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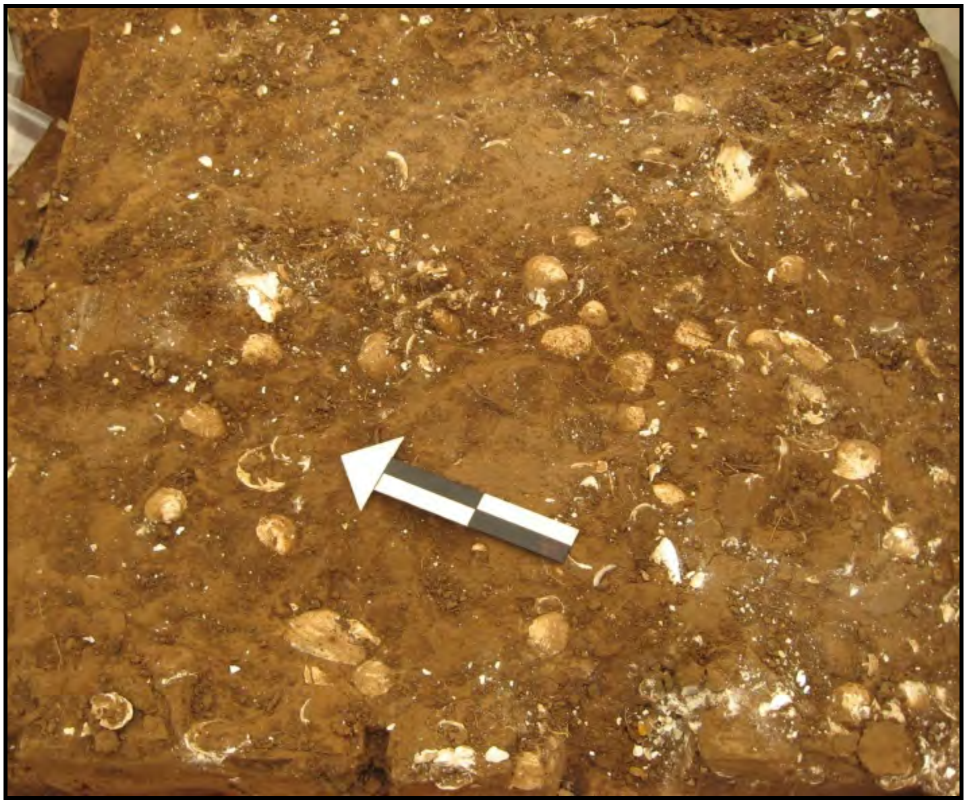

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EXECUTIVE SUMMARY

This cultural resource investigation was necessitated by the proposed bridge replacement and new right-of-way and easement along the Farm to Market road at Gages Creek crossing (CSJ: 3149-02-010) by the Texas Department of Transportation (TxDOT) in southern Young County. From January 29, 2007 through March 16, 2007, an archeological crew from the Cultural Resources Department of TRC Environmental Corporation's (TRC's) Austin office conducted data recovery excavations in part of site 41YN452 (Root-Be-Gone) before any disturbance from the planned bridge replacement activities occurred. This data recovery program was conducted under TxDOT Scientific Services Contract No. 575XX SA008 and Texas Antiquities Permit No. 4003.

Data recovery investigations were conducted along the western side of the existing two-lane paved road in two areas previously documented to have high concentrations of cultural activities centered on cultural features. These two areas were identified during TRC's 2006 site eligibility assessment, which was also conducted on adjacent site 41YN450. Only the Root-Be-Gone site was accepted as eligible for listing on the National Register of Historic Places and, therefore, subject to intensive data recovery investigations. This report provides the accepted research design that guided the analyses, describes the methods employed, discusses the excavation process, and presents detailed findings and results of technical analyses from the 50.5 m^3 (144 m^2) data recovery excavations for three, horizontally-separated Late and Terminal Archaic components at Root-Be-Gone.

The data recovery investigations included the mechanical removal of roughly 30 to 60 cm of sediment from above a previously identified target zone, cultural materials in a buried A horizon that contained an apparent Terminal Archaic assemblage in two horizontally-separated areas. Each area was targeted by a single block excavation, labeled North and South Block, which are roughly 70 m apart and which parallel the existing right-of-way. Following the mechanical stripping to access the targeted Terminal Archaic component in the buried A horizon, hand-excavations were conducted in 1-by-1 m units in continuous blocks through the targeted buried A horizon. The target zone varied from 20 to 40 cm thick. This buried A horizon appeared to contain a single, isolated Terminal Archaic component.

Root-Be-Gone (41YN452) yielded what is considered three horizontally-separate cultural components (labeled 1, 2, and 3) in the buried A horizon. This buried A horizon varied in depth from 45 to 70 cmbs. A few scattered Late Prehistoric arrow points were discovered on the surface and above the Terminal Archaic component. The younger and scattered Late Prehistoric artifacts were determined to occur above or on top of the buried A horizon. No definable cultural features were identified with the scattered arrow points. These scattered, Late Prehistoric materials were deemed insignificant and not targeted during the data recovery investigations.

The excavations yielded assemblages of chipped stone tools (N = 154), lithic debitage (N = 1,486), mussel shell (N = 8,430), faunal bone (N = 71), charcoal (N = 111), burned rocks (N = 4,421), features (N = 18), and other cultural materials, including sediment samples.

During the analyses, wood charcoal radiocarbon results from across the excavated areas revealed that a minimum of two, and possibly three different Terminal and/or Late Archaic components were represented in the buried A horizon in the two blocks. The North Block was radiocarbon dated by nine accepted dates to ca. a 230 year period between 1100 and 1330 B.P. The cultural materials recovered

were assigned to a single, well-defined and isolated Terminal Archaic Component 1. That component yielded three dart points and one tiny arrow point associated with 14 cultural features. The features were comprised mostly of quantities of freshwater mussel shell concentrations in dumps, most associated with small scattered burned rocks; a burned, rock-filled heating element, scattered mussel shells and lithic debitage, and a few scattered formal chipped stone tools. The absolute age documented for this Terminal Archaic component that yielded dart points overlaps in time with the Scallorn arrow point using populations of the Austin phase of the Late Prehistoric period.

The South Block yielded minimally two sets of radiocarbon dates. The northern two-thirds of the South Block yielded seven accepted absolute wood charcoal dates that range over a nearly 630 year period between 690 and 1320 B.P. The targeted buried A horizon yielded what appeared as a single Terminal Archaic dart point and a limited stone tool assemblage. This assemblage is assigned to the Late Archaic Component 2. TxDOT archeologists considered this part of the South Block to be potentially mixed based on the wood charcoal radiocarbon dates obtained. Therefore, TxDOT archeologists decided that detailed analyses were restricted to the two cultural features (Features 11 and 13) and the formal stone tool assemblage recovered from that area. Because of the possible mixed cultural materials, this data was not used to address the presented research questions. The southern one-third of the South Block was radiocarbon dated by four accepted wood charcoal dates to a narrow 120 year period with an average age of 1855 B.P. This area was dominated by a single 3.0 to 3.5 m diameter mussel shell feature (Feature 4) that lacked associated formal chipped stone tools and diagnostic dart points. Here, this material is assigned to the Late Archaic Component 3. Because of the documented age difference from the Terminal Archaic Component 1 in the North Block, this material was not used to address the research questions that focused on the Terminal Archaic period.

Six research questions were targeted and address issues that include: whether the excavations yielded an isolatable Terminal Archaic component, what cultural materials were associated with the Terminal Archaic component, how this assemblage compares to other Terminal Archaic assemblages in the region, what was the subsistence base and broader economic pattern for this period, and was the bow and arrow adopted simultaneously by all groups.

Following the acceptance of the final report, these materials were permanently curated at the Texas Archeological Research Laboratory (TARL) in Austin. The Texas Historical Commission granted permission to curate only a small sample of the freshwater mussel shells collected during these investigations. The curated shells originate mostly from identified cultural features in all three components.

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ACKNOWLEGEMENTS

The Texas Department of Transportation (TxDOT), Environmental Affairs Division (ENV), Archeological Studies Program sponsored and oversaw these archeological investigations. We would like to express our gratitude to the many archeologists at TxDOT for their support and guidance. Initially, Dr. Lain Ellis, Head of the Archeological Studies Program, oversaw this program followed by Dr. Scott Pletka, who also worked with TRC Environmental Corporation's (TRC's) archeological staff over the years to facilitate the many individual work authorizations, supplemental agreements, and other paperwork necessary to successfully complete the eligibility assessment of two sites, the data recovery excavations at 41YN452, followed by the analyses, and reporting for this project. Dr. James Abbott and Mr. Dennis Price worked closely with TRC archeologists on multiple work authorizations for the site eligibility assessment, the subsequent data recovery, and analyses phases. Dr. Abbott facilitated the radiocarbon dating of materials through outside laboratories. Both of these TxDOT individuals reviewed and commented on interim reports, research designs, and drafts of documents over the years. TxDOT archeologist Dr. John Arnn provided several important references concerning mussel shells. The TxDOT-ENV editorial group of James Abbott, Jason Barrett, Stephen (Waldo) Troell, and Scott Pletka all reviewed the draft final report and made comments and suggested changes to improve the quality of the final report. These gentlemen are thanked for their comments, direction, and support over the life of this project.

Individuals from the TxDOT district office in Wichita Falls also provided invaluable assistance during the fieldwork. Ms. Jill Holmes, Environmental Coordinator of TxDOT's Wichita Falls District Office, helped set up meetings, directed TxDOT archeologist on site, provided useful background information, and over saw the installation of safety cones. The Wichita Falls office also supplied the Gradall® needed for the stripping of the upper deposits to facilitate the hand-excavations in the two blocks during data recovery at 41YN452. The Gradall® from TxDOT's district office was operated by Mr. Tom Stacy, who provided the expertise that facilitated the trenching during the site eligibility assessment in 2006. This included the backfilling at the completion of the archeological investigations.

The hardworking archeological field staff from the Cultural Resources Department of TRC's Austin offices completed the data recovery excavations at Root-Be-Gone, and made significant contributions to the timely and efficient completion of the fieldwork during the cold, snowy, and rainy winter months. Mr. Greg Sundborg arrived at the site a week before the crew to guide and direct the TxDOT Gradall® operation and show exactly where and how deep to strip the deposits from the target zone. During the data recovery investigation, conducted from January 29, 2007 through March 16, 2007, the field crew was directed by Mike Quigg (Principal Investigator) and Dana Anthony (Project Archeologist). Mr. Quigg also operated a small backhoe to strip remaining deposits from above the target zone and move backdirt to speed the data recovery efforts. He also mechanically excavated two short trenches (Trenches 7 and 8) to facilitate geoarcheological sampling by Dr. Charles Frederick.

Ms. Anthony, with the assistance of Ms. Kendra Luedecke (presently Mrs. DuBois), the crew chief, supervised and directed the crew of archeological technicians, which included Ms. Shelly Fischbeck, Mr. Andy Bryant, Mr. Owen Ford, Mr. Jim Gillentine, Mr. John Hanna, Ms. Virginia Moore, Mr. Rob Sabo, Mr. Greg Sundborg, and Mr. David Yelacic. Mr. Sundborg drove the truck load of samples from the field to the Austin laboratory. Thank you, Ms. Anthony, for stepping in and working with our staff to help direct the fieldwork to a successful completion in a timely manner. Your directions and oversight of the crew are much appreciated.

Dr. Charles Frederick, TRC's geoarcheologist, conducted the in-field stratigraphic sampling and documentation of alluvial terrace sediments on each end of the two blocks from Trenches 7 and 8 and conducted detailed, close interval sampling of three cultural features for chemical analysis and extracted three short micromorphological columns from these same three features for microscopic analysis. Mr. Eric Schroeder served as the geoarcheologist during the site eligibility assessment in 2006. He provided greater detail to support the initial geoarcheological interpretations conducted in 2005 by TxDOT geoarcheologist, Dr. James Abbott.

Local landowner, Mr. Bob Roach, stopped by a couple of times to check on our progress and visit. Thanks, Mr. Roach, for your interest and for allowing us to park our equipment trailer on your property.

Many individuals and organizations worked together and contributed significantly to make this mitigation program a success.

Fieldwork would not have been possible without the large circus tents rented from Dallas Party and Tent Company in Dallas. One large tent was erected over each excavation block. Inside each tent were a propane heater and a set of lights. Regardless of the number of complications that arose with the mechanical equipment and the tents, without them the project would not be a success. The few snowy days and subsequent rains created very muddy conditions outside the tents and would have made controlled excavations impossible.

Back in the Austin laboratory, the Laboratory Supervisor directed and supervised the initial processing of the collections, established the electronic site database, and supported and facilitated the preparation of the interim report by preparing figures and tables. Ms. Dubois was assisted by Ms. Fischbeck and Mr. Yelacic, who sorted, washed, labeled, counted, and bagged samples and artifacts. Only part of the collections was processed under the work authorization for the interim report deliverable. After the final work authorization was issued for the data analyses and reporting tasks, the rest of the laboratory processing was completed. This latter processing was facilitated by Mr. Emanual (Manny) Moss and assisted by Ms. Trisha-Ann Gonzales. Mr. Moss also conducted the mussel shell identifications with the aid of TRC comparative collection and the Howell (1976) report under the direct supervision of Mr. Quigg. He also skillfully drafted most figures for the final report, continually updated the database, and compiled many of the data tables used in the final report. He also aided Mr. Quigg in photographing the artifacts for the final report. Ms. Gonzales conducted some of the initial sorting of the lithic debitage and artifact measurements under the direct supervision of Mr. Paul Matchen. She helped organize and prepare the artifacts and data for reporting and conducted a variety of tasks to help Mr. Quigg and Mr. Matchen.

Mr. Matchen served as the Project Archeologist and Field Director for the NRHP Evaluation for the both the Root-Be-Gone site and site 41YN450 and was primary author for the resulting Interim Report (See Appendix G). With Mr. Quigg, he helped devise the data recovery excavation plan and associated field logistics. He also conducted the lithic debitage analyses and incorporated these findings and interpretations into Chapters 6 and 7. In addition, Mr. Matchen wrote portions of the Introduction, Environmental Setting, and Research Design chapters.

Dr. Robert Ricklis provided his extensive background and knowledge to guide and help write the research design presented in Chapter 4. He also used his considerable skill in conducting the aging and seasonality estimations on the five fish otoliths. Dr. Ricklis provided peer review of the draft report, made editorial changes and corrections, and provided many useful comments to improve the overall quality of this report. Thanks, Dr. Ricklis, for your continued support and expertise.

Dr. Charles Frederick, project geoarcheologist, again worked closely with Mr. Quigg to collect the chemical samples from the three specific and different feature types, sample the two ends of the excavation areas and also conducted many of the laboratory procedures to extract the actual data to interpret the natural and cultural deposits. Dr. Frederick wrote the section on natural stratigraphy presented in Section 6.2. Thanks to Dr. Frederick for another excellent analysis and interpretation of the sediments. Ms. Elaine Goddard provided editorial assistance throughout the drafts and final report.

