectile points (n=18), bifaces (n=82), unifaces (n=213), cores (n=19), and unmodified debitage (n=18,046). After artifacts were catalogued, classes were analyzed according to a variety of attributes. The attributes provided a thorough technological and morphological characterization of the lithic assemblage at the site. The attributes for each class are defined below.

Projectile Points

Projectile points are one of the more important artifact categories because they can provide information on cultural affiliations and chronology. For projectile points, the following attributes were recorded: raw material type, raw material quality, burning, projectile point subgroup, projectile point type, serration, beveling, completeness, break type, maximum length, blade length, blade width, haft length, neck width, base width, and maximum thickness. Finally, all specimens were exposed to ultraviolet light to evaluate raw material source.

The eighteen projectile points found were classified into the following subgroups: arrow point, dart point, or dart point preform. In this system, preforms are recognizable as a stage of projectile point manufacture in that they have barbs and/or shoulders but were not completed, and they can be classified as a type (e.g., Marshall preform [Bradley 1975]).

The projectile points and preform were then assigned to a projectile point type based on the commonly accepted point typology developed for Central and South Texas (e.g. Turner and Hester 1999), and classified into types by Steve Tomka and Elton Prewitt. Points which could not be assigned with confidence to a previously established type were coded as "untypable," a designation generally reserved for fragmentary specimens lacking enough diagnostic attributes to determine their size or shape (see Table 10-1). One point was coded as "untyped"; it has enough diagnostic attributes to establish it as a type, but those attributes do not fit into any of the previously defined projectile point types.

If a point was incomplete, the break could be coded as either use/resharpening related, manufacture, post-depositional, or indeterminate. Length and width measurements were made only for those dimensions that were complete.

Tables 10-1 and 10-2 provide data on the projectile point assemblage, and Figures 10-1 and 10-2 show the points recovered during this project. All but two are made of fine-grained chert, and all but two have been burned or were otherwise exposed to intensive heat. Additional data including dimensions, results of ultraviolet light evaluations, and detailed provenience information were also recorded. The points were assigned Unique Item (UI) numbers in the lab.

Arrow Point

Perdiz (700-250 B.P.)

Although there is a wide variation in Perdiz arrow points, they are triangular in shape, usually exhibiting well-barbed shoulders and a contracted stem. In Central Texas Perdiz points are diagnostic to the Toyah phase of the Late Prehistoric interval, approximately 700-250 B.P. (Collins 1995).

UI 8–Perdiz

The only Perdiz recovered during this project (UI 8) was found in Unit 5, Level 6. Its distal end is missing, and its right barb (from a dorsal view) has been broken off, likely during its manufacture. The opposite side is well-barbed, and its slightly contracting stem is broad with a convex base (Figure 10-1a).

Table 10-1. Projectile points recovered during this project.

Point Type	**No.**
Perdiz	1
Marshall	2
Marshall-like	1
Marshall preform	1
Pedernales-Marshall transition	2
Pedernales	4
Travis	1
Untypable dart points	5
Untyped dart point	1
Total	**18**

Dart Points

Marshall Points (2300-2100 B.P.)

The blades of Marshall points "vary from triangular with straight sides to oval with markedly convex edges. Shoulders are always barbed and the barbs are often on line with the base. Notches are usually basal and vary from narrow to broad, and stems vary from square to slightly expanding, often short compared to the length of the blade. Bases are concave or straight to slightly convex, although Turner and Hester (1999:149) exclude convex bases from their type definition" (McKinney et al. 2001:157). Marshall points are most frequently dated between 2300 and 2100 B.P. on the eastern edge

Table 10-2. Projectile point data.

UI#	Unit	Level	Depth (cm bs)	Feature	UV Color	Mat Type	Grain Size	Burn	Point Type	Serr	Bevel	Compl	Break	Max Length	Blade Length	Blade Width	Haft Length	Neck Width	Base Width	Max Thick	Max. Width	Stem length	Color	Blank Type	Remarks
20	4	10	100-110	3	DY	1	1	1	Marshall preform	0	0	1	-	74.3	-	-	-	17.3	19.9	11.7	44.3	13.1	10YR5/2; gray brown	1	unfinished
13	4	9	90-100	3	O	1	1	2	Pedernales - Marshall	0	0	2	2	-	-	-	-	16.2	15.5	6.6	29.4	13.5	7.5YR5/2; pinkish gray	1	unfinished
16	4	12	120-130	3	P	1	1	1	Pedernales	1	0	2	2	-	-	-	-	23.2	20.7	-	-	-	10YR3/2; dark gray	3	heat spawled
14	4	14	140-150	none	DB	1	1	1	untypable	0	0	2	2	-	-	-	-	18.7	20.8	6.7	32.2	11.1	10YR3/2; dark gray	1	not completely corner notched
19	4	11	119	3	DO	1	2	1	Pedernales	1	0	1	-	47.7	-	-	-	19.8	17.1	10.1	32.3	15.7	10YR4/1; gray brown	1	unfinished
18	4	12	120	3	DY	1	1	1	Travis	0	0	2	2	-	-	-	-	20.6	18.0	8.2	30.0	18.0	10YR3/2; dark gray	1	unfinished
11	5	11	100-110	none	DY	1	1	1	Pedernales	0	0	2	2	-	-	-	-	22.9	20.5	-	-	-	10YR5/1; gray	3	
10	5	10	90-100	4	Y	1	1	1	untypable	0	0	2	2	-	-	-	-	-	16.9	-	-	-	10YR8/1; whitish	3	
9	5	9	83	4	DB	1	1	1	untypable	0	0	2	2	-	-	-	-	23.6	21.7	10.1	34.8	8.3	10YR3/2; dark gray	1	
12	5	12	110-120	8	DO	1	1	1	Marshall-like	0	0	2	1	-	-	-	-	17.1	19.0	8.9	-	16.3	10YR4/1; gray brown	1	
21	5	16	150-160	none	DO	1	1	1	untypable	0	0	2	1	-	-	-	-	-	-	6.0	-	-	10YR5/1; gray	1	
8	5	6	50-60	none	O	1	1	2	Perdiz	0	0	2	2	-	-	-	-	8.3	6.7	3.0	-	12.0	7.5YR 6/2; pinkish gray	1	broad stemmed
7	6	9	80-90	1	DO	1	1	1	Marshall	0	0	1	-	67.7	37.1	36.5	30.6	23.5	21.6	10.7	-	20.3	10YR6/3;light brown	1	both barbs broken off
5	6	12	110-120	none	DO	1	2	1	untypable	1	0	1	-	56.8	26.1	24.3	30.7	18.2	19.5	10.8	31.3	21.8	10YR4/1; gray brown	3	
3	6	15	140-150	none	DO	1	1	1	untyped	0	1	1	-	68.5	44.6	15.8	23.9	12.5	16.2	9.1	17.2	17.8	10YR3/3; brown	3	
4	6	13	120-130	none	DO	1	1	1	Pedernales - Marshall	0	0	1	-	37	18.5	19.7	18.5	17.5	16.8	7.4	-	12.7	10YR5/2; gray brown	1	one barb broken off
6	6	8	70-80	1	DO	1	1	1	Pedernales	0	0	2	2	-	-	-	-	-	21.5	-	-	20.1	7.5YR 6/2; pinkish gray	3	heat spalled; later post-dep break
1	Core C	unknown	unknown	none	DO	1	1	1	Marshall	0	0	2	1	-	-	-	22.7	18.0	19.9	6.5	-	11.9	10YR4/1; gray brown	1	battered from coring

Key:

UV Color: 1. DY- dull yellow
2. O- orange
3. P- purple
4. DB- dull brown
5. Y- yellow
6. DO- dull orange

Material Type: 1-Chert
2-Quartzite
3-Silicified Wood
4-Agate Jasper
5-Chalcedony
6-Other

Grain Size: 1-Fine (no inclusions)
2-Fine (w/inclusions)
3-Coarse

Burned: 0-No
1-Yes

Serriation: 0-Absent
1-Present
2-Indeterminate

Beveling: 0-Absent
1-Right
2-Left
3-Both
4-Indeterminate

Completeness: 1-Complete
2-Proximal
3-Medial
4-Distal
5-Longitudinal
6-Stem
7-Barb
8-Wedge
9-Indeterminate

Break Type: 0-None
1-Use/resharpening
2-Manufacturing
3-Post-depositional
4-Indeterminate

Blank Type: 1-Flake
2-Cobble
3-Indeterminate

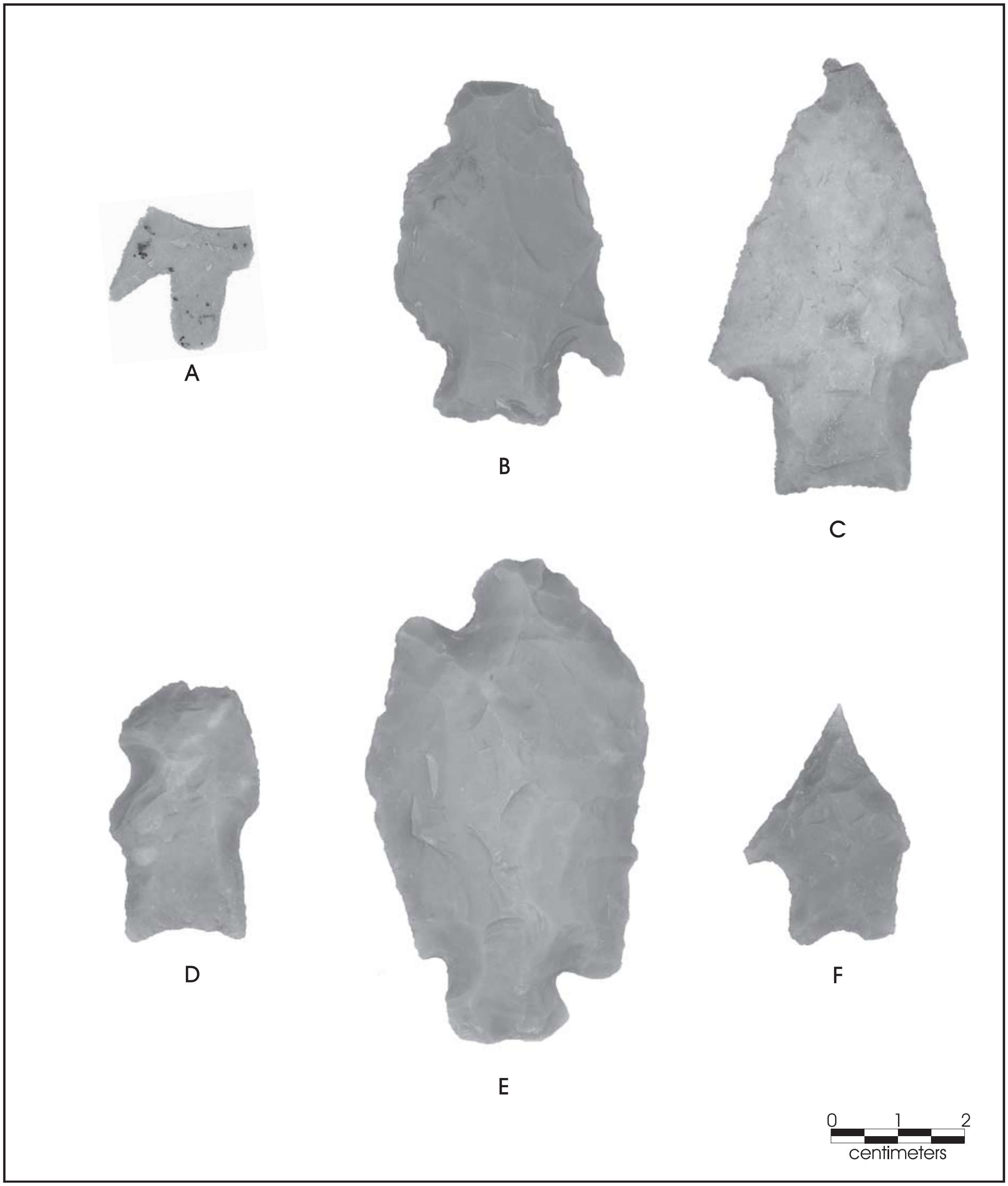

Figure 10-1. Projectile points recovered during this project: (a) Perdiz – Unit 5, Level 6; (b) Marshall – Core C backdirt pile; (c) Marshall – Unit 6, Level 9; (d) Marshall-like – Unit 5, Level 12; (e) Marshall preform or "practice point"; (f) Pedernales/Marshall transition – Unit 6, Level 13.

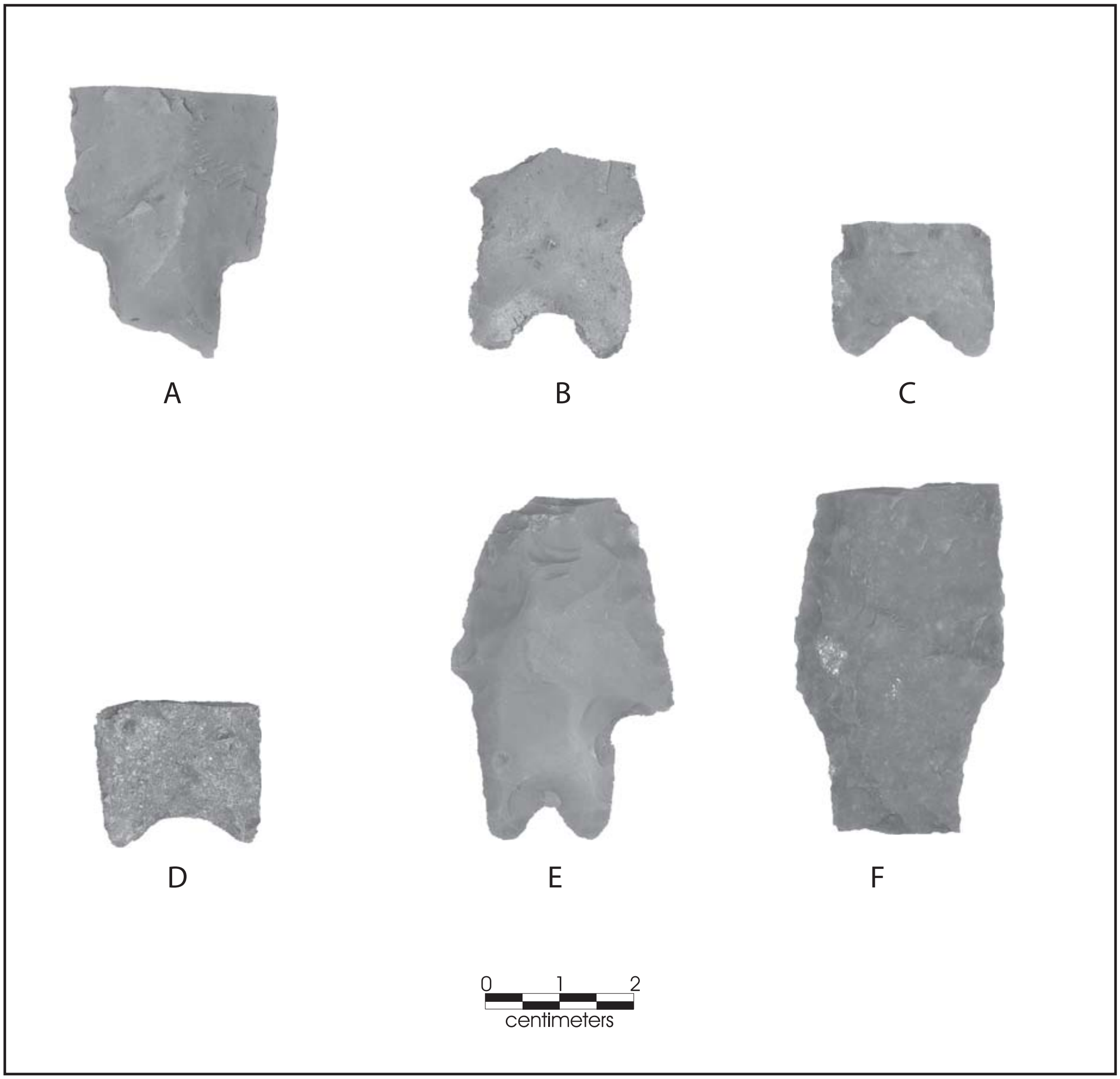

Figure 10-2. Projectile points recovered during this project: (a) Pedernales/Marshall transition – Unit 4, Level 9; (b) Pedernales – Unit 6, Level 8; (c) Pedernales – Unit 5, Level 11; (d) Pedernales – Unit 4, level 12; (e) Pedernales – Unit 4, level 11; (f) Travis – Unit 4, Level 12.

of the Edwards Plateau (Johnson and Goode 1994).

UI 1 – Marshall

UI 1 (Figure 10-1b) is a Marshall point collected from the backdirt pile of Core C. It is triangular in shape, with convex lateral edges, a slightly expanding stem, and originally a straight base. Its remaining barb was created as a result of corner notching. The core drill removed the other barb and notch, battered its ventral surface, and damaged the base. Edge-trimmed flakes along its right lateral edge on both its dorsal and ventral surfaces are evidence of resharpening. However, its distal tip is missing due to a resharpening failure.

UI 7 – Marshall

UI 7 (Figure 10-1c) is also triangular in shape, with straight lateral edges and a very thin distal end that gradually becomes thicker toward the shoulders. Complete except for two missing barbs, it has a straight stem, with a slightly concave, well-thinned base. According to Elton Prewitt (personal communication, April 2001), this specimen is a classic Marshall that has been nicely reworked, leaving a ridge on both faces from the reworking. It was found in Unit 6, Level 9.

UI 12 – Marshall-like

UI 12 (Figure 10-1d) has such extensive use damage along both lateral edges to its slight shoulders that it is difficult to identify as a type. It resembles a Zephyr base because of its slight edge smoothing, but unlike a Zephyr, its stem is not beveled. Given its other morphological characteristics and its excavated context from Unit 5, Level 12, it is most likely a Marshall (Elton Prewitt, personal communication, April 2001). Its stem is symmetrical, showing fine thinning flake removals, and a concave base. In addition, mineral accretions are adhered to the surface of this specimen.

UI 20 – Marshall Preform or "Practice Point"

According to Elton Prewitt (personal communication, April 2001), UI 20 is a Marshall practice point (Figure 10-1e), a form that is commonly found with completed Marshall points. It has a manufacturing failure along its distal end that has been deeply notched, constituting a practice piece. Its stem is typical Marshall size, although the stem expands moderately, getting toward Marshall expanding stem types. Although it has a slightly concave base, it is otherwise generally ovate in shape, formed from markedly convex lateral edges. Slight barbs have been formed by corner notching. This specimen was found in Unit 4, Level 10.

Pedernales/Marshall Transition Points (2700-2100 B.P.)

Two points (UIs 4 and 13) with characteristics of a Pedernales to Marshall technological transition were recovered. "Johnson (1995:202-206) demonstrated the close relationship among the Marshall, Pedernales, and Montell point types and postulates a Bulverde-Pedernales-Marshall-Montell/Castroville cultural continuum in the first part of the Late Archaic" (McKinney et al. 2001:157). Elton Prewitt (personal communication, April 2001) describes the Pedernales to Marshall transition as a temporal drift occurring against the Balcones Escarpment from San Antonio to Austin during the early part of the Late Archaic. Prewitt sees it as a gradual transition among a single social unit only in the corridor from San Antonio to Austin, in the Blackland Prairie to the Post Oak belt.

UI 4 - Pedernales/Marshall

UI 4 (Figure 10-1f) was found in Unit 6, Level 13. It is a Pedernales in transition to a Marshall that is missing part of one basal ear and has been heavily reworked (Elton Prewitt, personal communication, April 2001). This is a short (37 mm) point with one strong shoulder remaining that is barbed. Its stem is rectangular with a moderately deep basal concavity. Finally, it has a very sharp, needle-like distal end, with use wear along its slightly recurved lateral edges.

UI 13 - Pedernales/Marshall

UI 13 (Figure 10-2a) was found in Unit 4, Level 9. It is an unfinished specimen with slightly convex lateral edges and strong shoulders. Its stem is straight, with a concave base that has large basal thinning flakes removed from both sides. One basal ear is missing, and the distal end is missing due to a manufacture failure.

Pedernales Points (4250-2300 B.P.)

The Pedernales point is "one of the most common point types found in Central Texas, where they are frequently associated with burned rock middens" (Black and McGraw 1985:113; McKinney 2001:163). Their common occurrence in archaeological sites may be due to their supposed long span of manufacture, for perhaps nearly 2,000 years. "Thick, rectangular stems and deeply indented or bifurcated bases with a characteristic flake-scar pattern make up the most identifiable trait of the Pedernales dart point style (Black and McGraw 1985:113; Johnson 1995:200; Miller and Jelks 1952:175), a fortunate circumstance since Pedernales blades, though nominally triangular, in truth vary quite amazingly in size and shape." (McKinney 2001:163).

UI 6 – Pedernales

UI 6 (Figure 10-2b) is a Pedernales basal fragment that exhibits post depositional heat spalls and breakage. This proximal piece found in Unit 6, Level 8, has a slightly expanding stem that is deeply bifurcated, and has sub-cortex along its base.

UI 11 - Pedernales

UI 11 (Figure 10-2c) is a Pedernales stem with a deeply concave base. Although it is well-thinned, and has straight, slightly ground edges, it appears to have been broken while still in the manufacturing process. It was found in Unit 5, Level 11.

UI16 – Pedernales

UI 16 (Figure 10-2d) is a Pedernales stem collected from Unit 4, Level 12. It is straight, with well-trimmed lateral edges, a deeply concave base, and fluting flake scars. It exhibits a fracture due to extreme heat; presumably post-depositional damage.

UI 19 – Pedernales

UI 19 (Figure 10-2e) is a Pedernales point found in Unit 4, Level 11. Its rectangular-shaped stem has straight lateral edges, is deeply bifurcated, and exhibits fluting flake scars. One shoulder is lacking most of a barb, and the opposite shoulder is weak. Its distal tip has been broken off during use, and there is evidence of heavy use damage along the blade's distal portions.

Travis Point (4450-4000 B.P.)

Most recently, Travis points recovered from excavations at the Wilson Leonard site (41WM235) in Williamson County have been described as "rather elongate points [which] characteristically exhibit convex-edges blades that tend to converge into the stem area with little or no demarcation of shoulders…Stems are generally square to gently expanding, and basal edges may be dulled or lightly ground" (Dial et al. 1998:408). Collins (1995:376) approximates the age of Travis points in Central Texas to range between 4450 and 4000 B.P.

UI 18 – Travis

UI 18 (Figure 10-2f) is an unfinished Travis point that has a straight stem and base, but is lacking its distal point due to a manufacturing failure. Its generally straight lateral blade edges converge into the stem's very slight shoulders. It was collected from Unit 4, Level 12.

Untypable Points (Ages Indeterminate)

UI 5

UI 5 (Figure 10-3a) is an untypable Archaic-like dart point that has been reworked into a scraper. It is beveled to the left from a dorsal view, creating a scraper-like working edge; the opposite lateral edge is straight. A long flake scar is running down its ventral face, and the beveled edge is damaged from use. It has moderately strong shoulders, and a long, gently expanding stem. Its concave base contains cortex all along

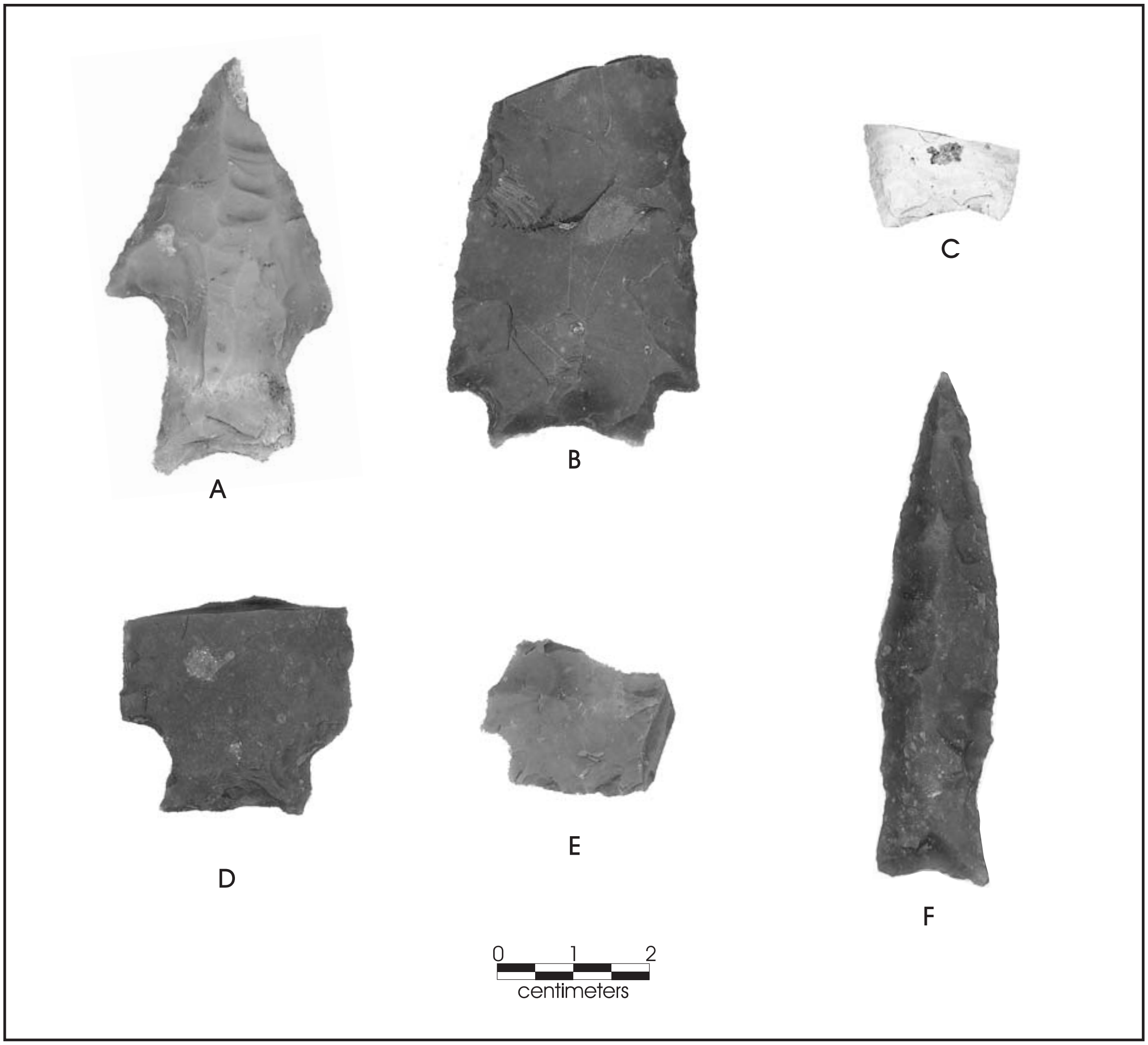

Figure 10-3. One untyped and five untypable points recovered during this project: (a) UI 5 – Unit 6, Level 12; (b) UI 9 – Unit 5, Level 9; (c) UI 10 – Unit 5, Level 10; (d) UI 14 – Unit 4, Level 17; (e) UI 21 – Unit 5, level 16. Untyped point: (f) UI 3 – Unit 6, Level 15.

its basal edge. The stem is edge ground, thus it is definitely not a Marshall; edge grinding occurs all through the Archaic in Texas. An example is the Late Archaic, Zephyr point (Elton Prewitt, personal communication, April 2001). This point was collected from Unit 6, Level 12.

UI 9

UI 9 (Figure 10-3b) is an unfinished, untypable point probably unfinished due to a possible manufacturing error. This thick (10 mm) specimen contains knots and hinge fractures on both sides, and exhibits incomplete corner notching, suggesting that it could be a perform. In its unfinished form, it has slightly convex lateral edges, with strong shoulders and weak barbs. It has a very wide and short contracting stem, with a concave base. In addition, it has mineral accretions adhering to both sides. It was found 83 cmbs in Unit 5, Level 9.

UI 10

UI 10 (Figure 10-3c) is a proximal, base fragment of a dart point broken due to a manufacturing failure. The stem is contracting, with a moderately deep basal concavity. There is lateral smoothing on its edges, but there is too little of the specimen remaining to type it. It is too thick to be Paleoindian, and too wide for Angostura; its excavated context suggests that it is likely Pedernales (Elton Prewitt, personal communication, April 2001). It was found in Unit 5, Level 10.

UI 14

UI 14 (Figure 10-3d) is a proximal fragment that exhibits moderate shoulders and an expanding stem with a slightly concave base. It is not completely corner notched (Elton Prewitt, personal observation, April 2001), and its distal end is missing due to a large flake removal attempt that hinged, causing a manufacturing failure. It was found in Unit 4, Level 17.

UI 21

UI 21 (Figure 10-3e) is an untypable point collected from Unit 5, Level 16. It exhibits use damage along the distal portion of its lateral edges, and its distal tip is missing due to a use fracture. A large portion of one lateral edge of this specimen is missing due to a post-depositional fracture; however, the remaining lateral edge is straight, with a moderate shoulder, a short expanding stem, and a straight base.

Untyped Point

Although UI 3 resembles a Darl (Figure 10-3f), it exhibits only slight beveling on its stem, and is lacking beveling along its blade. Otherwise, it could conceivably be a Darl, but its workmanship is not that normally observed on Darls (Elton Prewitt, personal communication, April 2001). This specimen is long (68.5 mm) and narrow (17.2 mm), with slightly convex lateral edges that slightly taper to converge into an expanding stem. It has a concave base, and a dorsal ridge beginning near its distal tip and running nearly three-fourths of the length of the blade. It was found in Unit 6, Level 15 and this provenience would suggest that it may be contemporary with Nolan or Travis forms.

Non-diagnostic Bifaces

Methodology

Chipped stone artifacts that have been flaked on both sides of the same lateral edge are classified as bifaces (Figure 10-4a). The goal of analyzing non-diagnostic bifaces at 41HY160 was to evaluate the manufacturing technology that was occurring at the site. A total of 82 bifaces provides a credible sample size. Included in the assemblage are 11 complete specimens. Classified functionally, the assemblage also includes a crude end scraper and a chopper (Figure 10-4b). One of the bifaces is beveled. Three could be classified as quarry blanks (Figures 10-5c, d; 10-6b), and two are sub-triangular types (Figures 10-4c, d) very common on the Edwards Plateau (Elton Prewitt, personal communication, April 2001).

For each specimen, the following attributes were recorded: raw material type, raw material grain, burning, presence or absence of cortex, tool completeness, length, width, stage of reduction, and evidence for tool recycling. While the analytical data for each individual specimen is presented in Appendix F, Table 10-3 presents a compilation of data for the entire assemblage. Colors ranged from grayish white to yellowish brown and brown. Material type is not shown in the Table 10-3 because all were made from chert.

Raw material grain was simply noted as fine or coarse. Burning or heating was coded as either being present or absent, and was determined by

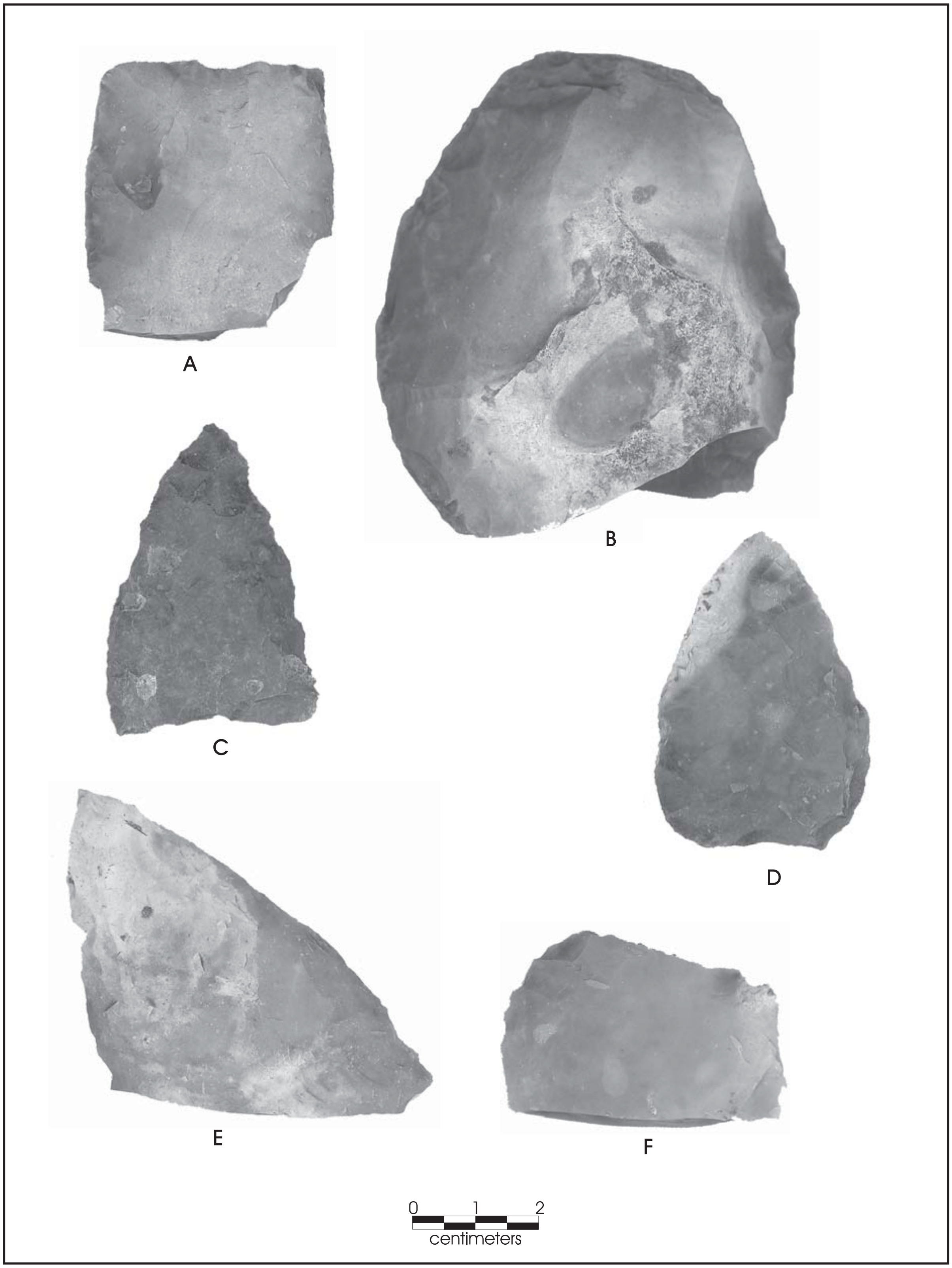

Figure 10-4. Selected bifaces from Unit 4, ordered by level: (a) typical biface, UI 30 – Level 11; (b) bifacial "chopper", UI 34 – Level 12; (c) sub-triangular biface, UI 33 – Level 12; (d) sub-triangular biface, UI 35 – Level 13; (e) typical biface, UI 37 – Level 13; (f) typical biface, UI 40 – Level 15.