We would also like to thank the many professional individuals and private enterprises whose technical expertise provided valuable contributions to interpreting different data sets that allowed greater and additional in-depth insights into the prehistory of the Root-Be-Gone site. Their contributions allowed for significant insights into the prehistoric peoples who occupied the Root-Be-Gone site.

Dr. Steven Bozarth, Palynologist at the University of Kansas, conducted presence/absence analyses of opal phytolith and pollen from a very limited suite of sediment samples to assess the feasibility of going forward with additional detailed analyses at a later date. He recommended that, because of the very good phytolith preservation in the samples, additional phytolith analysis be conducted. We thank Dr. Bozarth for his contributions.

The many individuals at the University of Georgia (UGA), Center for Applied Isotope Studies, are thanked for providing the necessary and valuable radiocarbon dates. Individual samples were sent to that laboratory through Dr. Abbott at TxDOT, who also approved each sample. The scientists, led by Dr. Alexander Cherkinsky, are thanked for their excellence in handling, cleaning, and the subsequent results from the diverse samples (wood, charcoal, burned rocks, fish otoliths, and sediments) used in this radiocarbon dating program.

The initial 21 wood and freshwater mussel shell samples selected for radiocarbon dating following the eligibility assessment fieldwork were submitted to Beta Analytic Inc. (Beta) in Florida for dating through TxDOT. Thanks to the many individuals at Beta, including Mr. Darden Hood, Mr. Ron Hatfield, Mr. Chris Patric and Ms. Teresa Zilko Miller for their handling and processing, and the subsequent results and contributions made to this report.

Dr. Phil Dering, of Shumla Consulting Service in Comstock, Texas, provided his extensive expertise in floating sediment samples and identification of macrobotanical materials in the light fractions from those float samples. His insightful comments and interpretations continue to add to our understanding of the fuel woods used prehistorically and in the paleoenvironment across Texas.

Dr. Bruce Hardy, Professor in the Department of Anthropology at Kenyon College, is thanked for his identifications of microfossils and excellent, high-powered use-wear analyses on the diverse stone artifacts from Root-Be-Gone. His insights into tool functions furthered our understanding of those tools and contributed to identifying human behaviors during the Terminal Archaic period.

Dr. Linda Perry, originally affiliated with the Smithsonian Institute in Washington D.C., presently a private contractor, conducted both the initial and subsequent starch grain analysis on a selected suite of samples that focused primarily on burned rocks. We want to especially thank Dr. Perry for her continuous communication and interest in working with us and her willingness to conduct starch analysis on the burned rocks.

Dr. J. Byron Sudbury, at J. S. Enterprises in Oklahoma, conducted the detailed phytolith analysis on a small suite of sediment samples from the North Block. His observations, identifications, and comparison provided significant contributions to understanding the natural deposits and cultural feature in the North Block. Thank you, Dr. Sudbury, for your interest and contributions.

Dr. Barbara Winsborough of Austin originally conducted diatom analysis on a limited suite of sediment and burned rock samples and then on a subsequent suite of sediments and burned rocks in the final data analyses phase. Her insights and expertise in her field has greatly advanced the understanding of the cooking practice undertaken at Root-Be-Gone. Thank you, Dr. Winsborough, for your dedication to science and attempts to add to the understanding of human behaviors through diatom interpretations.

Dr. Mary Malainey of Winnipeg, Manitoba, conducted the initial exploratory lipid residue extractions and analyses on 15 burned rocks to assess the feasibility of this approach in going forward in subsequent and more in-depth analyses. She proved an initial report that accompanied our interim report on the data recovery (Quigg et al. 2007). However, TxDOT archeologists denied further lipid residue analyses in the subsequent data analyses, even though it was an integral part of the original research design submitted to TxDOT. In her dedication to the science and desire for greater understanding of this unique data set, Dr. Malainey agreed to rerun the same initial 15 samples during her own time and at her personal expense using additional technology. In this reanalysis, she employed the use of high temperature-gas chromatography (HT-GC) and high temperature gas chromatography/mass spectrometry (HT-GC/MS). The high temperature aspect was not previously available and was an additional benefit to the reanalysis. We are grateful to her and would like to thank Dr. Malainey for her willingness to spend extra time to conduct important chemical analysis on this data set at no expense to TxDOT.

The Stable Isotope Research Unit in the Department of Crop and Soil Science at Oregon State University in Corvallis, under the direction of Dr. Rockie Yarwood, provided the stable carbon and nitrogen isotope data on sediment samples used in the geoarcheological section. The National Petrographic Institution in Houston conducted the preparation of thin section slides used by Dr. Frederick.

Combined, these many individuals, institutions, and companies contributed significant data and results to this technical report and allowed for greater insight and interpretation of human behavior. To all the above people and institutions, we are grateful and appreciate your expert contributions to this project. Thanks to all. Any problems, omissions, or errors are the responsibility of the project director and manager.

Mike Quigg
Project Director and Manager

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1.0 INTRODUCTION

J. Michael Quigg and Paul M. Matchen

1.1 INTRODUCTION

This report presents the archeological findings from the excavations conducted at 41YN452 (previously named the Root-Be-Gone site) before a proposed bridge replacement over Gages Creek by the Texas Department of Transportation (TxDOT). During January through March 2007, TRC Environmental Corporation (TRC) archeologists excavated a total of 50.5 m^3 (144 m^2) as data recovery investigations at this multicomponent Late Archaic site, to mitigate the adverse impact from the planned bridge replacement and road-widening activities. These archeological investigations were conducted under the National Historic Preservation Act (NHPA) of 1966, as amended through 1992 (PL-89-665; 80 Stat. 915; 16 U.S.C. § 470 et seq.), the Department of Transportation Act of 1966 (PL 89-670), and the Antiquities Code of Texas (as incorporated into Title 98, Chapter 191, of the Natural Resources Code of Texas [1977, as amended]).

TxDOT issued a Work Authorization (No. 57527SA008) to the Cultural Resources Department of TRC's Austin office under TxDOT Scientific Services Contract No. 575XXSA008 to conduct the data recovery excavations. TRC's investigations were also conducted under Texas Antiquities Committee Permit No. 4003 issued to Principal Investigator J. Michael Quigg.

1.2 GENERAL PROJECT LOCATION

The project area lies in the extreme southern part of Young County, just west of the town of Eliasville, Texas. Young County, with a land area of 240,975 hectares (ha) (595,463 acres [ac.]), is bordered by Archer and Baylor Counties to the north, Throckmorton County to the west, Jack County to the east, Palo Pinto County to the southeast, and Stephens County to the south (Figure 1-1). Elevations range from 305 meters (m) to 464 m (1,000 to 1,522 feet [ft.]). Young County is in the Rolling Plains physiographic province, often referred to as the Permian Redbeds. This is an extensive plain that encompasses much of north Texas, extending from the north-south trending Caprock Escarpment at the eastern edge of the Llano Estacado, eastward to the Western Cross Timbers, and northward into Kansas. This physiographic region consists of rolling topography, scattered high buttes, and extensive flat plains that are dissected by stream valleys.

The region contains very old Pennsylvanian deposits except in stream valleys that are filled with Holocene alluvium (Barnes 1972, 1987). The presently reported project lies within the Brazos drainage system near the confluence of the Salt Fork and the Clear Fork branches of the Brazos River south of Graham, Texas. The Clear Fork flows eastward across the Rolling Plains and ultimately joins the Brazos, which in turn flows southeastward to discharge into the Gulf of Mexico. Within our project area, the Clear Fork channel is at an elevation of about 312 m (1,025 ft.) above mean sea level (amsl). The gently rolling uplands in the vicinity reach elevations of 390 m (1,280 ft.).

1.3 TEXAS DEPARTMENT OF TRANSPORTATION PROPOSED DEVELOPMENT

TxDOT is planning to replace the current bridge (2.5 ha or 6.1 ac.), expand the right-of-way (0.5 ac. or 1.3 ha) to the west, and use an easement (0.5 ac or 1.3 ha.) along the Farm-to-Market road (FM 3109) over Gages Creek in southern Young County.

The proposed bridge replacement and road widening will directly impact parts of prehistoric sites 41YN450 and 41YN452. The Root-Be-Gone site, 41YN452, lies on a roughly 10 m (33 ft.) high alluvial terrace (T_1) on the south side of Gages Creek about 50 m (165 ft.) west of the confluence with

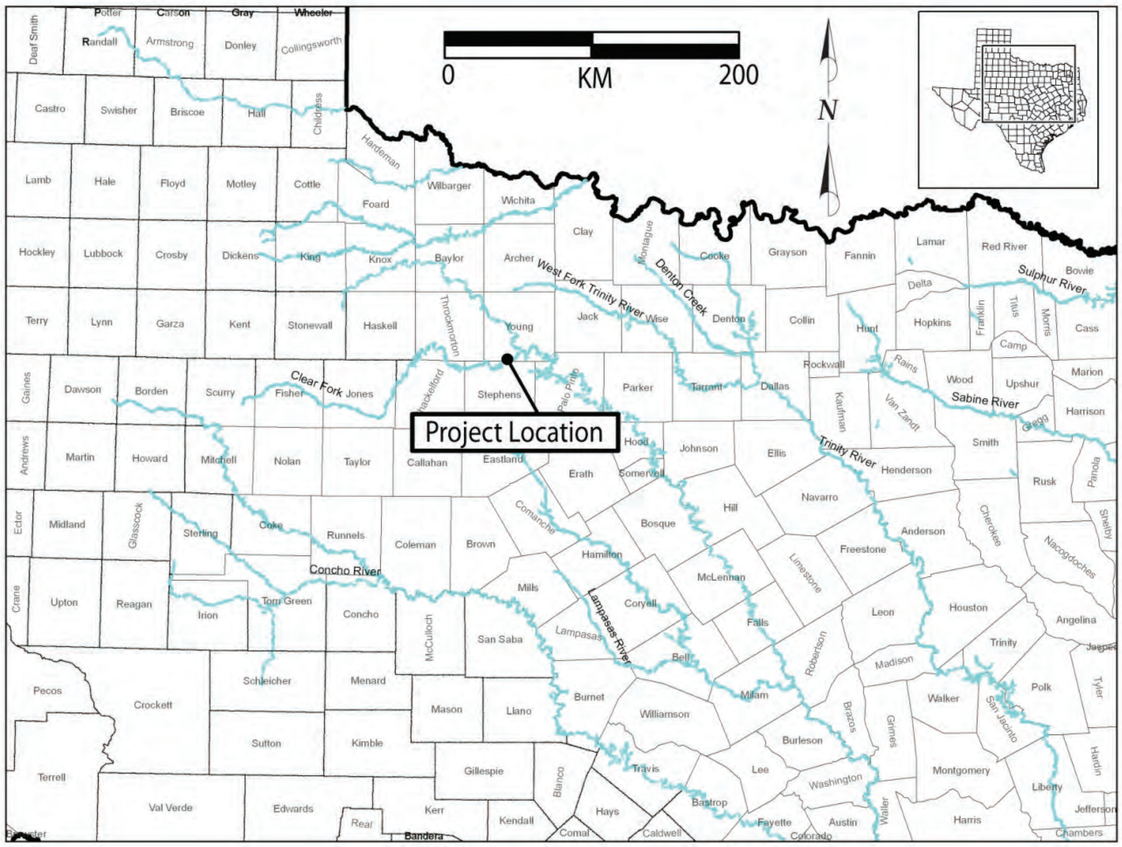

Figure 1-1. Project Location in Southern Young County, Texas

the Clear Fork of the Brazos River. The underlying geology consists of Pennsylvanian sandstones, mudstones, and limestones of the Thrifty and Graham formations (Barnes 1972). Gravels outside the river valleys in the region consist of sandy siliceous clasts of diverse lithology preserved at an elevation some 30 to 40 m (100 to 150 ft.) above the stream. One gravel source (shown as Qt2 on geology maps) is in the uplands immediately on the northern side of Gages Creek, just north of 41YN452. Pleistocene terrace remnants in the valley are in the vicinity, south of the site and at slightly higher elevations than the alluvial terrace (Barnes 1972).

1.4 PROJECT BACKGROUND

1.4.1 South Bend Reservoir Archeological Survey

In 1987 and 1988, archeologists from the Archeological Research Laboratory at Texas A&M University, College Station, conducted an intensive archeological survey of more than 14,911 ha (37,000 ac.) in the South Bend Reservoir that encompassed parts of southern Young, northern Stephens, and southeastern Throckmorton Counties (Sanders et al. 1992).

This project was planned and financed by the Brazos River Authority and conducted under Texas Antiquities Permit #648. The Reservoir was not built and other background studies relating to this reservoir were never completed.

The South Bend Reservoir archeological survey and shovel testing identified 541 prehistoric sites, 168 historic sites, and 522 isolated finds. A total of 3,461 shovel tests were excavated. The survey identified six archeological sites within or immediately adjacent to the area of potential effect (APE). The six sites are as follows:

Site 41YN447 is an open prehistoric campsite exposed in the cutbank of the Clear Fork of the Brazos on the eastern side of the roadway opposite 41YN450. This site consists of a possible hearth, evidenced by a cluster of burned rocks buried some 370 centimeters below surface (cmbs) in the alluvial deposits. Mussel shell, burned rock, and burned pecan shells were observed in this lenticular feature. Site 41YN448 is an open prehistoric site also exposed in the cutbank of the Clear Fork about 100 m south of 41YN447. This site exhibited an irregularly shaped burned zone with small quantities of burned sandstone and quartzite rocks. This burned zone was 150 to 210 cmbs in the alluvium. Site 41YN450 is a lithic scatter on the crest, side slopes, and toe-slopes of a distal terrace of the Clear Fork on the northern side, overlooking Gages Creek. Fifty-one flakes, three cores, three bifaces, mussel shell fragments, and a Castroville dart point were collected (Sanders et al. 1992). Site 41YN451 is a lithic scatter on a rock-strewn valley slope, southwest of 41YN450. The site was marked by chert flakes, mussel shells, burned rocks, and bifaces scattered across the slope. Site 41YN452 was identified as a lens of mussel shells exposed in the western facing cutbank of Gages Creek, west of the roadway. Site 41YN501 consists of the remains (metal trusses and cement piles) of the first bridge "Old Bridge 1" crossing over Gages Creek (Figure 1-2).

Figure 1-2. "Old Bridge 1" (41YN501) Crossing Gages Creek Adjacent to Site

Price (2005) and Abbott (2005) identified only prehistoric sites 41YN450 and 41YN452 (Root-Be-Gone) as likely to be directly impacted by the proposed new bridge construction activities at Gages Creek. These two sites are elaborated upon in the present report.

Site 41YN450 is primarily an upland, open site, estimated to cover 14,880 meters square (m^2) at an elevation of 332 m (1,090 ft.). It was recorded as a Late Archaic lithic scatter that lacked any observable burned rock (Sanders et al. 1992:109). No cultural features were observed during the survey. Two shovel tests were excavated into the deposits, neither of which yielded cultural materials.

Site 41YN452 consists of a mussel shell lens with associated burned rocks and scattered burned rocks that are about 40 cmbs in the

Gages Creek cutbank. The estimated size of the buried site was 2,800 m^2 at an elevation of 320.2 m (1,050 ft.) amsl (Sanders et al. 1992:114). The observed artifacts consisted of some 42 pieces of debitage, two bifaces, mussel shell, faunal bone, and one Darl dart point. Four shovel tests were excavated into the alluvial deposits and all four yielded cultural materials (Sanders et al. 1992). This site was identified as one of the 52 sites in Group 3 sites, those sites in excellent condition with good research potential (Sanders et al. 1992).

In the South Bend Reservoir, Late Archaic sites were the most abundantly represented of any time period, comprising at least 22 percent of the total number of recorded sites. Fifty-four sites yielded Late Archaic diagnostic artifacts and/or radiocarbon dates (Sanders et al. 1992). Sanders et al. (1992) used the terms Early, Middle, and Late Archaic following the general central Texas Archaic chronology, since the Lower Plains region in which their work was conducted did not have a well-defined culture chronology. These authors generally followed Prewitt's (1981, 1985) chronology for Central Texas, with the Early Archaic dated to between 8500 and 4600 B.P., the Middle Archaic between 4600 and 2500 B.P., and the Late Archaic between 2500 and 1250 B.P. These periods are generally represented by diagnostic projectile points, but precise temporal bracketing is an ongoing task, as additional radiocarbon dates are added to the existing roster of dates across Texas. The following points types reflect the general Late Archaic period in the South Bend Reservoir: 2 Trinity, 6 Yarbrough, 35 Castroville, 9 Marcos, 6 Gary, 32 Ellis, 12 Palmillas, 60 Ensor, 3 Frio, 141 Darl (only 22 from the actual survey with the other 119 from private collections in the area), and 65 Godley. The Late Prehistoric period in the South Bend Reservoir is represented by the following list of arrow points: 138 Scallorn, 2 Cuney, 35 Young, 5 Bonham, 87 Harrell, 35 Fresno, 36 Perdiz, and 20 Cliffton.

During the South Bend Reservoir survey, mussel shells were observed on 250 (46 percent) of the prehistoric sites. From the samples collected, six taxa were identified including threeridge (*Amblema plicata*), mapleleaf (*Quadrula quadrula*), smooth pimpleback (*Quadrula houstonensis*), pistolgrip (*Tritigonia verrucosa*), fat mucket (*Lampsilis siliquoidea*), and pocketbook (*Proptera cf. purpurata*) (Sanders et al. 1992:231). These taxa were mainly restricted to the Clear Fork and its tributaries and are nearly absent from sites within the Brazos River drainage system. In contrast, only 90 (just under 17 percent) of the prehistoric sites yielded vertebrate remains. Bison (*Bison* sp) was represented at only two prehistoric sites (less than 1 percent) and deer bones were collected from four sites (Sanders et al. 1992:231).

As part of the South Bend Reservoir investigations, geomorphological investigations were conducted concurrently with the archeological survey (Sanders et al. 1992). The objectives of these investigations were to: 1) determine the number and distribution of late Quaternary terraces in the valleys of the Brazos River and its tributaries, 2) determine the number of Holocene alluvial fill units within the pertinent stream valleys, 3) describe and analyze the development of alluvial fans along the valley margins, 4) establish the relative and absolute numerical ages of terrace fills and alluvial fan deposits, and 5) determine the radiocarbon ages of buried soils in the Holocene deposits. The attainment of these objectives would provide the basis for predictive modeling of the locations of buried prehistoric sites.

Geomorphologic field investigations involved a reconnaissance level examination of exposed stream cutbanks and wall profiles in gravel pits, as well as a program of mechanical trenching and coring. Thirty trenches were excavated to a maximum depth of 3.5 m. Twenty continuous cores, either 5.0 or 7.6 cm in diameter, were extracted with a truck mounted Giddings Hydraulic Soil Probe.

Cross sections of the stream valleys (*N* = 4) were constructed from the collected data. One generalized cross section was constructed for the Clear Fork of the Brazos (Area 8) across from Eliasville. Area 8 was 500 to 800 m to the south, and a similar distance to the north of the bridge replacement project in the western part of the main Clear Fork valley. In Area 8, six cores, six trenches, and three cutbank exposures provided data with which to reconstruct the depositional sequence. This was found to contain a terrace sequence that included T_2, T_{1a}, T_{1b}, $T_{1c,}$ and T_0 surfaces. A short distance upstream from the bridge, a Gages Creek cutbank exposure (8-3) was described in the following manner:

> A paleosol (Soil 2) is mantled by a 1.27 m thick unit of fine-grained overbank deposits. An A-C soil profile is developed at the top of the upper unit. Soil 2 has a 30-cm-thick A horizon above a C horizon. A second buried paleosol (Soil 3) is 3.03 m below the terrace surface. Soil 3 has a cumulic Ak horizon above a Bk horizon. The 3Akb horizon is 2.31 m thick, dark brown (10YR 3/3, dry) in color, and clay loam in texture. A hearth (41YN313) is exposed at a depth of 137 – 1.42 m below the surface of the 3Akb horizon. Charcoal from this feature yielded a radiocarbon date of 2,790 ± 70 years B.P. (TX 5971), and humates from the upper 20 cm of the 3Akb horizon yielded an age of 1,770 ± 70 years B.P. (TX 6131). Hence, slow aggradation and concomitant soil development on the late-Holocene floodplain of Gage Creek spanned a period of about 1,000 years. Gage Creek downcut sometime after 1,700 B.P., leaving its late-Holocene floodplain as the T-1 terrace (Mandel 1992:73).

Below these terrace surfaces were multiple, stratigraphically layered buried soil horizons. Soils in trenches, cores, and cutbanks were described and micromorphological analyses were conducted on selected samples. Charcoal and bulk soil samples were collected and submitted for radiocarbon analysis (Mandel 1992). The radiocarbon dates were reported as uncorrected dates.

In a summary statement, Mandel (1992) states that based on soil evidence, the late Holocene sedimentation in small valleys was gradual, as evidenced by thick, cumulic A horizons in the T_1 fills. On the Clear Fork of the Brazos, the T_{1a}, the highest surface of the T_1 complex, accumulated sometime before 7430 B.P. Fill beneath the next lowest surface, the T_{1b}, accumulated between ca. 7500 and 1300 B.P. Mandel determined that soils developed at ca. 7400, 5000, 2300 to 2000, and 1700 to 1300 B.P. (Mandel 1992).

1.4.2 TxDOT Investigations at Gages Creek

In October 2005, Dennis Price, TxDOT staff archeologist; Jim Abbott, TxDOT staff geoarcheologist; and two assistants from the Environmental (ENV) Affairs Division of TxDOT conducted an intensive 100 percent archeological survey for a bridge replacement section, a new right-of-way section, and easement along Farm to Market road at Gages Creek crossing. They investigated several prehistoric sites in the immediate vicinity, including 41YN450 and 41YN452.

Three mechanical trenches were excavated at 41YN450 together with one 50-by-50 cm hand-excavated unit adjacent to one side of Backhoe Trench (BT) 1, near the middle of the APE. The trenches were monitored for cultural materials and part of the walls of each trench were scraped and picked to expose the soil horizons and inspect for cultural materials (Price 2005; Abbott 2005). The investigations determined that the northern end of the development area and site had been cut back and resculpted during previous construction activities. Cultural materials were scattered across the slope and were in a secondary context. Backhoe trench 1 was dug to 120 cmbs and revealed a dense clayey A-B1w-B2w-B3w-B4w soil profile with dispersed gravels and gravel stringers. The hand-excavated test unit yielded cultural materials from 20 to 100 cmbs. The cultural materials were vertically dispersed and exhibited two peaks in density, one at 50 to 60 cmbs and another from 80 to 90 cmbs. The latter peak was associated with numerous rounded, siliceous fluvial gravels. At about 95 cmbs in BT 1, a small cluster of two burned sandstone rocks, one mussel shell, one tertiary flake, and an area of decomposing wood was encountered and designated as Feature 1. No clear cultural zones were identified and no temporally diagnostic artifacts were recovered. No cultural materials were noted during the excavation of BT 2. Backhoe Trench 3 yielded cultural and colluvial materials in the A and B horizons, with minor concentrations at 40 and 65 cmbs. The cultural materials at 40 cmbs were in association with gravel stringers (Abbott 2005).

At 41YN452, two backhoe trenches were excavated into what was anticipated to be the T_1 terrace of the Clear Fork of the Brazos. No hand-excavations were implemented at that time. The two trenches (designated BT 4 and BT 5) revealed very similar profiles that reflect the same depositional sequence. Both trenches were excavated to 159 cmbs and revealed a Ap-A-Bw-2Akb-2Bkb profile developed in sandy clay loam to clay loam (Abbott 2005). Backhoe Trench 5 yielded relatively large quantities of cultural materials, whereas BT 4 yielded almost no cultural materials. The majority of cultural materials were observed in the buried A horizon between 60 and 90 cmbs. One unifacial tool was recovered from the upper Akb horizon at 90 cmbs. These cultural materials appeared to correlate to the mussel shell lens observed in the cut bank of Gages Creek west of the right-of-way. Following these investigations, TxDOT archeologists recommended significance testing within the proposed APE at both 41YN450 and 41YN452 to better determine the nature and integrity of the deposits and cultural periods represented (Price 2005), and ultimately, to assess the sites' eligibility for listing on the National Register of Historic Places (NRHP) and as State Archeological Landmarks (SAL; Price 2005).

1.4.3 TRC Eligibility Assessment of Sites 41YN450 and 41YN452

Under TxDOT Scientific Services Contract No. 575XX SA008, TRC received a Work Authorization to conduct eligibility assessment of two prehistoric sites, 41YN450 and 41YN452, both of which were to be directly impacted by the planned bridge replacement activities. In January 2006, TRC archeologists reviewed existing documentation on file at the THC and TxDOT to locate information on previous cultural resource investigations conducted and any previously documented archeological properties in the vicinity of the areas of potential effect. The previous survey results, conducted by Dennis Price (Price 2005) and James Abbott (Abbott 2005) of TxDOT ENV, were also consulted.

TRC's field methods for the 2006 eligibility assessment (TRC project 50907 [111522]) involved the mechanical excavation of three trenches on site 41YN450 and four trenches on site 41YN452 with the use of a Gradall® furnished by TxDOT (Matchen et al. 2006; Appendix G). These trenches were placed to expose and document the natural stratigraphy at each location and to permit identification of specific target locations for test units. Each trench was excavated to a depth of about 1.5 m below the surface using a 1.75 cm wide bucket, and the trenches varied in length from 5 to 10 m. Trench placements were located arbitrarily so as to sample the long, narrow development zone parallel to the existing roadway, although the buried water pipeline within and along the western margin of the proposed new right-of-way in 41YN452 posed a potential hazard that influenced trench placement. Several 50-by-50 cm hand-excavated units were placed on the sides of selected trenches to sample the top 150 cm of Holocene deposits and to determine the vertical positions and frequency of cultural material by 10 cm arbitrary levels. A buried paleosol, or A horizon, was visible in all trenches. In all instances, clustering of cultural materials was observed to be within this buried paleosol. When clusters of cultural materials were found in the trenches, 1-by-1 m units were established to target these clusters/features for more fine-tuned investigation to follow. To expedite the recovery and concentrate efforts on cultural materials within the buried A horizon, the largely noncultural deposits above the buried A horizon were removed by the Gradall®. This created a working platform below the original ground surface to explore the clustered materials. Discussion of the trenches and units involved in each of the two sites is presented below by site.

1.4.4 Site 41YN450

Trenches 1, 2, and 3 were excavated in October 2005 during the investigations conducted by TxDOT archeologists Dennis Price and James Abbott (Figure 1-3). When TRC began the eligibility testing in January 2006, the trench numbering sequence began with Trench 4 and continued through Trench 6. Additionally, three 50-by-50 cm and one 1-by-1 m units were hand-excavated in the proposed new right-of-way, and a 50-by-50 cm unit and more 1-by-1 m units were excavated across the APE west of the existing roadbed.

These investigations yielded both horizontally and vertically scattered cultural materials that included chert flakes, chipped stone tools, bones, burned rocks, mussel shells, and charcoal, but diagnostic artifacts were not discovered during hand-excavations (Matchen et al. 2006; Appendix G). A single bison bone (#143-2-2a) from 43 cmbs in Unit 5 at Trench 5 was radiocarbon dated, yielding a $\delta^{13}C$ adjusted date of 430 ± 40 B.P. (Beta-230772). This places bison in the region during the Late Prehistoric period, and although it is difficult to directly associate the other scattered cultural materials to this particular period, some of the recovered cultural materials could pertain to this temporal interval.

In general, the cultural materials were recovered from various subsurface vertical zones at different locations across the tested area. This apparent elevational difference indicates that there were multiple occupational events across the area. Near the southern end, Units 3 and 4 yielded very sparse and widely dispersed cultural materials, mostly from a buried A horizon 60 to 90 cmbs. Unit 2 at the northern end and Unit 5 toward the northern half yielded vertically dispersed cultural materials within the top 70 cmbs and at 60 cmbs, respectively. These materials were in the apparently modern A horizon. In Unit 1, towards the middle of the APE, major peaks of material were at 50 to 70 cmbs and again at 80 to 90 cmbs (Abbott 2005).

The materials in the latter peak appeared intermixed with colluvial deposits, leading to uncertainty as to how to distinguish between *in situ* cultural materials from those that might have been redeposited by colluvial action. A dispersed cluster of artifacts, burned rocks, and mussel shells were observed in Trench 1. No other intact features were encountered.

TRC recommended that site 41YN450 was not eligible for listing on the National Register of Historic Places under Criterion d or designation as an SAL on the bases of a) limited quantities of cultural artifacts, b) a lack of well-defined cultural features, c) an absence of diagnostic artifacts from the excavations, d) a near absence of chipped stone tools, and e) the generally poor context of the materials recovered. This site did not appear to contain sufficient numbers of artifacts pertaining to any one material class to provide sufficiently robust data for meaningful interpretations.