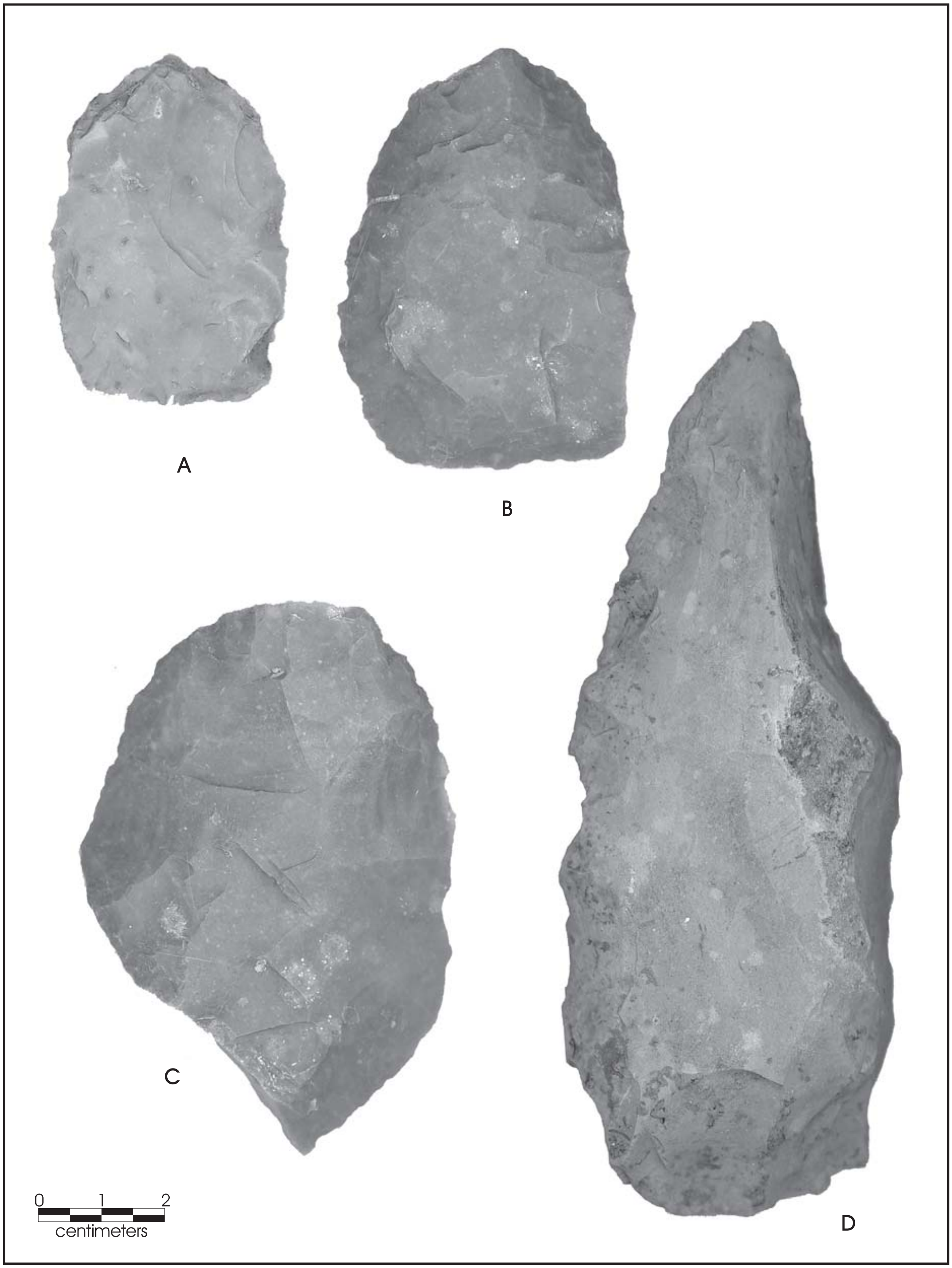

Figure 10-5. Selected bifaces from Unit 5, ordered by level: (a) typical biface, UI 50 – Level 8; (b) typical biface, UI 52 – Level 52; (c) quarry blank, UI 58 – Level 11; (d) quarry blank, UI 60 – Level 60.

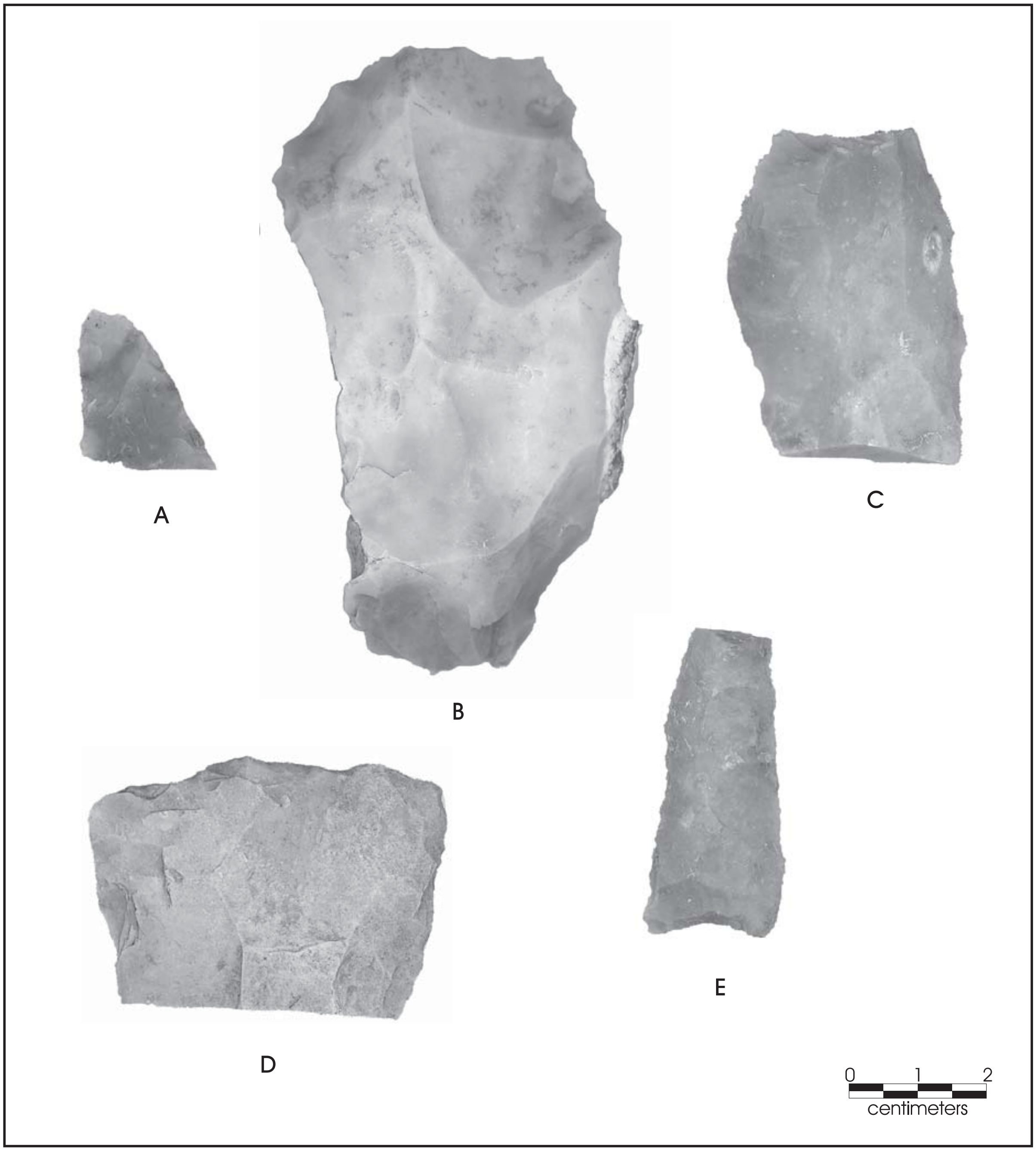

Figure 10-6. Selected bifaces from Unit 6, ordered by level: (a) typical biface, UI 74 – Level 4; (b) quarry blank, UI 75 – Level 6; (c) typical biface, UI 86 – Level 11; (d) typical biface, UI 90 – Level 12; (e) triangular drill, UI 98 – Level 15.

the presence of crazing, and/or discoloration with a waxy feel. Tool completeness was coded as either complete, incomplete, or indeterminate. All bifaces were measured to the nearest millimeter, Their attributes are summarized and discussed in the following paragraphs.

The stage of reduction of a biface was coded as either early, middle, late, or indeterminate (Collins 1975). To insure consistency, all bifaces were coded by the author. Early stage bifaces (n=15) usually retain a small to large amount of cortex and have relatively few flake removals, all of which were removed by hard hammer percussion. The edges of these bifaces are generally very sinuous when viewed in profile. Middle stage reduction bifaces (n=36) are typically thinner than early stage bifaces, have little or no cortex remaining, and have numerous flake scars, many of which may extend beyond the mid-line of the biface. The edges are less sinuous than those of early stage specimens. Late stage reduction bifaces (n=26) are thin, have no cortex, and have numerous flake scars. Most of the flakes from late stage reduction are removed by billet or soft hammer percussion. Flake scars are, therefore, relatively longer and more shallow than in early stage reduction. The edges of late stage bifaces are usually straight when viewed in profile. Five of the 82 bifaces were too fragmented to determine a stage of reduction, and were coded as "indeterminate".

Bifaces may be utilized at any stage in the reduction process. For example, artifacts functionally and typically classified as "choppers" are normally early stage bifaces with a cortex covered proximal end and a crudely flaked distal end. Their distal ends commonly show use-wear derived presumably from activities such as butchering and woodworking (Turner and Hester 1999). Three early or middle stage reduced pieces exhibited possible expedient use wear, and were likely used in this condition.

Biface shape was coded as either ovate, pointed-ovate, triangular, round, or indeterminate. The pointed-ovate form is characterized by a rounded or convex base with a pointed blade. A triangular biface has a pointed blade and straight base.

Break type was classified as manufacture, use, post-depositional, burning, or indeterminate. Manufacture breaks typically result from either lateral biface thinning failures or basal thinning failures (Tomka 1986). A common break type

Table 10-3. Biface attributes.

Grain Size	**No.**	**Blank Type**	**No.**
Fine	68	Flake	53
Fine w/inclusions	14	Nodule	1
Heat Treated or Burned?		Indeterminate	28
Yes	80	**Stage of Reduction**	
No	2	Early	15
Cortex Percentage		Middle	36
No Cortex	68	Late	26
<50% Cortex	14	Indeterminate	5
Mean Dimensions		**Shape**	
mean Length (mm) (n=11)	66.9	Ovate	5
mean Width (mm) (n=24)	40.0	Pointed-ovate	1
mean Thickness (mm) (n=48)	11.8	Triangular	12
Tool Completeness		Indeterminate	54
Complete	10	**Break Type**	
Proximal	21	Manufacturing	35
Medial	8	Use	15
Distal	7	Post-depositional	8
Longitudinal	2	Burning	9
Wedge	3	Indeteminate	4
Indeterminate	31		

associated with lateral biface thinning failures is known as a perverse fracture. Defined by Crabtree (1972:82), perverse fractures are easily identified by the twisting of the fracture plane on a rotational axis that corresponds to the direction of the force that initiated the fracture.

Use breaks commonly result from impact with a hard surface or material, or from prying (Tomka 1986). End shock, resulting in a transverse fracture, is caused when the elastic limits of the material are exceeded (Crabtree 1972:60). In replication studies, Tomka (1986:94) demonstrates that end shock type breaks result from using a biface to pry something, as well as from the suspended weight of the shaft when hafted bifaces were thrown with sufficient force to penetrate wood. Impact occasionally results in the removal of burin-like flakes along the lateral edge of a biface and/or crushing at the point of impact (Tomka 1986:94).

Post-depositional breaks are typically the result of force applied to the lateral surface of a biface. This results in a bulb of percussion originating not from the edge of the artifact, but from its face (Tomka 1986:96). Post-depositional breaks can result from numerous activities including natural and artificial factors.

Breaks resulting from burning are heat fractures, or pot lids, and are the result of differential expansion and contraction of the parent material. Unlike a fracture resulting from direct force on the material, as is the case with the removal of a flake, burning fractures and pot lids lack compression rings (Crabtree 1972:84).

Unifaces

Methodology

Stone tools that have been flaked on one surface are classified as unifaces. A total of 213 unifaces were recovered and classified during this project (Table 10-4). The degree of retouch for unifaces is a subjective category. The possible classifications are expedient, minimal, formal, and indeterminate. Expedient unifaces are flakes that have been modified through use, but not by intentional flaking or shaping. Without the use of a microscope, I scanned all 18,378 pieces of debitage for the presence/absence of expedient unifaces, finding a total of 148. Minimally retouched unifaces have not been drastically altered from their original form, but some flaking has been used to alter the shape of one or more of its edges; there are 60 within the assemblage. Five formal unifaces were also found. Formal unifaces include artifacts functionally classified as scrapers, gouges, or unifacial knives. One or more of their edges have been significantly shaped through the deliberate patterning of flake removals. Selected specimens of unifaces are shown in Figure 10-7.

Colors ranged from grayish white to yellowish brown and brown. Material type is not shown in Table 10-4 because all were made from chert.

Flake from Core E

A flake made from Edwards chert was recovered from Stratigraphic Unit A gravels in Core E at a depth of 7.14-8.53 meters below the surface (Figure 10-7d). This flake is 54.3 mm long, 34.3 mm wide and 11.2 mm thick. Much of the facetted platform and edges have been damaged recently from the drilling process. This is the oldest in situ cultural material recovered.

Ground and Pecked Stone

Ground Stone

Two pieces of ground stone were found; one milling slab fragment, and one mano fragment (see Figure 10-8). The limestone slab recovered from Unit 4 between 130-140 cmbd (centimeters

Table 10-4. Uniface attributes.

Grain Size	No.	Blank Type	No.
Fine	199	Flake	171
Fine w/inclusions	13	Blade	42
Coarse	1	**Modification Location**	
Heat Treated or Burned?		Distal End	38
Yes	137	Proximal End	1
No	76	1 Lateral Edge	141
Cortex Percentage		2 Lateral Edges	26
>50% Cortex	12	Lateral Plus Distal	10
<50% Cortex	201	Multiple	7
Mean Dimensions		**Edge Shape**	
mean Length (mm) (n=141)	36.8	Straight	59
mean Width (mm) (n=188)	20.7	Concave	34
mean Thickness (mm) (n=208)	5.4	Convex	95
Tool Completeness		Pointed	4
Complete	147	Multiple	21
Proximal	28	**Degree of Retouch**	
Medial	14	Expedient	148
Distal	17	Minimal	60
Longitudinal	5	Formal	5
Wedge	3	Burning	9
Indeterminate	31	Indeterminate	4

below datum) (Figure 10-8a) can be described as a flat- or concave-surface metate, or as a milling slab similar to those milling slabs illustrated from 41KM16, the Buckhollow Encampment, in Medina County (Johnson 1994:151-160). Although broken, this particular specimen is 103.2 mm long, 26.5 mm wide, and 26.5 mm thick at its thickest point. It is heavily encrusted with alkaline accretions, possibly hiding striations. Although its slightly concave dorsal surface is heavily coated with calcium carbonate, smoothed, rounded, and polished coarser granules are visible. This broken piece was apparently recycled as a tabular heating stone in the base of Feature 3, a slab-lined hearth (see Chapter 10).

Discolored from burning, a mano fragment (Figure 10-8b) was recovered near the base of Feature 3, two levels above the milling slab fragment described in the previous paragraph. The mano is also made from limestone, and is heavily encrusted with alkaline accretions. Although broken, it measures 88.9 mm long, 35.1 mm wide, and 49.2 mm thick at its thickest point. Definitive smoothing and striations are clear on its ventral surface, and what appear to be pecking marks are present on its outer sphere.

Hammerstone

A quartzite hammerstone (Figure 10-8c) was also found near the base of Feature 3 (see Chapter 11). It is a complete specimen, measuring 67.8 mm long, 59.4 mm wide, and 41.0 mm thick. It has deep pock marks, more so on one lateral edge and end than elsewhere.

Other Materials

The miscellaneous items we describe in this section are calcite and quartz crystals, and burned clay.

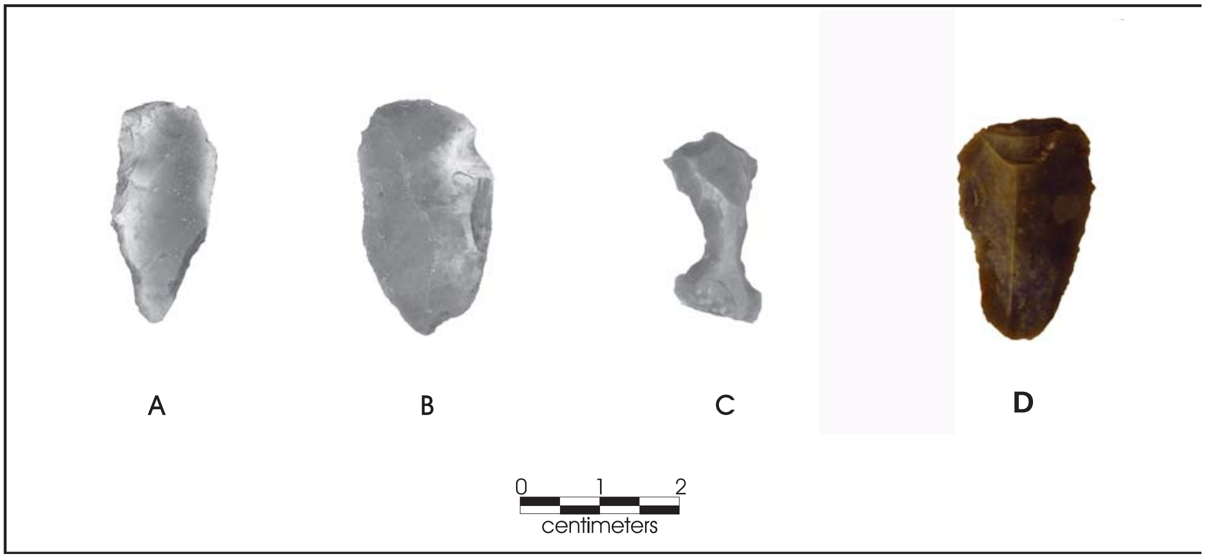

Figure 10-7. Selected unifaces: (a) Unit 6, 140-150 cm below datum (cmbd); (b) Unit 4, 140-150 cmbd; (c) Unit 6, 120-130 cmbd’ (d) Core E, 7.14-8.53 meters below surface, Stratigraphic Unit A.

Calcite Crystal

A small, prismatic, calcite crystal was found in Unit 6 between 150-160 cmbd. Its clarity has been dulled, it weighs 7.3 grams, and is 27.7 mm long. It is not culturally altered.

Quartz Crystal

A translucent piece of quartz crystal was found in the same unit and level as the calcite crystal described in the previous paragraph. It is 10.2 mm long and weighs only .7 grams. Only one flake out of the over 18,000 recovered during the excavations was made from quartz crystal.

Burned Clay

Chunks of burned clay weighing a total of 41.2 grams were recovered from Unit 6, between 120-130 cmbd. Although all were discolored in varying hues of red and gray, one piece appears to have an imprint of a piece of bark on its deeply reddened face. It cannot be determined whether the bark impression is natural or is the result of a daub mixture.

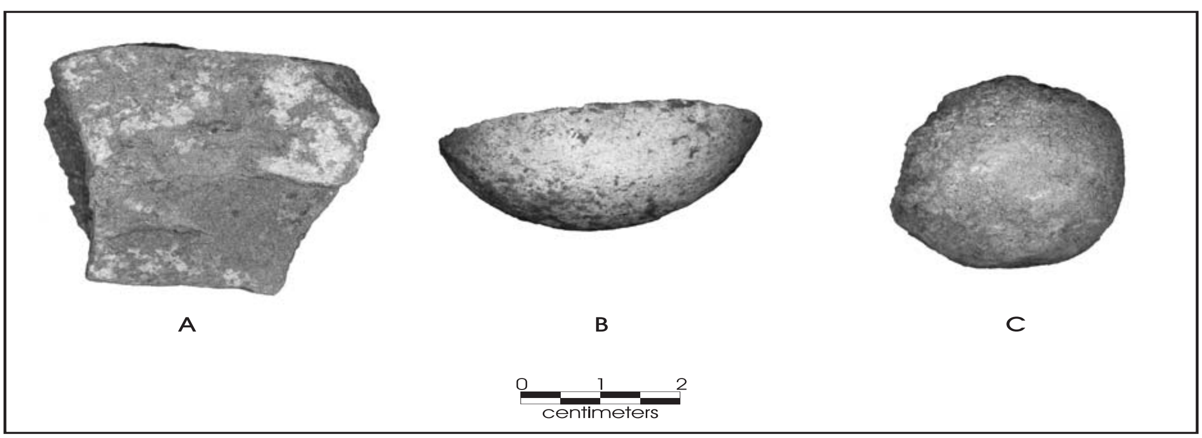

Figure 10-8. Milling stone, mano fragment, and hammerstone recovered from Feature 3: (a) milling stone fragment from Feature 3, 130-140 cmbd, (b) mano fragment from Feature 3, 110-120 cmbd, (c) hammerstone from Feature 3, 120-130 cmbd.

Chapter 11

Analysis of Cultural Features

David L. Nickels

Feature Excavations

Five unique features recorded in Units 4, 5, and 6 are listed in Table 11-1, and are described in this section. Data on the cultural remains discussed in connection with the features may be found in the accompanying appendices. Stereonet plots used in this discussion are duplicated from Wulf Gose's Appendix D to this report.

The reader will note that the feature numbers are not sequential. We liberally assigned feature numbers in the field with the approach that it's better to be a splitter than a lumper, and features are more easily combined than split once the fieldwork is complete and the units are backfilled. As such, after reviewing the data in the lab, we elected to combine feature numbers designated in the field. Features 1, 6 and 13 were combined as Feature 1. Although a scatter of bone, flakes, a tooth, and small FCR was assigned Feature 2 in the field, subsequent laboratory analysis indicated that there was nothing special about the scatter; it was not outside the norm of cultural material found in other levels and units, and thus Feature 2 was re-categorized as a non-feature. Feature 3, 7 and 9 were combined as Feature 3. Features 4 and 5 were combined as Feature 4. Features 8 and 10 were combined as Feature 8. Features 11 and 12 were combined as Feature 11.

Feature 1: Fire Cracked Rock Concentration – Unit 6

When the tops of fire-cracked rock were initially encountered 60 cmbs in Unit 6, they were designated as Feature 1. As excavation continued, additional fire- cracked rocks similar in size and quantity were uncovered in subsequent lower levels (see Table 11-2). During the excavation it was unclear whether the underlying fire-cracked rocks between 70 and 80 cm, and 80-100 were related, and thus they were designated as Features 6 and 13. However, as the rocks were analyzed in the laboratory, it became apparent that those from 60-100 cm were similar in size and quantity, and the plan maps and photographs showed no discretely distinct patterns between levels. That, along with the corroborating data from flakes, soil susceptibility, fauna, and snails suggest that

Table 11-1. Features and associated excavation units.

Feature No.	Unit	Depth (cm bs)	Description
1	6	60-100	FCR concentration
3	4	83-133	FCR, slab-lined hearth
4	5	80-100	FCR concentration
8	5	110-140	FCR concentration
11	4	154-170	FCR concentration

Table 11-2. Fire-cracked rock excavated from Unit 6.

Depth (cm)	**Feature**	**>8”**	**>7”**	**>6”**	**>5”**	**>4”**	**>3”**	**>2”**	**>1”**	**Totals**	**<1” Weight (grams)**
10-20										**0**	3.2
20-30										**0**	6.8
30-40					2	4		9	10	**25**	71.1
40-60					1	3	5	19	21	**49**	273
60-70	1				1	1	11	34	56	**103**	239.3
70-80	1				1	1	6	25	19	**52**	163.6
80-90	1					1	4	19	32	**56**	246.2
90-100	1				3	4	8	15	14	**44**	165.1
100-110		1	1	4	8	18	14	40	89	**175**	544.1
110-120							2	7	52	**61**	260.2
120-130							4	6	47	**57**	201.6
130-140				1		3	7	14	40	**65**	244
140-150							1	6	28	**35**	278.8
150-160							1	1	8	**10**	91.8
170-180						1	1	13		**15**	10.4
		1	**1**	**5**	**17**	**36**	**64**	**208**	**416**	**748**	**2799.2**

Features 1, 6 and 13 are one and the same, and hereinafter will be referred to as Feature 1.

Feature 1 is described as a loosely integrated scatter of fire-cracked limestone cobbles and oxidized clay (Figures 11-1 and 11-2) between 60-100 cmbs. Hearth stones spread approximately 40 cm vertically suggests that they may have been placed in a pit, however we saw no evidence of a pit in the rather homogeneous clays, nor were there tabular stones normally observed in slab-lined pit hearths (see for example, Nickels et al. 2001:45-118). Although the hearthstones had been scattered and were no longer in situ, the burned clay was reddened from oxidation, and provided a clear contrast to the surrounding, darker clay.

Cultural material recovered in association with Feature 1 included 2,241 complete and 3,985 incomplete flakes, 251 pieces of fire cracked limestone greater than 1-inch in size, 5,060 snails, and 368 grams of faunal material (see Table C5 for details). A wood charcoal fragmented dating to 3550±45 BP, and a Pedernales projectile point were found between 70-80 cmbs. A Marshall dart point was found between 80-90 cmbs. No flotation samples were analyzed as charred remains were not visible in the flotation sample.

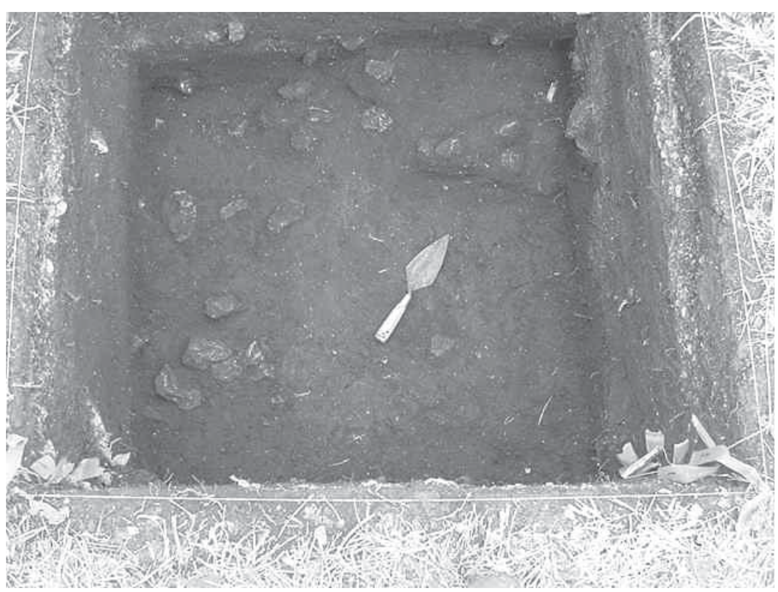

Figure 11-1. Fire-cracked rocks in Feature 1, Unit 6, at 80 cmbd.

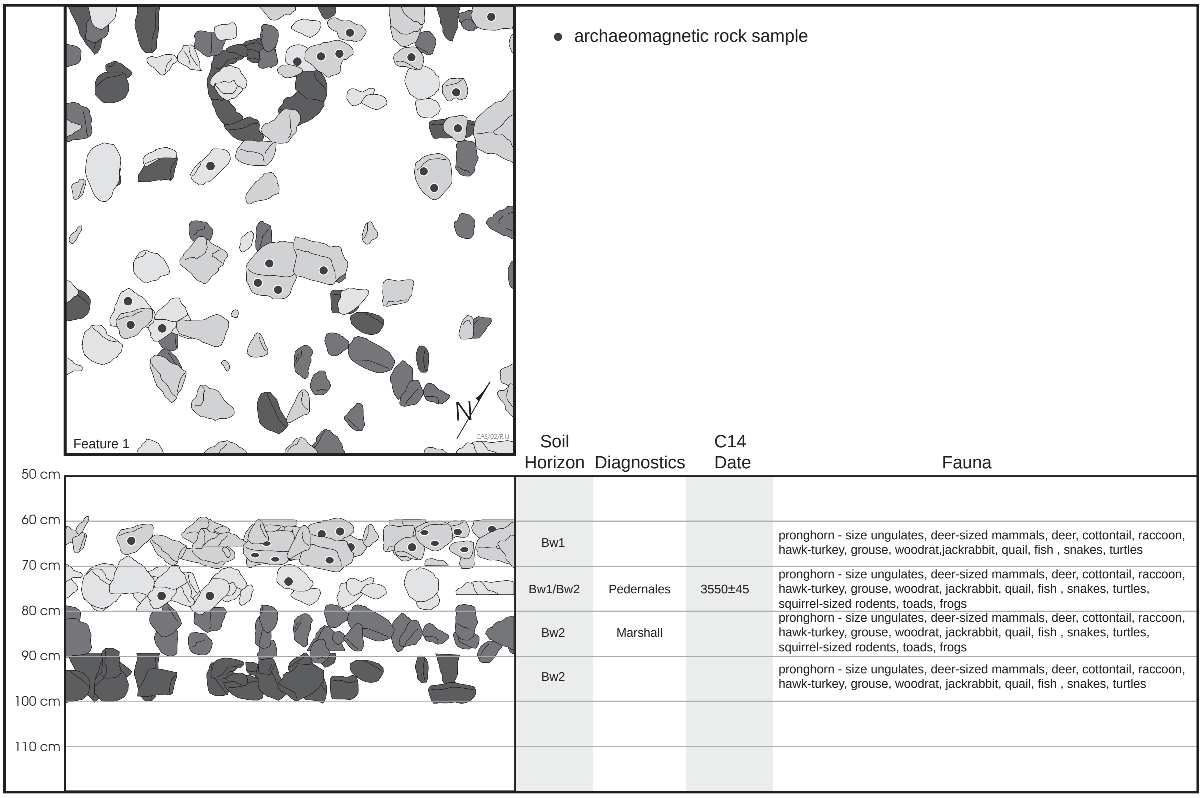

Figure 11-2. Feature 1 – Plan view and schematic profile of FCR views.

Archaeomagnetic Results

Based upon a review of their apparent context and suitability, a total of 13 archaeomagnetic core samples from 13 different rocks in Feature 1 were selected for analysis (Figure 11-2). A review of Figure 11-2 would seem to indicate two roughly in situ, circular patterns of fire cracked rocks in the north central and northeastern portions of the unit. Unfortunately, the archaeomagnetic data indicates that none of the 13 analyzed rocks were in situ (see Appendix D).

Feature 3: Slab-lined Hearth – Unit 4

Feature 3 (Figures 11-3 and 11-4) is described as a partially intact fire cracked limestone cobble

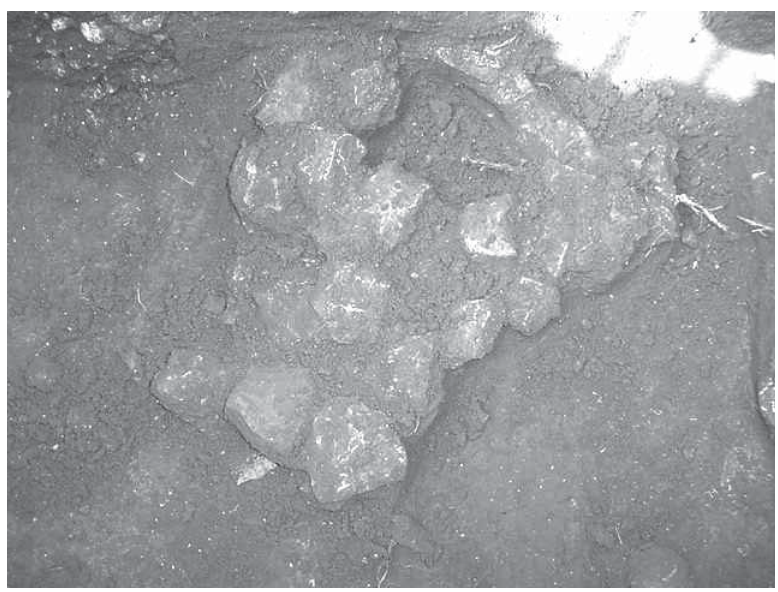

Figure 11-3. FCR in Feature 3, Unit 4, 110-120 cmbd. Note Travis point below rock at 120 cm.

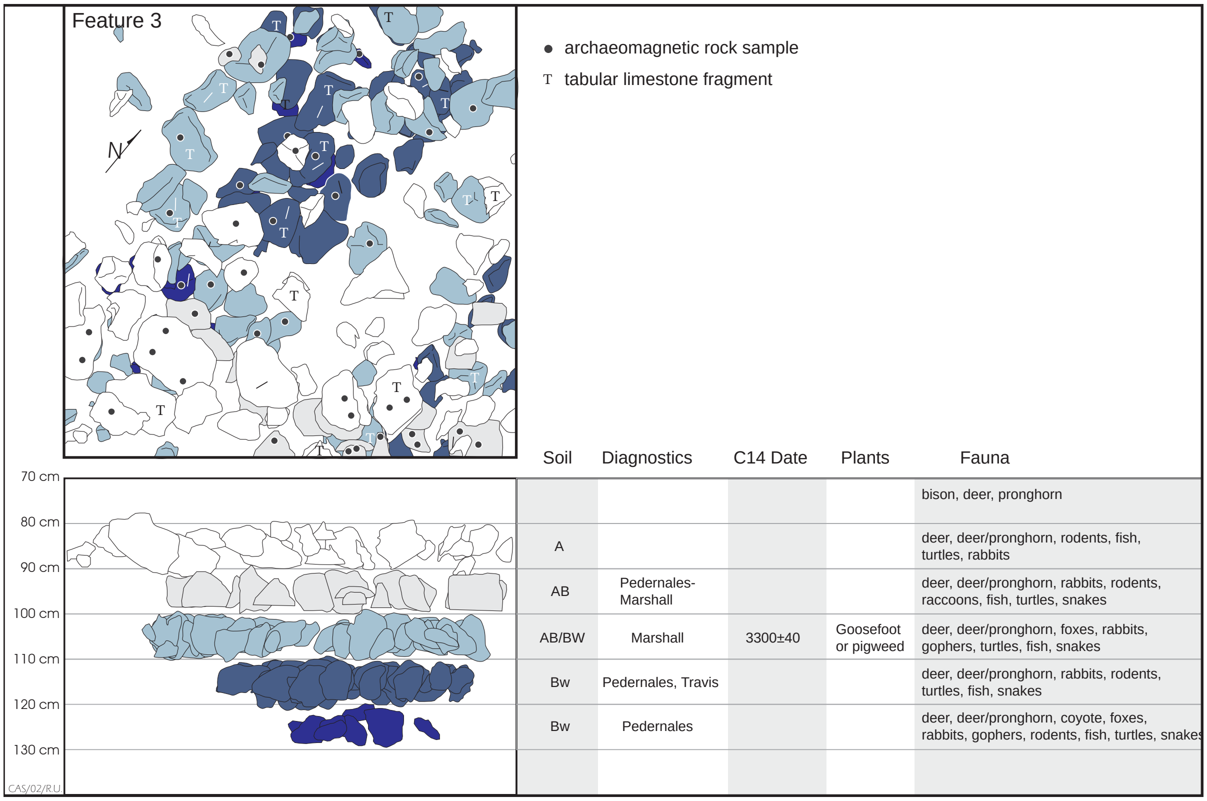

Figure 11-4. Feature 3 - Plan view and schematic profile of FCR outline taken from successive plan views.

feature with a basal tabular limestone lining inside a 50-cm deep pit between 83-133 cmbs. Although in overlain plan views, and when profiled in a schematic, the pit feature is readily apparent (see Figure 11-4), we saw no evidence of a pit in the field while excavating through the homogeneous clays. Diagnostic projectile points that can be associated with Feature 3 are a Pedernales, a Pedernales-Marshall transitional, and a Marshall.

Table 11-3. FCR excavated from Unit 4.

Depth (cm)	Feature	>8”	>7”	>6”	>5”	>4”	>3”	>2”	>1”	Totals	<1” Weight (grams)
10-20								1	1	**2**	43.8
20-30										**0**	3.2
80-90	3	1	1	2	5	9	9	43	188	**258**	1509.1
90-100	3			1	6	7	11	65	178	**268**	862.1
100-110	3			2	3	7	13	84	125	**234**	567.1
110-120	3			2	10	14	25	115	142	**308**	771.4
120-130	3						2	9	40	**51**	294.1
130-140							1	23	58	**82**	410.8
140-150								3	23	**26**	240.7
150-160					3	3	8	22	32	**68**	379.6
160-170					3	3	3	20	35	**64**	149.3
170-180							1	2	16	**19**	180.1
		1	**1**	**7**	**30**	**43**	**73**	**387**	**838**	**1380**	**5430.1**

Cultural material recovered in association with Feature 3 included 626 complete and 2,348 incomplete flakes, 1,119 pieces of fire cracked limestone greater than 1-inch in size Table 11-3), 3,613 snails, and 484.4 grams of faunal material (see Table C5 for details). In addition, a hammer stone, a mano and a tabular milling stone fragment that was apparently recycled for use as a heating stone within the base of the feature (see Chapter 11). A wood charcoal assay from 107 cmbs in Feature 3 dated to 3300±40 BP.

A single, charred cheno-am seed and an indeterminate species of charred wood were recovered from a flotation sample collected within Feature 3, between 105-110 cmbs. Phil Dering (see Chapter 9) suggests that the combination of these two specimens implies that cheno-am seeds (either goosefoot or pigweed) were being parched, or processed over hot coals. After parching, the seeds most likely would have been ground into flour. Most probably growing wild, the stems and leaves of cheno-am plants are known to have been used in historic times as both food and medicines (Castetter 1935).

Archaeomagnetic Results

A total of 42 archaeomagnetic samples were drilled from five different levels in Feature 3 (Table 11-4 and Figure 11-4).

Level 8 – The Top of Feature 3

A total of 12 samples representing eight rocks were analyzed from Level 8 (80-90 cmbd). The results of their being subjected to reheating and paleomagnetic analysis are shown in stereoplots in Figure 11-5. Of those, four samples representing three rocks (Numbers 25, 27, 28, 36) show evidence of being heated to in excess 550 ^{o}C, and have moved only slightly since they cooled in place after the last cooking event. Note that the rocks from which these samples came are relatively larger (Figure 11-4), suggesting they may represent the latest usage of the cooking feature. Had they been subjected to repeated usage, they likely would have fractured into smaller pieces. Of the remaining eight samples representing six rocks, seven might have been heated twice, with low temperature components ranging in temperatures from 200 ^{o}C to 400 ^{o}C, and high temperature components between 450 ^{o}C and 600 ^{o}C.

Of the 12 samples (eight rocks) that were heated to between 200 ^{o}C and 400 ^{o}C, eleven are generally in a grouped pattern when plotted on a stereo-net plot (see Figure 11-5), indicating that a few may have rotated only slightly since they were heated and allowed to cool. Notably, those rocks on the western edge of the hearth were heated to lesser temperatures than the rest of the hearths stones (Appendix D). One rock (Sample 33) has flipped upside down. Sample 29 is problematic; although it came from the same rock as Samples 27 and 28 which are relatively intact, Sample 29 does not group well with Samples 27 and 28. It could be that the sample moved during extraction after we measured its dip and angle, or we simply did not record the proper dip and angle.

Table 11-4. Archaeomagnetic samples analyzed from Feature 3.

Feature	Provenience	Sample No.
3	Level 8: 80-90 cm	24-33, 36-37
3	Level 9: 90-100 cm	38-47, 49-50
3	Level 10: 100-110	58-65
3	Level 11: 110-120	66-74
3	Level 12: 120-130	100-102

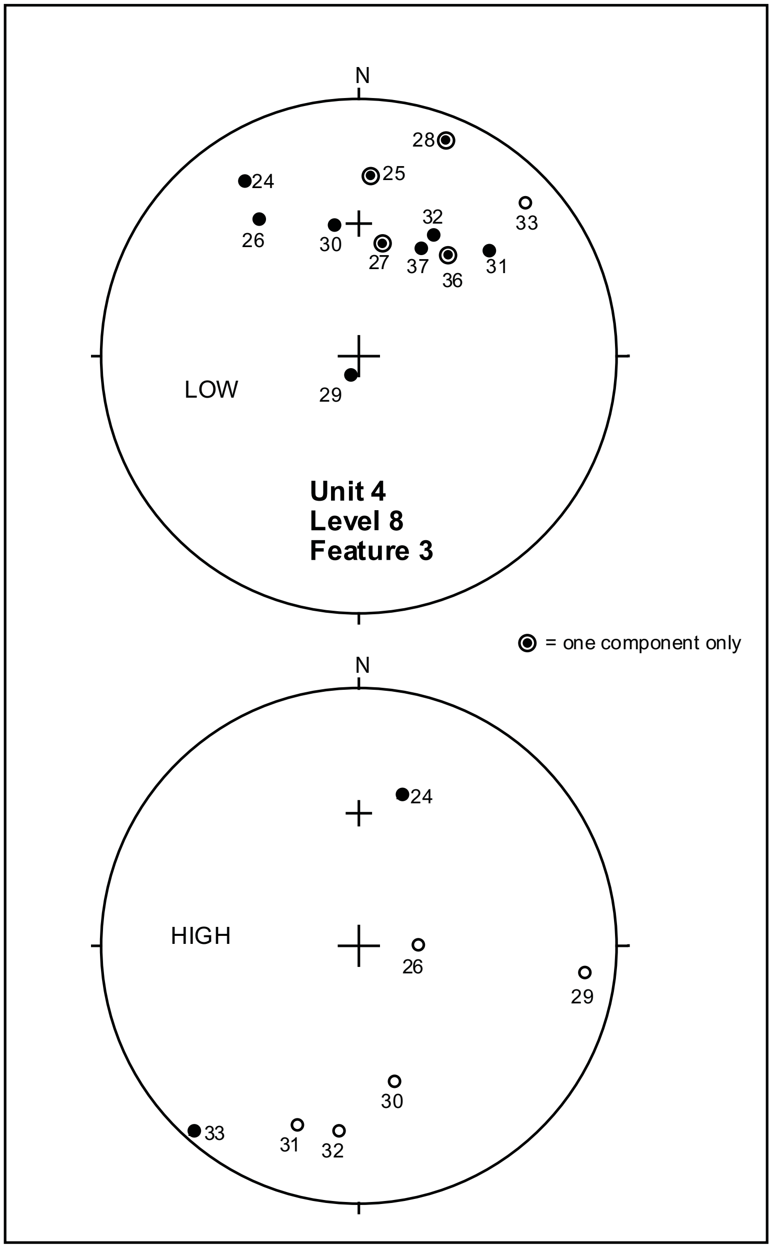

Figure 11-5. Stereonet plot for archaeomagnetic samples analyzed from Feature 3, Level 8, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

Of the seven samples that were heated in a campfire to between 450 °C and 600 °C, only one (Sample 24) has remained in situ. The others have both rotated away from their original alignment and flipped upside down (Figure 11-5).

Level 9 – Feature 3

A total of twelve samples representing ten different rocks were collected from Level 9 (90-100 cmbd). The results of their being subjected to reheating and paleomagnetic analysis are shown in stereoplots in Figure 11-6. Four of the twelve samples (Samples 43, 44, 46, 47), representing

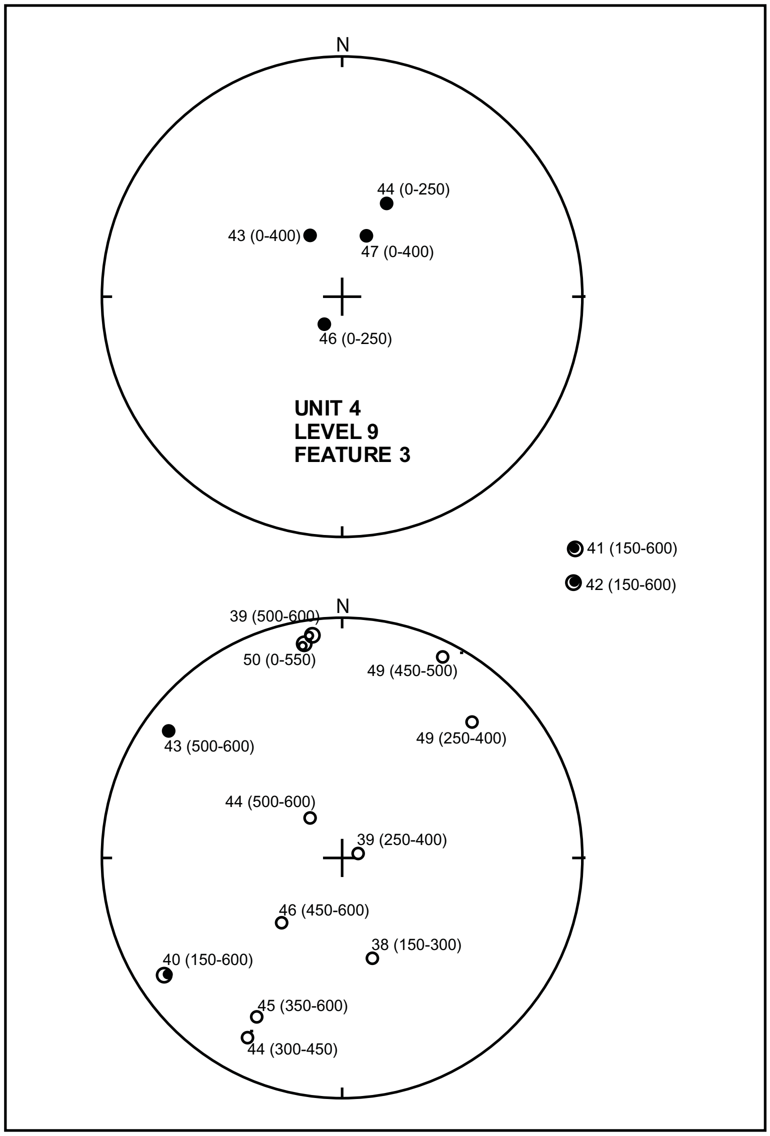

Figure 11-6. Stereonet plot for archeaomagnetic samples analyzed from Feature 3, Level 9, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

four rocks had been heated in a campfire to between 250 °C and 400 °C and three of these four (Samples 43, 44 and 47) have remained in situ since they cooled for the last time. Otherwise, the remaining hearthstones are generally scattered. Whether or not Samples 41 and 42 representing two of the larger rocks are in situ is unknown; both were broken off during drilling but were submitted for temperature information only.

Analysis of five of the twelve samples, representing five rocks (Samples 39-42, 50), indicates that they were subjected to one-time extreme heat in excess of 550 °C while in the campfire. The remaining seven samples, representing five rocks, provided evidence of multiple heating events (see Table 11-5). Note that Samples 38 and 39 came from the same rock; Sample 38 came from the outer portion of the rock, and Sample 39 came from deeper within the rock's interior.

Level 10 – Feature 3

A total of eight samples representing eight different rocks were collected from Level 10 (100-110 cmbd). The results of their being subjected to reheating and paleomagnetic analysis are shown in stereoplots in Figure 11-7. The plotted data indicates that the rocks have been generally scattered, and in some cases reoriented and/or turned upside down since they last cooled in place. All eight rocks sampled had been heated multiple times in a campfire (Table 11-6).

Level 11 – Feature 3

A total of nine samples representing eight different rocks were collected from Level 11 (100-110 cmbd). The results of their being subjected to reheating and paleomagnetic analysis presented in Table 11-7 and are shown in stereoplots in Figure 11-8. As with the previous level (Level 10), all rocks sampled have been generally scattered, and in some cases reoriented and/or turned upside down since they last cooled in place. Eight of the nine rocks sampled had been heated multiple times in a campfire (see Table 11-6).

Table 11-5. Heating events detected in burned rocks from Feature 3, Level 9, Unit 8.

Sample No.	Single Temperatures	Multiple Temperatures
38		150-300^{0}C 250-400^{0}C
39	500-600^{0}C	
40	150-600^{0}C	
41	150-600^{0}C	
42	150-600^{0}C	
43	0-400^{0}C 500-600^{0}C	
44		0-250^{0}C 300-450^{0}C 500-600^{0}C
45	350-600^{0}C	
46		0-250^{0}C 450-600^{0}C
47	0-400^{0}C	
49		250-400^{0}C 450-500^{0}C
50	0-550^{0}C	

Level 12 – Feature 3

Unfortunately, only a total of three samples representing three different rocks could be collected from Level 12 (110-120 cmbd). The results of their being subjected to reheating and paleomagnetic analysis presented in Table 11-8 and are shown in stereoplots in Figure 11-9. Only one of the three (No. 101) appears to have remained in situ after it was heated from 150-

Table 11-6. Heating events detected in burned rocks from Feature 3, Level 10, Unit 8

Sample No.	Multiple Temperatures
58	0-250^{0}C \ 300-400^{0}C \ 450-600^{0}C
59	150-250^{0}C \ 250-350^{0}C \ 350-450^{0}C \ 450-600^{0}C
60	0-300^{0}C \ 350-400^{0}C \ 500-600^{0}C
61	0-250^{0}C \ 400-600^{0}C
62	0-200^{0}C \ 150-400^{0}C \ 500-600^{0}C
63	0-200^{0}C \ 250-400^{0}C \ 500-600^{0}C
64	150-300^{0}C \ 400-500^{0}C \ 500-600^{0}C
65	0-200^{0}C \ 300-400^{0}C \ 450-600^{0}C

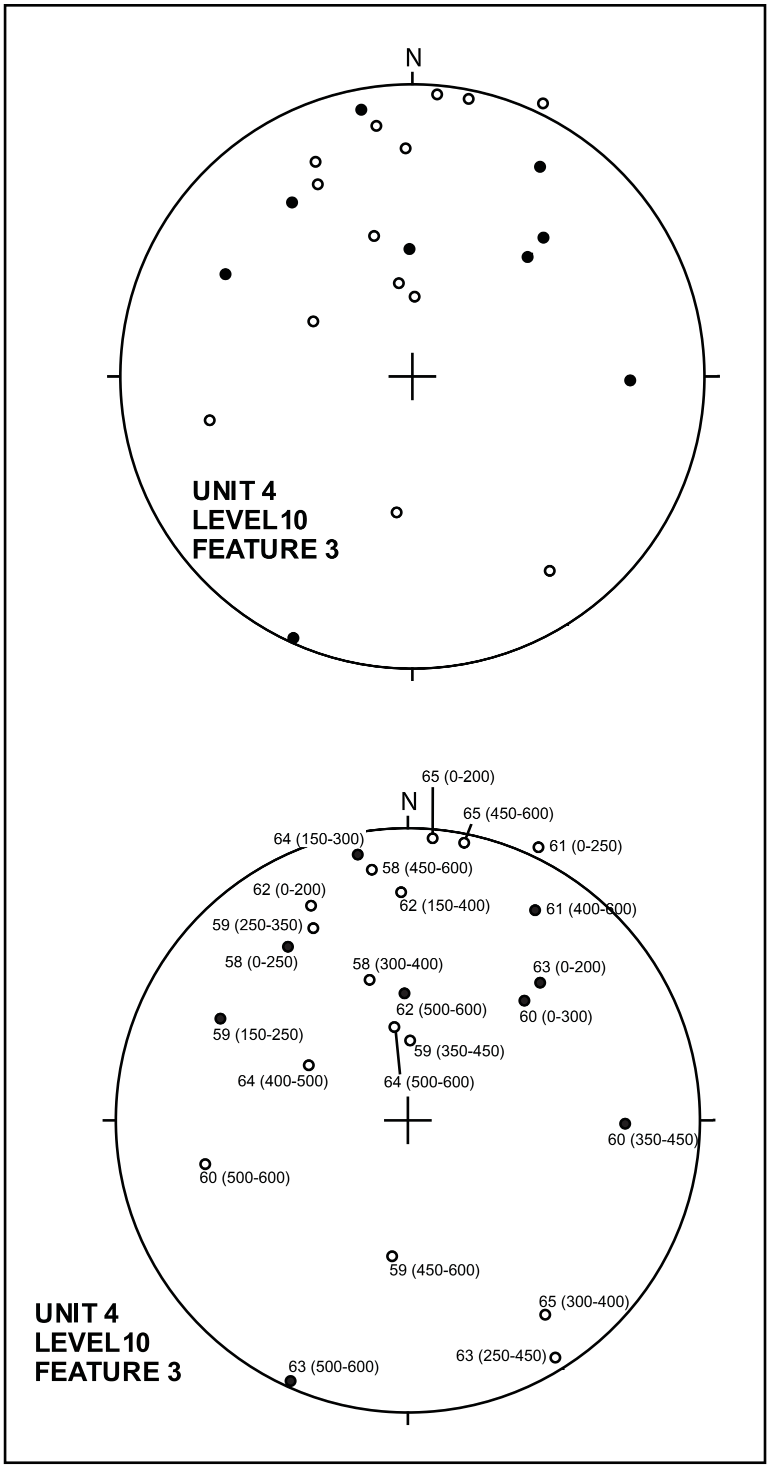

Figure 11-7. Stereonet plot for archeaomagnetic samples analyzed from Feature 3, Level 10, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

Table 11-7. Heating events detected in burned rocks from Feature 3, Level 11, Unit 8.

Sample No.	Multiple Temperatures
66	0-200^{0}C \ 500-600^{0}C
67	400-550^{0}C
68	150-300^{0}C \ 500-600^{0}C
69	0-300^{0}C \ 450-600^{0}C
70	0-200^{0}C \ 300-400^{0}C \ 450-600^{0}C
71	150-200^{0}C \ 300-400^{0}C \ 450-600^{0}C
72	150-250^{0}C \ 400-600^{0}C
73	200-350^{0}C \ 400-500^{0}C \ 450-550^{0}C
74	0-200^{0}C \ 300-450^{0}C \ 500-600^{0}C

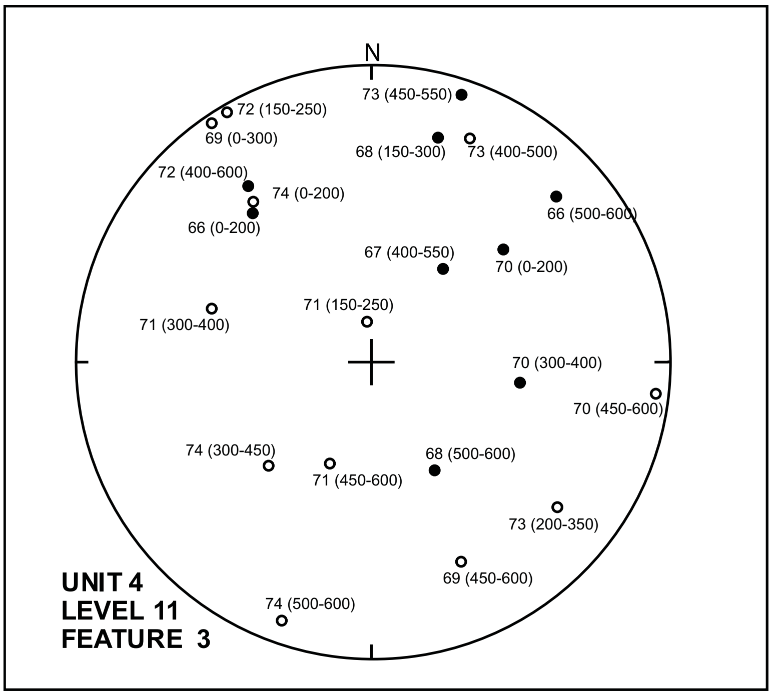

Figure 11-8. Stereonet plot for archeaomagnetic samples analyzed from Feature 3, Level 11, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

Table 11-8. Heating events detected in burned rocks from Feature 3, Level 12, Unit 4.

Sample No.	Multiple Temperatures
100	0-200^{0}C \ 350-600^{0}C
101	150-250^{0}C \ 250-350^{0}C \ 450-600^{0}C
102	0-200^{0}C \ 350-600^{0}C

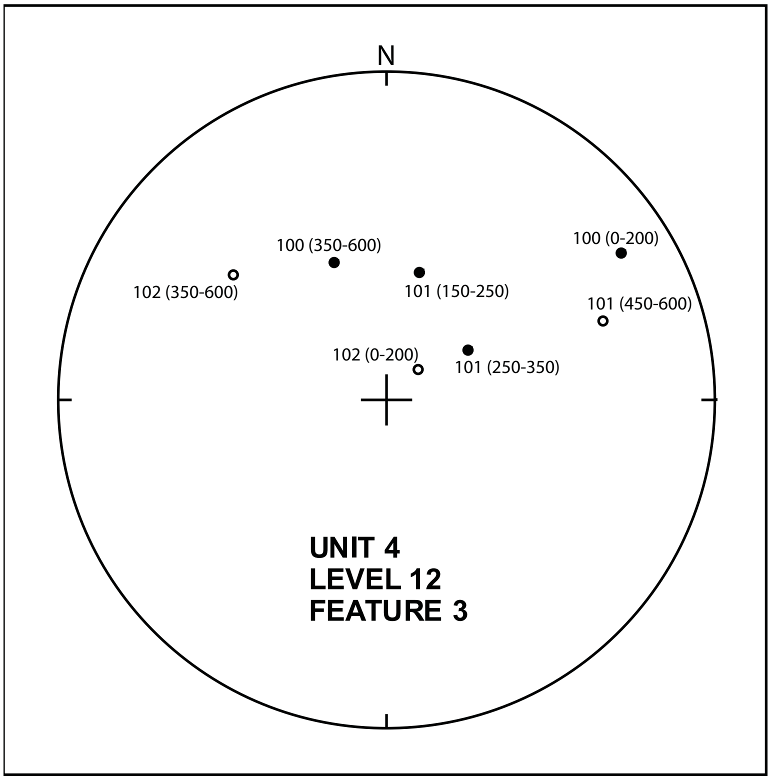

Figure 11-9. Stereonet plot for archeaomagnetic samples analyzed from Feature 3, Level 12, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

2500C. All three rocks sampled had been heated multiple times.

Summary of Feature 3

Feature 3 is a partially intact fire cracked limestone cobble feature with a basal tabular limestone lining inside a 50-cm deep pit between 83-133 cmbs. Although recovered in chronological stratigraphic order, diagnostic Pedernales and Marshall projectile points found between 90-119 cmbs may or may not date the pit accurately if the points were moved with turbated earth during the digging, covering, and cleaning out of the pit, in much the same manner as a burned rock midden (e.g. Leach and Bousman 1998; Leach et al. 2005; Mauldin et al. 2003). Although the same concept could apply to a radiocarbon date of 3300±40 BP obtained from about halfway into the pit at 107 cm, based on radiocarbon dates accumulated for multiple burned rock middens in Central Texas (Black et al. 1997; Mauldin et al. 2003), we believe the radiocarbon date more accurately dates its usage.

Evidence obtained through the use of archaeomagnetic analysis indicates multiple firings occurred in the pit, likely for parching or processing cheno-am seeds (either goosefoot or pigweed) over hot coals (see Chapter 9). Although relatively few rocks have remained in place since they were last heated and cooled, scattered and collapsing stones may be expected in and around a cooking pit feature that is repeatedly being used, cleaned out, and reused.

Normally, one would expect to see larger burned and/or fire cracked cobbles left in place at the bottom of a cooking feature within a burned rock midden. However, we believe that this pit feature may represent the initial use of a larger burned rock midden. An examination of Table 11-3 indicates that the larger rocks are near the top of Feature 3. Our personal observations and field sketches indicate that most of these are tabular, used to line the pit. Otherwise, the rocks remaining near the base of the pit are progressively smaller, presumably having been fired repeatedly. Archaeomagnetic data available for Levels 9-12 corroborates this scenario in that the rocks showing evidence of the least multiple firing events were in Level 9 (90-100 cmbd), while those with the most multiple firing events were in Level 10, between 100-110 cmbd (see Table 11-9),

Table 11-9. Multiple firing events in Feature 3, as detected by archaeomagnetic analysis.

Provenience	No. Samples	1 Event	2 Events	3 Events	4 Events
Lvl 9 (90-100 cm)	11	6	4	1	
Lvl 10 (100-110 cm)	9		2	6	1
Lvl 11 (110-120 cm)	8	1	3	4	
Lvl 12 (120-130 cm)	3		2	1	

with a like pattern in the lower two levels (sample size considered).

Finally, Mauldin and others (2003) have demonstrated that tiny pieces of fire cracked rock <1-inch in size will accumulate at the base of cooking features within the larger midden. However, Feature 3 is not within a midden context, has not likely been subjected to intensive use over long periods, and is generally more restricted in circumference near its base.

Feature 4: Fire cracked Rock Concentration – Unit 5

Feature 4 (Figures 11-10 and 11-11) is described as a loose scatter of fire cracked limestone cobbles between 80-100 cmbs. Cultural material recovered in association with Feature 3 included 248 complete and 746 incomplete flakes, 127 pieces of fire cracked limestone greater than 1-inch in size (Table 11-10), 799 snails, and 158.9 grams of faunal material (see Table C5 for details), and a smoothed pebble (see Chapter 10). No typeable diagnostics were recovered in association with Feature 4, and wood charcoal collected from the feature was not dated. Although a flotation sample was collected and processed, it was not analyzed.

The only two fire cracked rocks which could be successfully drilled in the field were submitted for analysis (see Figure 11-11). Admittedly two samples are not adequate for dependable results, and unfortunately, the archaeomagnetic data indicates that neither of the two were in situ (see Appendix D).

Figure 11-10. FCR in Feature 4, Unit 5, 80-90 cmbd.

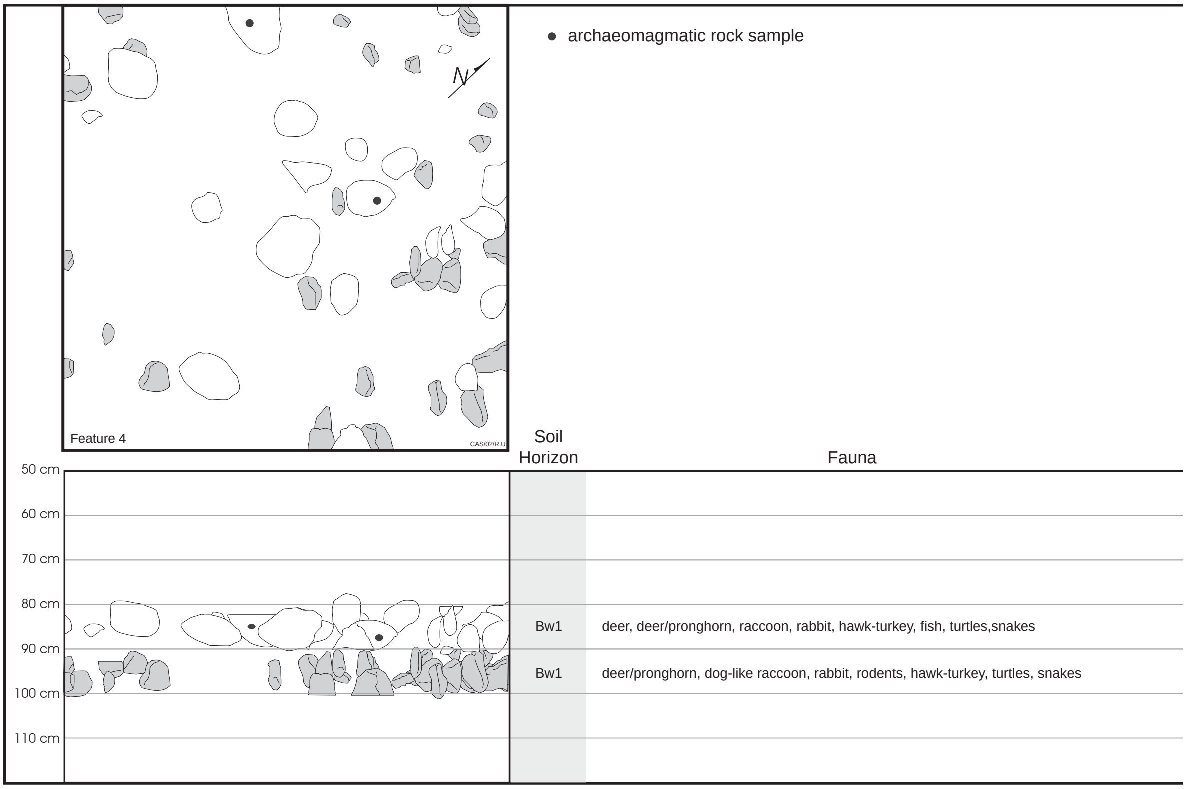

Figure 11-11. Feature 4 - Plan view and schematic profile of FCR outline taken from successive plan views.

Feature 8: Fire cracked Rock Concentration – Unit 5

Feature 8 (Figures 11-12 and 11-13) is described as a disarticulated fire cracked limestone cobble scatter between 110-140 cmbs. Cultural material recovered in association with Feature 8 included 251 complete and 817 incomplete flakes, 350 pieces of fire cracked limestone greater than 1-inch in size (see Table 11-10), 1,874 snails, and 279 grams of faunal material (see Table C5 for details). A Marshall-like projectile point was recovered near the top of Feature 8,

Table 11-10. FCR excavated from Unit 5.

Depth (cm)	Feature	>8”	>7”	>6”	>5”	>4”	>3”	>2”	>1”	Totals	<1” Weight (grams)
40-50										**0**	5.3
50-60										**0**	24.2
70-80								8	25	**33**	135.7
80-90	4						6	15	34	**55**	359.5
90-100	4						4	23	45	**72**	359.1
100-110					2	3	7	40	43	**95**	598.4
110-120	8		1		1	2	8	19	72	**103**	294.1
120-130	8				3	3	5	38	23	**72**	111.5
130-140	8				3	3	11	21	42	**80**	334.6
140-150					3	3	4	8	20	**38**	197.1
150-160								5	19	**24**	171.6
		0	**1**	**0**	**12**	**14**	**45**	**177**	**323**	**572**	**2591.1**

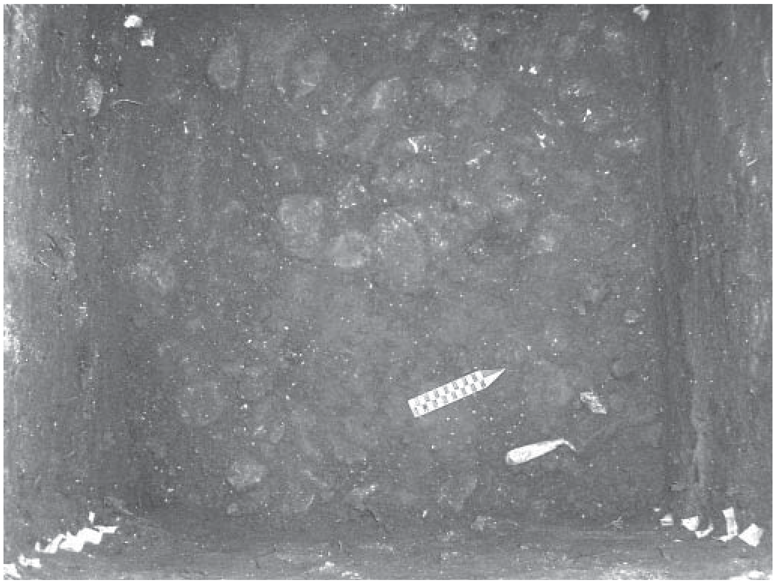

Figure 11-12. FCR in Feature 8, Unit 5, 120-130 cmbd.

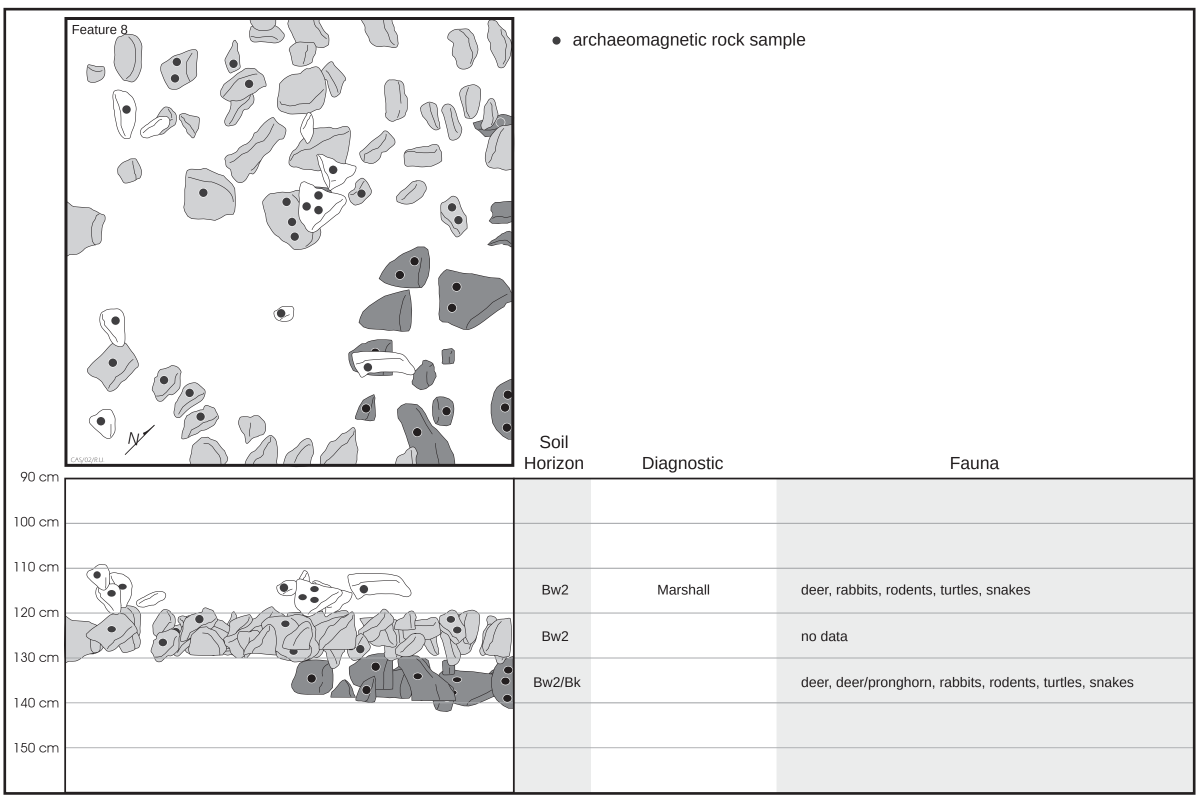

Figure 11-13. Plan view and schematic profile of FCR outline taken from successive plan views.

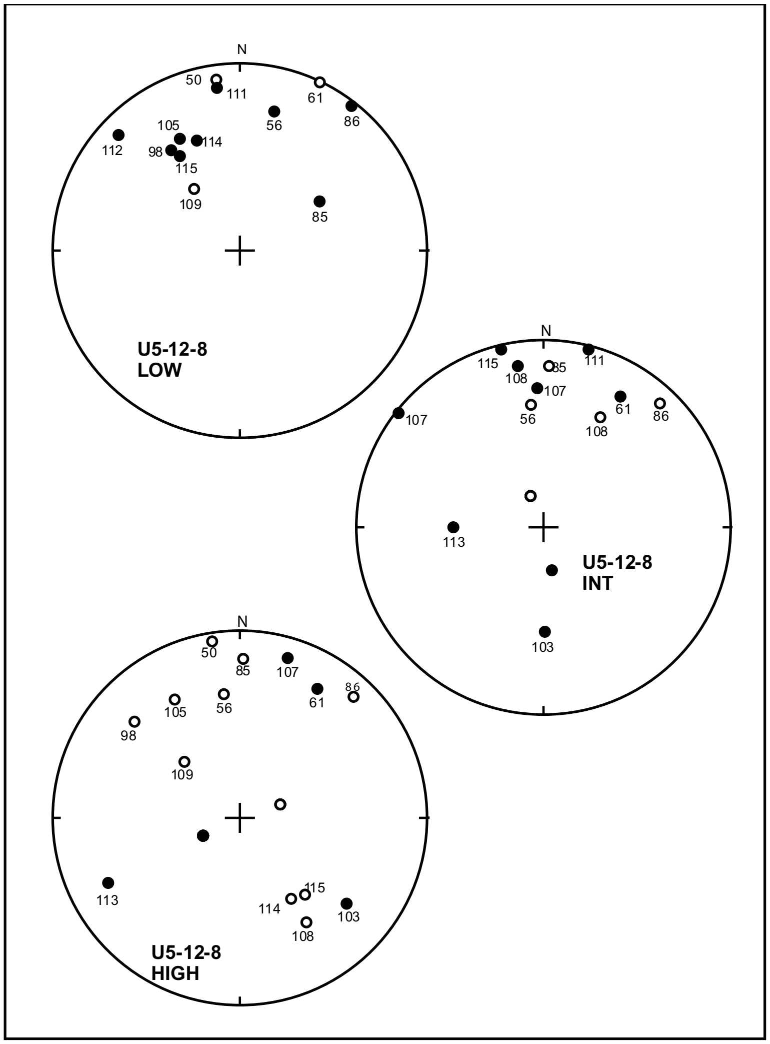

Figure 11-14. Stereonet plot for archaeomagnetic samples analyzed from Feature 8, Levels 12-14, Unit 5. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

between 110-120 cmbs. Wood charcoal and two flotation samples collected from the feature were not submitted for dating or for identification of carbonized plant remains.