The probable mixing of cultural materials with colluvial deposits also limits the reliability of any interpretations of those materials. The vertical dispersion was sufficient to preclude definition of isolable

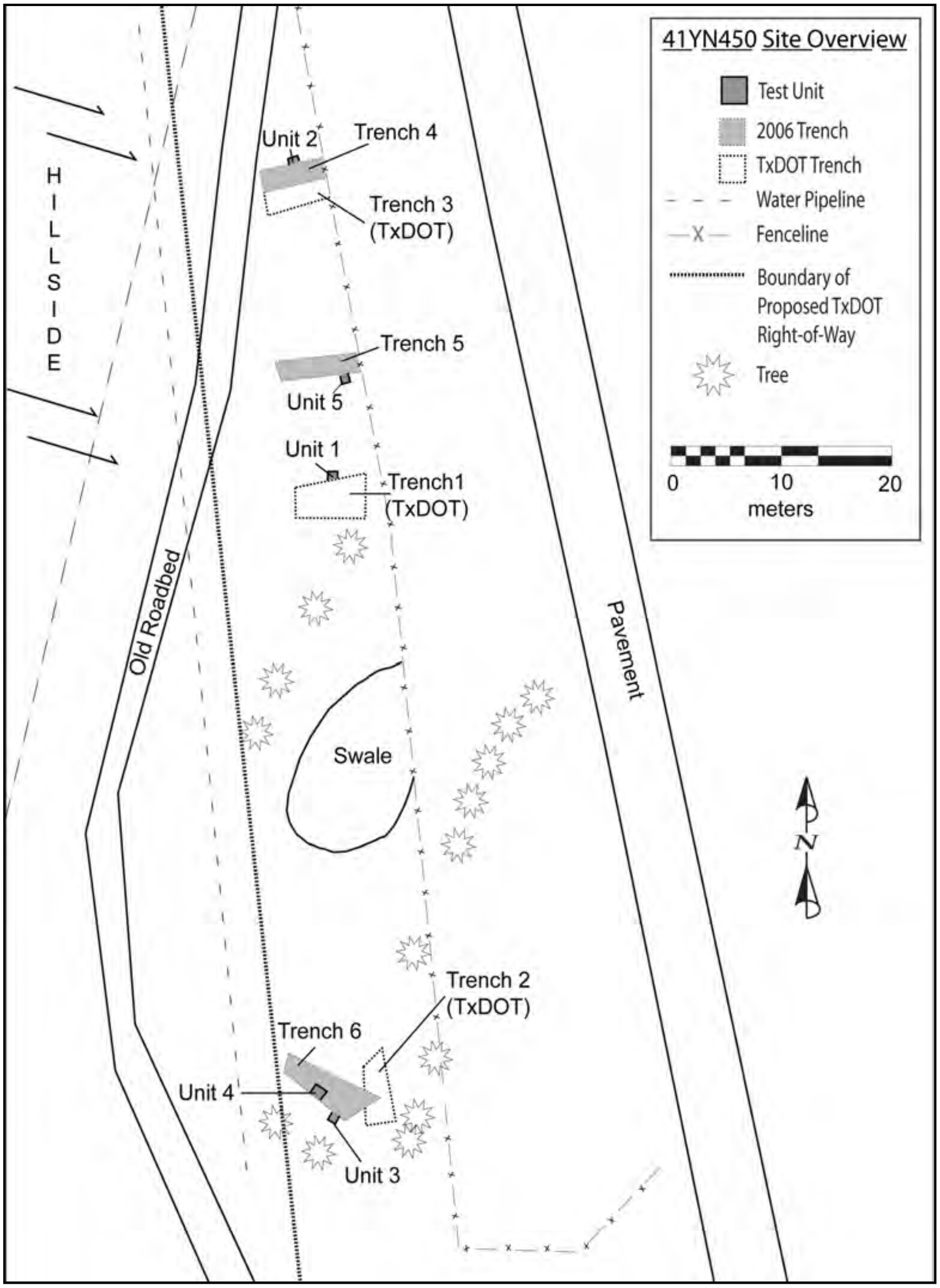

Figure 1-3. Plan Map of 41YN450 Showing Locations of Areas Investigated During Eligibility Assessment

components (e.g., episodes of occupation), such as would yield useful data on temporally discrete cultural patterns and on-site activities. The Texas Historical Commission and TxDOT concurred that this site did not warrant listing on the National Register, or as an SAL, and no further archeological investigations were proposed for 41YN450.

1.4.5 Site 41YN452

Trenches 1 and 2 were excavated during the fall of 2005 by TxDOT archeologists. Price

(2005) and Abbott (2005) referred to these as Trenches 4 and 5, and considered these activities to be a continuation of work done at 41YN450 where Trenches 1, 2, and 3 were excavated. TRC approached this project with the idea that the efforts at 41YN450 and 41YN452 were separate, and conceptualized the work at each site as a separate field effort. Therefore, these two trenches were renumbered as Trenches 1 and 2. TRC began its site evaluations by excavating additional backhoe trenches that were numbered as Trenches 3 through 6 (Figure 1-4).

Following the mechanical excavation of Trenches 3 through 6, five 50-by-50 cm units (Test Units 1 through 4, and 9) and six 1-by-1 m units (TUs 5 through 8, 10 and 11) were hand-excavated along the entire length of the APE. The 50-by-50 cm units, totaling 1.88 m^3, were intended to sample the top 150 cm of Holocene deposits exposed by the trenches. Following the excavation of the 50-by-50 cm units, the six 1-by-1 m units, totaling 2.9 m^3, were placed in specific areas that appeared to have high potential for the recovery of cultural materials observed in trench profiles or exposed by the 50-by-50 cm units. The initial 50-by-50 units revealed that the majority of cultural materials were within the aforementioned buried A horizon. Therefore, overlying sediments were stripped to the top of the buried A horizon, at which point hand-excavation proceeded in the 1-by-1 m units. Figure 1-4 depicts the horizontal placement of the trenches, the 50-by-50 cm units, and the 1-by-1 m units across the APE in relation to the current highway pavement.

Trench 3 was excavated in two parts, with the north-south trending fenceline between the two perpendicular trenches that formed an "L" shape. Trench 3 was about 7 m south of Trench 1 (originally Trench 4, as designated by Price [2005] and Abbott [2005]). The east-west section was positioned about 1 m east of the flagged waterline in the proposed new right-of-way. However, as trench excavation began, the 7 cm diameter plastic water line was encountered at the western end of the trench. The plastic pipe was not breached and investigations proceeded carefully to the east toward the fenceline. The fenceline was left intact, as the landowner had cattle in the area. This east-west section was 5 m long, 175 cm wide and 1.5 m deep. A 50-by-50 cm unit (Unit 2) was excavated towards the middle of the trench on the southern side. A burned rock and mussel shell concentration was observed on the northern side of the trench within the buried A horizon. The top of the A horizon began at about 60 cmbs. Subsequently, a 1-by-2 m area on the northern side of the east-west trench was stripped down to the top of the buried A horizon, just above the cultural materials exposed in the trench wall. Units 7 and 8, both 1-by-1 m, were placed side-by-side over the concentrated materials toward the middle of the buried A horizon to recover a sample of artifacts. These units were excavated by hand to 110 cmbs.

On the opposite, eastern side of the barbed wire fence that marks the current TxDOT right-of-way, a north-south section of Trench 3 was excavated. This section was about 7.5 m long by 175 cm wide by 150 cm deep. A cluster of three burned rocks in the buried A horizon was observed in the eastern wall towards the northern end. Again, the Gradall® was employed to remove the sediments above the buried A horizon at 60 cmbs, just above the observed cluster of burned rocks. Units 5 and 6, both 1-by-1 m in size, were placed side-by-side over this cluster and hand-excavated through the buried A horizon deposits to 100 cmbs. The burned rock cluster was designated as Feature 1.

Trench 4 was also excavated in two parts, separated by the north-south fenceline, which, as mentioned previously, created in an L- shaped trench. Trench 4 was positioned roughly 10 m south of the north-south section of Trench 3 (Figure 1-4).

The east-west section was excavated on the western side of the barbed wire fence in the proposed new right-of-way, perpendicular to the fenceline. Trench 4 was roughly 4 m long, 175 cm wide, and 150 cm deep. Caution was taken during the mechanical excavation to avoid impacting the buried waterline, which was not encountered in Trench 4. Unit 3, 50-by-50 cm, was hand-excavated from the surface to 150 cmbs on the northern side of the east to west section.

The north-south portion of the L-shaped Trench 4 was on the opposite side of the current fenceline, within the right-of-way and parallel to the pavement (Figure 1-4). This section measured 9 m long by 175 cm wide and 150 cm deep. Unit 9, a 50-by-50 cm unit, was hand-excavated from the surface to 150 cm deep on the western side of the trench. No concentrations of cultural material were observed in either section of Trench 4.

Trench 5 was excavated within the current right-of-way about 13 m south of the north-south section of Trench 4. This position was estimated to lie about 3 m south of Trench 2 (originally designated as Trench 5 by Price [2005] and Abbott [2005]). Trench 5 measured 6 m long by 175 cm wide and 150 cm deep. The buried A horizon was again observed at about 60 cmbs. No concentration of cultural debris was visible in the trench walls. An area on the eastern side was selected, and sediments above the A horizon were removed down to about 55 cmbs. Unit 10, a 1-by-1 m unit, was hand-excavated through the buried A horizon to 110 cmbs.

Trench 6 was positioned parallel to the highway, towards the western edge of the current right-of-way about 13 m south of Trench 5. It measured 10 m long by 175 cm wide and 150 cm deep. The buried A horizon was again visible in the trench walls. Scattered mussel shell fragments and burned rocks were observed throughout the profiles. Unit 4, a 50-by-50 cm unit, was hand-excavated from the surface to 150 cmbs. During the trench excavations, a concentration of mussel shells about 50 cm in length was encountered towards the southern end, at which point mechanical excavation was halted. An unknown amount of this concentration was removed by the Gradall®. Unit 11, 1-by-1 m, was hand-excavated to more precisely define this shell concentration. This unit was excavated from roughly 40 cmbs downward to 80 cmbs. The shell concentration was designated as Feature 3.

In summary, the NRHP eligibility testing at the Root-Be-Gone site (41YN452) yielded cultural materials concentrated within a 30- to 40-cm thick buried A horizon detected across the entire APE. This A horizon is well-buried under, and sealed by, at least 50 cm of overlying alluvium that had preserved and protected the contextual integrity of the A horizon and its inclusive cultural materials. Previous road construction activities missed the buried A horizon within the current right-of-way. The cultural component within the A horizon reflected a very limited time period, documented at roughly 750 years B.P., based on the two wood charcoal radiocarbon dates obtained from Feature 1. So, this buried cultural component appeared to have potential to yield significant information concerning cultural patterns during the Terminal Archaic.

The cultural materials recovered, such as the intact heating element (Feature 1) and the two thin mussel shell concentrations (Features 2 and 3), as well as lithic debitage, chipped stone tools, burned rocks, and faunal bone fragments, indicate that this locality apparently served as a short-term habitation site. A few horizontally and vertically discrete activity areas appeared to be represented across this nearly 100 m long APE. This buried, intact, and apparently single component, radiocarbon dated to a specific time period, provided an excellent opportunity to investigate intrasite behavioral patterns.

Further excavations of these identified cultural remains seemed warranted, as it was apparent that they would provide data with which to address a variety of research issues such as intrasite utilization of space for on-

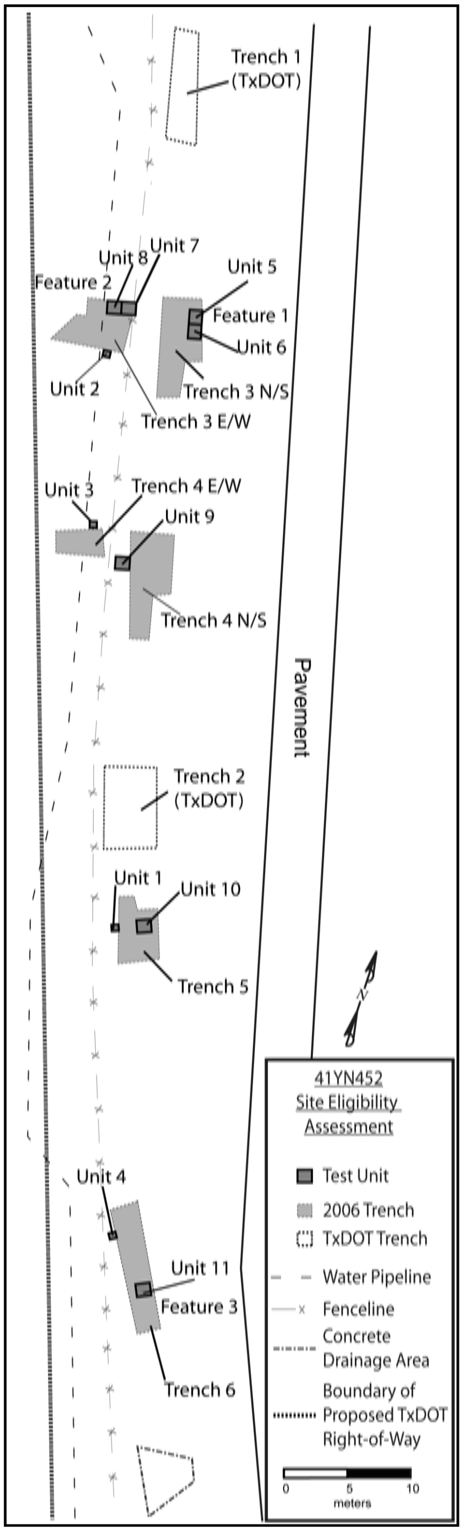

Figure 1-4. Plan Map of 41YN452 Showing Locations of Areas Investigated During Eligibility Assessment

site activities, resource-processing procedures, and subsistence patterns.

Not only is this Terminal Archaic cultural component important for its potential to elucidate the nature of activities at a Terminal Archaic campsite, but the buried A horizon that contains these cultural materials also was in a sealed depositional context that could provide environmental information. Data obtained from analyses of phytoliths, carbon and nitrogen isotopes, and other microfossils in the buried A horizon and immediately overlying and underlying sediments could be used to address questions concerning the environment in which the prehistoric human occupants of the site were operating.

The cultural component within the buried A horizon might shed light on the age and functions of an open campsite during this specific time period for the poorly known and investigated southern Rolling Plains region of northern Texas, which has been subjected to very limited excavation and analysis. Excavations at this site would allow for comparisons with other excavated Late Archaic sites in the central Texas and north-central Texas regions, to determine if human adaptations were similar across these regions, or alternatively, show definable differences according to environmental variability. For these reasons, TRC recommended that site 41YN452 be eligible for listing on the National Register of Historic Places under Criterion D and/or designation as an SAL (Matchen et al. 2006), an assessment with which THC and TxDOT concurred.

1.5 CONTENTS OF REPORT

Following this introductory chapter, Chapter 2.0 presents an overview of the environmental setting for Young County and the surrounding region. Chapter 3.0 presents a regional overview of the Late Archaic period for north-central Texas, central Texas and the Rolling Plains to the west. Chapter 4.0 is the final version of the data recovery research design that guided and directed the analyses and discussions of findings at the Terminal Archaic component at the Root-Be-Gone site.

Chapter 5.0 describes field and laboratory methods, and the technical analytical procedures implemented following fieldwork. Chapter 6.0 presents the comprehensive information concerning the Root-Be-Gone site in a few sections that deal with the natural stratigraphy of the site, followed by the presentation of the cultural stratigraphy and the inclusive artifacts, and radiocarbon dates. Once the cultural stratigraphy is defined, there is a discussion of how recovered materials pertain to definable, isolable cultural components. The cultural assemblages assigned to each component are described and discussed according to identifiable classes of materials.

Chapter 7.0 addresses the six individual research questions presented in Chapter 4.0. These discussions combine the information derived from the analyses of the different artifact classes and from technical analyses. Chapter 8.0 presents recommendations following the data recovery program. Chapter 9.0 is a list of references cited throughout the document, and Chapter 10.0

is a glossary of technical terms used in this document that may not be familiar to all potential readers. These are bound as volume I.

Volume II includes 11 appendices, A through K, accompany this report and provide detailed data generated by technical experts who served as consultants to TRC on this project. Appendix A is a presentation of the radiocarbon laboratory reports on assays performed on each sample. Starch grain analysis, preformed on a suite of materials including burned rocks by Dr. Linda Perry, is discussed in Appendix B. The results of high-powered use-wear analyses conducted on the stone tools by Dr. Bruce Hardy are presented in Appendix C. Appendix D by Dr. Phil Dering presents the findings and interpretations of the macrobotanical information. Appendix E by a discussion of phytolith analyses by Dr. Byron Sudbury. Dr. Barbara Winsborough presents her findings and interpretations of diatom analysis in Appendix F. Appendix G presents the eligibility assessment report concerning sites 41YN450 and 41YN452 that preceded the data recovery investigations. Appendix H, by Dr. Mary Malainey and Mr. Timothy Figol, presents findings obtained through lipid residue analysis. Appendix I presents the pollen presence and/or absence findings by Dr. Bozarth, which prompted further phytolith work during subsequent data analysis. Appendix J presents the aging and seasonality estimations on fish otoliths by Dr. Robert A. Ricklis. Finally, Appendix K contains numerous tabulations of data, predominantly related to chipped stone tools and mussel shell analyses.

2.0 ENVIRONMENTAL SETTING

J. Michael Quigg and Paul M. Matchen

2.1 PHYSIOGRAPHY

The project area is in the southernmost margin of Young County, which is in north-central Texas (Figure 2-1). The region lies within the broader Central Lowlands of the Interior Plains and is often referred to as the Osage Plains (Fenneman 1931). This region occurs across a limited part of north-central Texas and extends up through the central part of Oklahoma and most of eastern Kansas. Sometimes this same region is referred to as the North-Central Plains (Bureau of Economic Geology-Map 1996). This region was originally dominated by tallgrass prairie with scattered groves of blackjack oak (*Quercus marilandica*) in the uplands and along drainages.

This Osage Plains region is the transition from the shortgrass plains to the west, which transitions into savanna and the forest regions to the east. The topography of the Osage Plains began forming during the Cretaceous period when a shallow continental sea covered the region, depositing carbonate rocks.

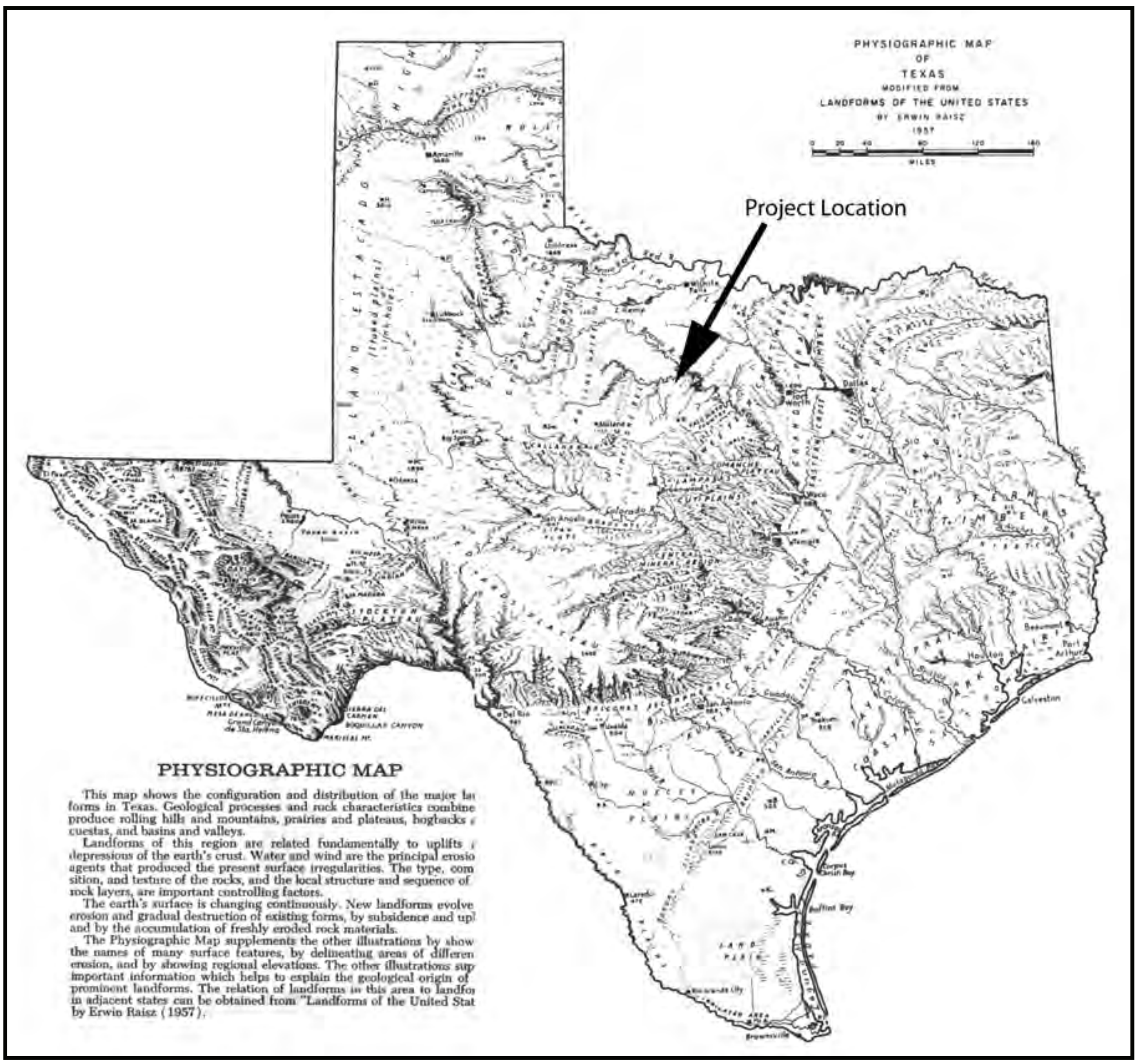

Figure 2-1. Physiographic Map of Texas (After Raisz 1957)

More sediments washed into the region from the Rocky Mountains during the Tertiary. The region remained relatively flat with gently rolling hills and plateaus. The average relief is between 91 and 152 m (300 and 500 ft.), although the incised river valleys and low hills and plateaus make this seem even greater.

2.2 GEOLOGY

Young County reveals a diverse series of surficial geological formations that developed over time (Figure 2-2). The southeastern third of the county, from just north of Graham, is primarily Pennsylvanian in age represented primarily by the undivided Thrifty and Graham formations (Barnes 1972, 1987). These formations are characterized by mudstones, shale, sandstone, and limestones. Immediately surrounding 41YN452 and just west, north, and east of the Clear Fork, is Avis Sandstone (IPa). Avis Sandstone is characterized by brown, fine-grained to very coarse-grained, with lenses of chert pebble conglomerate locally at the base of channel fill deposits. These sandstones vary in thickness from 3 to 9 m (10 to 30 ft).

Most geological deposits surrounding Possum Kingdom Lake in the adjacent Palo Pinto County are Pennsylvanian in age, but represent mostly the undivided Palo Pinto and Mineral Wells formations (Barnes 1972).

The northwestern two thirds of Young County are primarily Permian in age with multiple formations. The area just northwest of the site is dominated by the

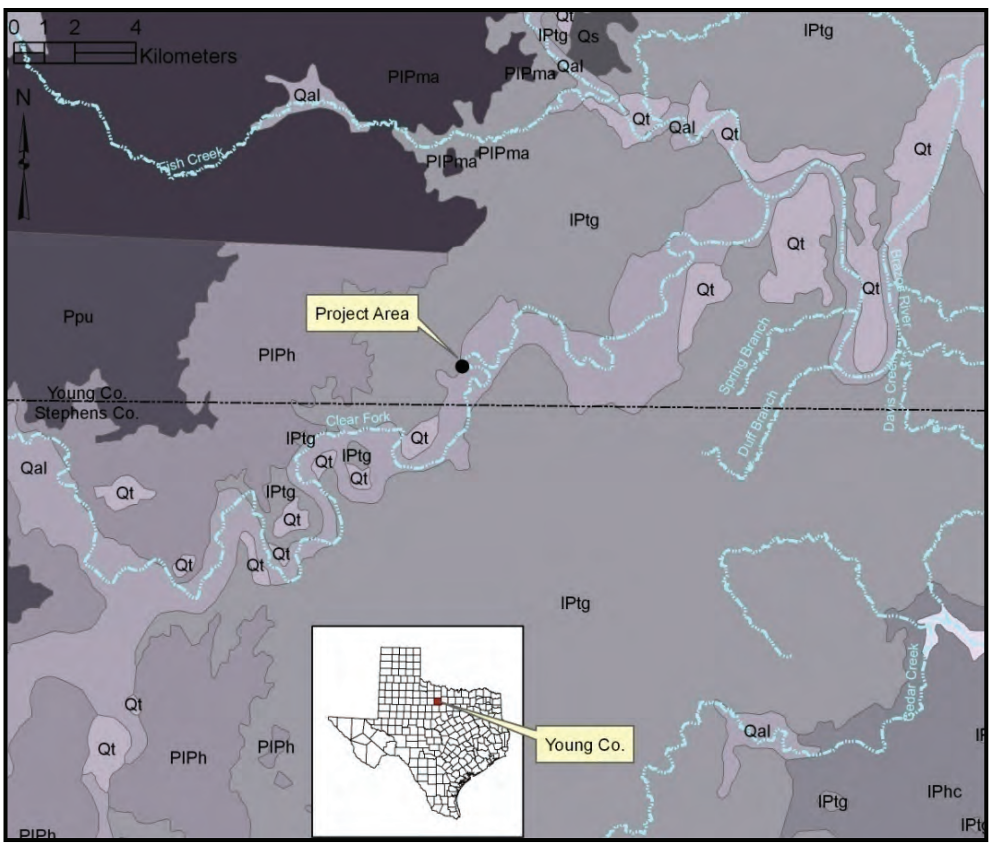

Figure 2-2. Geological Formation in and Surrounding Young County. Note: Qt is Pleistocene fluvial terrace deposits, Qs is Quaternary sands, Qal is Holocene alluvium, PIPh is Lueders Formation and Hoods Creek Limestone, Ppu is Petrolia (new) Formation, IPtg is Talpa Formation limestone with gravel, IPhc is Home Creek limestone, PIPma is Lueders Formations and Maybelle Limestone.

Pueblo (revised), Harpersville (revised), and Markley formations (Barnes 1987). These formations are characterized by sandstone and mudstones, with some scattered conglomerates. The sandstones are of various colors and textures (Barnes 1987). An important aspect of the Markley Formation is the presence of discontinuous seams of subbituminous coal (Newcastle Coal). A short distance north of the site, on top of the valley, is an area of Pleistocene fluvial terrace deposits (Qt2) that are gravels.

The Lower Cretaceous period, often represented by the Edwards limestone, Comanche Peak limestone, and Walnut formations, is not mapped in the immediate vicinity. These formations are much further south in Erath County. The Paluxy, Glen Rose, and Twin Mountain formations are not present either. These chert bearing formations are much further to the south in Eastland County and southwest in Callahan and Taylor counties. Consequently, there are no immediate outcrops of Edwards chert in the vicinity of the site.

The major river valleys contain numerous fluvial terrace deposits with pockets or limited areas of Pleistocene gravel deposits mapped as Qt1. These deposits can be found along the Clear Fork of the Brazos River and many of its tributaries. In the immediate vicinity of this site is Holocene alluvium (Qal) from the Clear Fork of the Brazos River. Gages Creek cuts through the alluvium deposited by the Clear Fork.

2.3 SOILS

Generally, the soils across the region are Alfisols, Mollisols, Entisols, and Inceptisols. The Alfisols range from red to yellow and occupy areas of gentle or rolling relief. These soils were formed over sandstone bedrock and in the sandy alluvium. The well developed Mollisols range from reddish brown to grayish brown and occur on gentle and/or flat relief. The Entisols and Inceptisols also vary from reddish brown to grayish-brown and are found on low floodplains and/or areas of greatest relief (Dyksterhuis 1948). The Mollisols are associated with calcareous bedrock.

A majority of the sediments in this area have been deposited within the last 10,000 years by the Clear Fork of the Brazos River in the form of clays, loams, and silts. The Clearfork and Wheatwood map unit makes up about 1 percent of the county (Figure 2-3). The Clearfork soils (CkA) account for about 49 percent of the region, with the Wheatwood soils (WeA) and soils of minor extent accounting for nearly 39 percent and 12 percent, respectively. Clearfork soils are moderately slowly permeable and very deep (Cyprian 2009). Wheatwood soils are moderately permeable and very deep. Clearfork and Wheatwood soils are developed on flood plains and are occasionally flooded. Clearfork soils typically have a surface layer of reddish brown silty clay loam. The subsoil is dark reddish gray and reddish brown silty clay loam. Wheatwood soils typically have a surface layer of light brown loam. The subsoil is brown, light brown, or reddish yellow loam, clay loam, and fine sandy loam. The Wheatwood series are very deep, nearly level, well drained soils on river valleys and flood plains. These soils are moderately permeable (Cyprian 2009). They formed in calcareous loamy alluvium and slope ranges from 0 to 1 percent. The soils are fine-silty, mixed, active, and thermic fluventic haplustepts.

The following is a typical soil profile for Wheatwood loam documented by the Natural Resource Conservation Service (NRCS) located approximately 3 kilometers (km) north of 41YN452 in rangeland (Cyprian 2009).

> Ap—0 to 15.24 cm (0 to 6 in); light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; many fine, medium and few coarse roots; few fine and medium tubular pores; strongly effervescent, moderately alkaline; clear smooth boundary.