Archaeomagnetic Results

A total of 23 samples representing ten different rocks were successfully collected from Feature 8 (see Figure 11-13). The results of their being subjected to reheating and paleomagnetic analysis are shown in stereo-net plots in Figure 11-14. The plotted data indicates that although the rocks generally cluster, they are definitely not in situ and have been moderately impacted. Most have been rotated, and/or turned upside down since they were last heated and cooled.

Feature 11: Fire cracked Rock Concentration – Unit 4

Feature 11 (Figures 11-15 and 11-16) is described as a nearly intact fire cracked limestone cobble feature between 154-170 cmbs. Cultural material recovered in association with Feature 3 included 174 complete and 448 incomplete flakes,

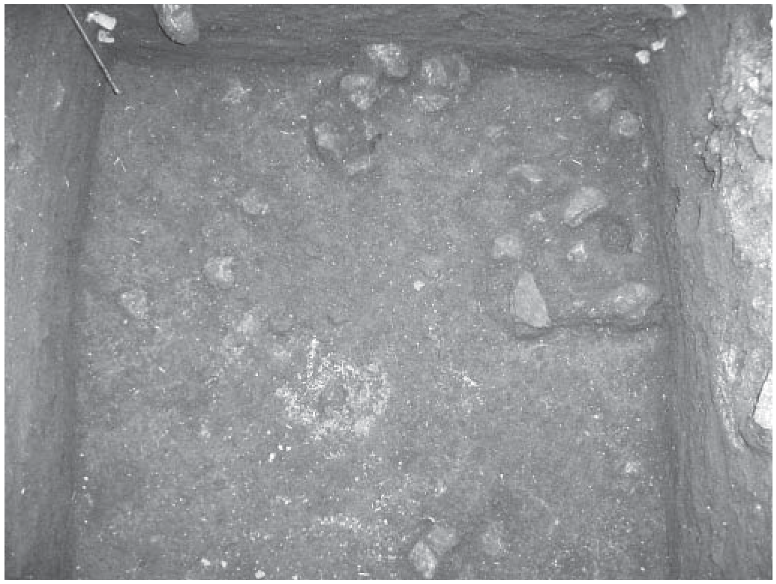

Figure 11-15. FCR in Feature 11, Unit 4, 160 cmbd.

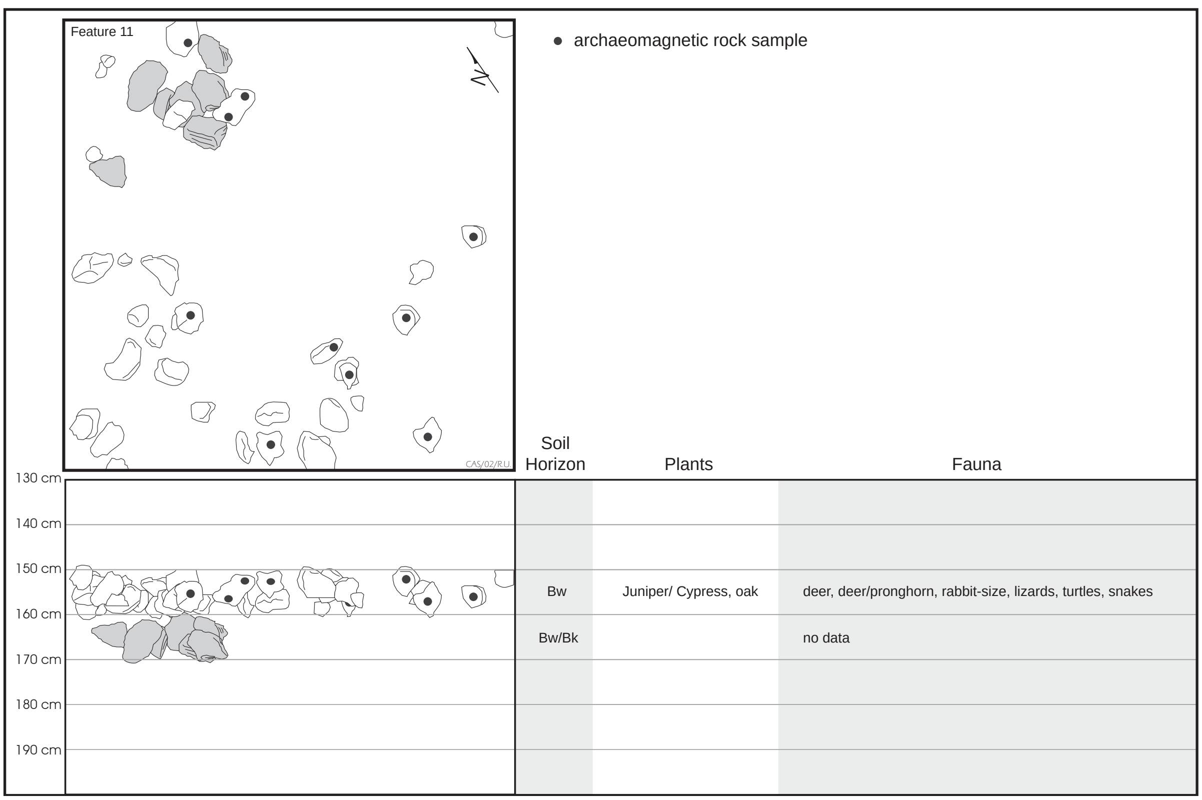

Figure11-16. Feature 11 - Plan view and schematic profile of FCR outline taken from successive plan views.

132 pieces of fire cracked limestone greater than 1-inch in size (see Table 11-3), 799 snails, and 34.4 grams of faunal material (see Table C5 for details). Although no diagnostics can be associated with Feature 11, a wood charcoal assay from 170-180 cmbs in Feature 3 dated to 4325±45 BP. One of two flotation samples collected from the feature contained charred pieces of juniper or cypress, and oak, most likely used as fuel wood (see Chapter 9).

Archaeomagnetic Results

A total of ten samples representing nine different rocks were successfully collected from Feature 11 (see Figure 11-16). The results of their being subjected to reheating and paleomagnetic analysis are shown in stereo-net plots in Figure 11-17. The plotted data indicates that although the rocks generally cluster, most have been rotated, and/or turned upside down since they were last heated and cooled. They are not in situ and have been moderately impacted.

Summary

A total of five fire cracked rock features were discovered during excavations at the Texas Rivers Center in January 2001. Four of the five are determined to be generally scattered hearth remnants, while a fifth is considered as a generally intact limestone cobble cooking pit with tabular limestone lining around its upper portion. Diagnostic projectile points found in association with the five features suggest that they were used during the Late Archaic period, and radiocarbon dates obtained from wood charcoal more specifically indicate their use at 3300±40 BP, 3550±45 BP, and 4325±45 BP.

Limited charred remains from these features suggest that cheno-am seeds (either goosefoot or pigweed) may have been parched, or processed over hot coals. After parching, the seeds most likely would have been ground into flour. Most probably growing wild, the stems and leaves of cheno-am plants are known to have been used in historic times as both food and medicines (Castetter 1935). The recovery of a ground stone mano and a milling stone fragment suggests that the occupants ground some form of seeds or nuts for consumption. Juniper or cypress, and oak were being used as fuel wood for the campfires. The bones of a variety of animals were also recovered in association with the features (see Chapter 8), as well as snails. Whether or not snails were used as a food source is debatable (see Chapter 7).

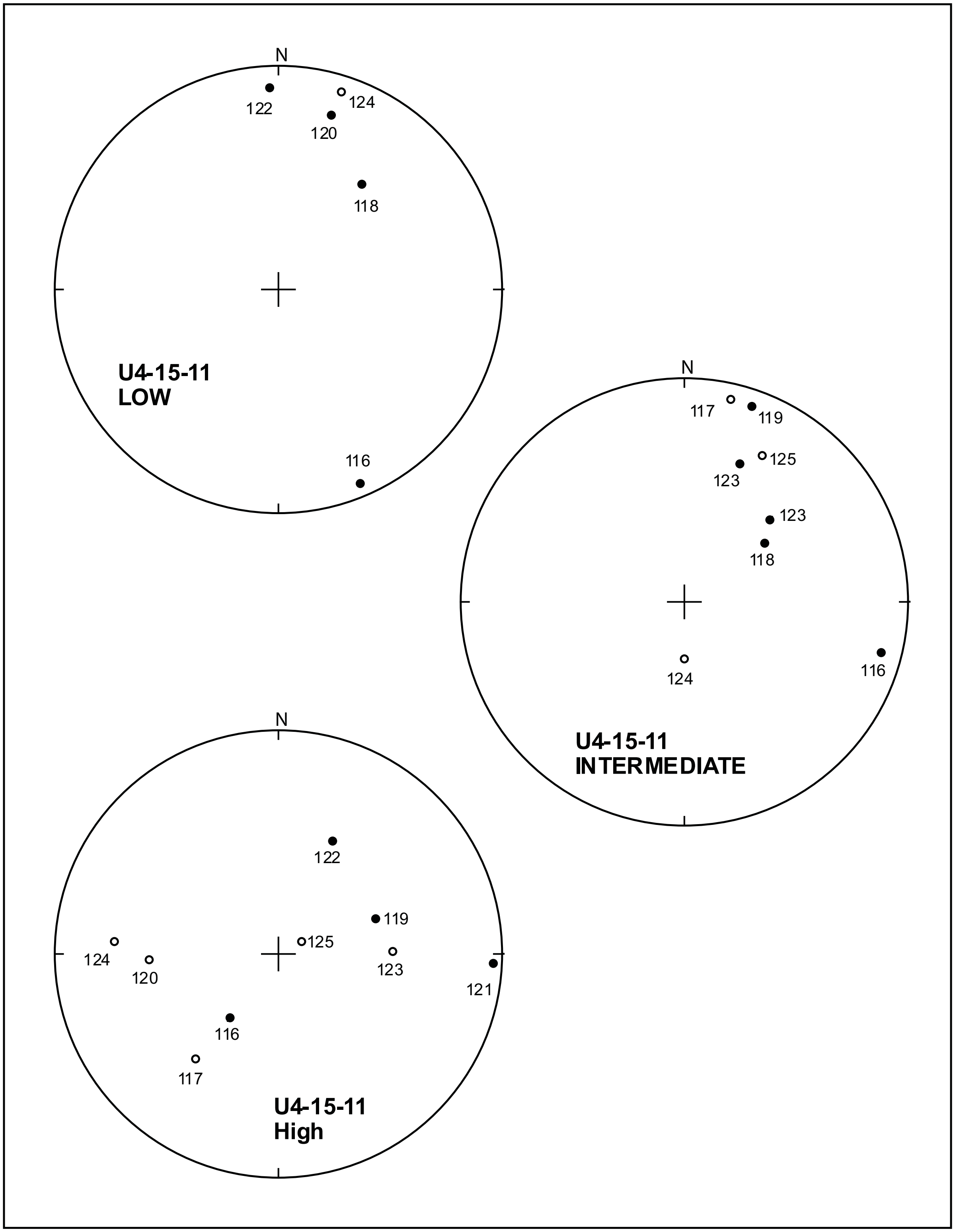

Figure 11-17. Stereo-net plot for archaeomagnetic samples analyzed from Feature 11, Levels 15-16, Unit 4. Solid circles represent samples that are right-side-up; open circles represent samples that have flipped upside down since their last cooling event.

Chapter 12

Summary and Recommendations

C. Britt Bousman

Results of Testing

In January of 2001 the Center for Archaeological Studies excavated six 1-x-1-meter excavation units at the Spring Lake Site (41HY160) in the area to be affected by the construction of the Texas Rivers Center. Units 1-3 sampled disturbed sediments throughout their exposures. Units 4-6, however, did encounter in situ sediments within some of the exposed sediments.

Geoarchaeology and Chronological Results

The geological sequence presented by Lee Nordt in Chapter demonstrates that the San Marcos River has a complex and remarkably complete sedimentary record of Late Pleistocene and Holocene geological history. The potential for a remarkable archaeological record is great. Twenty two geologic cores were extracted from the floodplain of the San Marcos River and Sink Creek extending from the hotel across the valley to the Texas State University football field. The geoarchaeological investigations demonstrated the presence of five depositional units in the floodplain. Nine radiocarbon dates have been measured on organic carbon from these deposits. The discussion will use both radiocarbon years and tree-ring calibrations using the OxCal program. It should be noted that no attempt was made to date stratigraphic boundaries, but this should be a goal in future geoarchaeological investigations.

First, the valley was scoured to bedrock by erosion before ~11,470 B.P. (13,320 cal B.P.) when some of the earliest alluvial sediments were deposited in the present floodplain. The initial deposit, Depositional Unit A, consisted of wide spread channel gravels that were capped by marsh deposits. Unit A accumulated between 11,470-9585 B.P. (13,320-10,940 cal. B.P.) and potentially contains significant Early Paleoindian occupations as a flake recovered from the channel gravels in Core E suggests. At some point between 9585-7365 B.P. (10,320-8185 cal. B.P.) localized channel entrenchment terminated the deposition of Unit A and the eroded channel began to fill with marsh and gravel deposits that constitute Unit B sediments. A reasonable age estimate for the erosion event between Unit A and Unit B is 9500 cal. B.P. It is possible that important Late Paleoindian materials are contained in Unit B sediments as a flake recovered from Core R suggests. Renewed channel aggradation beginning no later than 7365 B.P. (8185 cal. B.P.) marks the accumulation of Unit C sediments. These overbank gravels and marsh deposits continued to accumulate until at least 5925 B.P. (6740 cal. B.P.) and possibly as late as cal. 5910 cal. B.P.. Early Archaic materials might be preserved in Unit C sediments. At the latest by 4325 B.P. (4910 cal. B.P.) but probably as early as 5910 cal. B.P. a thick fine-grained floodplain sediment was rapidly deposited to form Unit D and it covered the entire floodplain. Unit D sediments form the bulk of the T1 sediments and contain Middle and Late Archaic occupations. After 3300 B.P. (3535 cal. B.P.) deposition slowed considerably and a thick A Horizon formed on the surface. Also at this time Sink Creek began to downcut its channel and the area around the springs were also entrenched. Unit E T0 alluvial sediments began to accumulate creating a narrow modern floodplain adjacent to Sink Creek and the springs. Late Archaic and Late Prehistoric materials are present in the top of Unit D and probably present in the Unit E sediments. No radiocarbon assays were obtained from Unit E.

Archaeology Findings

Only disturbed sediments were exposed in Excavation Units 1-3, near the Hotel, but the sediments (Depositional Unit D) exposed in Excavation Units 4-6 uncovered Late Prehistoric to Middle Archaic components in a well-stratified and datable context. In Units 4-6 temporally and culturally diagnostic artifacts consisted of Perdiz arrow points and Marshall, Pedernales and Travis dart points. Radiocarbon assays of wood charcoal document a Middle Archaic component dated to 4325 B.P. (4910 cal. B.P.) and Late Archaic components dated to 3550 B.P. (3830 cal. B.P.) and 3300 B.P. (3535 cal. B.P.). The vertical frequency and size distribution of lithic artifacts as well as burned rock cooking features suggested that multiple prehistoric components were present in the A and B horizons of Unit D. Archaeomagnetic analysis of the burned rock demonstrate that the features were intact cooking facilities. Additional findings indicate that faunal preservation is very good and these materials consist of a wide variety of small animals (mammals, snakes, turtles and fish) as well as many larger mammals including bison, antelope, and deer. Most of the bones are highly fragmented, but it appears to be due to human processing and cooking, and not to carnivore gnawing. There is limited botanical evidence for cheno-am (*Chenopodium* and *Amaranthus* spp.) seed consumption in the Late Archaic Feature 3, and very good preservation of Late Pleistocene and Early Holocene macrobotanical remains (goosefoot, hackberry, prickly pear, grape, and acorn fragments) from Depositional Unit A. It is unclear if these older, well-preserved, floral remains are related to human activities as they were recovered from a geological core, but if older occupations are present it is highly probable that well preserved floral remains could be recovered from these deposits and the other marsh deposits in Depositional Units A, B and C..

Significance Assessment of the Recovered Cultural Resources and Recommendations for Future Investigations

41HY160 is a State Archaeological Landmark and, in regard to the criteria employed by the National Register of Historic Places (especially Criterion D), its significance is not in question. The major question asked of these investigations is whether the area planned for construction of the Texas Rivers Center contained archaeological deposits in a well preserved context or had they been disturbed by 20th Century construction activities?

In the west side of the project area, near the Hotel, intact sediments were not encountered in Excavation Units 1-3. This is due to a number of factors. First, it is clear that before any significant construction at the San Marcos Springs, a natural channel lead into the Springs from the north that was possibly an overflow channel of Sink Creek (see Figure 7-23). The ground level of the Hotel was approximately 1.5 meters lower than the current ground level. The swimming pool, which is now removed, was placed in this channel. It appears that a limited amount of terrace sediment was removed for the deeper portions of the pool, but in order to place the pool at its height, a fair amount of sediment was needed to fill in the natural channel. This resulted in the burial of the lower stairways leading from the hotel to the Springs. Also at some point, gravel was placed in the area with the paved parking lot to the northeast of the Hotel. This created a flat and level area between the golf course and the Springs. Because of the elevated water table in this area, intact sediments were only observed in cores.

Further to the east in the area near Excavation Units 4-6, a thin sediment cap representing fill was encountered at various thicknesses in these three units, but below this were intact sediments. These sediments contain the archaeological materials described in this report. It is clear from these results that the archaeological materials in this area are well-preserved in a good stratigraphic context and that they should be investigated if further construction is undertaken. Unpublished, and at this time, unanalyzed materials from previously excavated units suggests that archaeological materials are very near the surface on the peninsula at 41HY160. Also the work of Shinier and other investigators demonstrates that the immediate area contains a wealth of Paleoindian, Archaic and Late Prehistoric materials. The sediments adjacent to and below Excavation Units 4-6 will also contain similar aged prehistoric occupations. Any future construction or other activities that would adversely impact the known or suspected archaeological materials at the Spring Lake Site, 41HY160, should be mitigated.

The primary goal of this project was successfully achieved and the results of the archaeological testing indicate that high resolution well-preserved artifactual and faunal materials will be present in future excavations. The preliminary analyses undertaken in the project will not conclusively answer all of the research questions posed in Chapter 4, however, the results of this project suggest that the research questions that consider prehistoric economy, technology and mobility in a environmental context can be successfully addressed with data recovered from 41HY160.

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Appendix A

Catalog of Cultural Remains

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
Unit 1																
0-10															X	
10-20										2	1		36			
20-30																
30-40																
40-50																
50-60																
60-70																
70-80																
80-90																
90-100																
100-110																
110-120																
120-130																
130-140																
140-150																
150-160																
160-170																
170-180																
180-190																
190-200																
Total	0	0	0	0	0	0	0	0	0	2	1	0	36			

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
Unit 2																
0-10																
10-20																
20-30																
30-40																
40-50																
50-60																
60-70																
70-80																
80-90																
90-100																
100-110														X		
110-120																
120-130																
130-140																
140-150																
150-160																
160-170																
170-180																
180-190																
190-200																
Total	0	0	0	0	0	0	0	0	0	0	0	0	0			
Unit 3																
0-10														X		
10-20													1	X		
20-30																
30-40																
40-50													1			
50-60													1			
60-70																
70-80																
80-90																
90-100																
100-110																
110-120																

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
120-130																
130-140																
140-150																
150-160																
160-170																
170-180													2			
180-190																
190-200																
Total	0	0	0	0	0	0	0	0	0	0	0	0	5			

Unit 4

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
0-10													1			
10-20													16		X	
20-30																
30-40																
40-50																
50-60																
60-70																
70-80																
80-90										5	5	59	231	X	X	X
90-100			1							2	5	75	384	X	X	X
100-110						1				1	15	172	786	X	X	
110-120		1								4	25	202	681	X	X	
120-130	1	1								2	7	118	266	X	X	X
130-140										4	4	151	293	X	X	
140-150							1			1	3	83	350	X	X	
150-160										4	4	91	293	X	X	
160-170										5	3	73	155	X	X	
170-180											1	61	192	X	X	X
180-190																
190-200																
Total	1	2	1	0	0	1	1	0	0	28	72	1085	3648			

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
Unit 5																
0-10													4			
10-20																
20-30										1						
30-40													4	X		
40-50											1		34		X	
50-60									1		3	30	96		X	
60-80										1	7	99	215	X	X	
80-90							1			1	12	149	531	X	X	
90-100							1			4	6	152	653	X	X	
100-110		1								4	10	243	793	X	X	
110-120										1	5	115	443	X	X	
120-130					1								8	X		
130-140										4	2	136	466	X	X	
140-150										4	4	149	569	X	X	
150-160							1			4	11	94	664		X	X
160-170																
170-180																
180-190																
190-200																
Total	0	1	0	0	1	0	3	0	1	24	61	1167	4480			

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
Unit 6																
0-10													2		X	
10-20											1				X	
20-30											2	8	44		X	
30-40										2	3	37	139	X	X	
40-60										2	4	149	363	X	X	
60-70											13	208	869	X	X	
70-80				1						2	9	224	903	X	X	X
80-90				1						4	19	261	1258	X	X	
90-100										3	4	121	453		X	
100-110										3	3	114	469		X	X
110-120							1			4	4	103	461	X	X	
120-130			1							4	4	168	441		X	

Unit &Depth	Travis	Pedernales	Pedernales-Marshall	Marshall	Marshall-like	Marshall preform	Untypable Dart Points	Untyped dart point	Perdiz	Bifaces	Unifaces	Complete Flakes	Incomplete Flakes	Charcoal	Faunal Remains	Mussel Shells
130-140										1	3	111	387		X	X
140-150								1		3	4	61	182	X	X	X
150-160											4	15	35		X	X
160-170															X	
170-180															X	
180-190																
190-200																
Wall Cleaning											1		15		X	
Total	0	0	1	2	0	0	1	1	0	28	78	1580	6021			
Core C				1							1					
Grand Total	1	3	2	3	1	1	5	1	1	82	213	3832	14190			

Appendix B

Faunal Remains

Brian Shaffer

Faunal remains recovered from 41HY160 identified the presence all five classes of vertebrates from a total sample consisting of 4,388 specimens. Analysis was undertaken to identify the taxa represented, the taphonomic condition of the remains, and any unique aspects, such as specific forms of cultural modification. This was accomplished using the comparative specimens housed at the Institute of Applied Sciences Zooarchaeology Laboratory at the University of North Texas (UNT). Identifications were made based primarily on morphology and comparison with specimens from the UNT collection. The one exception to this was the identification of cf. *Bison* sp. from tooth specimens. The provenience of the specimens indicated they were prehistoric and hence could not be domestic cattle. Since the specimens were not readily separable from domestic cattle, the identification was left as "cf." This denotes that the specimens compare favorably with the identification as bison but that the identification is not definite. Data were recorded using the vertebrate Faunal Analysis Coding System (Shaffer and Baker 1992) with the data transferred into Microsoft Excel as a spreadsheet. All original identifications are presented here.

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Legend

Side: A-Axiel, L-Left, R-Right
Age: A-Adult, S-Subadult
Weathering: L-Light
Breakage: A-Angular, S-Spiral, U-Unbroken
Gnawing: R-Rodent
Chemical Etching: L-Light
M-Marked
4* - 4 transverse cuts

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
1	1	1	Aves (Large)	Hawk-turkey-sized birds	Long bone	Fragment		S	L	S	U				
4	10	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	10	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	11	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	11	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Indeterminate	Fragment			L	S	U				
4	11	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	U	U				
4	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U	R			
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ca				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Ulna	Fragment	R		L	A	Ch				
4	10	1	Testudinata	Turtles	Pleural	Fragment			L	A	Ch				
4	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ch				
4	10	1	Odocoileus sp.	Deer	Permanent tooth	Lower M	L	A	L	A	U				
4	10	1	cf. Vulpes sp.	Foxes	Permanent tooth	Upper M1	R	A	L	A	U				
4	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Enamel fragment		A	L	A	U				
4	10	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
4	10	1	Testudinata	Turtles	Neural	Fragment	A		L	A	U				
4	10	1	Geomyidae	Pocket gophers	Cranium	Maxilla	A		L	A	U				
4	10	1	Anura	Toads and frogs	Pelvis	Acetabular end of ilium	L		L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Incisor and diastema area only	L		L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM3	L		L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Incisor and diastema area only	R		L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	10	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horiz.ramus w/incisor alveolus	R		L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower I1	R		L	A	U				
4	10	1	Testudinata	Turtles	Plastron	Fragment			L	A	U				
4	10	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Metacarpal	Proximal end			L	A	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Distal end	L		L	S	U				
4	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metacarpal	Fragment			L	S	U				
4	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M1	R		L	U	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M2	R		L	U	U				
4	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM4	R		L	U	U				
4	10	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
4	10	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	10	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	10	2	Testudinata	Turtles	Pleural	Fragment			L	A	U				
4	10	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
4	10	3	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
4	10	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	10	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	10	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	10	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	10	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	10	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	10	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	10	11	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	10	16	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	10	18	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	10	45	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			
4	11	1	Odocoileus sp.	Deer	Tibia	Distal end	R		L	S	U	R			
4	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
4	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	11	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
4	11	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
4	11	1	Chrysemys sensu lato	Painted turtles/cooters/sliders	Hypoplastron	Complete	L	A	L	A	U				
4	11	1	Lepisosteidae	Gars	Vertebra	Centrum	A		L	A	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Ulna	Proximal end	L		L	A	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus portion	R		L	A	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Pelvis	Acetabular end of ilium	R		L	A	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Calcaneus	Complete	R		L	A	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Cranium	Petrosal	R		L	A	U				
4	11	1	Osteichthyes (Small)	Small bony fish	Cranium	Fragment			L	A	U				
4	11	1	Leporidae	Rabbits and hares	Permanent tooth	Upper I1			L	A	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Metapodial	Proximal end			L	A	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	A	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Distal articular condyle			L	A	U				
4	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Proximal portion of shaft	L		L	S	U				
4	11	1	Lepus sp.	Jackrabbits	Humerus	Distal end	R		L	S	U				
4	11	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Distal end	R		L	S	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Pelvis	Ischium fragment			L	S	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	S	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Distal fibula	Complete	L		L	U	U				
4	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused second & third carpal	Complete	R		L	U	U				
4	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Cranium (cf. deer fragment)	Fragment			L	A	U		8		
4	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				1
4	11	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U			L	
4	11	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	11	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Fragment			L	A	U				
4	11	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	U	U				
4	11	3	Serpentes	Snakes	Dorsal vertebra	Fragment	A		L	A	U				
4	11	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
4	11	4	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	11	4	Testudinata	Turtles	Pleural	Fragment			L	A	U				
4	11	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	11	5	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
4	11	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	11	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
4	11	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	11	11	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	11	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	11	13	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	11	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	11	22	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	11	24	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	11	28	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	11	30	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	11	60	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal articular condyle			L	A	Ca				
4	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
4	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal end		S	L	A	U				
4	12	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Mandible	Incisor and diastema area only	L		L	A	U				
4	12	1	Geomyidae	Pocket gophers	Ulna	Proximal end	L		L	A	U				
4	12	1	Sylvilagus sp.	Cottontail rabbits	Ulna	Proximal end	R		L	A	U				
4	12	1	Sylvilagus sp.	Cottontail rabbits	Calcaneus	Fragment	R		L	A	U				
4	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Enamel fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	12	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper cheek tooth			L	A	U				
4	12	1	Sylvilagus sp.	Cottontail rabbits	Metatarsal	Proximal end			L	A	U				
4	12	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Humerus	Distal end			L	A	U				
4	12	1	cf. Canis latrans	Coyote	Permanent tooth	Upper I	L		L	U	U				
4	12	1	cf. Vulpes sp.	Foxes	Permanent tooth	Upper PM3	R		L	U	U				
4	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Ulnar carpal bone	Complete	R		L	U	U				
4	12	1	cf. Canis latrans	Coyote	Proximal phalange	Complete			L	U	U				
4	12	1	Odocoileus sp.	Deer	Prox. phalange of paradigit	Complete			L	U	U				
4	12	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	12	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	12	3	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
4	12	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	12	4	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
4	12	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
4	12	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	12	11	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	12	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	12	16	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	12	41	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	13	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			M	S	U	R			
4	13	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
4	13	1	Odocoileus sp.	Deer	Permanent tooth	Upper PM	L		L	A	U				
4	13	1	Vertebrata	Vertebrates	Phalange	Distal end			L	A	U				
4	13	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
4	13	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
4	13	1	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
4	13	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	13	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	S	U				
4	13	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Ulnar carpal bone	Complete	R		L	U	U				
4	13	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
4	13	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	13	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	13	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	13	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	13	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	13	6	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	13	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	13	13	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	13	25	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	14	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
4	14	1	cf. Vulpes sp.	Foxes	Permanent tooth	Upper M1	L		L	A	Ch				
4	14	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
4	14	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Cranium	Maxilla			L	A	Ch				
4	14	1	Artiodactyla (Large)	Bison/cow-sized ungulates	Tooth	Enamel fragment			L	A	Ch				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	Ch				
4	14	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
4	14	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
4	14	1	Colubridae	Colubrid snakes	Dorsal vertebra	Fragment	A		L	A	U				
4	14	1	Viperidae	Pitviper snakes	Dorsal vertebra	Fragment	A		L	A	U				
4	14	1	Sylvilagus sp.	Cottontail rabbits	Sacrum	Sacral element 1	A		L	A	U				
4	14	1	Sigmodon sp.	Cotton rats	Mandible	Horiz.ramus w/incisor alveolus	L		L	A	U				
4	14	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower I1	L		L	A	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Cranium	Petrosal	L		L	A	U				
4	14	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal articular condyle			L	S	U				
4	14	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M1	L		L	U	U				
4	14	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M2	L		L	U	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	14	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M3	L		L	U	U				
4	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment	R		L	S	U				1
4	14	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
4	14	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
4	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			M	A	U				
4	14	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	14	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	14	3	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	Ch				
4	14	3	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
4	14	3	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
4	14	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	14	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	14	5	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
4	14	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	14	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ca				
4	14	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	14	12	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	14	13	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	14	16	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	14	18	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	14	24	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	14	30	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	14	39	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	15	1	Squamata	Lizards and snakes	Dorsal vertebra	Centrum and neural area	A		L	A	U				
4	15	1	Lacertilia	Lizards	Dorsal vertebra	Complete	A		L	A	U				
4	15	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
4	15	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Metapodial	Distal end			L	A	U				
4	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Enamel fragment			L	A	U				
4	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	A	U				
4	15	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fourth carpal bone	Complete	R		L	U	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	15	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	15	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
4	15	2	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
4	15	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
4	15	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	15	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
4	15	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	15	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	15	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	15	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	15	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	15	14	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	15	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	17	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	17	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	17	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
4	17	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
4	17	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	S	U				
4	17	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	17	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	17	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	17	11	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	2	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U	R			
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ca				
4	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	8	1	Odocoileus sp.	Deer	Calcaneus	Distal aspect	L		L	S	Ch				
4	8	1	cf. Bison	Bison	Permanent tooth	Lower M	L	A	L	A	U				
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
4	8	1	cf. Bison	Bison	Tooth	Root fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal end			L	S	U				
4	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal end			L	S	U				
4	8	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	8	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	8	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	8	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	8	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
4	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	8	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	8	9	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	8	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	8	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	8	20	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	9	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U	R			
4	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			
4	9	1	Rodentia (Small)	Mouse-sized rodent	Humerus	Complete minus prox. epiphysis	R	S	L	A	U				
4	9	1	Rodentia (Small)	Mouse-sized rodent	Scapula	Glenoid fossa & incom. blade	L		L	A	U				
4	9	1	Lepisosteidae	Gars	Ganoid scale	Fragment			L	A	U				
4	9	1	Testudinata	Turtles	Peripheral	Fragment			L	A	U				
4	9	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Metapodial	Distal end			L	A	U				
4	9	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Permanent tooth	Upper I1			L	A	U				
4	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Proximal end			L	A	U				
4	9	1	cf. Bison	Bison	Tooth	Lower cheek tooth			L	A	U				
4	9	1	Odocoileus sp.	Deer	Radius	Distal end	R		L	S	U				
4	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
4	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Proximal end			L	S	U				
4	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				3

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
4	9	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	9	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	9	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
4	9	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
4	9	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
4	9	4	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
4	9	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
4	9	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
4	9	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
4	9	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
4	9	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
4	9	22	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	10	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
5	10	1	Aves (Large)	Hawk-turkey-sized birds	Carpometacarpus	Fragment			L	A	Ch				
5	10	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	10	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	10	1	Canidae	Dogs and relatives	Permanent tooth	Upper M1	R	S	L	A	U				
5	10	1	Kinosternidae	Mud and musk turtles	Nuchal	Fragment	A		L	A	U				
5	10	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	10	1	Testudinata	Turtles	Pleural	Fragment			L	A	U				
5	10	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
5	10	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Pelvis	Acetabular end of ischium			L	A	U				
5	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Root fragment			L	A	U				
5	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal end			L	A	U				
5	10	1	Aves (Large)	Hawk-turkey-sized birds	Long bone	Fragment			L	S	U				
5	10	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Pelvis	Ischium fragment			L	S	U				
5	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
5	10	1	Procyon lotor	Raccoon	Permanent tooth	Upper M2	R	A	L	U	U				
5	10	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	U	U				
5	10	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper I1	R		L	U	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	10	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	10	2	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	10	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	10	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	10	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	10	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	10	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ca				
5	10	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	10	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	10	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	10	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	10	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	10	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	10	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	10	9	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	10	11	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	10	40	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U	R			
5	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ca				
5	11	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal end			L	S	Ch				
5	11	1	Odocoileus sp.	Deer	Permanent tooth	Upper M		A	L	A	U				
5	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Cranium	Maxilla	A		L	A	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Astragalus	Complete	L		L	A	U				
5	11	1	Odocoileus sp.	Deer	Permanent tooth	Upper PM	L		L	A	U				
5	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Cranium	Zygomatic	R		L	A	U				
5	11	1	Vertebrata	Vertebrates	Phalange	Distal end			L	A	U				
5	11	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	11	1	Testudinata	Turtles	Pleural	Fragment			L	A	U				
5	11	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	11	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper cheek tooth			L	A	U				
5	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Permanent tooth	Upper I1			L	A	U				
5	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Metapodial	Proximal end			L	A	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	A	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused second & third tarsal	Complete			L	A	U				
5	11	1	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
5	11	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Proximal portion of shaft	R	S	L	S	U				
5	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	11	1	Aves (Large)	Hawk-turkey-sized birds	Tibiotarsus	Fragment			L	S	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
5	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal end			L	S	U				
5	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Long bone	Fragment			L	S	U				1
5	11	2	Serpentes	Snakes	Dorsal vertebra	Neural area only	A		L	A	U				
5	11	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
5	11	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	11	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	11	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	11	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	11	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	11	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	11	4	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	11	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	11	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
5	11	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	11	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	11	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	11	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	11	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	11	14	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	11	18	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	11	60	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U	R			
5	12	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Complete distal epiphysis		S	L	A	Ca				
5	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	12	1	Testudinata	Turtles	Neural	Fragment	A		L	A	U				
5	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Caudal vertebra	Fragment	A		L	A	U				
5	12	1	Lepus sp.	Jackrabbits	Pelvis	Acetabulum w/il., isch., pub.	R		L	A	U				
5	12	1	Sylvilagus sp.	Cottontail rabbits	Scapula	Glenoid fossa & incom. blade	R		L	A	U				
5	12	1	Sylvilagus sp.	Cottontail rabbits	Metatarsal 2	Proximal end			L	A	U				
5	12	1	Odocoileus sp.	Deer	Tooth	Fragment			L	A	U				
5	12	1	Odocoileus sp.	Deer	Calcaneus	Fragment	R		L	S	U				
5	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
5	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
5	12	1	Sylvilagus sp.	Cottontail rabbits	Metacarpal	Complete			L	U	U				
5	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				1
5	12	2	Viperidae	Pitviper snakes	Dorsal vertebra	Fragment	A		L	A	U				
5	12	2	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus diastema	R		L	A	U				
5	12	2	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower I1	R		L	A	U				
5	12	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	12	2	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
5	12	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	12	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	12	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	12	5	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
5	12	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	12	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	12	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	12	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
5	12	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	12	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	12	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	12	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	12	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	12	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	12	21	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	12	45	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	14	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	14	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
5	14	1	Viperidae	Pitviper snakes	Dorsal vertebra	Centrum	A		L	A	U				
5	14	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Pelvis	Acetabulum w/il., isch., pub.	L		L	A	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Cranium	Maxilla	R		L	A	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus with diastema	R		L	A	U				
5	14	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
5	14	1	Odocoileus sp.	Deer	Tooth	Fragment			L	A	U				
5	14	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Indeterminate	Fragment			M	S	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper PM2	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper PM3	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper PM4	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper M1	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper M2	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM3	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM4	R		L	U	U				
5	14	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M1	R		L	U	U				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	14	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	14	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	14	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Enamel fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	14	2	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
5	14	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	14	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
5	14	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	14	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	14	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	14	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch	R			
5	14	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	14	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	14	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	14	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	14	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	14	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	14	51	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Calcaneus	Proximal anterior aspect	L		L	A	U			L	
5	15	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	15	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	Ch				
5	15	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	15	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
5	15	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horiz.ramus w/incisor alveolus	L		L	A	U				
5	15	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM3	L		L	A	U				
5	15	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM4	L		L	A	U				
5	15	1	Neotoma sp.	Wood rats	Cranium	Maxilla	L		L	A	U				
5	15	1	Lepus sp.	Jackrabbits	Astragalus	Complete	R		L	A	U				
5	15	1	Sylvilagus sp.	Cottontail rabbits	Cranium	Zygomatic	R		L	A	U				
5	15	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	15	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	15	1	Chrysemys sensu lato	Pnted turtles/cooters/sliders	Peripheral	Fragment			L	A	U				
5	15	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Tooth	Enamel fragment			L	A	U				
5	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Incisor			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Fragment			L	A	U				
5	15	1	Odocoileus sp.	Deer	Permanent tooth	Upper M			L	A	U				
5	15	1	Odocoileus sp.	Deer	Permanent tooth	Lower M			L	A	U				
5	15	1	Odocoileus sp.	Deer	Distal phalange	Complete			M	A	U				
5	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
5	15	1	Neotoma sp.	Wood rats	Permanent tooth	Upper M1	L		L	U	U				
5	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused second & third tarsal	Complete	L		L	U	U				
5	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Distal fibula	Complete	R		L	U	U				
5	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Permanent tooth	Incisor			L	U	U				
5	15	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
5	15	2	Sylvilagus sp.	Cottontail rabbits	Metatarsal 2	Proximal end	L		L	A	U				
5	15	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
5	15	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	15	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	15	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	15	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
5	15	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	15	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	15	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	15	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	15	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	15	16	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	15	26	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	15	30	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	15	70	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	16	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U			L	
5	16	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal articular condyle			L	S	Ca				
5	16	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Accessory carpal bone	Complete	R		L	U	Ch				
5	16	1	Sylvilagus sp.	Cottontail rabbits	Radius	Proximal end	R		L	A	U				
5	16	1	Sylvilagus sp.	Cottontail rabbits	Pelvis	Acetabular end of ischium	R		L	A	U				
5	16	1	Vertebrata	Vertebrates	Long bone	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	16	1	Osteichthyes (Medium)	Medium bony fish	Cranium	Fragment			L	A	U				
5	16	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Metapodial	Distal end			L	A	U				
5	16	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	16	1	Sylvilagus sp.	Cottontail rabbits	Metatarsal	Proximal end			L	A	U				
5	16	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Complete distal epiphysis			L	A	U				
5	16	1	Mammalia (Large/very large)	Deer/bison-sized mammals	Indeterminate	Fragment			L	S	U				
5	16	2	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	16	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	16	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	16	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	16	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	16	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	16	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	16	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	16	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	16	9	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	16	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	16	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	16	13	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	5	1	Odocoileus sp.	Deer	Permanent tooth	Upper PM	L		L	A	U				
5	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	6	1	Artiodactyla (Large)	Bison/cow-sized ungulates	Tooth	Enamel fragment			L	A	Ch				
5	6	1	Mammalia (Large/very large)	Deer/bison-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	6	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
5	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	6	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	6	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	6	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	6	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	6	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	6	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	6	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Fragment			L	A	Ch				
5	8	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Permanent tooth	Upper I1			L	A	Ch				
5	8	1	Lepisosteidae	Gars	Vertebra	Centrum	A		L	A	U				
5	8	1	Emydidae	Water and box turtles	Neural	Fragment	A		L	A	U				
5	8	1	cf. Bison	Bison	Permanent tooth	Upper M	L		L	A	U				
5	8	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Distal end	R		L	A	U				
5	8	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Fragment			L	A	U				
5	8	1	Odocoileus sp.	Deer	Tooth	Fragment			L	A	U				
5	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Humerus	Distal end	R		L	S	U				
5	8	1	Mammalia (Large/very large)	Deer/bison-sized mammals	Indeterminate	Fragment			L	S	U				
5	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
5	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Permanent tooth	Lower I1	R		L	U	U				
5	8	1	Sylvilagus sp.	Cottontail rabbits	Tarsal	Complete			L	U	U				
5	8	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	8	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	8	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	8	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
5	8	9	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
5	8	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	8	33	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	8	40	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			
5	9	1	Testudinata	Turtles	Peripheral	Fragment			L	A	Ch				
5	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal end			L	S	Ch				
5	9	1	Osteichthyes (Small)	Small bony fish	Vertebra	Centrum	A		L	A	U				
5	9	1	Sylvilagus sp.	Cottontail rabbits	Cranium	Maxilla	R		L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Cranium	Petrosal	R		L	A	U				
5	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Proximal phalange	Proximal end			L	A	U				
5	9	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Humerus	Fragment			L	A	U				
5	9	1	Procyon lotor	Raccoon	Permanent tooth	Upper cheek tooth			L	A	U				
5	9	1	Lepus sp.	Jackrabbits	Humerus	Distal end	L		L	S	U				
5	9	1	Aves (Large)	Hawk-turkey-sized birds	Tibiotarsus	Fragment			L	S	U				
5	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Fragment			L	S	U				
5	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
5	9	1	Odocoileus sp.	Deer	Prox. phalange of paradigit	Complete			L	U	U				
5	9	2	Serpentes	Snakes	Dorsal vertebra	Complete	A		L	A	U				
5	9	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
5	9	2	Vertebrata	Vertebrates	Phalange	Distal end			L	A	U				
5	9	2	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
5	9	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	9	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	9	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
5	9	3	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	9	3	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
5	9	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
5	9	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
5	9	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	9	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
5	9	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
5	9	6	Testudinata	Turtles	Shell	Fragment			L	A	U				
5	9	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
5	9	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
5	9	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	9	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
5	9	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
5	9	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
5	9	26	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
5	9	30	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	12	1	Vertebrata	Vertebrates	Long bone	Fragment			L	A	U				
6	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U	R			
6	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U	R			
6	10	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Fragment			L	S	Ch				
6	10	1	Serpentes	Snakes	Dorsal vertebra	Fragment	A		L	A	U				
6	10	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
6	10	1	Mammalia (Micro)	Shrew/mouse-sized mammals	Thoracic vertebra	Fragment	A		L	A	U				
6	10	1	Testudinata	Turtles	Peripheral	Fragment			L	A	U				
6	10	1	Chrysemys sensu lato	Pnted turtles/cooters/sliders	Peripheral	Fragment			L	A	U				
6	10	1	Mammalia (Micro)	Shrew/mouse-sized mammals	Pelvis	Fragment			L	A	U				
6	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Femur	Fragment			L	A	U				
6	10	1	Lepus sp.	Jackrabbits	Permanent tooth	Upper cheek tooth			L	A	U				
6	10	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			M	S	U				
6	10	1	Lepus sp.	Jackrabbits	Proximal phalange	Complete			L	U	U				
6	10	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Fragment			L	S	U				1
6	10	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	10	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	10	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	10	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	10	3	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
6	10	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	10	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	10	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	10	9	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	10	9	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	10	10	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	10	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Fragment			L	S	U	R		L	
6	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Shaft fragment			L	A	U	R			

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	Ca				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Astragalus	Complete	L		L	U	Ca				
6	11	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Incisor and diastema area only	L		L	A	Ch				
6	11	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	11	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	11	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Middle phalange	Distal end			L	S	Ch				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Vertebra	Anterior zygapophysis	A		L	A	U				
6	11	1	Geomyidae	Pocket gophers	Mandible	Horizontal ramus with diastema	L		L	A	U				
6	11	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus with diastema	R		L	A	U				
6	11	1	Testudinata	Turtles	Peripheral	Fragment			L	A	U				
6	11	1	Aves (Large)	Hawk-turkey-sized birds	Hind middle phalange	Complete			L	A	U				
6	11	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Proximal phalange	Complete minus prox. epiphysis			L	A	U				
6	11	1	Sylvilagus sp.	Cottontail rabbits	Tibia	Fragment			L	S	U				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
6	11	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	U	U				
6	11	1	Geomyidae	Pocket gophers	Permanent tooth	Lower PM3	L		L	U	U				
6	11	1	Geomyidae	Pocket gophers	Permanent tooth	Lower M1	L		L	U	U				
6	11	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal abaxial sesamoid	Complete			L	U	U				
6	11	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	11	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	11	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	11	2	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
6	11	2	Odocoileus sp.	Deer	Antler	Fragment			L	A	U				
6	11	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	11	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	11	3	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	11	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	11	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	11	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	11	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	11	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	11	14	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	11	24	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
6	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Scapula	Glenoid fossa & incom. blade			L	A	Ca				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	12	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Proximal portion of shaft	L	S	L	A	U				
6	12	1	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
6	12	1	Lepus sp.	Jackrabbits	Permanent tooth	Lower PM3	L		L	A	U				
6	12	1	Odocoileus sp.	Deer	Permanent tooth	Lower M	L		L	A	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Ulna	Proximal end	R		L	A	U				
6	12	1	cf. Canis latrans	Coyote	Astragalus	Fragment	R		L	A	U				
6	12	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	12	1	Osteichthyes (Medium)	Medium bony fish	Cranium	Fragment			L	A	U				
6	12	1	Testudinata	Turtles	Pleural	Fragment			L	A	U				
6	12	1	Testudinata	Turtles	Plastron	Fragment			L	A	U				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Mandible	Fragment			L	A	U				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Fragment			L	A	U				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Shaft fragment			L	A	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Cranium	Maxilla			L	A	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus with diastema			L	A	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower I1			L	A	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M1			L	A	U				
6	12	1	cf. Canis latrans	Coyote	Tarsal	Fragment			L	A	U				
6	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Distal articular condyle			L	A	U				
6	12	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	A	U				
6	12	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	12	1	Mammalia (Large/very large)	Deer/bison-sized mammals	Indeterminate	Fragment			L	S	U				
6	12	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM4			L	U	U				
6	12	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	12	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	12	2	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
6	12	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	12	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	12	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	12	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	12	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	12	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	12	6	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	12	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	12	14	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	12	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	13	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	13	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			M	S	U				
6	13	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	13	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	13	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	13	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	13	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	13	26	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	13	28	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	14	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Distal articular condyle			L	A	Ch				
6	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ch				
6	14	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Complete distal epiphysis		S	L	A	U				
6	14	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Vertebra	Centrum	A		L	A	U				
6	14	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Vertebra	Anterior zygapophysis	A		L	A	U				
6	14	1	Ictalurus sp.	Catfish	Pectoral spine	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	14	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	14	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Fragment			L	A	U				
6	14	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus portion			L	A	U				
6	14	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Proximal end			L	A	U				
6	14	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Mandible	Fragment			L	A	U				
6	14	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Metapodial	Proximal end			L	A	U				
6	14	1	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	U				
6	14	1	Sylvilagus sp.	Cottontail rabbits	Femur	Fragment	L		L	S	U				
6	14	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	U	U				
6	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Intermediate carpal bone	Complete	L		L	U	U				
6	14	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal axial sesamoid	Complete			L	U	U				
6	14	2	Testudinata	Turtles	Pleural	Fragment			L	A	Ch				
6	14	2	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
6	14	2	Sylvilagus sp.	Cottontail rabbits	Ulna	Proximal end	R		L	A	U				
6	14	2	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	14	2	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	14	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	14	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	14	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	14	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	14	11	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	14	12	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	14	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	14	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	14	15	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	14	40	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	15	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	15	1	Aves (Large)	Hawk-turkey-sized birds	Scapula	Fragment			L	A	Ch				
6	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	Ch				
6	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	S	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	15	1	Sylvilagus sp.	Cottontail rabbits	Lumbar vertebra	Centrum and neural area	A	A	L	A	U				
6	15	1	Serpentes	Snakes	Dorsal vertebra	Complete	A		L	A	U				
6	15	1	Serpentes	Snakes	Dorsal vertebra	Fragment	A		L	A	U				
6	15	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
6	15	1	Ictalurus sp.	Catfish	Articular	Complete	L		L	A	U				
6	15	1	Sigmodon sp.	Cotton rats	Mandible	Horizontal ramus portion	L		L	A	U				
6	15	1	Lepus sp.	Jackrabbits	Mandible	Incisor and diastema area only	R		L	A	U				
6	15	1	Lepus sp.	Jackrabbits	Permanent tooth	Lower PM4	R		L	A	U				
6	15	1	Lepus sp.	Jackrabbits	Permanent tooth	Lower PM3	R		L	A	U				
6	15	1	Lepus sp.	Jackrabbits	Permanent tooth	Lower I1	R		L	A	U				
6	15	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horiz.ramus w/incisor alveolus	R		L	A	U				
6	15	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM4	R		L	A	U				
6	15	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower PM3	R		L	A	U				
6	15	1	Testudinata	Turtles	Plastron	Fragment			L	A	U				
6	15	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	15	1	Sylvilagus sp.	Cottontail rabbits	Metapodial	Proximal end			L	A	U				
6	15	1	Sylvilagus sp.	Cottontail rabbits	Calcaneus	Fragment			L	A	U				
6	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Distal articular condyle			L	A	U				
6	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
6	15	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal articular condyle			L	S	U				
6	15	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M1	L		L	U	U				
6	15	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M2	L		L	U	U				
6	15	2	Testudinata	Turtles	Pleural	Fragment			L	A	Ch				
6	15	2	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	15	2	Mammalia (Large/very large)	Deer/bison-sized mammals	Indeterminate	Fragment			L	S	U				
6	15	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	U				
6	15	3	Testudinata	Turtles	Pleural	Fragment			L	A	U				
6	15	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	15	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	15	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	15	13	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	15	16	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	15	16	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	15	22	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	16	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Distal end	L		L	A	Ch				
6	16	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Cranium	Maxilla	R		L	A	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus portion	R		L	A	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Fragment	R		L	A	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Scapula	Glenoid fossa & incom. blade	R		L	A	U				
6	16	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	16	1	Mammalia (Micro/small)	Shrew/rabbit-sized mammals	Cranium	Zygomatic process			L	A	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Femur	Fragment	L		L	S	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M2	R		L	U	U				
6	16	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Lower M3	R		L	U	U				
6	16	1	Aves (Large)	Hawk-turkey-sized birds	Hind distal phalange	Complete			L	U	U				
6	16	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			
6	16	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	16	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
6	16	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Fragment			L	A	U				
6	16	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	16	4	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	16	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	16	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	16	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	16	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	3	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	3	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	3	1	Artiodactyla (Large)	Bison/cow-sized ungulates	Tooth	Root fragment			L	A	U				
6	4	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	4	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	4	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	4	1	Geomyidae	Pocket gophers	Cranium	Maxilla	A		L	A	U				
6	4	1	Geomyidae	Pocket gophers	Permanent tooth	Upper M1	L		L	A	U				
6	4	1	Sylvilagus sp.	Cottontail rabbits	Calcaneus	Complete minus prox. epiphysis	R		L	A	U				
6	4	1	Geomyidae	Pocket gophers	Permanent tooth	Upper M1	R		L	A	U				
6	4	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	4	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Permanent tooth	Incisor			L	A	U				
6	4	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Pelvis	Ilium fragment			L	A	U				
6	4	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	4	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper cheek tooth			L	A	U				
6	4	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Lower I			L	A	U				
6	4	1	Antilocapra americana	Pronghorn antelope	Tooth	Fragment			L	A	U				
6	4	1	Sylvilagus sp.	Cottontail rabbits	Tibia	Distal end	L		L	S	U				
6	4	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metatarsal	Fragment			L	S	U				
6	4	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	4	2	Testudinata	Turtles	Peripheral	Fragment			L	A	U				
6	4	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	4	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	4	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	4	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	4	9	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	4	14	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	4	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	4	76	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			
6	6	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
6	6	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Proximal end	L		L	A	Ch				
6	6	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	6	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	6	1	Emydidae	Water and box turtles	Peripheral	Fragment			L	A	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	6	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Fragment	A		L	A	U				
6	6	1	Osteichthyes (Large)	Large bony fish	Vertebra	Fragment	A		L	A	U				
6	6	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Ulna	Complete distal epiphysis	L		L	A	U				
6	6	1	Lepisosteidae	Gars	Cranium	Fragment			L	A	U				
6	6	1	Lepisosteidae	Gars	Ganoid scale	Fragment			L	A	U				
6	6	1	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	6	1	Testudinata	Turtles	Peripheral	Fragment			L	A	U				
6	6	1	Testudinata	Turtles	Plastron	Fragment			L	A	U				
6	6	1	Aves (Large)	Hawk-turkey-sized birds	Phalange	Distal end			L	A	U				
6	6	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Tooth	Fragment			L	A	U				
6	6	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	6	1	Sylvilagus sp.	Cottontail rabbits	Mandible	Horizontal ramus portion			L	A	U				
6	6	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
6	6	1	Sigmodon sp.	Cotton rats	Mandible	Ramus complete	L		L	U	U				
6	6	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M1	L		L	U	U				
6	6	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M3	L		L	U	U				
6	6	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower I1	L		L	U	U				
6	6	1	Sigmodon sp.	Cotton rats	Permanent tooth	Lower M2	L		L	U	U				
6	6	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	6	2	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metacarpal	Fragment			L	S	Ch				
6	6	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	6	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	6	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	6	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	6	5	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	6	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	6	11	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	6	14	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	6	26	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	6	53	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	7	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U	R			

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	7	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Long bone	Fragment			L	A	U	R			
6	7	1	Sylvilagus sp.	Cottontail rabbits	Ulna	Proximal end			L	A	Ch				
6	7	1	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	Ch				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Indeterminate	Fragment			L	S	Ch				
6	7	1	Procyon lotor	Raccoon	Permanent tooth	Lower M	L	A	L	A	U				
6	7	1	Odocoileus sp.	Deer	Permanent tooth	Upper PM	R	S	L	A	U				
6	7	1	Aves (Large)	Hawk-turkey-sized birds	Tarsometatarsus	Distal end	L		L	A	U				
6	7	1	Neotoma sp.	Wood rats	Humerus	Distal end	L		L	A	U				
6	7	1	Lepus sp.	Jackrabbits	Metatarsal 2	Proximal end	R		L	A	U				
6	7	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	7	1	Lepus sp.	Jackrabbits	Scapula	Glenoid fossa & incom. blade			L	A	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Fragment			L	A	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tooth	Enamel fragment			L	A	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Distal articular condyle			L	A	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal end			L	A	U				
6	7	1	Odocoileus sp.	Deer	Prox. phalange of paradigit	Complete			L	A	U				
6	7	1	Phasianidae	Turkeys, grouse, quails, etc.	Coracoid	Distal end	R		L	S	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Fused 3rd & 4th metacarpal	Fragment			L	S	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Distal end			L	S	U				
6	7	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Distal fibula	Complete	L		L	U	U				
6	7	2	Osteichthyes (Medium)	Medium bony fish	Cranium	Fragment			L	A	U				
6	7	2	Lepisosteidae	Gars	Ganoid scale	Fragment			L	A	U				
6	7	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	U	U				
6	7	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	7	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	7	7	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	7	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	7	8	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	7	10	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	7	11	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	7	14	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	7	16	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	7	24	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	7	30	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	7	40	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U	R			
6	8	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	8	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	8	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	8	1	Trionyx sp.	Softshell turtle	Shell	Fragment			L	A	Ch				
6	8	1	Aves (Large)	Hawk-turkey-sized birds	Tibiotarsus	Distal articular condyle			L	A	Ch				
6	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	A	Ch				
6	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Metapodial	Fragment			L	S	Ch				
6	8	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Lumbar vertebra	Complete	A	S	L	A	U				
6	8	1	Geomyidae	Pocket gophers	Humerus	Complete shaft	R	S	L	A	U				
6	8	1	Osteichthyes (Medium)	Medium bony fish	Vertebra	Centrum	A		L	A	U				
6	8	1	Osteichthyes (Large)	Large bony fish	Vertebra	Centrum	A		L	A	U				
6	8	1	Serpentes	Snakes	Dorsal vertebra	Complete	A		L	A	U				
6	8	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Cranium	Maxilla	A		L	A	U				
6	8	1	Lepus sp.	Jackrabbits	Cranium	Maxilla	L		L	A	U				
6	8	1	Sylvilagus sp.	Cottontail rabbits	Humerus	Distal end	L		L	A	U				
6	8	1	Sylvilagus sp.	Cottontail rabbits	Calcaneus	Proximal aspect	L		L	A	U				
6	8	1	Lepus sp.	Jackrabbits	Ulna	Proximal end	R		L	A	U				
6	8	1	Sylvilagus sp.	Cottontail rabbits	Scapula	Glenoid fossa & incom. blade	R		L	A	U				
6	8	1	Sylvilagus sp.	Cottontail rabbits	Radius	Proximal end	R		L	A	U				
6	8	1	Sylvilagus sp.	Cottontail rabbits	Radius	Proximal end	R		L	A	U				
6	8	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	8	1	Anura	Toads and frogs	Long bone	Fragment			L	A	U				
6	8	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	8	1	Aves (Large)	Hawk-turkey-sized birds	Humerus	Proximal end			L	A	U				
6	8	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Metapodial	Distal end			L	A	U				
6	8	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	8	1	Sylvilagus sp.	Cottontail rabbits	Metatarsal	Complete minus dist. epiphysis			L	A	U				
6	8	1	Odocoileus sp.	Deer	Mandible	Fragment			L	A	U				
6	8	1	cf. Antilocapra americana	Pronghorn antelope	Permanent tooth	Lower cheek tooth			L	A	U				
6	8	1	Lepus sp.	Jackrabbits	Radius	Proximal end	R		L	S	U				
6	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Humerus	Fragment			L	S	U				
6	8	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Radial carpal bone	Complete	R		L	U	U				
6	8	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
6	8	2	Odocoileus sp.	Deer	Tooth	Enamel fragment			L	A	Ch				
6	8	2	Colubridae	Colubrid snakes	Dorsal vertebra	Complete	A		L	A	U				
6	8	2	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
6	8	2	Trionyx sp.	Softshell turtle	Shell	Fragment			L	A	U				
6	8	3	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				
6	8	3	Testudinata	Turtles	Pleural	Fragment			L	A	U				
6	8	3	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Proximal phalange	Fragment			L	S	U				
6	8	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ca				
6	8	4	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	Ch				
6	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	8	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	8	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ch				
6	8	6	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	8	8	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	8	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	8	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	8	9	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	8	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	8	10	Odocoileus sp.	Deer	Permanent tooth	Lower M	L	A	L	A	U				
6	8	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	8	11	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	8	11	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	8	13	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	8	15	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	8	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	8	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	8	21	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	8	28	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	8	30	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	9	1	Testudinata	Turtles	Shell	Fragment			L	A	Ca				
6	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ca				
6	9	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	9	1	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	9	1	Testudinata	Turtles	Shell	Fragment			L	A	Ch				
6	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Rib	Fragment			L	S	Ch				
6	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Femur	Fragment			L	S	Ch				
6	9	1	Procyon lotor	Raccoon	Permanent tooth	Lower M1	L	A	L	A	U				
6	9	1	Serpentes	Snakes	Dorsal vertebra	Neural area only	A		L	A	U				
6	9	1	Colubridae	Colubrid snakes	Dorsal vertebra	Centrum and neural area	A		L	A	U				
6	9	1	Viperidae	Pitviper snakes	Dorsal vertebra	Complete minus dist. epiphysis	A		L	A	U				
6	9	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Humerus	Distal end	L		L	A	U				
6	9	1	Osteichthyes (Medium)	Medium bony fish	Cranium	Fragment			L	A	U				
6	9	1	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	9	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Tooth	Root fragment			L	A	U				
6	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Tooth	Enamel fragment			L	A	U				
6	9	1	Sylvilagus sp.	Cottontail rabbits	Permanent tooth	Upper cheek tooth			L	A	U				
6	9	1	Sylvilagus sp.	Cottontail rabbits	Astragalus	Fragment			L	A	U				
6	9	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Cranium	Premaxilla			L	A	U				
6	9	1	Rodentia (Medium)	Rat/squirrel-sized rodent	Femur	Distal articular condyle			L	A	U				
6	9	1	Geomyidae	Pocket gophers	Mandible	Ascend.ramus w/part hor. ramus			L	A	U				
6	9	1	Lepus sp.	Jackrabbits	Radius	Distal end	L		L	S	U				
6	9	1	Artiodactyla (Medium)	Deer/pronghorn-sized ungulates	Tibia	Fragment			L	S	U				
6	9	1	Mammalia (Small/medium)	Rabbit/canid-sized mammals	Proximal phalange	Complete			L	U	U				
6	9	1	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U		4*		
6	9	2	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	Ca				

Unit	Level	Qty	Taxon	Common Name	Element	Portion	Side	Age	Weathering	Breakage	Burning	Gnawing	# Cut Marks	Chemical Etching	# Impact Fractures
6	9	2	Testudinata	Turtles	Pleural	Fragment			L	A	U				
6	9	2	Kinosternidae	Mud and musk turtles	Peripheral	Fragment			L	A	U				
6	9	3	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	9	3	Viperidae	Pitviper snakes	Dorsal vertebra	Complete	A		L	A	U				
6	9	3	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	9	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	9	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	9	4	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	Ch				
6	9	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	9	4	Serpentes	Snakes	Dorsal vertebra	Complete	A		L	A	U				
6	9	4	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	9	5	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	Ch				
6	9	5	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	Ch				
6	9	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	9	6	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	9	7	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	S	U				
6	9	8	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	9	9	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	9	9	Mammalia (Medium/large)	Canid/deer-sized mammals	Indeterminate	Fragment			L	A	U				
6	9	10	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	9	11	Testudinata	Turtles	Shell	Fragment			L	A	U				
6	9	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				
6	9	12	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	9	13	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	9	18	Vertebrata	Vertebrates	Indeterminate	Fragment			L	S	U				
6	9	20	Vertebrata	Vertebrates	Indeterminate	Fragment			L	A	U				

Appendix C

Archaeomagnetic Analysis

Wulf Gose

Introduction

A total of 111 archaeomagnetic samples from the Texas Rivers Center was processed and analyzed in the Paleomagnetic Laboratory, Department of Geological Sciences at The University of Texas at Austin. The purpose of this appendix is to provide detailed data and information regarding the individual samples. Archaeomagnetic analysis of fire-cracked rock reveals whether or not a feature has been disturbed since the last heating and cooling event. It can also provide an estimate for the how many times a rock has been heated and to what temperatures.

The methods used in collecting and processing the samples has been discussed in Chapter 4. All samples were thermally demagnetized in 50°C increments from 150 to 600°C in the laboratory. After each demagnetizing event they were allowed to cool, their magnetic vectors were measured by a cryogenic magnetometer, and then recorded on a computer database, before being reheated to the next higher increment. The resulting data were plotted in orthogonal vector diagrams and equal-area stereonets for principal component analysis. An example of how these are interpreted follows below.

Example of How the Analysis is Conducted

Figure C-1 shows the changes in the vectors of magnetism for four samples from Unit 4, Level 8, Feature 3 (U4-8-3). In this equal area projection, declination is measured clockwise in angles with north plotted at the top of the circle and inclination is 0° at the periphery and 90° at the center of the stereonet. Positive inclinations are shown by crosses and negative inclination by open circles. "PDF" indicates the present magnetic field direction in San Marcos. The direction of magnetization of culturally burned rocks should plot within about 30° of this orientation if they have remained fully undisturbed since their last heating. The shaded ellipse in Figure C-1 delineates this 30° area.

The magnetic vector of Sample 36 from Feature 3 groups tightly up to the 550° demagnetization step. Upon exceeding the magnetite Curie point (580°C), the direction vector changes orientation. Sample 24 changes in the same manner. The direction of both samples falls within the expected area. By contrast, Samples 30 and 26 have negative inclinations. All archeological samples should have positive inclinations if they remained in situ and thus the stereonet implies that these samples have moved significantly since their last heating.

However, a different interpretation emerges when one looks at the data in vector component diagrams. These graphs plot the intensities of magnetization in the north-east-south-west plane and, within the same graph, the projection onto the up-down-horizontal plane is also shown. A component of magnetization is defined by a linear trend of at least three consecutive data points. Figure C-2 shows such diagrams for the same samples as depicted in Figure 1. Sample 36 provides an easy example. From the 150°C step to the final step at 600°C the data define a linear trend towards the origin. The initial change from the undermagnetized natural remanent magnetization (NRM) to 150°C probably represents a magnetization acquired after the sample had been collected and is interpreted as contamination. Principal component analyses (Kirshvink 1980) are used to calculate the best-fitting vector over the entire linear range, from 150 to 600° in this case. Sample 24, which looked very similar in the stereonet, exhibits two well-defined components of magnetization. Component 1 is defined by the demagnetization steps 150° through 400°, and component 2 is revealed by the steps from 450° to 600°.

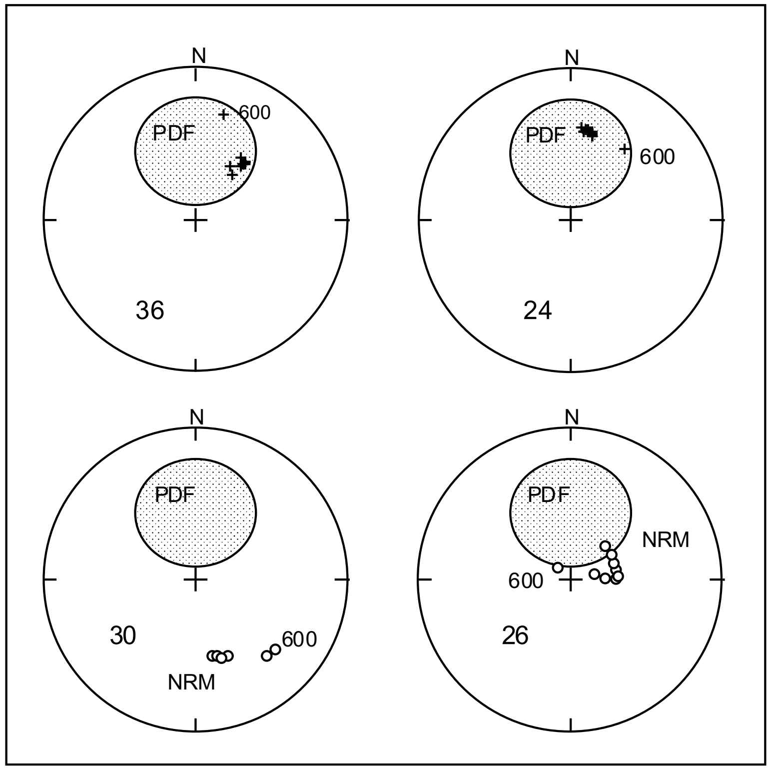


Figure C-1. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic Samples 24, 26, 30 and 36 from Feature 3, Level 8, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere. All samples were demagnetized to 600°C.

Sample 30 contains two nearly antipodal directions. The trace through the vector end points first moves away from the origin (NRM-200°) and then aims back to the origin. Although all directions in the stereonet were pointing south with negative inclinations, the vector component diagram reveals a low-temperature component (NRM-200°) which has a northerly declination and a positive inclination. This component was masked in the stereonet because the high-temperature component is about twice as strong as the low-temperature component. The low-temperature component does point south and has a negative inclination. Similarly, Sample 26 has a north-pointing low-temperature component (NRM-300°) with a positive inclination and a high-temperature component with an easterly declination and a negative inclination.

These examples demonstrate the power of principal component analyses and justify the extra effort to progressively demagnetize every sample. All samples used in this study were subjected to this procedure and all the directions of magnetization are based on principal component analyses.

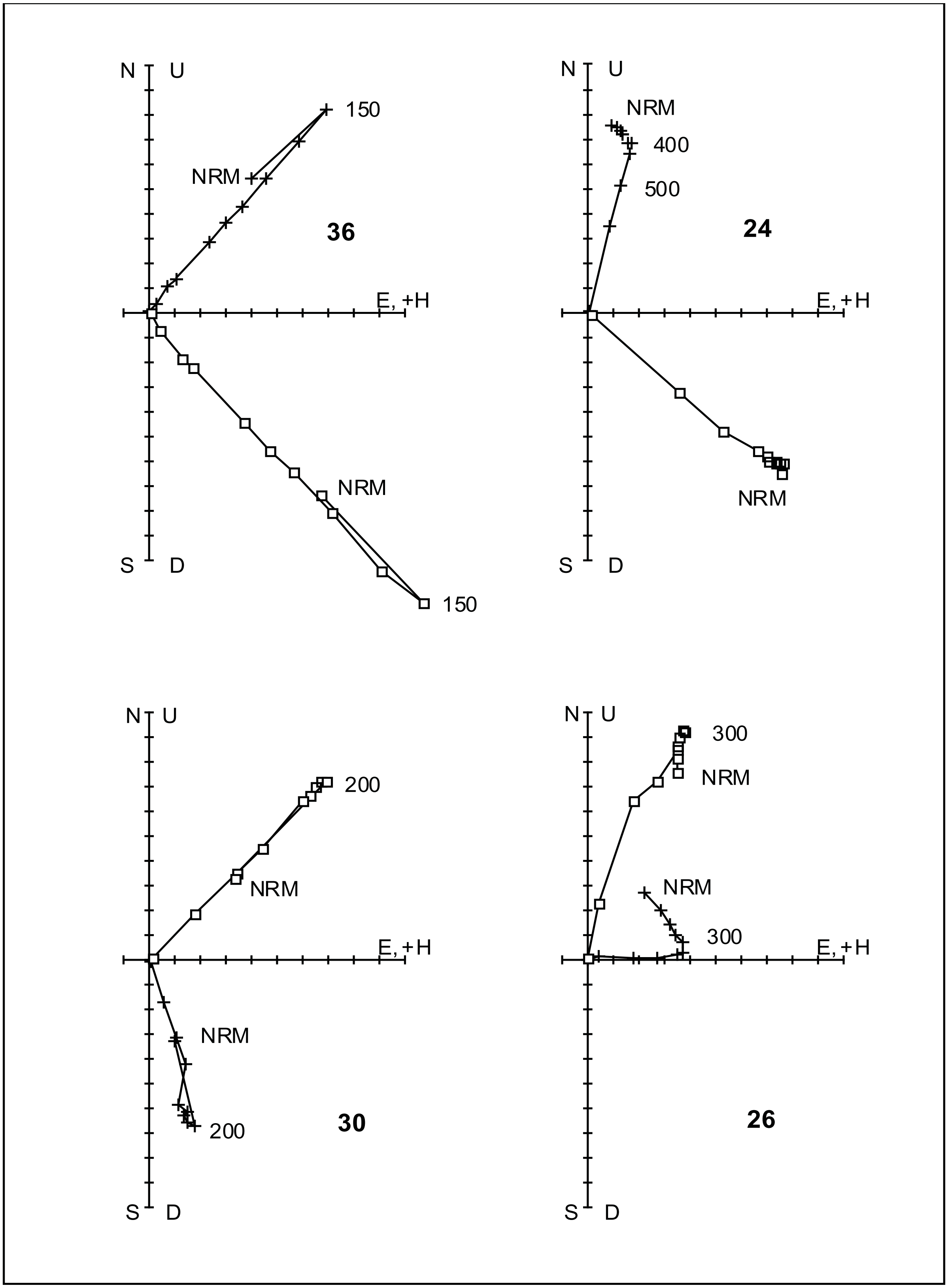


Figure C-2. Vector component diagrams for archaeomagnetic Samples 24, 26, 30 and 36 from Feature 3, Level 8, Unit 4. Open squares are the projection onto the up-down-horizontal plane; crosses represent the projection onto the N-S-E-W plane.