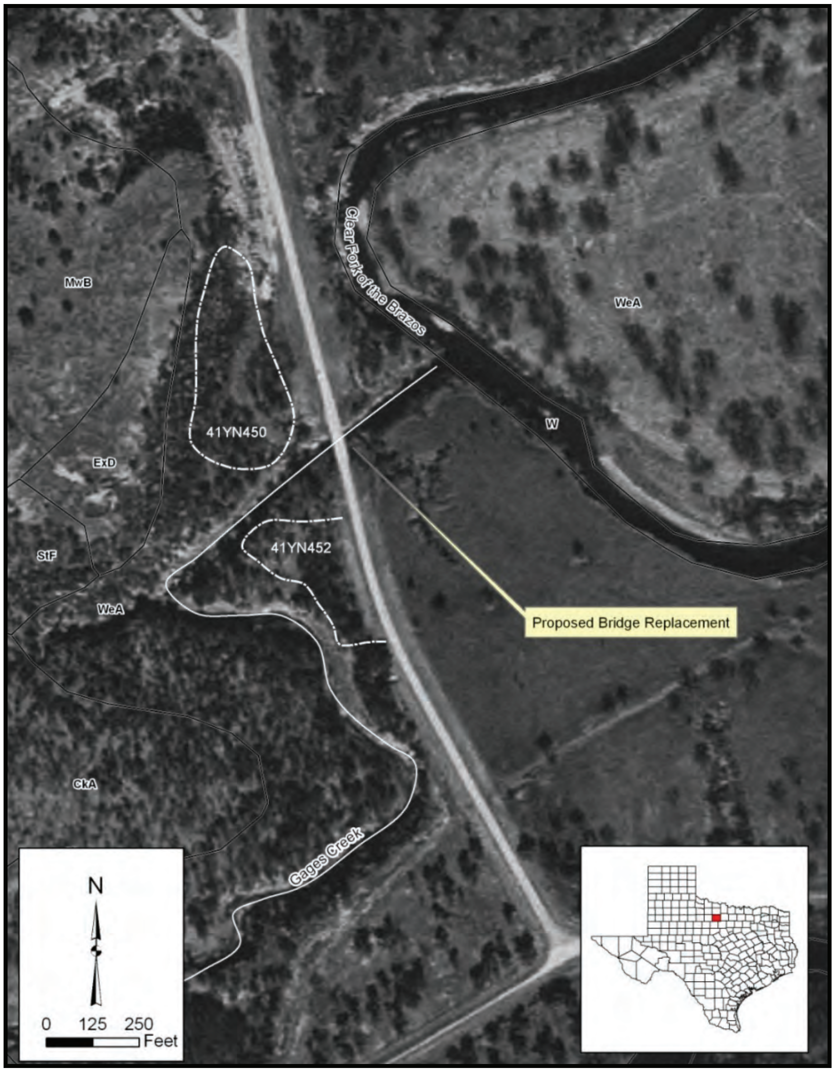

Figure 2-3. Soils Map for APE and Surrounding Area

Note: Clearfork soil is CkA, Wheatwood soil is WeA, Minwells soil is MwE, Water is W, Exray-Loving soil is ExD, and Shatruce gravel is StF. Soils from United States Department of Agricultural, Natural Resources Conservation Service.

Bw—15.24 to 35.6 cm (6 to 14 in); light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable; many fine, medium and few large roots; few fine and medium tubular pores; few wormcasts; strongly effervescent; moderately alkaline; clear smooth boundary.

Ab—35.6 to 58.4 cm (14 to 23 in); brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable; common very fine, fine and few medium and large roots; many fine and few medium pores; few films and threads of calcium carbonate; strongly effervescent; mod-erately alkaline; clear smooth boundary.

Bk1—58.4 to 94 cm (23 to 37 in); light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable; many fine and few medium roots; many fine and few medium pores; few thin clay films on some ped surfaces; common films and threads of calcium carbonate; common wormcasts; few discontinuous thin strata (less than 1.3 cm) of weak red (2.5YR 4/2) very fine sandy loam; strongly effervescent, strongly alkaline; gradual smooth boundary.

Bk2—94 to 129.5 cm (37 to 51 in); light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable; many fine and few medium roots; many fine and few medium pores; common films and threads of calcium carbonate; common wormcasts; few discontinuous thin strata (less than 1.3 cm) of weak red (2.5YR 4)

Bk3—129.5 to 180.3 cm (51 to 71 in); light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, very friable; many fine and few medium roots; many fine and few medium pores; few thin clay films on some ped surfaces; common films and threads of calcium carbonate; common wormcasts; few discontinuous thin strata (less than 1.3 cm) of weak red (2.5YR 4/2) very fine sandy loam; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk4—180.3 to 203.2 cm (71 to 80 in); reddish yellow (7.5YR 6/6) very fine sandy loam, strong brown (7.5YR 5/6) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; few very fine and fine roots; many/2) very fine sandy loam; strongly effervescent; strongly alkaline; gradual smooth boundary.

The solum thickness ranges from 152.4 to 203.2 cm (60 to more than 80 in.). The 25.4 to 101.6 cm (10 to 40 in.) control section is loam, silt loam, silty clay loam, and clay loam with 20 to 35 percent clay. Thin stratification of very fine sandy loam is common below a depth of 50.8 cm (20 in.).

The A horizon has a hue of 5YR or 7.5YR. The Bw and Bk horizons have hue of 5YR or 7.5YR. The BC or C horizons, where present, have hue of 5YR or 7.5YR. The C horizon is weakly structured, structureless, or stratified with textures that range from very fine sandy loam to silty clay loam.

Soils that make up a minor portion of the composition include Gageby, Gowen, Grandfield, Harpersville, Lincoln, Padgett, Owens, and Westola. Gageby and Gowen soils have a dark colored surface layer and are on flood plains of small tributaries. Grandfield soils are on terraces and have a layer of clay accumulation. Lincoln and Westola soils are sandier. Padgett soils have shrink swell properties. Owens and Harpersville soils are underlain with shale and are across the uplands. The soils in this map unit are currently used mainly as cropland and pasture.

In a summary statement concerning the work Mandel (1992) did for the surrounding South Bend Reservoir survey, he states that based on soil evidence, the late Holocene sedimentation in small valleys was gradual, as evidenced by thick, cumulic A horizons in the T_1 fills. On the Clear Fork of the Brazos, the T_{1a}, the highest surface of the T_1 complex, accumulated sometime before 7430 B.P. Fill beneath the next lowest surface, the T_{1b}, accumulated between ca. 7500 and 1300 B.P. He determined that soils developed throughout the Holocene at 7400, 5000, 2300 to 2000, and 1700 to 1300 B.P. (Mandel 1992). Hall (1977, 1990) has identified a regional paleosol that dates to roughly 1000 B.P. that encompasses this region. Low rates of sedimentation have also been identified by Ferring (1982, 1986), beginning about 2000 B.P. and lasting for roughly 1,000 years for this region. This buried A horizon appears to be wide spread and reflects a regional soil and stratigraphic marker, which has been referred to by several names in the literature including the West Fork Paleosol (Ferring 1986), the Navarro Paleosol (Bruseth et al. 1987), the Caddo Paleosol (Ferring 1982), and possibly the Copan Soil (Hall 1977).

2.4 PRESENT CLIMATE

Young County has a modern climate that is dry and subhumid with long, hot summers and short, mild winters. The characteristically humid, subtropical climate is influenced primarily by the tropical Maritime air masses from the Gulf of Mexico. Winters are often modified by polar air masses with tropical Maritime air masses dominating the rest of the year. The average annual total precipitation is about 78.7 cm (31 in.). Of this, about 58.4 cm (23 in.), or 72 percent, usually falls in April through October (Figure 2-4).

The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 20.8 cm (8.22 in.) at Graham on October 13, 1981. Thunderstorms occur about 50 days each year, and most occur in May. The average seasonal snowfall is about 7.6 cm (3.0 in.). The greatest snow depth at any one time during the period of record was 20.3 cm (8.0 in.) recorded in February 1895 and 17.8 cm (7.0 in.) in March 1989. On an average, there are no days in the year that have at least 2.54 cm (1 in.) of snow on the ground. The heaviest 1-day snowfall on record was 22.4 cm (8.8 in.) recorded on December 15, 1932. The average relative humidity in mid-afternoon is about 51 percent. Humidity is higher at night, and the average at dawn is about 82 percent. The sun shines 80 percent of the time in summer and 60 percent in winter. The prevailing wind is from the south-southeast.

In winter, the average temperature is about 6.7 degrees (°) Celsius (C) (44° Fahrenheit [F]) and the average daily minimum temperature is about -1.1°C (30°F). The lowest temperature on record, which occurred at Graham on December 23, 1989, is -22°C (-8°F). In summer, the average temperature is about 27.8°C (82°F) and the average daily maximum temperature is about 35°C (95°F). The highest temperature, which occurred at Graham on August 11, 1936, is 47.2°C (117°F).

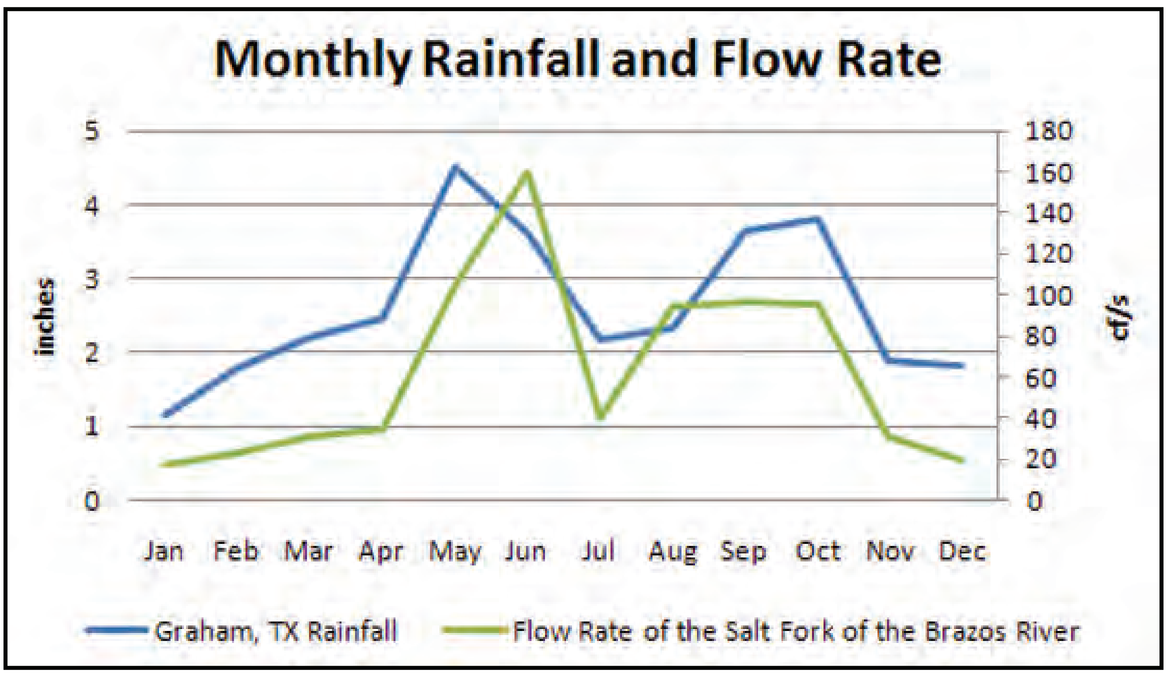

Figure 2-4. Graph of Monthly Rainfall and Flow Rate in Project Area

2.5 HYDROLOGY

The project is on Gages Creek, just 100 m upstream from its confluence with the Clear Fork of the Brazos River (Figure 2-5). Gages Creek begins in southwestern Young County, and runs nearly straight southeast for 6.4 km (4 mi.) to its mouth on the Clear Fork of the Brazos River, near Eliasville. This small tributary traverses flat terrain with local shallow depressions. As it enters the Clear Fork valley, it is deeply incised into the broad valley alluvium of the Clear Fork (Figure 2-6).

The Clear Fork of the Brazos River drains primarily eastward from its headwaters in Fisher, Nolan, and Taylor counties. Parts of its headwaters are along the northern side of the Callahan Divide, a major outcrop of Cretaceous rocks that contains the well known Edwards chert. The Clear Fork flows some 290 km (180 mi.) across the Rolling Plains and then jogs northward where it joins the Double Mountain Fork of the Brazos River in southern Young County. The upstream section of the Clear Fork in Jones, Shackelford, Throckmorton, and Stephens counties is characterized by muddy water, steep banks, and low overhanging trees. The flood plain generally is utilized for farming and ranching, but these activities are not normally noticeable from river level because of steep banks. Primarily, the Clear Fork lacks major reservoirs, although small tributaries that flow into the Clear fork, such as the Paint Creek in Haskell County (Lake Stamford), have small reservoirs that limit the flow downstream. Thus, flows are being regulated today. Except during periods of heavy rainfall, the river moves slowly.In one location, a series of dangerous stair-stepped falls exist where the water flows over two rock ledges, about 6 m (20 ft.) in height. These falls would require a portage (www.tpwd.state.tx.us/publications/may 28, 2010).

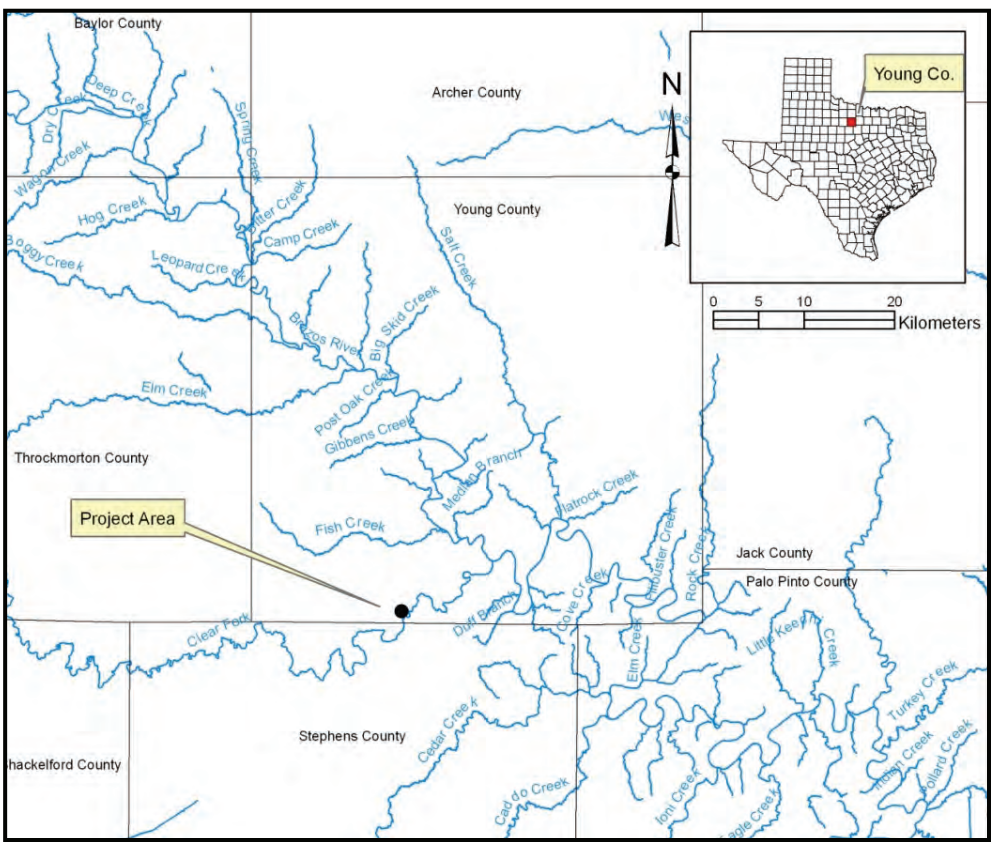

Figure 2-5. Rivers and Streams Surrounding the Project Area.