Analysis of the Texas Rivers Center Samples

Feature 3, Unit 4

Level 8 (80-90 cm bd)

Feature 3 in Unit 4 was excavated at four different levels. The highest level sampled for magnetic analyses is level 8. Four cores carry only one component of magnetization pointing in a north-easterly direction (Figure C-3a). This implies that these rocks were heated to above 550°C and moved only slightly since the last heating event. The other cores from this level carry two components of magnetization. It is the low-temperature component which is roughly aligned with the present magnetic field direction. This component was identified over the temperature range from ambient to 200° in three samples to as high as 400 °C in one sample.

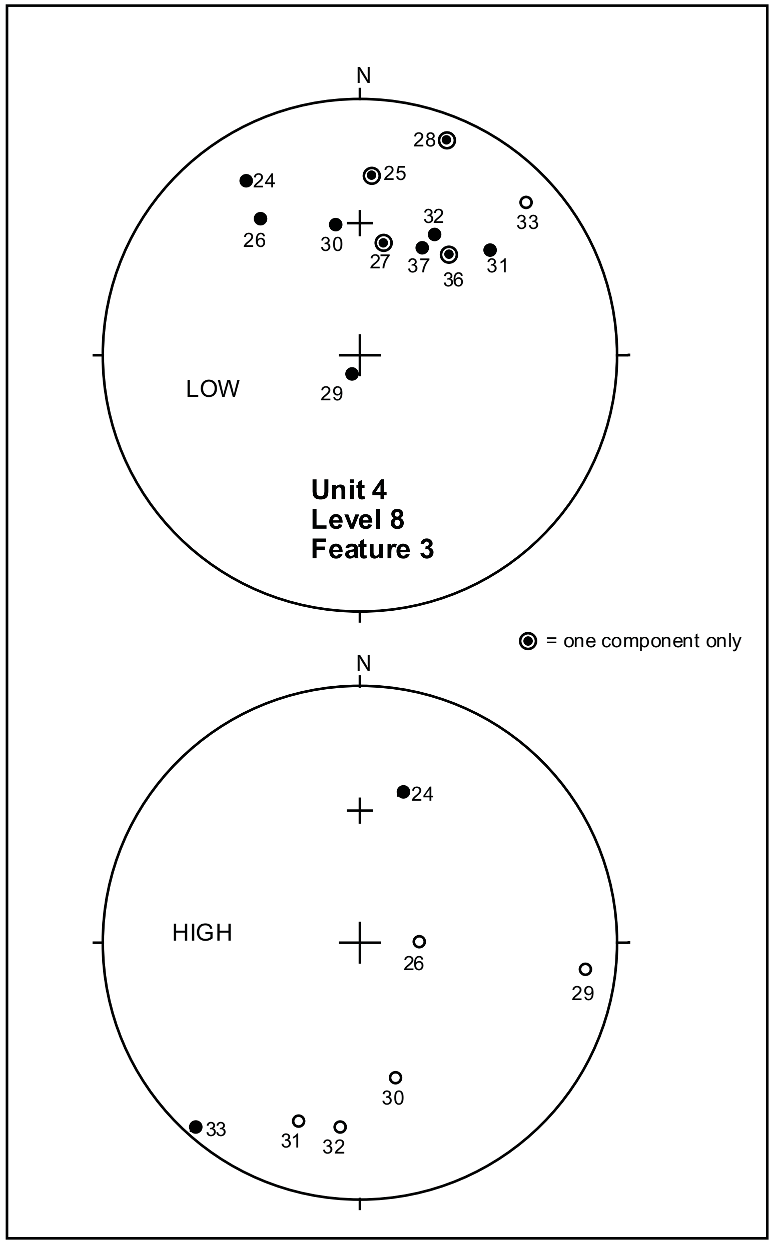
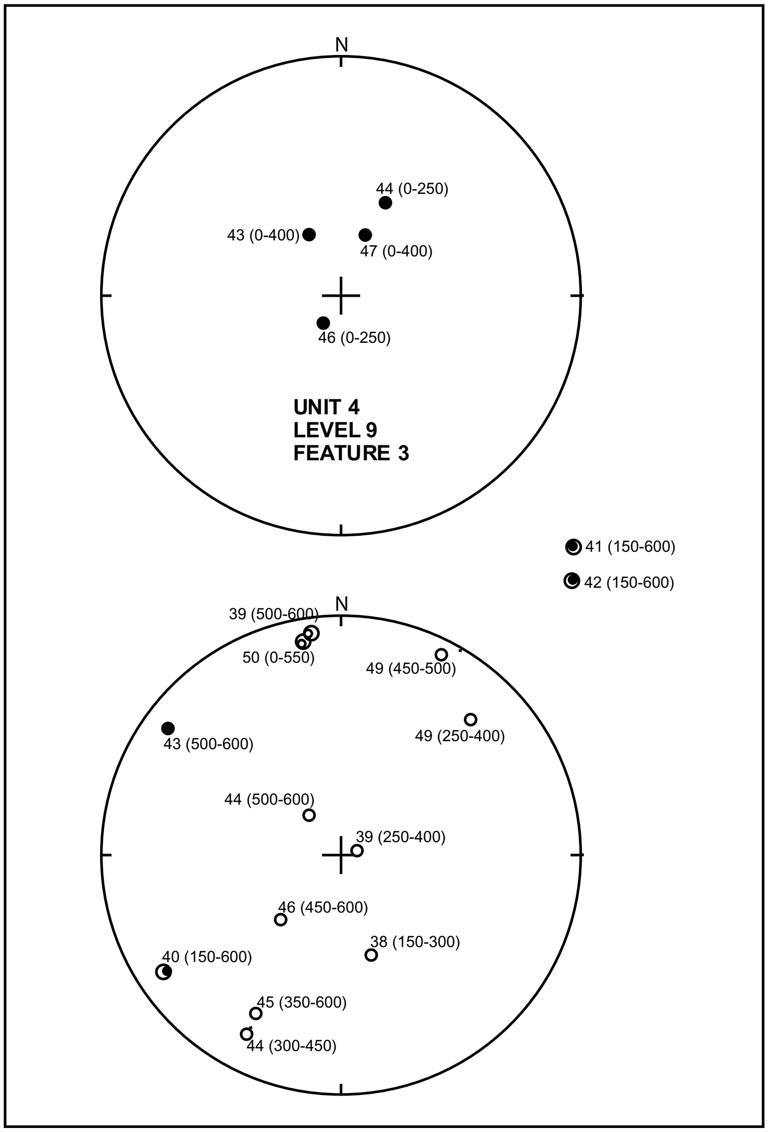


Figure C-3. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 3, Level 8, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

The high temperature directions of these samples are far removed from the present field direction except for one sample (Figure C-3b). These results suggest that these samples experienced only moderate heating and were subjected to a fair amount of movement after heating. The samples that saw the least heating are at the western margin of Feature 3.

Level 9 (90-100 cm bd)

Of the twelve samples taken at this level, only three have a component of magnetization that points near the expected direction (Figure C-4). These are all low-temperature magnetizations. All



FigureC-4. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 3, Level 9, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere. The numbers in parentheses indicate the temperature range in which the components were identified.

other identifiable directions are widely scattered. Samples 39, 40, 41, 42, and 50 contain only one component which suggests that these samples were exposed to temperatures above 550°C.

Level 10 (100-110 cm bd)

The directions of magnetization for all eight samples are randomly distributed (Figure C-5), indicating that they have been disturbed since they were last heated and cooled. However, the temperature data indicates they were heated more than once.

Level 11 (110-120 cm bd)

As in samples from the previous level, the directions of magnetization for the nine samples

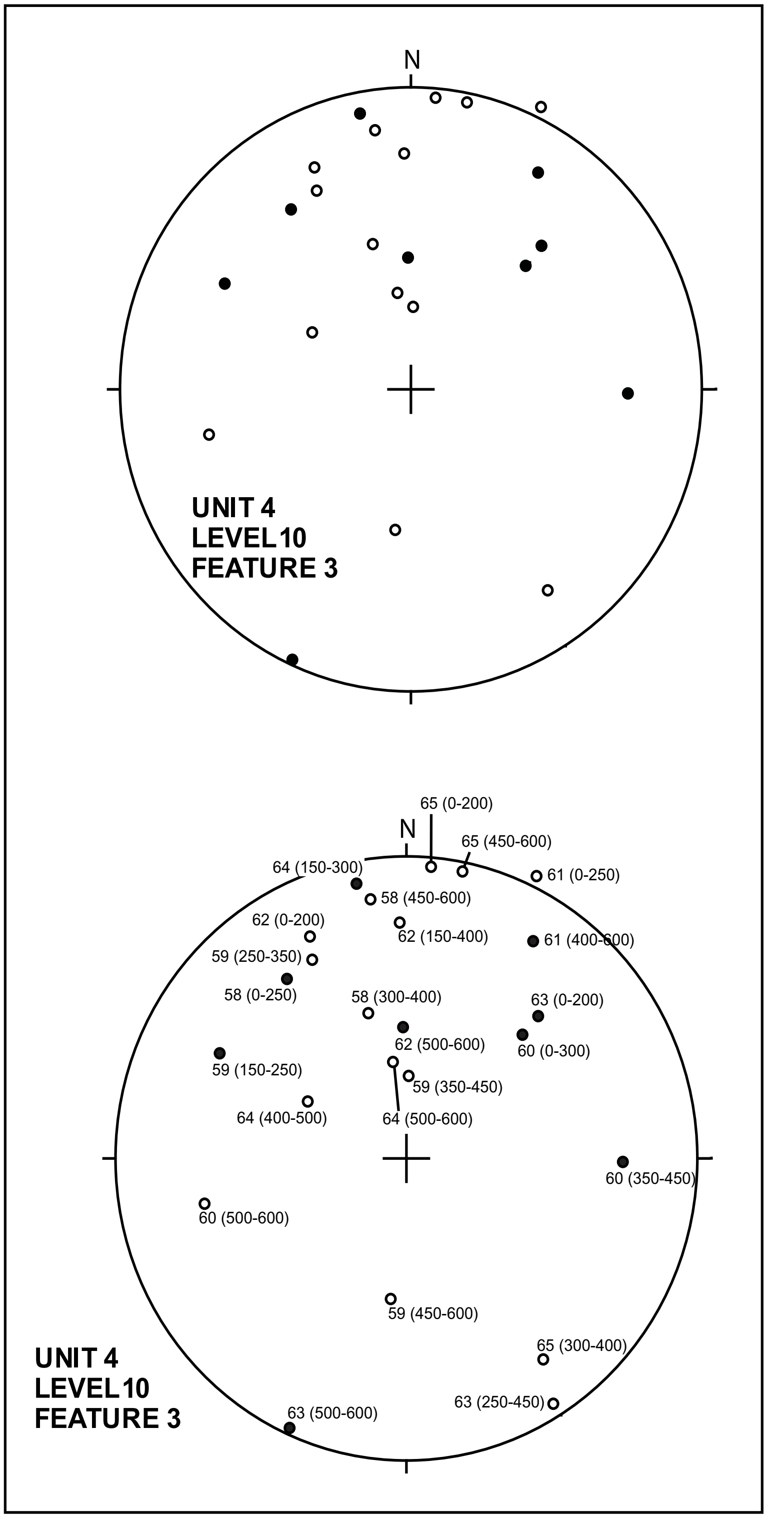


Figure C-5. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 3, Level 10, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere. The numbers in parentheses indicate the temperature range in which the components were identified.

from Level 11 are also randomly distributed (Figure C-6). However, the temperature data provides probable heating events for eight of the nine heavily disturbed rocks.

Level 12 (120-130 cm bd)

Of the 3 samples collected at this level, only Sample 101 carries a magnetization (low-T) which may have been acquired in situ (Figure C-7). All three have temperature components indicating more than one heating.

Summary

The archaeomagnetic data do not delineate a distinct heating pattern. Only a limited number of samples yield directions of magnetization that could be interpreted as having been acquired during a cultural heating event. Most of the directions scatter which suggests that the rocks of this feature have been severely disturbed.

Feature 1, Unit 6

Figures C-8 and C-9 depict the equal-are stereographic projections for the 13 samples from Levels 7, 8, and 9. Most of the directions of magnetization are randomly distributed which raises the question whether the few directions which may indicate in situ heating, are not also part of a random distribution.

Feature 4, Unit 5

Only two samples is not sufficient for an overall evaluation of a feature. Both samples have been disturbed (Figure C-10).

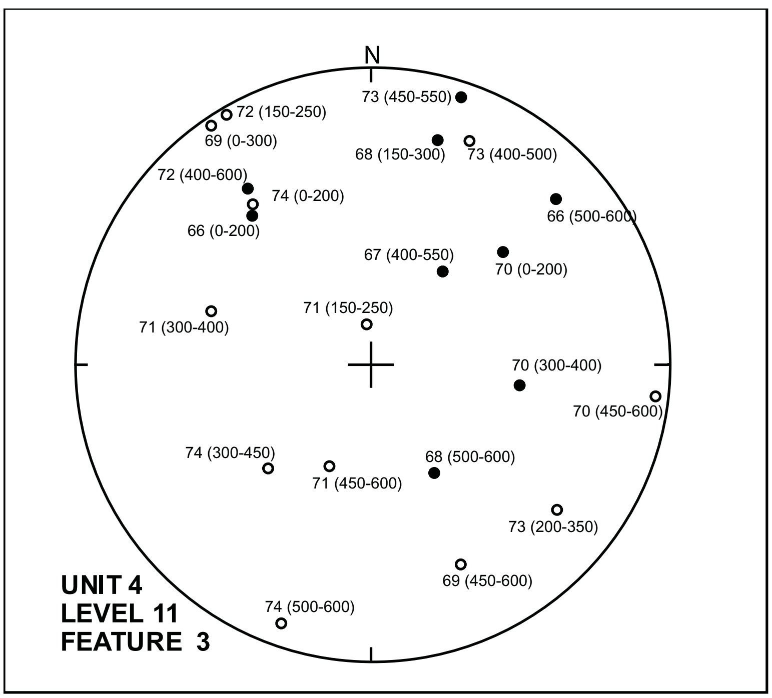


Figure C-6. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 3, Level 11, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere. The numbers in parentheses indicate the temperature range in which the components were identified.

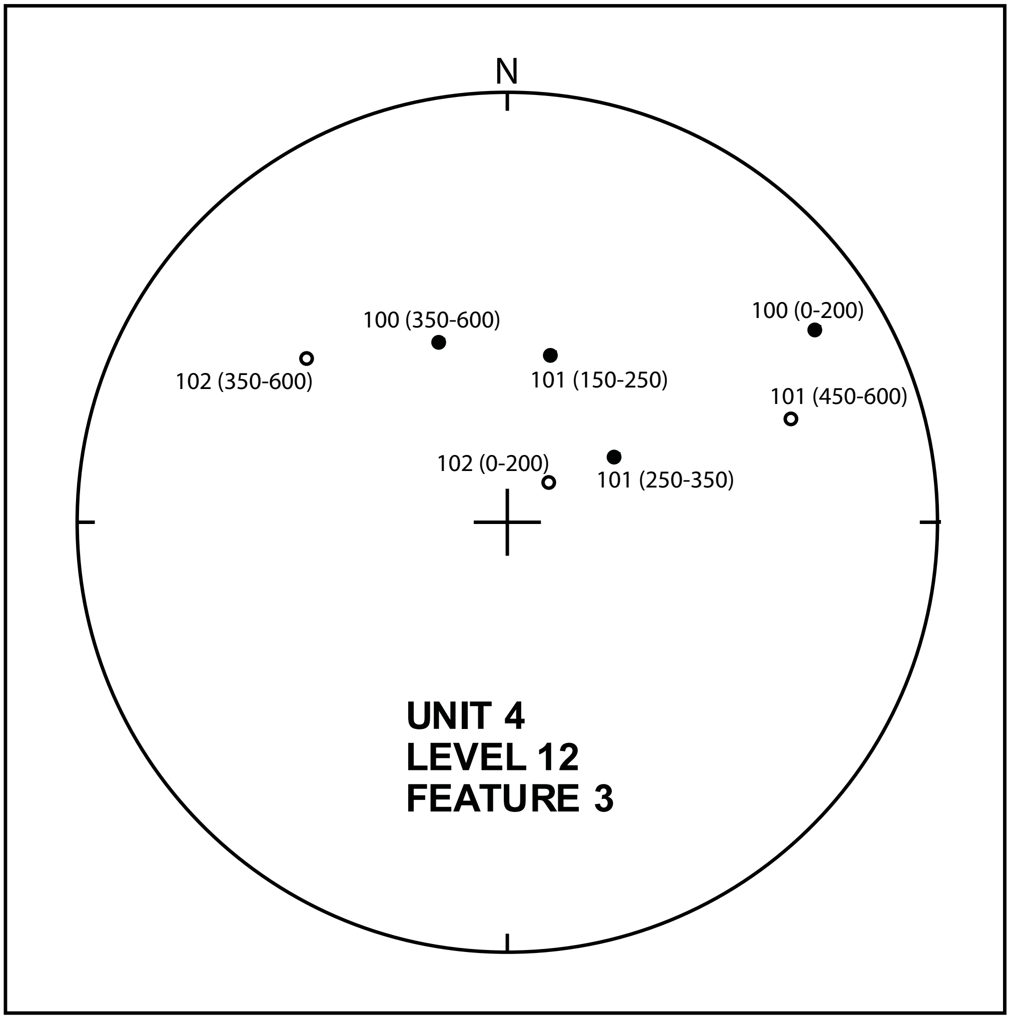


Figure C-7. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 3, Level 12, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere. The numbers in parentheses indicate the temperature range in which the components were identified.

Feature 8, Unit 5

An equal-area stereographic plot of the data from 23 samples from Feature 8 (Figure C-11) indicates that the samples are not quite random but nearly so. This indicates that they are highly disturbed.

Feature 11, Unit 4

The ten samples from Feature 11 provided little useful data (Figure C-12). Although it appears that the rocks generally cluster, no component of magnetization with linear trend of at least three consecutive data points was identified.

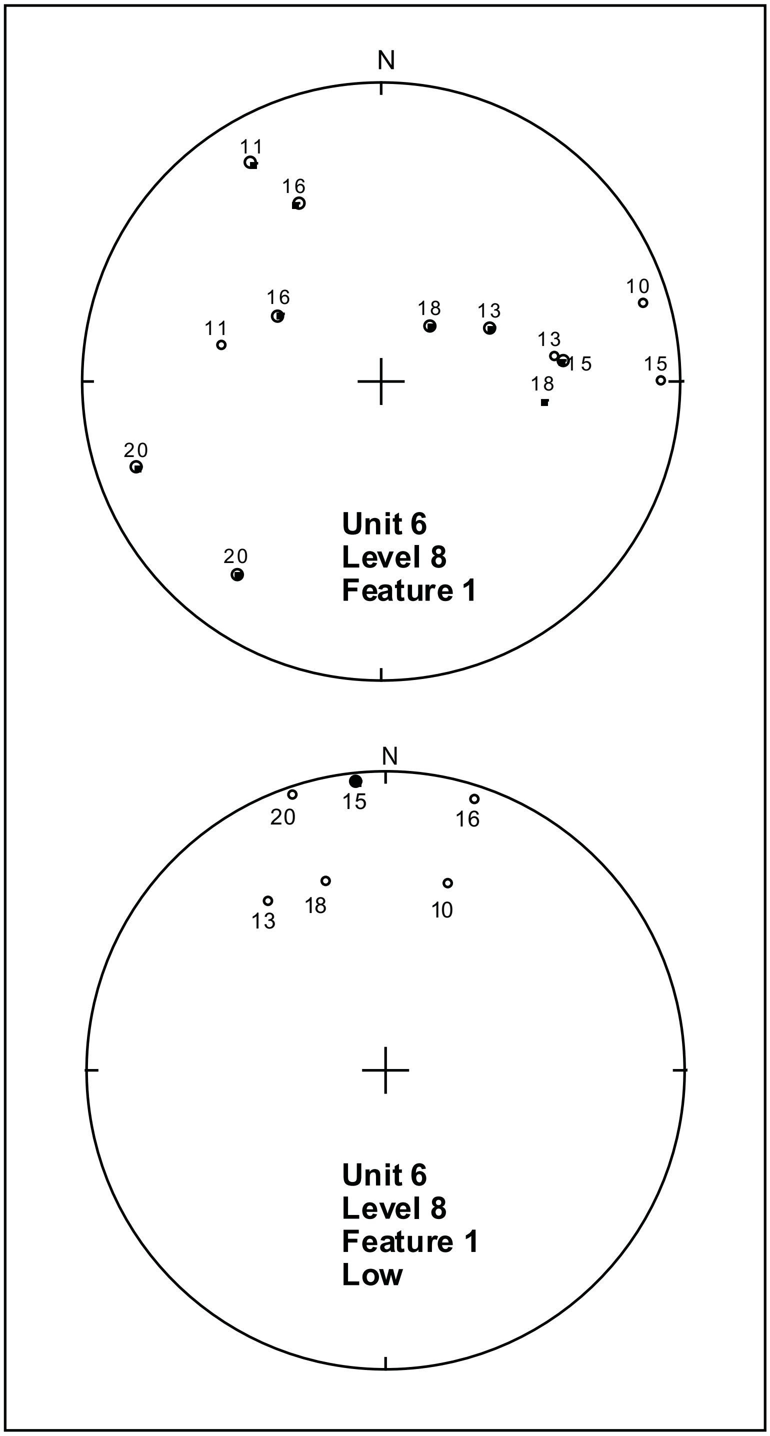


Figure C-8. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 1, Level 8, Unit 6. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

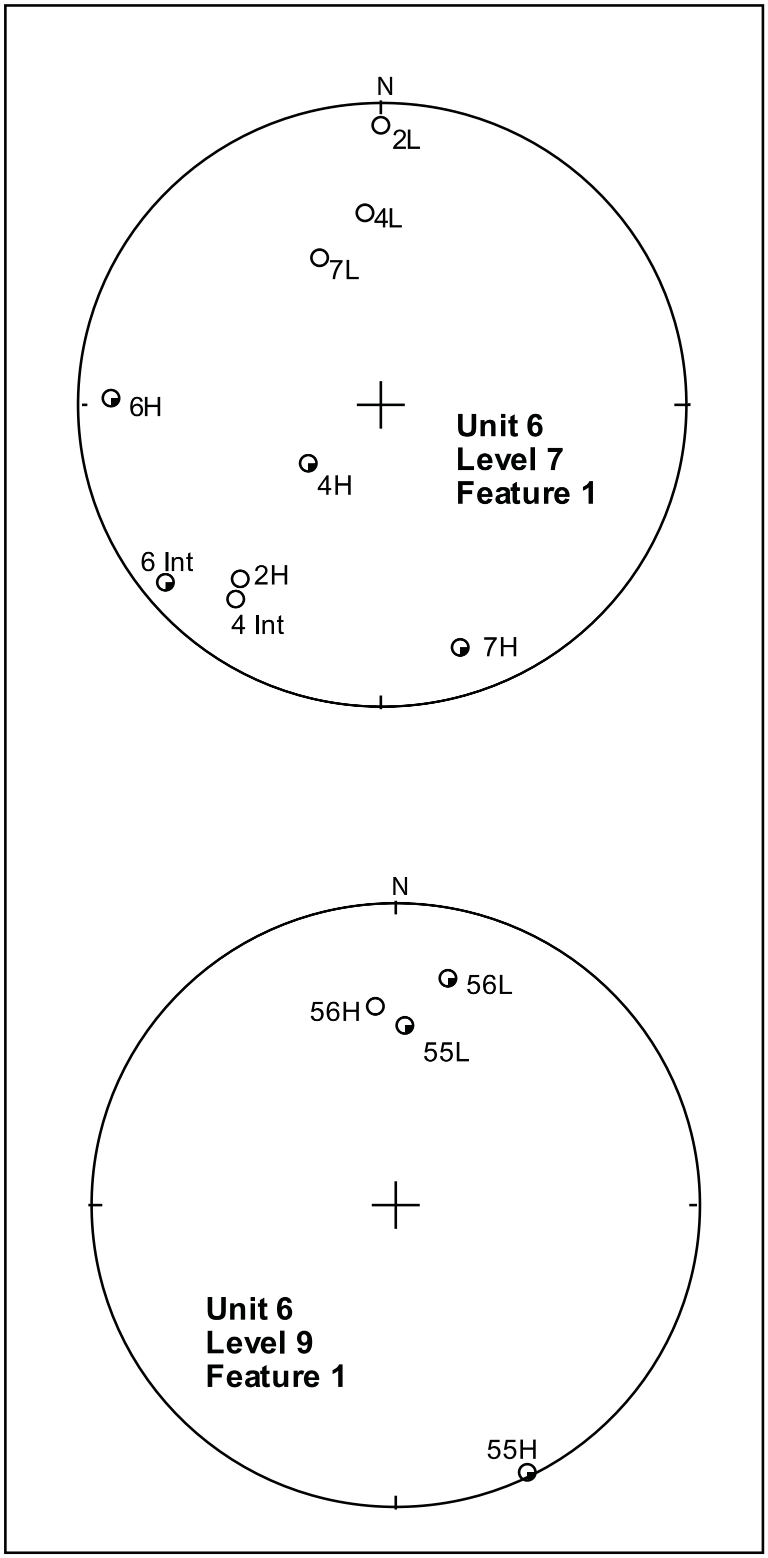


Figure C-9. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 1, Levels 7 and 9, Unit 6. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

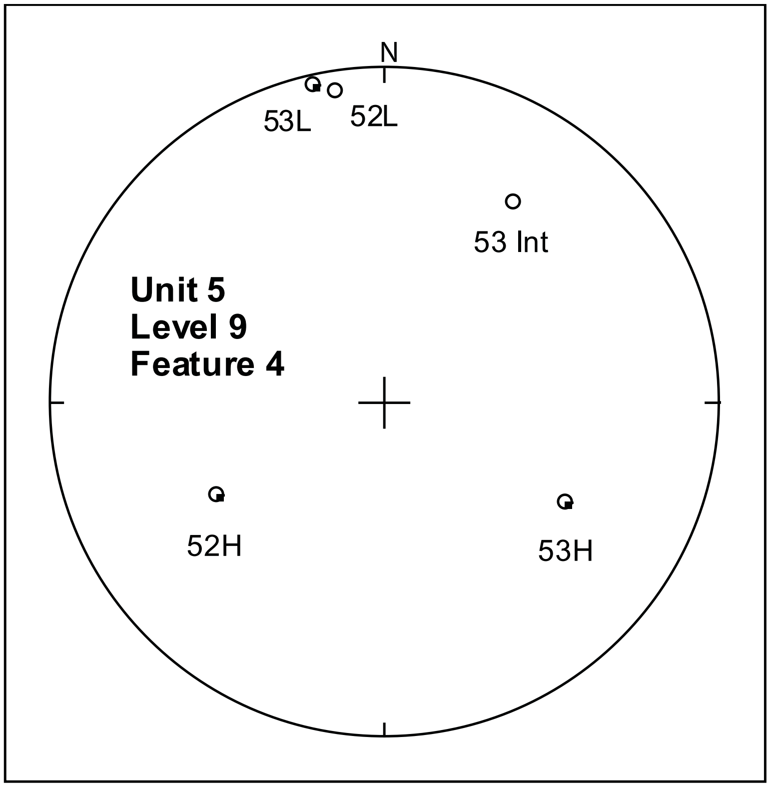


Figure C-10. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 4, Level 9, Unit 5. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

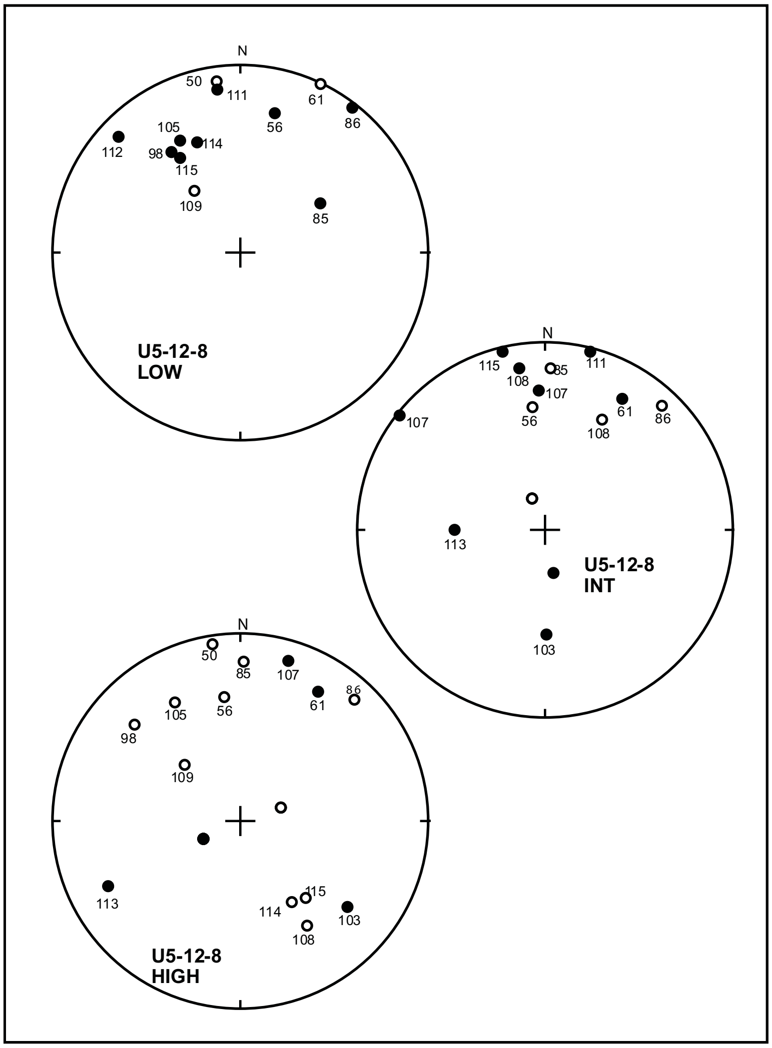


Figure C-11. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 8, Levels 12-14, Unit 5. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

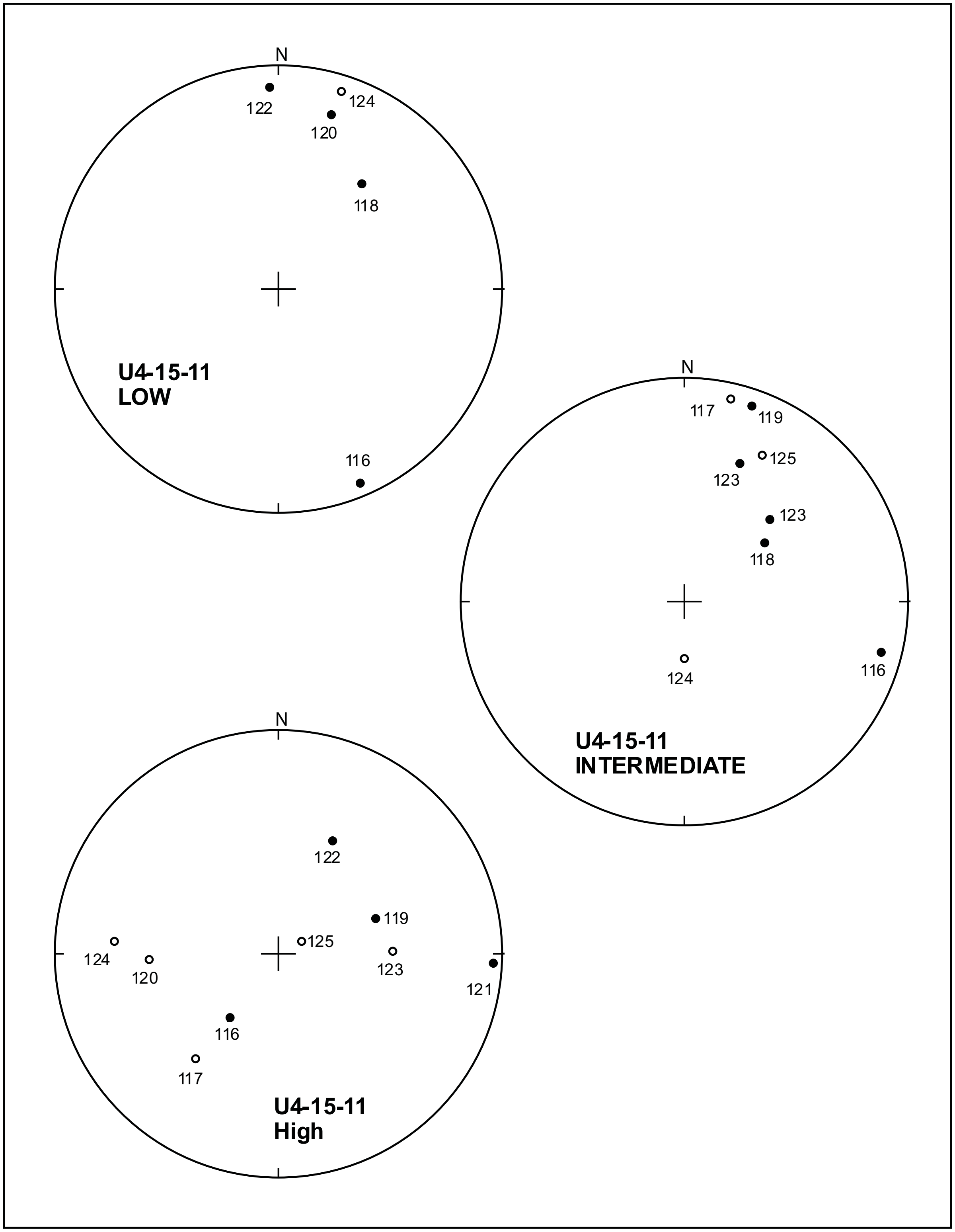


Figure C-12. Equal-area stereographic projections of the directions of magnetization, calculated by the principal component method, for archaeomagnetic samples from Feature 11, Levels 15 and 16, Unit 4. Open symbols are in the northern hemisphere and solid symbols are in the southern hemisphere.

Appendix D

Soil Stratigraphic Description

Lee Nordt

Core A

Between swimming pool and valley wall; calcareous, moist throughout; all gravels are limestone unless otherwise stated.

Fill	0-102 cm; dark yellowish brown (10YR 4/4) sandy clay loam; 60% pebbles, 0.3 to 1 cm diameter, subrounded, abrupt.
Fill	102-111 cm; 10YR 4/2.5; sandy clay loam; 2% pebbles, 0.3 to 0.8 cm diameter, angular to subrounded; abrupt.
Fill	111-157 cm; pale brown (10YR 6/3) sandy loam; few medium distinct yellowish red (5YR 4/6) iron pore linings; 40% pebbles, 0.2 to 0.5 cm diameter, few silt loam and loamy sand beds, 2 to 3 cm diameter; abrupt.
Fill	157-204 cm; brown (4.5/3) sandy clay loam; 70% coarse fragments, 0.4 to 2 cm diameter, subrounded to angular; abrupt.
Fill	204-253 cm; dark brown (10YR 3/3) and light olive brown (2.5Y 5/4) clay loam in two, six cm beds; 50% coarse fragments, 1 to 7 cm diameter, angular; abrupt.
Fill	253-261 cm; brown and dark brown (10YR 4/3, 3/3) clay/clay loam; 30% coarse fragments, 0.5 to 1.5 cm diameter, angular; abrupt.
A/C	261-292 cm; mixed zone; very dark gray (10YR 3.5/1) clay; few medium distinct iron pore linings; 5% pebbles, 0.2 to 0.5 cm, angular; two clasts, 6 cm and 12 cm diameter; many fine snail fragments; abrupt.
AB	292-314 cm; (Unit D); brown (10YR 3.5/3) clay; few coarse dark gray (10YR 4/1) iron depletions along modern root channels; few fine snail fragments; 5% pebbles, 0.2 to 0.5 cm diameter; clear.