Figure 2-6. Current Gages Creek Channel Adjacent to 41YN452

The Salt Fork of the Brazos River drains the more northern section of the Rolling Plains, with its headwaters in Crosby, Kent and Stonewall counties with waters coming off the Llano Estacado and along the eastern Caprock. The main stream of the Brazos River is formed in northeastern Stonewall County by the confluence of the Salt and Double Mountain Forks. As the name implies, natural salt pollution occurs in the upper reaches of the Salt Fork. These waters flow primarily southeast for roughly 280 km (174 mi.) to join with the Double Mountain Fork in Stonewall County. The Salt Fork is intermittent and very shallow at normal water levels. Meandering across a wide stream bed, which contains many large sand bars, the Salt Fork usually has insufficient water for recreational use unless heavy rains cause a rise. Some small tributaries to the Salt Fork, such as Millers Creek in western Haskell and southwestern Baylor counties, presently contain small reservoirs (Millers Creek Reservoir), which control water flow. During heavy rains, flash floods are common. Water during these periods is normally muddy and contains high concentrations of salty, brackish minerals. The confluence of the Clear Fork and Brazos is just a few kilometers downstream from the project area, and a few kilometers west of Possum Kingdom Reservoir.

The Brazos River may have been formed as early as the Eocene, but definitely established by the Miocene (Dyksterhuis 1948). The subsequent Clear Fork River course is thought to have formed much later, sometime during the early Pleistocene.

Gages Creek flows into the Clear Fork of the Brazos River and at this project area, has a valley channel of about 9 m (30 ft.) across. The actual water is about a 30 to 60 cm (1 to 2 ft.) wide and 2 to 10 cm (1 to 3 in.) deep with a very slow flow with stagnant water in some places. Gages Creek is not considered navigable.

2.6 BIOTIC ENVIRONMENT

The climax vegetation characteristics are directly tied to the geologic deposits (Phelan 1976), but intensive land use and tree clearing have muted the current vegetation differences. Site 41YN452 lies at or near the transition zone between two major biotic provinces, with Blair’s (1950) southern Kansan province towards or on the western side, and the Texan province on the eastern side (Figure 2-7). The Kansan province is characterized by the mesquite plains. Texan province is primarily a north to south transitional zone from the Kansan plains to the Austroriparian forests in eastern Texas.

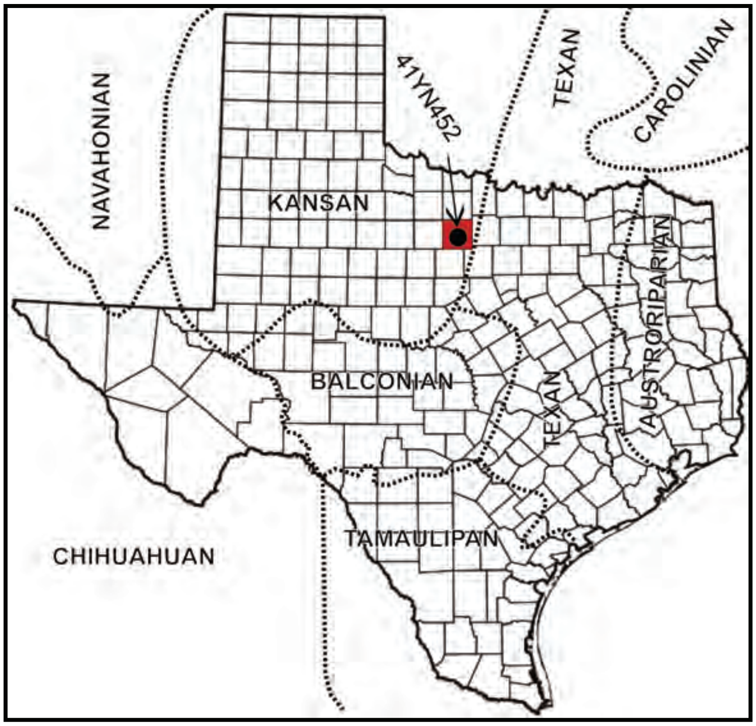

Figure 2-7. Biotic Provinces in Region (after Blair 1950)

Because this project area lies along an ecotone (between the Rolling Plains and the Western Cross Timbers to the east), different authors have classified Young County in various ways (Figure 2-8). It is quite likely the vegetation in the immediate area surrounding this site has fluctuated through time as climate conditions changed. McMahan et al. (1984) have assigned this area as post oak parks and woods that are most characteristic of the Western Cross Timbers. The uplands to the west are mapped as mesquite (*Prosopis*)/lotebrush (*Ziziphus parryi* Torrey), scrub. This latter vegetation is characteristic of the Rolling Plains. The uplands to the east are mapped as live oak (*Quercus*)-ashe juniper (*Juniperus ashei*) parks and are representative of the Edwards Plateau vegetation. Gould (1975) places this area near the boundary between the Cross Timbers and Prairies to the east and the Rolling Plains to the west. The project area falls within what Correll and Johnston (1979) have mapped as the Western Cross Timbers region (Figure 2-8). Others, such as Freeman (2003), show that Young County is within the Osage Plains, just west of the oaks and prairies. To help the reader gain a greater understanding of the complexities of the vegetation in and around the region, these classification terms are discussed in this environmental section.

2.6.1 Rolling Plains

This physiographic province is often referred to as the Permian Redbeds, Osage Plains (Lobeck 1948; Wiessenborn 1948) Lower Plains, Low or Rolling Plains, or the Rolling Redbed Plains (Albert and Wyckoff 1984; Morris et al. 1976). This long plain stretches from Kansas into north Texas. The Rolling Plains region is just east of the High Plains and generally marked by the well-defined edge of the Eastern Caprock escarpment. Erosion of the Cretaceous, Tertiary, and Quaternary strata has created an expanse of low relief, with undulating and rolling hills dissected by numerous creeks and rivers that drain eastwards and southeastwards.

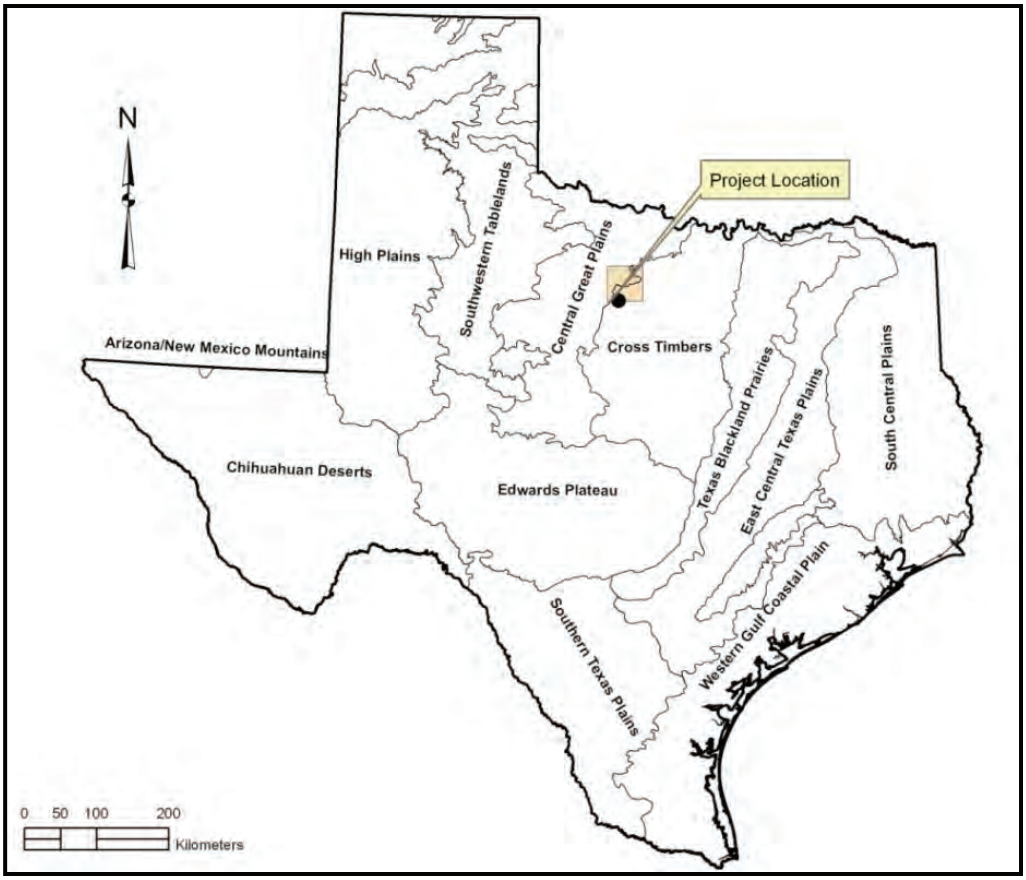

Figure 2-8. Map Showing Vegetation Areas of Texas with Young County on Boundary between Cross Timbers and Prairie Region (Correll and Johnston 1979)

The native vegetation is a tall grass prairie with scattered pecan (*Carya illinoinensis*), cottonwood (*Hibiscus tiliaceus*), and elm (*Ulmus americana*) trees. The dominant grasses are little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum)*, and big bluestem (*Andropogon gerardii*).

2.6.2 Cross Timbers

The Cross Timbers ecosystem is a vast mosaic of grasslands and woodlands that form a broad mosaic ecotone between the eastern deciduous forests and the grasslands of the southern Great Plains; it covers about 67,340 square kilometers (26,000 square miles). The Cross Timbers is considered a vegetation subregion that consists of two north to south trending strips of forested regions that extend parallel to each other from central Texas near Waco, and northward through Oklahoma. In some reports, the Eastern (or Lower) and Western (Upper in reference to an increased elevation) Cross Timbers are divided into two narrow strips. The Eastern Cross Timbers occur through the eastern parts of Denton, Tarrant, and Johnson counties over to and including the western parts of Grayson, Dallas, Ellis, and Hill counties. On average, this narrow belt is some 24 km (15 mi.) across. This region is only slightly higher than the surrounding prairies. The soils of the region are more fertile, leading to a greater growth in the size of the trees and a greater diversity in shrubs.

The Cross Timbers biogeographic setting is marked by Pennsylvanian sandstone underlying Cretaceous aged geologic formations which have been largely stripped off by long-term erosion. This vegetation zone was once dominated by post oak (*Quercus stellata*) and blackjack oak (*Quercus marilandica*) trees. The sandy Trinity Formation is the western most of these Cretaceous Formations and composes the Western Cross Timbers and also forms the boundary between the Great Plains and the West Gulf Coastal Plain (Fenneman 1938; Thoms 1994).

The Western Cross Timbers are further west, and again generally form a narrow band that is roughly 30 km wide in a north to south trending direction. This extends through Montague, Wise, Jack, Parker, Hood, Young, Shackelford, Erath, and Comanche counties. The geology is complex and diverse, resulting in a variety of soils across the diverse terrain, which also is reflected in the vegetation communities. At least three groups of geological formations underlie this region and include the Trinity sands of the Comanchean or Lower Cretaceous, the hard rocks of various Pennsylvanian Formations, and the Continental Redbeds of the Wichita Formation. These bedrock formations directly affect the vegetation that occurs throughout this region. These parent materials are primarily noncalcareous, directly affecting the soils. The Trinity sands allow for the penetration of the rain water. Where there is the hard outcrop within Pennsylvanian Formations, these limited exposures are comprised of scattered mesquite shrubs surrounded by a mosaic of short grasses. In general, the natural vegetation is comprised of woody vegetation dominated by dwarfed post oaks and blackjack oaks. Other woody species scattered throughout include; shin oak (*Quercus sinuate*), Spanish oak (*Quercus buckleyi*), live oak (*Quercus fusiformis*), Texas Ash (*Fraxinus texensis*), Ashe juniper (*Juniperus ashei*), roughleafed dogwood (*Cornus sp)*, mesquite (*Prosopis*), hackberry (*Celtis*), lotebush (*Ziziphus parryi* Torrey), tasajillo (*Pereskiopsis aquosa*), flame-leaf sumac (*Rhus virens*), osage orange (*Maclura pomifera*), cedar elm (*Ulmus carrassifolia*), red cedar (*juniperus virginiana*), and hawthorne (*Crataegus pinnatifida*). Short grasses occur over much of the area.

The riverine vegetation consists of bottomland forests of such species as pecan (*Carya illinoinensis*), bur oak (*Quercus macrocarpa*), post oak (*Quercus stellata*), cottonwood (*Populus*), sugarberry (*Celtis laevigata*), black willow (*Salix nigra*), and elm (*Ulmus*, Figure 2-9).

Few grasses grow in these riverine or riparian settings. These settings provide unique micro-environments that are significantly different than the surrounding uplands. These also provide greater diversity and density in the flora and fauna resources.

Figure 2-9. Densely Forested Area along Gages Creek.

2.7 FLORA AND FAUNA

The area within Young County has been previously defined by Blair (1950) as being situated on the border of the Kansan biotic province to the west and the Texan province to the east. Generally, this area lies within a transitional zone that is described as a mesquite plain and constrained by the Western Cross Timbers to the east. Original vegetation has largely been obliterated by modern agriculture and settlement, also known as disclimax. The most common disclimax vegetation in the area includes hairy grama (*Bouteloua hirsute*), western ragweed (*Ambrosia psilost*achya), silver bluestem (*Andropogon saccharoides*), blue grama (*Bouteloua gracilis*), and buffalograss (*Buchloe dactyloides*). Climax vegetation would have included: Indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon fucatus*), dropseed (*Sporobolus asper*), and little bluestem (*Andropogon scoparius*) (Figure 2-10). Larger vegetation that is associated with disclimax ecological areas include: oak (*Quercus*) greenbrier (*Smilax*), fringeleaf paspalum (*Paspalum ciliatifolium*), tasajillo (*Opuntia leprocaulis*), lotewood condalia (*Condalia obtusifolia*), mesquite (*Prosopis*), post oaks, and blackjack oaks.

Figure 2-10. Little Bluestem

(Andropogon scoparius) Once Prominent Throughout the Western Cross Timbers before Modern Agricultural Efforts and Clearcutting.

Gages Creek has very little water. In a few restricted spots, there are cattails (*Typha domingensis*), spike rush (*Eleocharis caribaea*), switch grass (*Panicum virgatum*), sedges (*Carex* sp), and black willow (*Salix nigra*) along the creek. Mixed hardwood communities are in the immediate vicinity and include American elm (*Ulmus american*), hackberry (*Celtis laevigata*), and live oak (*Quercus virginiana*).

The Cross Timbers ecological region is also home to a diversity of wildlife. Historically, bison (*Bison* sp) roamed the vast grasslands as they roamed through the region. Their presence was part of a web of life that included prairie dogs (*Cynomys ludovicianus*), black-footed ferrets (*Mustela nigripes*), and burrowing owls. Mountain lions (*Felis concolor*) and black bears (*Ursus americanus*) also ranged across the Cross Timbers. Today, most of these species have been extirpated from the area.

Faunal inventories are difficult to classify given the nature of this transitional zone (Blair 1950; Schmidly 1994). Although Young County is located at the threshold of the Rolling Plains and the Cross Timbers regions, Schmidly (1994) refers to this area simply as the Plains region. This designation includes the High Plains, Rolling Plains, Cross Timbers area, and the Edwards Plateau.