Bw	314-341 cm; dark yellowish brown (10YR 4/4) clay/clay loam; 15% dark grayish brown (10YR 4/2) pockets; 10% pebbles, 0.3 to 2 cm diameter; 2% carbonate filaments; few fine snail fragments; clear.
Bk1	341-372 cm; dark yellowish brown (10YR 4/4) clay/clay loam; many medium distinct dark gray (10YR 4/1) iron depletions along channels; few medium distinct gray (10YR 5/1) iron depletions; 15% pebbles, 0.2 to 0.4 cm diameter; 5% carbonate nodules, 0.5 cm diameter; few fine snail fragments; gradual.
Bk2	372-415 cm; dark yellowish brown (10YR 4/4) clay loam; few medium distinct gray (10YR 5/1) iron depletions; 15% pebbles, 0.2 to 0.4 cm diameter; 5% carbonate nodules, 0.5 cm diameter; few fine snail fragments; gradual.
Bk3	415-492 cm; strong brown (7.5YR 4/6) clay/clay loam; common medium distinct gray and light gray (10YR 5/1, 6/1) iron depletions; 5% pebbles, 0.2 to 0.5 cm diameter; 5% carbonate nodules, 0.5 to 1 cm diameter; gradual.
Bk4	492-505 cm; (saturated); brown (7.5YR 5/4) clay loam; common medium distinct light gray (10YR 6/1) iron depletions; 5% pebbles, 0.2 to 0.5 cm diameter; few carbonate nodules, 1 cm diameter; gradual.
Bk5	505-567 cm; yellowish brown (10YR 5/6) clay/clay loam; common medium distinct light gray (10YR 6/1) iron depletions; few medium distinct yellowish red (5YR 4/6) soft iron masses; 5% pebbles, 0.2 to 0.5 cm diameter, angular; 5% carbonate nodules, 0.5 to 1 cm diameter; gradual.
Bk6	567-591 cm; mottled dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2) heavy clay; 5% pebbles, 0.2 to 0.5 cm diameter; 5% carbonate nodules, 0.5 to 1 cm diameter; clear.
Bk7	591-635 cm; yellowish brown (10YR 5/6) clay/clay loam; many medium distinct gray (10YR 5/1) iron depletions; 5% pebbles, 0.2 to 0.5 cm diameter; 5% carbonate nodules, 0.5 to 1 cm diameter; gradual.
2C1	635-719 cm; (Unit A); mottled brownish yellow (10YR 6/6) and light grayish brown (10YR 7/2) clay loam; 15% pebbles and cobbles, 2 to 8 cm diameter, subangular; gradual.
C2	719-817; mottled light yellowish brown (10YR 6/4) and light gray (10YR 7/1) heavy clay; 20% pebbles and cobbles, 2 to 8 cm diameter, subangular; abrupt.
R	817-872cm; (bedrock); dark grayish brown (10YR 4/2) limestone.

Core B

Parking lot northeast of swimming pool; calcareous, moist throughout; all gravels are limestone unless otherwise stated.

Fill	0-55 cm; asphalt upper 5 cm; very dark grayish brown (10YR 3/2) and yellowish brown (10YR 5/4) sandy clay; 15% pebbles, 0.3 to 1.5 cm diameter, subrounded; abrupt.
Fill	55-79 cm; yellowish brown (10YR 5/4) clay loam; 10% pebbles, 0.3 to 1.5 cm diameter, flat to angular; gradual.
Fill	79-113 cm; very dark grayish brown (10YR 3/2) loam; 5% pebbles, 0.3 to 1 cm diameter, subrounded, abrupt.
Fill	113-199 cm; dark grayish brown (10YR 4/2) sandy clay loam; few medium distinct strong brown (7.5YR 4/6) and few medium distinct brownish yellowish (10YR 6/6) soft iron masses; abrupt.
Fill	199-267 cm; black (10YR 2/1) mucky silty clay loam; 8 cm diameter coarse fragment at base; modern root mats; abrupt.
A	265-373 cm; (Unit E); black (10YR 2/1) mucky silty clay; few carbonate filaments; common snail fragments; one coarse fragment, 5 to 6 cm diameter at 345 cm; gradual.
Bk1	373-418 cm; brown (10YR 3.5/3) mucky clay loam/clay; few medium distinct dark gray (10YR 3.5/1) iron depletions along roots; 10% carbonate filaments; many snail fragments; few carbonate nodules, 1 cm diameter; gradual.
Bk2	418-462 cm; dark yellowish brown (10YR 4/4) clay; common medium distinct gray (10YR 4.5/1) soft iron masses; many snail fragments; one coarse fragment, 1 cm diameter, flat; few carbonate masses, 0.5 cm diameter; clear.
Bk3	462-483 cm; very dark gray (10YR 3/1) clay; 5% coarse fragments, 0.5 to 2 cm diameter; common carbonate filaments; many snail fragments; flake (475 cm); abrupt.
2Bk4	483-570 cm; (Unit D); brown (10YR 4/3) clay; many medium distinct strong brown (7.5YR 4/6) soft iron masses; few medium gray (10YR 4/1.5) carbonate rhyzoliths; 10% calcans; few carbonate nodules, 0.5 cm diameter; gradual.
Bk5	570-674 cm; strong brown (7.5YR 4/6) clay; 15% calcans; few carbonate nodules, 0.5

cm diameter; gradual.

3Bk6 674-722 cm; (Unit A); pale brown (10YR 6/3) clay; many medium distinct yellowish brown (10YR 4/6) soft iron masses; few carbonate nodules, 1 cm diameter; few carbonate filaments; abrupt.

C 722-857 cm; (saturated); 70% pebbles, 0.4 to 3 cm diameter; angular to subrounded; brownish yellowish (10YR 6/6) mud matrix; abrupt.

R 857-875 cm; (bedrock); olive gray limestone.

Core C

Parking lot east of swimming pool; calcareous, moist throughout; all gravels are limestone unless otherwise stated.

Fill 0-77 cm; asphalt upper 8 cm; mixed brown (10YR 4/3), very dark brown (10YR 2.5/2), and strong brown (7.5YR 4/6) clay loam; 10% coarse fragments, 0.5 to 2 cm diameter, subrounded, abrupt.

Fill 77-119 cm; very dark brown (10YR 2/2) silty clay loam; clear.

AB 119-187 cm; (Unit D); dark brown (10YR 3/3) clay loam; few medium distinct gray (10YR 5/1) iron depletions along roots; common snail fragments; gradual.

Bk1 187-255 cm; dark brown (7.5YR 3/4) clay loam; 2% carbonate nodules, 1 cm diameter; common snail fragments; gradual.

Bk2 255-341 cm; dark brown (7.5YR 3/4) clay loam; 5% carbonate nodules, 1 cm diameter; few calcans; common snail fragments; gradual.

Bk3 341-448 cm; (lower 30 cm saturated); dark brown (7.5YR 3/4) and strong brown (7.5YR 4/4) clay/clay loam; 10% calcans; few carbonate nodules, 0.5 cm diameter; few snail fragments; gradual.

Bk4 448-513 cm; strong brown (7.5YR 4/4) clay/clay loam; common medium distinct yellowish red (5YR 4/6) soft iron masses; few carbonate nodules, 0.5 to 1 cm diameter; gradual.

Bk5 513-569 cm; yellowish red (5YR 4/6) clay/clay loam; many medium distinct gray (10YR 6/1) iron depletions; common iron manganese stains; few carbonate nodules, 0.5 cm diameter; gradual.

Bw 569-625 cm; yellowish red (5YR 4/6) clay/clay loam; many medium distinct light grayish brown (10YR 6/2) iron depletions; 5% coarse fragments, 0.2 to 0.4 cm diameter; subrounded to angular; abrupt.

2C1	625-722 cm; (Unit A); 60% pebbles and cobbles, 0.5 to 5 cm diameter, subrounded to angular; yellow (10YR 7/6) mud matrix; yellow (10YR 7/6) clay/clay loam bed in middle; clear.
C2	722-807 cm; 70% pebbles and cobbles, 1 to 5 cm diameter, subrounded angular; yellow (10YR 7/6) mud matrix.
R	807-851 cm; (bedrock); olive gray limestone.

Core D

Grass area on edge of parking; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill	0-49 cm; very dark grayish brown (10YR 3/2) sandy clay loam; 20% brown (10YR 5/3) patches; clear.
Fill	49-98 cm; light yellowish brown (10YR 6/4) sandy loam; 15% dark brown (10YR 3.5/2) sandy clay loam; clear.
Fill	98-143 cm; very dark brown (10YR 3/2) and dark brown (7.5YR 3/3) clay loam; limestone clast (4 cm diameter) and PVC pipe at base; abrupt.
AB	143-167 cm; (Unit D); dark brown (7.5YR 3/3) clay/clay loam; few carbonate filaments; few snail fragments; gradual.
Bk1	167-259 cm; strong brown (7.5YR 3.5/4) clay/clay loam; 5% carbonate filaments; gradual.
Bk2	259-348 cm; dark brown (7.5YR 3/4) clay/clay loam; few medium distinct dark gray (10YR 4/1) iron depletions; 1% carbonate nodules, 1 cm diameter; 5% carbonate filaments; gradual.
Bk3	348-369 cm; strong brown (7.5YR 3/4) clay/clay loam; few medium distinct dark gray (10YR 4/1) iron depletions; 1% carbonate nodules, 1 cm diameter; 5% carbonate filaments; three coarse clasts, 5 cm diameter; gradual.
Bk4	369-419 cm; strong brown (7.5YR 4/4) clay/clay loam; 2% carbonate nodules, 1 cm diameter; gradual.
Bk5	419-514 cm; strong brown (7.5YR 4/4) clay/clay loam; common medium distinct yellowish red (5YR 4/6) soft iron masses; few medium distinct light brownish gray (10YR 6/2) iron depletions, some partially filled with carbonate; clear.

Bk6 514-576 cm; yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) heavy clay; many medium distinct light gray (2.5Y 6/1) iron depletions; few carbonate nodules, 1 to 3 cm diameter; common iron manganese stains; gradual.

Bk7 576-668 cm; (saturated); strong brown (7.5YR 4/6) clay; common fine distinct light brownish gray (10YR 6/2) iron depletions; common iron manganese stains; few carbonate nodules, 0.5 cm diameter; gradual.

Bw 668-712 cm; strong brown (7.5YR 4/6, 4/4) clay; many medium distinct light gray (10YR 6/1) iron depletions; few iron manganese stains; calcareous; clear.

2Agb1 712-729 cm; (Unit A, marsh); dark gray (2.5Y 4/1) clay/clay loam; common fine faint very dark grayish brown (10YR 3/2) soft iron masses; many fine snail fragments; common fine plant fragments; noncalcareous; gradual.

Bgb1 729-751 cm; (marsh); gray (10YR 5/1) and dark gray (10YR 3/1.5) clay/clay loam; common fine plant fragments; common fine snail fragments; noncalcareous; gradual.

Agb2 751-777 cm; (marsh); black (N 2.5/0) clay/clay loam; common medium distinct gray (N 5/0) iron depletions along channels; few medium distinct very dark grayish brown (2.5Y 3/2) soft iron masses; many fine plant fragments; noncalcareous; gradual.

Bg1b2 777-795 cm; (marsh); very dark gray (2.5Y 3/1) silty clay loam; few medium distinct light olive brown (2.5Y 5/6) soft iron masses; common fine to medium snail fragments; common fine plant fragments; clear.

Bg2b2 795-851 cm; (marsh); dark gray (2.5Y 3.5/1) silty clay loam; common fine and medium snail fragments; few fine plant fragments; gradual.

Cg 851-873 cm; very dark grayish brown (10YR 3/2) clay/clay loam; 5% pebbles, 1 to 3 cm diameter, subrounded to angular; abrupt.

R 873-881 cm; (bedrock); olive gray limestone.

Core E

South end of parking lot; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-10 cm; pebbles (0.2 to 1 cm) and asphalt; abrupt.

A 10-92 cm; (Unit D); very dark brown (10YR 2/2) silty clay loam; few pebbles, 0.2 to 0.3 cm diameter; few snail fragments; weakly calcareous; gradual.

Bw	92-151 cm; dark brown (7.5YR 3.5/3) clay/clay loam; few medium snail fragments; gradual.
Bk1	151-290 cm; strong brown (7.5YR 3.5/4) clay/clay loam; 2% carbonate nodules, 1 cm diameter; 5% carbonate filaments; gradual.
Bk2	290-330 cm; dark reddish brown (5YR 3/4) clay/clay loam; few medium distinct light gray (10YR 6/1) iron depletions along roots, bordered by yellowish red (5YR 5/6) soft masses; few calcans; gradual.
Bk3	330-425 cm; dark brown (7.5YR 3/4) clay/clay loam; common medium to large snails; few calcans; 1% carbonate nodules, 0.5 cm diameter; gradual.
Bk4	425-496 cm; yellowish red (5YR 4/6) clay/clay loam; common medium distinct dark grayish brown (10YR 3.5/2) pockets; common fine distinct gray (10YR 5/1) iron depletions; 5% calcans; 1% carbonate nodules, 0.5 cm; gradual.
Bk5	496-645 cm; mottled yellowish red (5YR 4/6) grayish brown (10YR 5/2) clay/clay loam; common iron stains; 2% calcans; gradual.
Bg	645-666 cm; dark gray (10YR 4/1) clay/clay loam; many medium distinct dark yellowish brown (10YR 4/6) soft iron masses; few carbonate filaments, calcans; clear.
2Ag1b	666-678 cm; (Unit A, marsh); very dark gray (2.5Y 3/1) clay/clay loam; many fine plant fragments; weakly calcareous; clear.
Ag2b	678-706 cm; (marsh); black (10YR 2/1) clay; many fine plant fragments; many fine and medium snail fragments; calcareous from shells; abrupt.
C	706-836 cm; 70% pebbles, 0.2 to 0.4 cm diameter in one 3 cm thick bed, and 0.5 to 4 cm diameter, subrounded to angular; brownish yellow (10YR 6/6) loam matrix; large chert flake; abrupt.
R	836-853 cm; (bedrock); olive yellow limestone.

Core F

Valley next to spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill	0-18 cm; very dark gray (10YR 3/1) clay; 35% dark grayish brown (10YR 4/2); 8% pebbles, 0.2 to 0.4 cm diameter; abrupt.

Fill	18-42 cm; dark grayish brown (10YR 3.5/2) clay loam; 3% pebbles, 0.5 to 1 cm diameter, angular to subrounded; abrupt.
Fill	42-115 cm; black (10YR 2.5/1) clay/clay loam; few medium distinct strong brown (7.5YR 4/6) iron concentrations; 3% pebbles, 1 to 3 cm diameter, angular; clear.
A1	115-142 cm; (Unit E); black (10YR 2/1) silty clay; common fine/medium snail fragments; gradual.
A2	142-191 cm; black (10YR 2.5/1) silty clay; common fine/medium snail fragments; gradual.
Bk1	191-231 cm; very dark gray (10YR 3.5/1) silty clay; 2% carbonate filaments; few fine/medium snail fragments; gradual.
Bk2	231-356 cm; dark brown (7.5YR 3.5/2) clay/clay loam; 3% carbonate filaments; common medium distinct gray (10YR 6/1) iron depletions along root channels; common calcans along root channels; few fine/medium snails; gradual.
2Bkg1	356-393 cm; (Unit D?); dark gray (10YR 4/1) clay; many medium distinct dark yellowish brown (10YR 4/6) soft iron masses; 5% carbonate nodules, 0.2 to 0.5 cm diameter; gradual.
Bkg2	393-420 cm; dark gray (10YR 4.5/1) clay loam; few fine distinct dark yellowish brown (10YR 4/6) soft iron masses; 20% carbonate nodules, 0.2 to 0.5 cm diameter; gradual.
Bkg3	420-451 cm; dark gray (10YR 4.5/1) clay; common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; 20% carbonate filaments and 25% carbonate nodules, 0.2 to 0.5 cm diameter; gradual.
2Agb1	451-472 cm; (Unit C, marsh); very dark gray (10YR 2.5/1) clay; few medium distinct gray (10YR 5/1) iron depletions; many fine snail fragments; many fine plant fragments; clear.
Bgb1	472-496 cm; (marsh); very dark gray (10YR 3/1) and gray (10YR 5/1) clay and loam laminations; common fine plant fragments; common fine snail fragments; clear.
Agb2	496-514 cm; (marsh); very dark gray (10YR 3/1) silty clay; few fine distinct gray (10YR 5/1) iron depletions; few fine distinct dark yellowish brown (10YR 3/4) soft iron masses; common fine plant fragments; common fine/medium snail fragments; gradual.
Bgb2	514-541 cm; (marsh); dark gray (10YR 3.5/1) clay/clay loam; common fine plant fragments; many fine/medium snail fragments; gradual.

Cg	541-572 cm; dark gray (10YR 4/1) and dark yellowish brown (10YR 4/4) clay; 20% pebbles, 0.3 to 3 cm diameter, subrounded to subangular; abrupt.
C	572-654 cm; 70% pebbles, 0.3 to 4 cm diameter, subrounded; strong brown (7.5YR 4/4) mud matrix; abrupt.
3Agb3	654-724 cm; (Unit B, marsh); black (2.5Y 2/1) and very dark gray (10YR 3/1) clay; 5% pebbles, 0.2 to 1 cm diameter; abrupt.
R	724-736 cm; (bedrock); olive gray limestone.

Core G

Golf course fairway; moist throughout; calcareous unless otherwise stated; all gravels limestone unless otherwise stated.

A1	0-15 cm; (Unit D); black (10YR 2/1) clay/clay loam; weakly calcareous; gradual.
A2	15-98 cm; very dark grayish brown (10YR 3.5/2) clay/clay loam; common fine snails, burned rock, 36 to 82 cm; gradual.
Bk1	98-150 cm; dark brown (7.5YR 3/3) clay/clay loam; 2% calcans; few fine snail fragments; gradual.
Bk2	150-216 cm; dark brown (7.5YR 3.5/3) clay/clay loam; 1% calcans; many fine snail fragments; hearth charcoal and burned rock, 160-166 cm; gradual.
Bk3	216-266 cm; dark brown (7.5YR 3.5/3) clay/clay loam; 1% carbonate nodules, 1 cm diameter; few fine snail fragments; gradual.
Bk4	266-351 cm; dark brown (7.5YR 3.5/3) clay/clay loam; few medium distinct dark gray (2.5Y 3.5/1) iron depletions along roots; 1% carbonate nodules, 1 cm diameter; one burned rock and flake, 305 cm; gradual.
Bk5	351-418 cm; dark brown (7.5YR 3/4) clay; few medium distinct gray (2.5Y 5/1) iron depletions, few medium distinct strong brown (7.5YR 4/6) pockets; few iron manganese stains; 1% carbonate nodules, 1 cm diameter; gradual.
Bk6	418-473 cm; strong brown (7.5YR 4/4) clay; common fine distinct yellowish red (5YR 4/6) iron concentrations; 1% carbonate nodules, 1 to 1.5 cm diameter; common medium distinct gray (2.5Y 5/1) iron depletions along channels; few iron manganese stains; gradual.
Bw1	473-597 cm; brown (10YR 4.5/3) clay; many medium distinct yellowish brown (10YR 5/6) and yellowish red (5YR 4/6) soft iron masses; common medium gray (2.5Y 5/1) iron depletions; few iron manganese stains and concretions (0.3 cm diameter); gradual.

Bw2	597-722 cm; brown (10YR 5/3) clay; many medium distinct yellowish red (5YR 4/6) iron concentrations; few iron manganese stains; clear.
2Bw3	722-792 cm; (Unit C); mottled yellowish red (5YR 4/6) and gray (10YR 6/1) clay; few iron manganese stains; gradual.
Bw4	792-837 cm; yellowish red (5YR 4/6) clay; few fine distinct gray (10YR 6/1) iron depletions; 2% pebbles, 0.2 to 0.5 cm diameter; common fine snail fragments; abrupt.
C1	837-870 cm; yellowish red (5YR 4/6) and yellowish brown (10YR 5/6) mud; 50% pebbles, 0.2 to 4 cm diameter, subrounded to angular; clear.
C2	870-903 cm; 70% pebbles, 0.5 to 4 cm diameter, subrounded to angular; brownish yellow (10YR 6/6) loam matrix; abrupt.
C3	903-932 cm; muddy dark gray (N 4/0) and gray (N5/0, 2.5Y 5/1); 50% pebbles, 0.2 to 2 cm diameter, angular to subrounded; abrupt.
R	932-972 cm; (bedrock); fractured bluish gray limestone.

Core H

Sink Creek channel; moist throughout; calcareous unless otherwise stated; all gravels limestone unless otherwise stated.

Fill	0-9 cm; black (10YR 2.5/1) clay; 5% pebbles, 0.2 to 0.6 cm diameter, subrounded to subangular; gradual.
A1	9-21 cm; (Unit E); black (10YR 2.5/1) clay; common fine distinct strong brown (7.5YR 4/6) iron pore linings; 5% pebbles, 0.2 to 0.5 cm diameter, subrounded to subangular; gradual.
A2	21-61 cm; very dark gray (7.5YR 3/1) clay; common fine distinct strong brown (7.5YR 4/6) iron pore linings; 2% pebbles, 0.2 to 0.4 cm diameter; gradual.
Bw1	61-152 cm; brown (10YR 3.5/3) clay; many coarse distinct very dark gray (10YR 3/1) patches; 1% pebbles, 0.2 to 0.3 cm diameter; gradual.
Bw2	152-243 cm; strong brown (7.5YR 4/4) clay; many fine distinct dark gray (10YR 4/1) iron depletions; 1% detrital carbonate nodules, 0.5 to 1 cm diameter; gradual.
Bw3	243-305 cm; strong brown (7.5YR 4/6, 5/6) clay; few fine distinct dark gray (10YR 4/1) iron depletions; 1% detrital carbonate nodules, 0.5 to 1 cm diameter; 10% pebbles, 0.2 to 0.5 cm diameter; clear.

2Bk3 303-448 cm; (Unit D); grayish brown (10YR 5/2) clay loam; common medium distinct dark yellowish brown (10YR 4/6) soft iron masses; 5% calcans; few fine iron manganese stains; 1% carbonate nodules, 1 cm diameter; gradual.

3C 446-504 cm; (Unit A?); yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) clay; 50% pebbles, 0.2 to 3 cm diameter, subrounded to angular; abrupt.

Cr 504-576 cm; (bedrock); light yellowish brown (2.5Y 6/4) shale; many medium distinct light gray (2.5Y 7/1) iron depletions.

R 574-716 cm; gray (2.5Y 5/1) limestone.

Core I

Golf course fairway; moist throughout; calcareous unless otherwise stated; all gravels limestone unless otherwise stated.

A 0-27 cm; (Unit D); black (10YR 2/1) silty clay loam; weakly calcareous; gradual.

Bw 27-119 cm; dark brown (7.5YR 3.5/3) silty clay loam; common medium distinct very dark gray (10YR 3/1) biocasts; gradual.

Bk1 119-203 cm; strong brown (7.5YR 4.5/4) silty clay loam; many medium distinct very dark gray (10YR 3/1) biocasts; 1% carbonate nodules, 0.5 to 1 cm diameter; gradual smooth.

Bk2 203-298 cm; strong brown (7.5YR 4/4) silty clay loam; common fine distinct light brown gray (10YR 6/2) iron depletions; few medium distinct very dark gray (10YR 3/1) biocasts; 1% carbonate nodules, 0.5 to 1 cm diameter; gradual.

Bk3 298-390 cm; strong brown (7.5YR 4.5/4) silty clay loam; 3% carbonate nodules, 0.5 to 2 cm diameter; few iron manganese concretions, 0.2 to 0.3 cm diameter; clear.

Bk4 390-507 cm; strong brown (7.5YR 4/6) clay; few medium distinct grayish brown (10YR 5/2) iron depletions; 3% iron manganese concretions, 0.2 to 0.4 cm diameter; 2% carbonate nodules, 0.5 to 2 cm diameter; gradual.

Bk5 507-592 cm; dark yellowish brown (10YR 4/6) and brown (10YR 5/3) clay; common medium and coarse gray (10YR 5/1) iron depletions along roots; 5% carbonate nodules, 0.3 to 2 cm diameter; few calcans along root channels; gradual.

Bk6 592-641 cm; mottled gray (10YR 6/1) and yellowish brown (10YR 5/6) and brown (7.5YR 5/3) clay; 3% carbonate nodules, 0.5 cm diameter; gradual.

Bk7 641-687 cm; mottled strong brown (7.5YR 4/4) and light grayish brown (10YR 6/2) clay; few medium distinct gray (10YR 6/1) iron depletions; common medium distinct brown (7.5YR 5/3) patches; 5% carbonate nodules, 0.5 cm diameter; gradual.

Bk8 687-717 cm; light brownish gray (2.5Y 6.5/2) dense clay; many medium distinct olive yellow (2.5Y 6/6) iron concentrations; 5% carbonate nodules, 0.5 cm diameter; 15% pebbles, 0.3 to 1 cm diameter, subrounded to subangular; gradual.

Bg 717-741 cm; (Unit A); gray (10YR 5/1) dense clay; common medium distinct yellowish brown (10YR 4/4) and common medium distinct strong brown (7.5YR 4/6) soft iron masses; 15% pebbles, 0.3 to 1 cm diameter, subrounded to subangular; abrupt.

C 741-751 cm; 65% pebbles, 0.2 to 3 cm diameter, angular to subangular; yellowish brown (10YR 5/6) mud matrix; abrupt.

Cr 751-782 cm; (bedrock); pale yellow (2.5Y 7/4) shale, faintly bedded; few fine distinct yellow (2.5Y 7/6) soft iron masses; abrupt.

R 782-853 cm; dark gray (N 5/0) shale/limestone.

Core J

Football parking lot; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-24 cm; 65% pebbles, 0.2 to 3 cm diameter, angular to subrounded, yellowish brown (10YR 5/4) matrix; abrupt.

Fill 24-152 cm; black (10YR 2.5/1) dense clay; 5% pebbles, 0.2 to 0.8 cm diameter; gradual.

Fill 152-185 cm; mixed black (10YR 2.5/1) and brown (10YR 4/3) clay; 3% pebbles, 0.2 to 0.8 cm diameter; abrupt.

Fill 185-198 cm; mixed grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) clay; 25% coarse fragments, 0.2 to 3 cm diameter, angular to subrounded; clear.

Bk1 198-301 cm; strong brown (7.5YR 4/6) clay; few iron manganese stains; 10% carbonate nodules, 0.3 to 3 cm diameter; gradual.

Bk2 301-355 cm; strong brown (7.5YR 5/6) clay; 10% yellowish brown (10YR 5/6) patches; few iron manganese stains; 12% carbonate nodules, 0.3 to 3 cm diameter; abrupt.

Bk/Cr 355-395; brownish yellow (10YR 6/6) and strong brown (7.5YR 4/6) clay/clay loam; 15% carbonate nodules, 0.3 to 3 cm diameter; clear.

Cr 395-716 cm; yellow (2.5Y 7/6), olive yellow (2.5Y 6/6), and light gray (N 7/0) dense shale; few iron manganese stains.

Core K

Football parking lot; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-6 cm; asphalt; abrupt.

Fill 6-22 cm; light yellowish brown (10YR 6/4) clay loam; 55% pebbles, 0.2 to 2 cm, subrounded to subangular; abrupt.

Fill 22-110 cm; black (N 2/0) silty clay loam; 2% pebbles, 0.2 to 0.5 cm diameter; abrupt.

Fill 110-168 cm; very dark grayish brown (2.5Y 3/2) dense clay; 1% pebbles, 0.2 to 0.4 cm diameter; abrupt.

Bk 168-262 cm; dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) clay; 40% pebbles and cobbles, 0.2 to 5 cm diameter, angular to subangular; abrupt.

Bk/Cr 262-280 cm; yellow (2.5Y 7/6) and olive yellow (2.5Y 6/6) shale; common medium distinct light gray (2.5Y 7/1) iron depletions; 30% carbonate nodules, 0.5 to 4 cm diameter; clear.

Cr 280-414 cm; olive yellow (2.5Y 6/6), yellowish brown (10YR 5/6), and light gray (2.5Y 7/1) shale.

Core K2

Near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-21 cm; very dark grayish brown (10YR 3/2) clay/clay loam; 1% pebbles, 0.2 to 0.5 cm, subangular to subrounded, limestone; common fine carbonate sand grains; clear.

A 21-63 cm; (Unit E); very dark grayish brown (10YR 2.5/2) clay; 1% pebbles, 0.2 to 0.5 cm, subangular to subrounded; gradual.

Bw1 63-123 cm; very dark grayish brown (10YR 3/2) clay; few medium distinct very dark gray (2.5Y 3/1) iron depletions along roots in lower half; few fine snail fragments; gradual.

Bw2	123-190 cm; brown (7.5YR 4/3) clay; common fine and medium snail fragments; gradual.
Bw3	190-251 cm; brown (7.5YR 3.5/3) clay; common coarse snails in lower one-third; gradual.
2Bk1	251-351 cm; (Unit D); reddish brown (5YR 4/3) clay; 3% carbonate nodules, 0.3 to 1 cm diameter; gradual.
Bk2	351-412 cm; reddish brown (5YR 4/3) clay; few fine distinct gray (2.5Y 5/1) iron depletions; few medium distinct yellowish red (5YR 4/6) soft iron masses; 5% carbonate nodules, 0.3 to 1 cm diameter; clear.
Bk3	412-479 cm; mottled yellowish red (5YR 4/6), gray (2.5Y 6/1), and yellowish brown (10YR 5/6) heavy clay; few fine and medium iron manganese stains; 2% carbonate nodules, 0.3 to 1 cm diameter; gradual.
Bw	479-555 cm; mottled yellowish red (5YR 4/6), gray (2.5Y 6/1), and yellowish brown (10YR 5/6) heavy clay; few fine and medium iron manganese stains; 1% carbonate nodules, 0.2 to 0.5 cm diameter, hard; gradual.
3Bkg	555-613 cm; (Unit C); mottled brown (7.5YR 4/3), yellowish red (5YR 4/6), and gray (2.5Y 5/1) heavy clay; few fine and medium iron manganese stains; 1% carbonate nodules, 0.2 to 0.5 cm diameter; few fine and medium charcoal fragments; abrupt.
C1	613-754 cm; 60% pebbles, 0.2 to 3 cm diameter, subrounded to subangular; strong brown (7.5YR 4/4) mud matrix; gradual.
C2	754-770 cm; 70% pebbles, 0.2 to 3 cm diameter; subrounded to subangular; strong (7.5YR 5/4) mud matrix.
C3	770-783 cm; 50% pebbles, 0.2 to 0.5 cm diameter, subrounded to subangular; yellowish brown (10YR 5/6) mud matrix; abrupt.
4Ab	783-796 cm; (Unit B, marsh); very dark gray (2.5Y 3/1) clay; 1% pebbles, 0.2 to 0.5 cm diameter, subrounded to subangular; abrupt.
R	796-806 cm; (bedrock); greenish gray (5G 5/1, 6/1) limestone.

Core L

Near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

A1	0-42 cm; (Unit E); black (10YR 2.5/1) silty clay; few fine and medium snail fragments; gradual.
A2	42-93 cm; very dark brown (7.5YR 3/2) silty clay; few fine and medium snail fragments; gradual.
Bw	93-196 cm; dark brown (7.5YR 3.5/2) silty clay; few fine snail fragments; common fine burned soil fragments, yellowish red (5YR 4/6); few medium distinct gray (2.5Y 4/1) iron depletions along roots; gradual.
2Bk1	196-263 cm; (Unit D); brown (7.5YR 4/3.5) clay; few medium distinct gray (2.5Y 5/1) iron depletions along roots; 1% carbonate nodules, 0.5 cm diameter; few medium to coarse snail fragments; few medium dark organic stains; gradual.
Bk2	263-433 cm; very dark brown (7.5YR 3.5/2) clay; 5% carbonate rhyzoliths, 1 cm diameter; gradual.
Bk3	433-567 cm; reddish brown (5YR 4/4) clay; few medium distinct gray (2.5Y 5/1) iron depletions; 2% carbonate nodules, 0.5 to 1 cm diameter; common iron manganese stains; gradual.
Bw	567-637 cm; strong brown (7.5YR 4/4) clay; many medium distinct gray (2.5Y 5/1) iron depletions; 2% carbonate filaments, 5% carbonate nodules, 0.2 to 0.4 cm diameter; gradual.
Bg	637-677 cm; gray (2.5Y 4/1) clay; many medium distinct light olive brown (2.5Y 5/4) soft iron masses; common fine snail fragments, 15% carbonate nodules, 0.2 to 0.4 cm diameter; few fine plant fragments; clear.
3A1gb	677-695 cm; (Unit C, marsh); very dark gray (2.5Y 3.5/1) clay; common fine snail fragments; 10% carbonate nodules, 0.2 to 0.4 cm diameter; few fine plant fragments; abrupt.
A2gb	695-719 cm; (marsh); black (2.5Y 2.5/1) clay; common fine snails; 2% pebbles, 0.2 to 1 cm diameter; 10% carbonate nodules, 0.2 to 0. 4 cm diameter; many fine plants fragments; abrupt.
C1	719-809 cm; 70% pebbles, 0.5 to 3 cm diameter, mostly subangular; strong brown (7.5YR 4/6) mud; abrupt.
C2	809-843 cm; light yellowish brown (2.5Y 6/4) clay (saturated); 25% pebbles, 0.5 to 3 cm diameter, mostly subangular; abrupt.
R	843-910 cm; (bedrock); light gray limestone.

Core M

Near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill	0-47 cm; black (10YR 2/1) silty clay; few medium distinct strong brown (7.5YR 4/4) pockets; 5% pebbles, 0.3 to 1 cm, subrounded to subangular; common carbonate sand grains; 1 cm thick laminated flood silt at base, light yellowish brown (10YR 6/4); abrupt.
A	47-202 cm; (Unit E); black (10YR 2.5/1) clay; common fine and medium dark grayish brown (10YR 4/2) patches; few coarse snail fragments; few carbonate sand grains; gradual.
2Bk	202-410 cm; (Unit D?); dark brown (7.5YR 3/3) clay; 5% carbonate nodules, 0.2 to 0.4 cm diameter; few fine snail fragments; gradual.
Bkg1	410-486 cm; dark gray (2.5Y 3/1) clay; few medium distinct light olive brown (2.5Y 5/4) soft iron masses; 20% carbonate nodules, 0.2 to 0.4 cm diameter; gradual.
Bkg2	486-562 cm; gray (2.5Y 4.5/1) clay; many medium distinct olive brown (2.5Y 4/3) soft iron masses; 10% carbonate nodules, 0.2 to 0.4 cm diameter; few plant fragments; gradual.
3Agb1	562-586 cm; (Unit C, marsh); black (2.5Y 2.5/1) silty clay; many fine snail fragments; common fine plant fragments; 10% pebbles, 1 to 3 cm, angular to subangular at base; clear.
Bg1b1	562-652 cm; (marsh); gray (2.5Y 3.5/1) silty clay; common fine faint dark brown (7.5YR 3/4) iron pore linings; few fine snail fragments; common plant remains and organic stains; gradual.
Bg2b1	652-682 cm; (marsh); gray (2.5Y 3.5/1, 4/1) silty clay; common fine faint dark brown (7.5YR 3/4) iron pore linings; many fine snail fragments (bedded); common plant remains and organic stains; gradual.
4Agb2	682-757 cm; (Unit B, marsh); black (2.5Y 2.5/1, 3/1) silty clay; few medium distinct light gray (N 7/0) iron depletions; common fine snail fragments and carbonate sand grains; common plant fragments and organic stains; gradual.
C	757-779 cm; brown (10YR 5/3) and dark gray (2.5Y 3/1) clay; 20% pebbles and cobbles, 2 to 5 cm diameter, subrounded to subangular; abrupt.
R	779-811 cm; (bedrock); white (N 7/0, 8/0) limestone; common medium distinct light yellowish brown (2.5Y 6/4) soft iron masses and common medium distinct dark gray (2.5Y 3/1) organic stains.

Core N

Near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill	0-9 cm; black (10YR 2/1) clay; 1% pebbles, 0.5 cm diameter, subangular to subrounded; few carbonate sand grains; clear.
A	9-36 cm; (Unit E); black (10YR 2/1) clay; 3% pebbles, 0.2 to 1.5 cm, subangular to subrounded, upper half; gradual.
Bw1	36-78 cm; very dark gray (10YR 3/1) clay; few fine snail fragments; gradual.
Bw2	78-166 cm; very dark grayish brown (10YR 3/2) clay; few fine distinct dark gray (2.5Y 4/1) iron depletions along roots; few fine snail fragments; few fine burned soil fragments in upper half; gradual.
2Bk	166-354 cm; (Unit D); brown (7.5YR 3.5/3) clay; few fine distinct dark gray (2.5Y 4/1) iron depletions along roots; 2% carbonate nodules and rhyzoliths, 0.5 cm diameter; few fine burned soil fragments; clear.
Bkg1	354-412 cm; mottled gray (2.5Y 5/1), yellowish red (7.5YR 4/6), and brownish yellow (10YR 6/6) clay; 5% carbonate nodules, 0.2 to 0.4 cm diameter; gradual.
Bkg2	412-460 cm; mottled gray (2.5Y 5/1) and yellowish brown (10YR 5/6) clay; few medium distinct light gray (2.5Y 7/1) iron depletions; few medium distinct strong brown (7.5YR 4/6) soft iron masses; 10% carbonate nodules, 0.2 to 0.4 cm diameter; abrupt.
3Ag	460-493 cm; (Unit C, marsh); very dark gray (2.5Y 3/1) and dark gray (2.5Y 4/1) heavy clay; common fine plant fragments; common carbonate sand grains.
Missing	493-717 cm
4Ag’	717-744 cm; (Unit B, marsh); very dark gray (2.5Y 3.5/1) clay (saturated); 1% pebbles, 0.5 cm diameter, subrounded to subangular; few fine plant fragments; abrupt.
Cg	744-844+ cm; 50% pebbles, 0.2 to 3 cm diameter, chert and limestone, subrounded to subangular; dark gray (2.5Y 4/1) mud matrix.

Core O

Near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

A	0-54 cm; (Unit E); black (10YR 2.5/1) clay; common fine snail fragments; gradual.

Bw1	54-126 cm; very dark grayish brown (10YR 3/2) clay; common fine and medium snail fragments; gradual.
Bw2	126-172 cm; dark brown (10YR 3/3) clay; few fine and medium distinct dark gray (2.5Y 3.5/1) iron depletions along roots; common fine and medium snail fragments; gradual.
2Bw3	172-263 cm; (Unit D); dark brown (7.5YR 4/3) clay loam; common fine snail fragments; two burned rocks, 4 cm diameter at 187 and 193 cm; few fine charcoal fragments; gradual.
Bk1	263-347 cm; dark brown (7.5YR 3.5/3) clay loam; 5% carbonate nodules, 0.5 to 1 cm diameter; gradual.
Bk2	347-391 cm; dark brown (7.5YR 4/3) clay/clay loam; common fine and medium distinct gray (2.5Y 5/1) iron depletions along roots; 1% carbonate nodules, 0.5 to 1 cm diameter; few fine snail fragments; clear.
Bk3	391-437 cm; mottled dark brown (7.5YR 3/3, 4/3) and dark gray (2.5Y 3.5/1) clay/clay loam; 5% carbonate filaments; 10% carbonate nodules, 0.2 to 0.4 cm diameter; few fine snail fragments; clear.
Bw1	437-476 cm; yellowish brown (10YR 5/6) clay; common fine and medium distinct dark gray (2.5Y 4/1) iron depletions; few fine and medium distinct strong brown (7.5YR 4/6) soft iron masses; 5% carbonate nodules, 0.2 to 0.4 cm; few fine snail fragments; gradual.
Bw2	474-524 cm; strong brown (7.5YR 4/4) clay; common fine and medium distinct dark gray (2.5Y 4/1) and very dark gray (2.5Y 3/1) iron depletions; 2% carbonate filaments; 10% carbonate nodules, 0.2 to 0.4 cm diameter; common fine snail fragments; clear.
Bg	524-546 cm; olive brown (2.5Y 4/3) and brown (10YR 5/3) clay; common medium distinct gray (N 5/0, 6/0) iron depletions along roots; 20% carbonate nodules, 0.2 to 0.4 cm diameter; few fine snail fragments; clear.
3Ag	546-697 cm; (Unit C, marsh); black (2.5Y 2.5/1, 10YR 2/1, N 2/0) and very dark gray (2.5Y 3/1) mucky clay loam; many fine and medium snail fragments, faintly laminated; many fine and medium plant fragments; abrupt.
4C	697-871 cm; (Unit B); 70% coarse fragments, 0.3 to 4 cm diameter, subrounded to subangular; yellowish brown (10YR 5/4) mud matrix.

Core P

Golf course fairway; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

A 0-51 cm; (Unit D); very dark brown (10YR 2/2) silty clay; few fine distinct brown (10YR 4/3) pockets; few fine snail fragments; weakly calcareous; gradual.

Bw1 51-114 cm; very dark grayish brown (10YR 3/2) silty clay; few fine and medium snail fragments; one burned rock, 1.5 cm, 96 cm; gradual.

Bw2 114-166 cm; very dark brown (7.5YR 3.5/2) silty clay loam; few fine and medium snail fragments; gradual.

Bk1 166-267 cm; very dark brown (7.5YR 3/3) silty clay loam; 1% carbonate nodules, 0.5 to 1 cm diameter; few fine snail fragments; gradual.

Bk2 267-328 cm; very dark brown (7.5YR 3/3) silty clay; 3% carbonate rhyzoliths along root channels, 1 cm diameter; 1% carbonate nodules, 0.5 cm diameter; gradual.

Bk3 328-404 cm; very dark brown (7.5YR 3/2) silty clay; 2% carbonate nodules, 0.5 to 1 cm diameter; few fine snail fragments; gradual.

Bk4 404-511 cm; strong brown (7.5YR 4/6) clay; 1% carbonate nodules, 0.5 to 1 cm diameter; common fine distinct light gray (2.5Y 7/1) iron depletions along roots; few medium iron manganese stains; abrupt.

2C1 511-571 cm; (Unit A); yellowish brown (10YR 5/6) heavy clay; 10% pebbles, 0.5 to 2 cm diameter, subrounded to subangular; abrupt.

C2 571-723 cm; 60% pebbles, 0.3 to 2 cm diameter, subrounded to subangular; yellowish brown (10YR 5/6) and strong brown (7.5Y 4/4) mud matrix; abrupt.

C3 723-832 cm; 50% pebbles, 0.2 to 2 cm diameter, subrounded to subangular; dark yellowish brown (10YR 4/4) mud matrix; abrupt.

R 832-875 cm; (bedrock); yellow (2.5Y 7/6) limestone in upper part and gray (N 5/0) in lower part.

Core Q

Floodplain near Sink Creek; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

A 0-33 cm; (Unit D); black (10YR 2/1) silty clay; few fine snail fragments; burned rock at 20 cm; weakly calcareous; gradual.

Bw 33-111 cm; very dark grayish brown (10YR 3/2) silty clay; few fine snail fragments; burned rock at base; gradual.

Bk1 111-199 cm; dark brown (7.5YR 3/2) silty clay; few fine snail fragments; 2% carbonate filaments; gradual.

Bk2 199-293 cm; dark brown (7.5YR 3/2) silty clay; 1% carbonate filaments; gradual.

Bk3 293-382 cm; brown (7.5YR 3.5/3) silty clay; few medium distinct gray (10YR 5/1.5) iron depletions along roots; 2% carbonate rhyzoliths, 1 cm diameter and 1% carbonate filaments; few fine to medium snail fragments; gradual.

Bk4 382-463 cm; brown (7.5YR 4/3) silty clay; 2% carbonate rhyzoliths, 1 cm diameter and 1% carbonate filaments; fine to medium snail fragments; gradual.

Bk5 463-507 cm; mottled yellowish brown (10YR 5/4) and brown (7.5YR 4/4) clay; few medium distinct gray (2.5Y 6/1) iron depletions; common medium iron manganese stains; 1% carbonate nodules, 0.5 cm diameter; common fine snail fragments; clear.

Bk6 507-551 cm; yellowish brown (10YR 5/4) clay; common medium distinct yellowish red (5YR 4/6) soft iron masses; 1% carbonate nodules, 0.5 cm diameter; 2% pebbles, 0.2 to 0.5 cm diameter; abrupt.

2C 551-813 cm; (Unit A); 60% pebbles, 0.3 to 3 cm, subrounded to subangular; yellowish brown (10YR 5/6) mud matrix; abrupt.

R 813-870 cm; (bedrock); upper half – yellow (2.5Y 7/6) and light gray (2.5Y 7/1), few fine distinct yellow (10YR 7/8) soft iron masses; lower half – gray (N 5/0, 6/0); limestone.

Core R

Floodplain near spring; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-5 cm; asphalt; abrupt.

Fill 5-54 cm; bedded very dark brown (10YR 2/2) and dark grayish brown (10YR 4/2) clay and brown (7.5YR 5/4) loam; 30% pebbles, 0.3 to 2 cm diameter; subrounded to angular; abrupt.

A 54-108 cm; (Unit D); black (10YR 2/1) silty clay; few fine and medium distinct dark brown (7.5YR 3/3) pockets; few fine snail fragments; weakly calcareous; gradual.

Bw 108-163 cm; dark brown (7.5YR 3.5/2) silty clay; few medium distinct dark gray (2.5Y 4/1) iron depletions along roots; few fine and medium snail fragments; gradual.

Bk1 163-220 cm; dark brown (7.5YR 3/3) silty clay; 1% carbonate nodules, 0.5 cm diameter and 1% carbonate rhyzoliths, 1 cm diameter; few fine snail fragments; gradual.

Bk2 220-348 cm; dark brown (7.5YR 3/3) silty clay; 3% carbonate nodules, 0.5 to 1 cm diameter; few fine and medium snail fragments; gradual.

Bk3 348-430 cm; yellowish red (5YR 4/6) clay; few fine and medium distinct gray (10YR 5/1) iron depletions; common iron manganese stains; 2% carbonate rhyzoliths, 2 cm diameter; gradual.

Bw1 430-536 cm; brown (10YR 5/2.5) clay; many medium distinct yellowish brown (10YR 5/6) soft iron masses; few medium distinct yellowish red (5YR 4/6) soft iron masses; 3% iron manganese stains; clear.

Bw2 536-564 cm; brown (10YR 5/2.5) clay; many medium distinct yellowish brown (10YR 5/6) soft iron masses; few medium distinct yellowish red (5YR 4/6) soft iron masses; 3% iron manganese stains; clear.

Bk1' 564-610 cm; strong brown (7.5YR 4/4) clay; few fine distinct pale brown (10YR 6/3) iron depletions; 3% iron manganese stains; 2% carbonate nodules, 0.2 to 0.5 cm diameter; chert flake; clear.

2Bk2' 610-676 cm; (Unit A); light yellowish brown (10YR 6/4) clay; common medium distinct strong brown (7.5YR 4/6) soft iron masses; 3% iron manganese stains; 5% carbonate nodules, 0.2 to 0.4 cm diameter; clear.

Bk3' 676-737 cm; brown (10YR 5/3) clay; many medium distinct dark yellowish brown (10YR 4/6) soft iron masses; 3% iron manganese stains; 2% carbonate nodules, 0.2 to 0.5 cm diameter; 1% carbonate filaments; abrupt.

C 737-818 cm; 70% coarse pebbles, 0.5 to 4 cm diameter, subrounded to subangular; yellowish brown (10YR 6/4) mud matrix; abrupt.

R 818-824 cm; (bedrock); olive yellow (2.5Y 5/3) and white (2.5Y 8/2) limestone.

Core U

Floodplain on parking lot; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-2 cm; asphalt; abrupt.

Fill 2-9 cm; dark yellowish brown (10YR 4/4) loam; 50% pebbles, 0.2 to 2 cm diameter, subrounded to angular; abrupt.

A 9-55 cm; (Unit D); black (10YR 2.5/1) silty clay; 3% dark brown burned soil pockets, 0.2 to 0. 3 cm diameter; one burned rock, 2 cm diameter; few fine snail fragments; weakly calcareous; gradual.

BA 55-100 cm; brown (7.5YR 3.5/3) clay; 5% strong brown (7.5YR 4/6) biocasts; 2% black (10YR 2/1) biocasts; few fine snail fragments; gradual.

Bk1 100-146 cm; brown (7.5YR 3.5/3) clay; few fine faint grayish brown (10YR 5/2) iron depletions; 2% carbonate calcans; few fine snail fragments; gradual.

Bk2 146-210 cm; strong brown (7.5YR 4/4) clay; few fine and medium distinct grayish brown (10YR 5/2) iron depletions along roots; 2% calcans; 1% carbonate nodules, 0.5 to 1 cm diameter; few fine snail fragments; gradual.

Bk3 210-262 cm; strong brown (7.5YR 3.5/4) clay; 5% strong brown (7.5YR 4/6) pockets; 3% carbonate nodules, 1 cm diameter; gradual.

Bk4 262-402 cm; strong brown (7.5YR 4.5/4) clay; 30% very dark brown (7.5YR 3/2); few fine distinct grayish brown (10YR 5/2) iron depletions; 1% carbonate nodules, 0.5 to 1 cm diameter; gradual.

Bk5 402-490 cm; strong brown (7.5YR 4/4) and grayish brown (10YR 5/2) clay; few distinct iron manganese stains; 1% carbonate rhyzoliths, 1 cm diameter; gradual.

Bk6 490-566 cm; strong brown (7.5YR 5/4) and yellowish red (5YR 4/4) clay; 20% gray (10YR 5/1) iron depletions; 2% carbonate rhyzoliths, 2 cm diameter, along root channels; few distinct iron manganese stains; gradual.

Bk7 566-727 cm; strong brown (7.5YR 4/4, 4/6) clay; 5% light gray (2.5Y 7/1) iron depletions; common distinct iron stains; 3% carbonate nodules, 0.2 to 0.5 cm diameter; abrupt.

2C1 727-737 cm; (Unit C); strong brown (7.5YR 5/4) clay; 30% pebbles, 0.2 to 0.5 cm diameter, subrounded to subangular; abrupt.

C2 737-774 cm; 80% pebbles and cobbles, 0. 3 to 5 cm diameter, subrounded to subangular; strong brown (7.5YR 5/4) loam matrix.

Test Unit 4

Inside pool fence near Core C; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-10 cm; very dark grayish brown (10YR 3/2.5) loam; 5% pebbles, 0.3 to 1.5 cm diameter; subrounded to angular; clear.

Fill 10-76 cm; mixed brown (10YR 5/4) and yellowish brown (10YR 5/4, 5/6) loam; upper 1/3 - 40% pebbles, 0.2 to 3 cm diameter, subrounded with few 3 to 12 cm diameter, angular; middle 1/3 - 20% pebbles, 0.2 to 3 cm diameter, subrounded; lower 1/3 - 60% pebbles, 0.3 to 5 cm diameter, subrounded; abrupt.

A 76-89 cm; (Unit D); very dark grayish brown (10YR 3/2.5) silty clay; common fine distinct reddish brown (5YR 4/4) biocasts; moderate medium to coarse angular blocky; firm; many fine snail fragments; few flakes; gradual.

AB 89-107 cm; black (7.5YR 2.5/1) and very dark gray (7.5YR 3/1) silty clay; moderate coarse subangular blocky; firm; many fine to medium snail fragments; burned rock feature/flakes; gradual.

Bw 107-166 cm; dark brown (7.5YR 3.5/3) clay/clay loam; moderate coarse subangular blocky; firm; few medium and coarse distinct iron depletions along modern roots (outer - very dark grayish brown, 10YR 3.5/2; inner - gray 2.5Y 5/1); many fine and medium snail fragments; clear.

Bk 166-171+ cm; dark brown (10YR 3.5/3) and dark yellowish brown (10YR 4/4) clay loam; weak coarse angular block; firm to friable; many fine and medium snail fragments; 1% carbonate nodules, 0.5 to 1 cm diameter.

Test Unit 5

Near Test Unit 4 in parking lot; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill 0-6 cm; asphalt; abrupt.

Fill 6-46 cm; bedded 70% pebbles, 0.2 to 2 cm diameter, then dark brown (10YR 3/3) and olive yellow (2.5Y 6/4) sandy loam to clay loam, then 70% pebbles, 0.2 to 1 cm diameter; abrupt.

A 46-57 cm; (Unit D); black (10YR 2.5/1) silty clay; moderate medium and coarse angular blocky; very firm; many fine snail fragments; common medium distinct dark yellowish brown (10YR 3/4); gradual.

Bw1 57-106 cm; very dark grayish brown (10YR 3/2) silty clay; common medium distinct brown (10YR 3.5/3) biocasts; moderate medium and coarse angular blocky; firm; few medium distinct dark gray (2.5Y 4/1) iron depletions along roots; many fine snails; few burned rocks; gradual.

Bw2	106-137 cm; brown (7.5YR 3/3) silty clay loam; many medium distinct dark gray (10YR 3.5/1) iron depletions; weak coarse angular blocky; firm; common fine distinct black (10YR 2/1) coats along roots; common fine and medium snail fragments; burned rock at lower contact; gradual.
Bk	137-155 cm; brown (7.5YR 3.5/3) clay loam; common medium and coarse distinct dark gray (2.5Y 4/1) iron depletions along roots; weak coarse angular blocky; firm; many fine and medium snail fragments; 1% carbonate nodules, 0.5 cm diameter.

Test Unit 6

Inside fence in picnic area; moist throughout; calcareous unless otherwise stated; all gravels are limestone unless otherwise stated.

Fill	0-15 cm; upper 1/2 very dark gray (10YR 3/1) clay; lower 1/2 - 70% pebbles in brownish yellow (10YR 6/6) clay loam matrix; abrupt.
A	15-25 cm; (Unit D); black (10YR 2/1) silty clay; moderate medium subangular blocky; very firm; few medium distinct yellowish brown (10YR 5/6) biocasts; few fine snail fragments; gradual.
AB	25-42 cm; black (10YR 2.5/1) silty clay; moderate medium and coarse angular blocky; very firm; common fine snail fragments; gradual.
Bw1	42-76 cm; dark brown (10YR2.5/1) silty clay; moderate medium and coarse angular blocky; very firm common fine snail fragments; gradual.
Bw2	76-102 cm; dark brown (7.5YR3/2) silty clay; moderate coarse angular blocky; firm; few medium distinct very dark gray (10YR3/1) iron depletions; many fine and medium snail fragments; burned rock at lower contact; gradual.
Bw3	102-145 cm; dark brown (7.5YR 3/3) clay loam,; weak course angular blocky; firm; many fine to coarse snail fragments; charcoal zone 120 to 130 cm; burned rock at 145 cm.

Appendix E

Radiocarbon Testing Results

Table E-1. Radiocarbon dates and age calibrations.

SR-6095 FIELD No. 2002 AR-190
SUBMITTER: BRITT BOUSMAN
PROJECT: AQUARENA SPRINGS, TEXAS
SITE: AQUARENA SPRINGS, TEXAS
MACROFLORA IN SEDIMENT
700-724 cm BGL
Core F, 700-724 cm BGL

Estimated Age: 10,000 yr
Chemical Fraction Used for Analysis:
ACID/BASE-TREATED MACROFLORA
CHEM-7039
Fraction Modern: 0.3997 ± 0.0018
14C AGE: = 7,365 ± 40 yr. BP
(CAMS-85776)
1 sigma: 8280 BP-8050 BP
2 sigma: 8330 BP-8030 BP

SR-6096 FIELD No. 2002 AR-191
SUBMITTER: BRITT BOUSMAN
PROJECT: AQUARENA SPRINGS, TEXAS
SITE: AQUARENA SPRINGS, TEXAS
MACROFLORA IN SEDIMENT
678-690 cm BGL
Core E, 678-690 cm BGL

Estimated Age: 11,000 yr
Chemical Fraction Used for Analysis:
ACID/BASE-TREATED MACROFLORA
CHEM-7042
Fraction Modern: 0.3033 ± 0.0014
14C AGE: = 9,585 ± 40 yr. BP
(CAMS-85777)
1 sigma: 11,100 BP-10,750 BP
2 sigma: 11,130 BP-10,740 BP

SR-6097 FIELD No. 2002 AR-192
SUBMITTER: BRITT BOUSMAN
PROJECT: AQUARENA SPRINGS, TEXAS
SITE: AQUARENA SPRINGS, TEXAS
WOOD
19.2-19.6 ft BGL
Core O, 19.2-19.6 ft BGL

Estimated Age: 11,000 yr
Chemical Fraction Used for Analysis:
ACID/BASE-TREATED MACROFLORA
CHEM-7043
Fraction Modern: 0.4752 ± 0.0023
14C AGE: = 5,975 ± 40 yr. BP
(CAMS-85778)
1 sigma: 6860 BP-6740 BP
2 sigma: 6900 BP-6670 BP

SR-6098 FIELD No. 2002 AR-193
SUBMITTER: BRITT BOUSMAN
PROJECT: AQUARENA SPRINGS, TEXAS
SITE: AQUARENA SPRINGS, TEXAS
MACROFLORA IN SEDIMENT
21.3-21.5 ft BGL
Core O, 21.3-21.5 ft BGL

Estimated Age: 12,000 yr
Chemical Fraction Used for Analysis:
ACID/BASE-TREATED MACROFLORA
CHEM-7046
Fraction Modern: 0.4783 ± 0.0021
14C AGE: = 5,925 ± 40 yr. BP
(CAMS-85779)
1 sigma: 6800 BP-6670 BP
2 sigma: 6860 BP-6660 BP

Table E-1. Radiocarbon dates and age calibrations. (continued).

SR-6099 FIELD No. 2002 AR-194 SUBMITTER: BRITT BOUSMAN PROJECT: AQUARENA SPRINGS, TEXAS SITE: AQUARENA SPRINGS, TEXAS CHARCOAL Test Unit 4, Level 10 (FEA-7) 107 cm BGL	Estimated Age: 2000 yr Chemical Fraction Used for Analysis: ACID-BASE-HNO3-TREATED CHARCOAL CHEM-7047 Fraction Modern: 0.6630 ± 0.0031 **14C AGE: = 3,300 ± 40 yr. BP** **(CAMS-85780)** 1 sigma: 3570 BP-3470 BP 2 sigma: 3640 BP-3440 BP
SR-6101 FIELD No. 2002 AR-196 SUBMITTER: BRITT BOUSMAN PROJECT: AQUARENA SPRINGS, TEXAS SITE: AQUARENA SPRINGS, TEXAS CHARCOAL Test Unit 6, Level 8 (FEA-6) 70-80 cm BGL	Estimated Age: 2000 yr Chemical Fraction Used for Analysis: ACID-BASE-HNO3-TREATED CHARCOAL CHEM-7048 Fraction Modern: 0.6428 ± 0.0032 **14C AGE: = 3,550 ± 45 yr. BP** **(CAMS-85781)** 1 sigma: 3000 BP-3720 BP 2 sigma: 3970 BP-3690 BP
SR-6102 FIELD No. 2002 AR-197 SUBMITTER: BRITT BOUSMAN PROJECT: AQUARENA SPRINGS, TEXAS SITE: AQUARENA SPRINGS, TEXAS CHARCOAL Test Unit 4, Level 17 170-180 cm BGL	Estimated Age: 2000 yr Chemical Fraction Used for Analysis: ACID-BASE-HNO3-TREATED CHARCOAL CHEM-7049 Fraction Modern: 0.5836 ± 0.0029 **14C AGE: = 4,325 ± 45 yr. BP** **(CAMS-85782)** 1 sigma: 4970 BP-4830 BP 2 sigma: 5040 BP-4820 BP

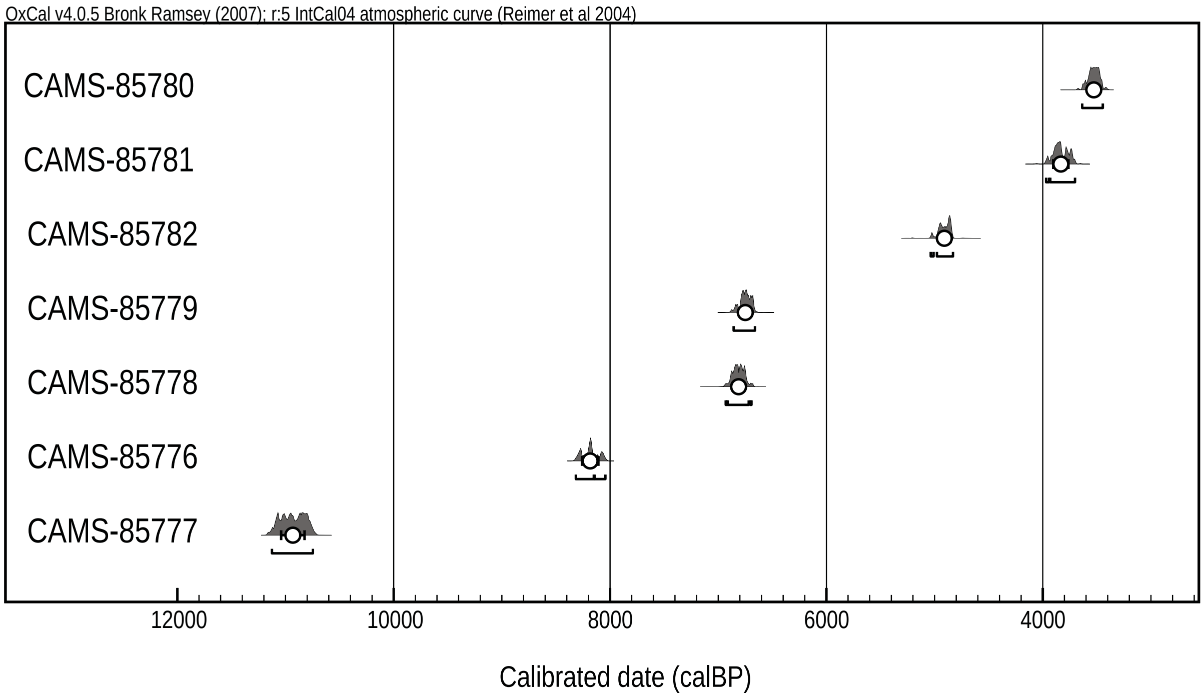


Figure E-1. Chart of calibrated ages with means (open circles) with 1-standard deviaiton bars and 2-sigma ranges shown below the calibrated age frequency distribution

APPENDIX F

OTHER BIFACES DATA

Key:

Raw Material Type	L- W - Th	Stage of reduction	Break Type
1 - Chert	Blank = Incomplete	1 - Early	1 - Manufacturing
		2 - Middle	2 - Use
Raw Material Grain Size	Tool Completeness	3 - Late	3 - Post-depositional
1 - Fine (no inclusions)	1 - Complete	4 - Indeterminate	4 - Burning
2 - Fine (w/inclusions)	2 - Proximal		5 - Indeterminate
3 - Coarse	3 - Medial	Shape	
	4 - Distal	1 - Ovate	Tool Recycled?
Burned	5 - Longitudinal	2 - Pointed-ovate	0 - No
1 - Yes	6 - Wedge	3 - Triangular	1 - Yes
2 - No	7 - Indeterminate	4 - Indeterminate	
		5 - Round	
Cortex	Blank Type		
0 - Absent	1 - Flake		
1 - 1 to 50%	2 - Nodule		
2 - 51 to 99%	3 - Indeterminate		

Unique Item #	Unit	Level	Feature#	Depth (cm bs)	Material Type	GrainSize	Burned?	% Cortex	Length (mm)	Width (mm)	Thickness Width (mm)	Tool Completeness	Blank Type	Reduction Stage	Shape	Break Type	Color	Remarks
19	1	2		10-20	1	1	1	0	-	-	5.3	3	1	3	4	2	19	
20	1	2		10-20	1	1	1	0	-	-	-	3	1	4	4	1	5	
21	4	8		80-90	1	1	1	0	-	52.9	11.3	2	1	1	4	1	9	
22	4	8		80-90	1	1	1	1	-	-	14.8	3	4	1	4	1	6	
23	4	8		80-90	1	1	1	0	-	-	6.7	3	3	3	4	4	4	
24	4	8		80-90	1	1	2	0	-	-	6.5	6	1	2	4	3	5	
25	4	8		80-90	1	1	1	0	-	-	-	7	3	2	4	4	17	
26	4	9		90-100	1	1	1	1	-	41.6	20.6	7	4	1	4	1	9	
27	4	9		90-100	1	1	1	0	-	-	-	7	1	1	4	1	8	
28	4	10		100-110	1	2	1	0	-	-	16.7	3	3	2	4	1	6	
29	4	11		110-120	1	1	1	0	-	-	5.0	2	1	3	4	2	18	
30	4	11		110-120	1	1	1	0	-	40.3	7.8	2	1	3	4	3	9	Post-depositional heat spalls
31	4	11		110-120	1	2	1	0	-	-	12.7	3	3	2	4	1	28	
32	4	11		110-120	1	1	1	0	-	36.7	6.3	3	3	3	4	2	5	
33	4	12		120-130	1	1	1	0	50.0	34.9	8.4	1	1	2	3	-	6	Sub-triangular biface
34	4	12		120-130	1	1	1	0	-	71.2	36.9	7	2	1	1	1	5	Edgewear (chopper)
35	4	13		130-140	1	1	1	1	52.5	35.4	10.3	1	1	2	3	-	6	Sub-triangular biface
36	4	13		130-140	1	1	1	0	-	-	-	2	1	3	4	1	6	
37	4	13		130-140	1	1	1	0	-	-	8.7	4	3	2	4	1	9	Slightly beveled on one edge.
38	4	13		130-140	1	1	1	0	-	-	-	7	3	4	4	1	29	
39	4	14		140-150	1	1	1	0	-	-	-	6	3	3	4	5	23	
40	4	15		150-160	1	1	1	0	-	48.1	8.8	2	1	2	3	1	5	
41	4	15		150-160	1	1	1	0	-	32.0	10.1	2	1	2	4	3	5	
42	4	15		150-160	1	1	1	0	-	-	9.9	2	1	2	4	1	9	
43	4	15		150-160	1	1	1	0	-	-	-	7	3	3	4	5	1	
44	4	16		160-170	1	1	1	0	-	-	-	2	3	1	4	5	17	Appears to be a point base fragment.
45	4	16		160-170	1	1	1	1	43.8	-	18.6	7	1	1	4	1	6	
46	4	16		160-170	1	1	1	0	-	-	-	7	3	3	4	2	8	
47	4	16		160-170	1	1	1	0	-	-	-	7	3	3	4	2	17	
48	4	16		160-170	1	1	1	0	-	-	-	7	1	4	4	4	30	
49	5	3		20-30	1	1	1	0	-	-	9.6	2	3	2	4	4	6	
50	5	8		70-80	1	2	1	0	57.4	39.8	8.6	1	1	2	3	-	5	
51	5	9		80-90	1	1	1	0	-	-	-	-	3	3	3	1	18	Biface notch.
52	5	10		90-100	1	2	1	0	68.4	49.1	15.4	1	1	2	3	-	6	
53	5	10		90-100	1	1	1	0	-	-	6.2	2	1	3	3	2	28	

Unique Item #	Unit	Level	Feature#	Depth (cm bs)	Material Type	GrainSize	Burned?	% Cortex	Length (mm)	Width (mm)	Thickness Width (mm)	Tool Completeness	Blank Type	Reduction Stage	Shape	Break Type	Color	Remarks
54	5	10		90-100	1	1	1	0	-	-	19.1	4	3	2	4	3	5	Fine retouch on one edge suggests it may have been expediently recycled.
55	5	10		90-100	1	1	1	0	-	-	-	7	1	2	4	1	28	
56	5	11		100-110	1	1	1	1	46.8	37.7	15.0	1	1	1	3	-	28	
57	5	11		100-110	1	1	1	1	64.3	42.5	8.1	1	1	3	1	-	5	Crude, but finished end scraper.
58	5	11		100-110	1	2	1	1	-	62.3	20.8	7	1	2	1	1	6	Quarry blank
59	5	11		100-110	1	1	1	1	-	-	11.4	7	1	2	4	1	6	
60	5	12		110-120	1	1	2	1	145.3	60.7	34.1	1	1	1	2	-	19	Quarry blank.
61	5	14		130-140	1	1	1	0	-	-	9.6	7	1	2	4	1	5	
62	5	14		130-140	1	2	1	0	-	-	8.3	7	3	2	4	3	18	
63	5	14		130-140	1	1	1	0	-	-	9.2	7	1	2	4	1	28	
64	5	14		130-140	1	2	1	0	-	-	7.1	7	1	2	4	1	5	
65	5	15		140-150	1	1	1	0	-	-	-	2	1	2	4	4	5	
66	5	15		140-150	1	1	1	0	-	33.0	6.6	2	1	2	4	1	28	
67	5	15		140-150	1	2	1	0	-	-	6.0	4	1	2	4	3	6	
68	5	15		140-150	1	1	1	0	-	-	-	7	1	3	4	1	28	
69	5	16		150-160	1	1	1	1	49.4	36.2	13.2	1	1	1	1	-	23	
70	5	16		150-160	1	1	1	0	-	-	-	2	3	2	4	1	5	
71	5	16		150-160	1	1	1	0	-	-	-	4	3	2	4	3	18	
72	5	16		150-160	1	1	1	0	-	-	-	7	1	3	4	2	18	
73	6	4		30-40	1	2	1	0	65.5	54.2	21.4	1	1	1	3	-	28	
74	6	4		30-40	1	1	1	0	-	-	-	4	1	3	4	4	24	
75	6	6		50-60	1	1	1	1	93.5	48.6	32.9	1	4	1	1	-	8	Could be considered a quarry blank.
76	6	6		50-60	1	1	1	0	-	-	-	7	1	4	4	2	28	
77	6	8		70-80	1	1	1	1	-	-	16.5	5	1	1	4	1	28	
78	6	8		70-80	1	1	1	0	-	-	-	7	3	3	4	4	6	
79	6	9		80-90	1	1	1	0	-	-	-	2	1	3	4	2	5	
80	6	9		80-90	1	2	1	0	-	-	7.1	5	1	2	3	1	28	
81	6	9		80-90	1	1	1	0	-	-	-	7	1	2	4	1	28	
82	6	9		80-90	1	1	1	0	-	-	-	7	1	3	4	2	23	
83	6	10		90-100	1	1	1	0	-	-	-	2	1	3	4	4	30	
84	6	10		90-100	1	1	1	0	-	-	-	4	1	2	4	5	30	
85	6	10		90-100	1	1	1	0	-	-	12.4	6	3	2	4	1	30	
86	6	11		100-110	1	2	1	0	-	34.5	11.6	2	1	2	4	1	5	
87	6	11		100-110	1	1	1	1	-	-	9.2	3	1	2	4	3	6	
88	6	11		100-110	1	1	1	0	-	-	-	7	3	3	4	2	4	
89	6	12		110-120	1	2	1	0	-	43.7	16.9	2	3	2	4	1	9	
90	6	12		110-120	1	1	1	0	-	54.1	9.6	2	3	2	3	1	9	
91	6	12		110-120	1	1	1	1	-	-	-	7	1	1	4	1	25	
92	6	12		110-120	1	1	1	0	-	-	-	7	1	2	4	4	5	
93	6	13		120-130	1	2	1	0	48.6	35.7	11.0	2	1	1	4	1	9	
94	6	13		120-130	1	1	1	0	-	-	-	7	3	2	4	1	23	
95	6	13		120-130	1	1	1	0	-	-	-	7	1	3	4	2	23	
96	6	13		120-130	1	1	1	0	-	-	-	7	1	3	4	2	17	
97	6	14		130-140	1	2	1	0	-	-	10.7	2	1	3	4	2	23	Large flake scars over finely worked surface suggest an attempt at recycling after the tool was initially broken
98	6	15		140-150	1	1	1	0	-	21.0	9.1	2	1	3	3	1	9	Minimal edge wear suggests this specimen was probably a drill; not ground; triangular biface.