Mammals found across the entirety of Texas include: Virginia opossum (*Didelphis virginiana*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), eastern cottontail (*Sylvilagus floridanus*), black-tailed jackrabbit (*Lepus californicus*), hispid pocket mouse (*Chaetodipus hispidus*), American beaver (*Castor canadensis*), white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), hispid cotton rat (*Sigmodon hispidus*), coyote (*Canis latrans*), common gray fox (*Urocyon cinereoargenteus*), ringtail (*Bassariscus *astutus*), common raccoon (*Procyon lotor*), long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), mountain lion (*Felis concolor*), and white-tailed deer (*Odocoileus virginianus*). Those mammals specifically from the Plains region include: thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), Plains pocket gopher (*Geomys bursarius*), Jones' pocket gopher (*Geomys knoxjonesi*), Llano pocket gopher (*Geomys texensis*), Plains pocket mouse (*Perognathus flavescens*), Texas kangaroo rat (*Dipodomys elator*), Texas mouse (*Peromyscus attwateri*), and Prairie vole (*Microtus ochrogaster haydeni*).

There are fourteen species of amphibians, which include green toad (*Bufo debilis*), cricket frog (*Acris gryllus*), the western spadefoot (*Scaphiopus hammondi*), ornate box turtle (*Terrapene ornate*), and the Couch's spadefoot toad (*Scaphiopus couchii*). Forty-five species of reptiles found in the area include: Texas earless lizard (*Holbrokia maculata*), collard lizard (*Crotophytus callaris*), and fence lizard (*Sceloporus undunlatus*) (Blair 1950). Snakes include Texas blind snake (*Leptotyphlops dulcis*), plains black-headed snake (*Tantilla nigiriceps*), and the Brazos water snake (*Nerodia harteri*).

In general, the Brazos River supports a broad array of fish populations. A few of the freshwater fish in the river system include: channel catfish (*Ictalurus melas*), the flathead catfish (*Pylodictus olivaris*), gar (*Lepisosteus* sp), carp (*Cyprinus* sp), bass (*Micropterus* sp), various other sunfish (*Centrarchidae*), freshwater drum (*Aplodinotus grunniens*), and the misquitofish (*Gambusia affinis*).

A variety of freshwater mussels in the family Unionidae are also found in the waters of the Brazos and its tributaries. Pennak (1978) stated that Texas had some 78 species of Unionidae and Sphaeriidae. These are most abundant in oxygenated, shallow waters of medium to large rivers and occupy a variety of stable substrates including different combinations of silt, sand, gravel, and cobble (Smith 2001 cited in Karatayev and Burlakova 2008). Howell et al. (1996) states that mussels are filter feeders and require a rich and plentiful food supply that is dominated by diatoms, desmids, algae, and detritus. They can also use nutrient in solutions. Their growth rates are quite variable and fluctuate on locations, species, shell thickness, age, and maturity. Growth rates and sizes at maturity for species in Texas are largely unknown (Howell et al. 1996). Unionids are more abundant in areas with low flows and generally live partially or completely buried in the sediments of rivers. Consequently, the substrate and hydrodynamic conditions have a profound effect on the mussel community structure. Mussels often avoid densely vegetated and heavily shaded areas (Karatayev and Burlakova 2008).

At least 12 species of mussels, including the smooth pimpleback (*Quadrula houstonensis*) and southern mapleleaf (*Quadrula apliculata*), are living in the Brazos River and its tributaries (Karatayev and Burlakova 2008). The highest relative unionid density is also in the Brazos River, with smooth pimpleback native to the Brazos and the Colorado. It is still abundant in at least the Brazos River system (Karatayev and Burlakova 2008), and in the Colorado and San Jacinto river drainages (Howells et al. 1996). The smooth pimpleback can grow to a maximum 66 mm long and 59 mm in height (Simpson 1914 cited in Howells et al. 1996). It occurs in mixed mud, sand, and fine gravel. The southern mapleleaf has grown at least 118 mm in length. Its habitat includes flowing waters of rivers and streams, slow moving or still water in reservoirs on mud, mud and gravel, mud and sand, and gravel and cobbles. It can occur to depths of 4.6 m (Howells et al. 1996). Specimens in large rivers are more susceptible to water temperature, stores, and flood events. Mussels in smaller streams and tributaries must contend with temperature differences due to variable channel depth and flow rate, and stress created by diminished nutrient fluctuations. Freshwater mussels that occupy small tributaries in Texas potentially will have false seasonal growth rates and lines due to the above conditions. Therefore, seasonality studies based on growth rate lines are not good indications of seasonality.

Mussels are also an excellent source of protein; are low in cholesterol, fat and calories; contain several vitamins and minerals, and are rich in Omega-3 (www.helpwith cooking.com). They can be prepared through steaming, boiling, baking, and grilling and need only a few minutes cooking to open the shells for meat extraction. Lintz (1996) provides some specific dietary data on Texas mussels from the Colorado River and comparisons with other studies. He states that although mussels appear less nutritious relative to other kinds of game animals, they do contain important nutrient components. When the amount of time and energy of hunting and preparation of other game animals are taken into consideration, freshwater mussels assume more importance than many kinds of terrestrial game (Lintz 1996).

Unique species of birds that are found in the Kansan biotic province include: chachalaca (*Ortalis vetula*), kiskadee flycatcher (*Pitangus sulphuratus*), yellow-green vireo (*Vireo flavoviridus*), groove-billed ani (*Crotophaga sulcirostrus*), green jay (*Cyanocorax yncas*), and the crow (*Corvus imparts*) (Blair 1950). The Cross Timbers eco-region also lies within the central flyway of avian migration. Many neotropical migrants, waterfowl, and birds of prey pass through this part of the country, or stop and spend their breeding or winter season here. Freeman (2003) provides an in-depth list of species for the Osage Plains and information on when they are present during seasons.

3.0 CULTURAL BACKGROUND AND REGIONAL OVERVIEWS

J. Michael Quigg and Robert A. Ricklis

3.1 PREVIOUS LOCAL INVESTIGATIONS

Young County is in the north-central part of Texas and, in comparison to most other archeological regions across the state, this area has been subjected to a relatively small number of archeological excavations. Consequently, a comprehensive and well controlled cultural history for this region of the state has yet to be documented. In 1979 and 1980, a compilation of all archeological sites known at that time in Texas was made (Biesaart et al. 1985). According to this data, more than 20,000 prehistoric sites were recorded across Texas over some 100 years. As of April 1980, only 60 sites had been recorded in Young County. In the 12 county region that was considered part of the Nortex Regional Planning Commission (primarily north and west of Young County), only 347 sites had been recorded (1.72 percent of the state's total to that time). Of these, only four sites had been excavated and two others tested by hand (Biesaart et al. 1985). Most counties immediately around Young County have considerably fewer sites, with the exception of Palo Pinto County, which had 98 sites recorded. Most sites in Young County were recorded during the surface survey of Possum Kingdom Dam basin by the Works Progress Administration (WPA) and the University of Texas Archeological Survey in 1937 (Figure 3-1, Table 3-1).

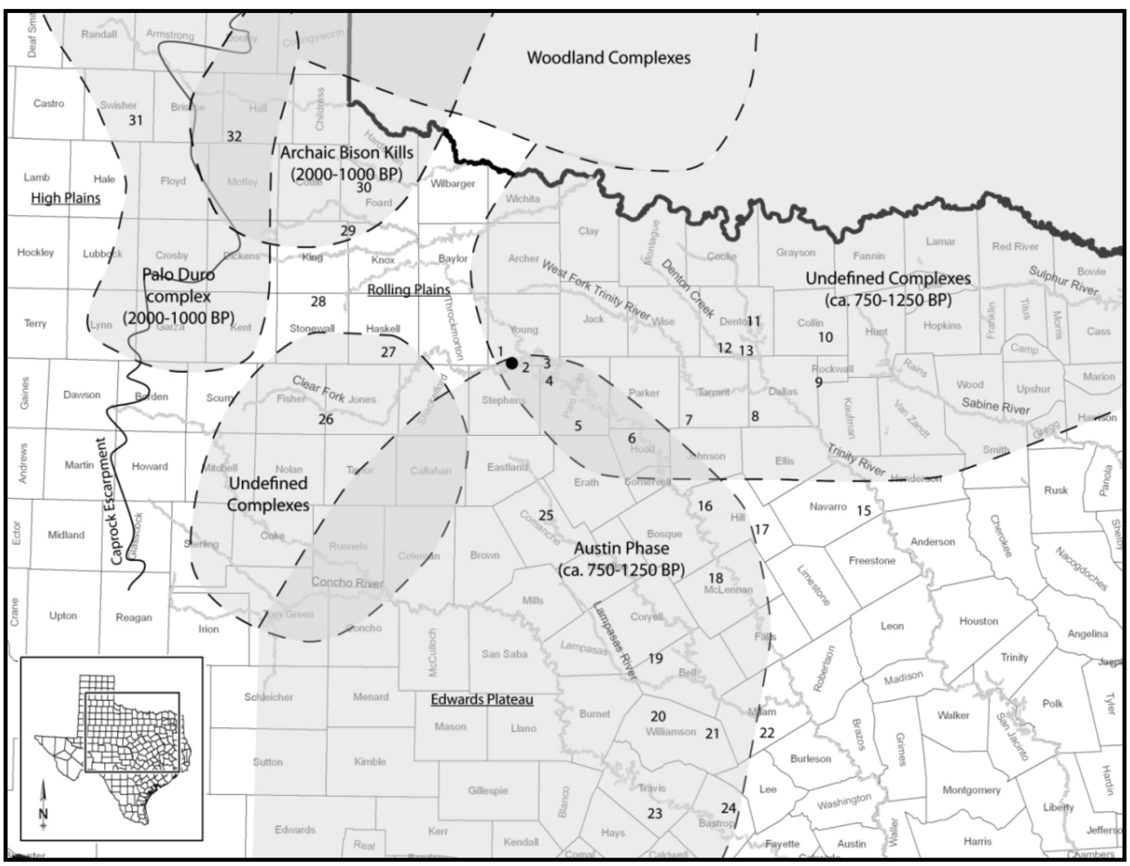

Figure 3-1. Map Depicting Projects and Sites Mentioned in Text across Central and Northern Texas with Probable Cultural Regions

Table 3-1. List of Projects and References for Locations Shown on Figure 3-1 Map

Map No.	Project/Site Name	Reference
1	Root-Be-Gone (41YN452)	Matchen et al. 2007, this report
2	South Bend Reservoir	Sanders et al. 1992
3	Harrell Site (41YN1)	Hughes 1945; Krieger 1945
4	Possum Kingdom Reservoir	No report
5	Palo Pinto Reservoir	Jelks 1954
6	Lake Granbury/De Cordova Bend	Jelks 1954; Skinner 1968; Lorain 1967
7	Benbrook Reservoir	Stephenson 1949a, 1949b
8	Joe Poole Reservoir/Lakeview	Skinner and Conner 1979;
9	Ray Hubbard	Harris and Sahm 1963
10	Lavon Reservoir	Stephenson 1948, 1949b, 1952; Lynott 1975
11	Lewisville Reservoir	Stephenson 1949b; Ferring and Yates 1998
12	Grapevine Reservoir	Stephenson 1948
13	Prikryl MA thesis	Prikryl 1990
14	Ray Roberts Reservoir	Skinner and Connors 1979; Raab 1982; Skinner et al. 1982; Skinner and Baird 1985
	-	Ferring and Yates 1997; Prikryl and Yates 1987; Prikryl 1987
15	Richland Chambers Reservoir	Bruseth and Martin 1987; McGregor and Bruseth 1987
16	Lake Whitney	Skinner and Harris 1971; Stephenson 1947, 1970; Jelks 1953, 1962
	- Kyle site (41HI1)	Jelks 1962
	- Bear Creek Shelter (41HI17)	Lynott 1978
	- Pictrograph Shelter (41HI53)	Stephenson 1970
	- Buzzard Shelter	Stephenson 1970
	- Sheep Shelter (41HI38)	Stephenson 1970
	- Blum Shelter	Jelks 1953; Stephenson 1970
17	Aquilla Reservoir	Skinner et al. 1978; Brown et al. 1987, Lynott and Peter 1977
	- McDonald (41HI105)	Brown et al. 1987
	- McKenzie (41HI115)	Brown et al. 1987
	- Pilgrim (41HI124)	Brown et al. 1987
	Sour Mash Site (41HI134	Chandler 1985
18	Lake Waco	Prikryl & Jackson 1985; Duffied 1959; Story & Shafer 1965; Scott et al. 2002; Mehalchick & Kibler 2008
	- Britton (41ML37)	Story and Shafer 1965; Scott et al. 2002; Mehalchick and Kibler 2008
	- Baylor (41ML35)	Story and Shafer 1965; Scott et al. 2002; Mehalchick and Kibler 2008
19	Fort Hood	Many
	- Belton Reservoir	Stephenson 1949; Miller and Jelks 1952; Shafer et al. 1964;
	Stillhouse Hollow Reservoir	Johnson 1962b

Table 3-1, continued

Map No.	Project/Site Name	Reference
	- Landslide (41BL85) & Evoe Terrace (41BL104)	Sorrow et al. 1967
	Youngsport	Shafer 1963
20	North Fork Reservoir	Patterson & Moore 1976; Patterson & Shafer 1980; Hays 1982; McCormick 1982a & 1982b
21	Granger Reservoir	Shafer and Corbin 1965; Eddy 1973; Patterson and Moore 1946; Hays 1982
	- Loeve-Fox (41WM230)	Prewitt 1974, 1982; Valastro et al. 1977
22	J. B White (41MM341)	Mahoney et al. 2003; Gadus et al. 2006
	Little River site (41WM340)	Mahoney et al. 2003
23	Smith Rockshelter (41TV42)	Suhm 1977
24	McKenney Roughs (41BP627)	Carpenter et al. 2006
25	Proctor Reservoir	Prewitt 1964
26	Yellow Jacket Shelter (41CJ62)	Bandy et al. 1981
27	Upper Clear Fork Survey	Wulfkukle 1986
28	Stamford/Paint Creek	Jelks and Mooreman 1953
30	Brazos Natural Salt Pollution project	Thurmond et al. 1981
31	Truscott Brine Control Lake	Etchienson et al. 1978
32	Crowell Reservoir	Etchienson et al. 1979
33	Justiceburg/ Lake Alan Henry	Many
	- Sam Wahl (41GR291)	Boyd et al. 1994; Boyd 1995, 1997, 2004
34	Kent Creek (41HL66)	Cruse 1992; Boyd 1995, 1997, 2004
35	Deadman's Shelter (41SW23)	Willey and Hughes 1978

The proposed reservoir also involved Palo Pinto and Stephens counties. Sixty-six sites were recorded, but unfortunately the results of that survey were never formally and completely published.

At least three sites (41YN1 - the Harrell site; 41YN2 - the O. W. Hill site; and 41YN9) discovered during the Possum Kingdom Dam basin survey were subsequently excavated. Both Hughes (1942) and Kreiger (1946) reported on the major excavations conducted at the Harrell site, although there is also an unpublished report describing the site by Fox (n.d., b). In 1938 and 1939, the excavations at the Harrell site were conducted in three large blocks (labeled Excavations 1, 2, and 3) into deep alluvial deposits adjacent the river. The arbitrary levels were excavated in ca. 30 cm increments. This is the only major excavated site in the region, but the reporting is not at today's standards. Kreiger (1946) only reports on the cultural materials from Excavation 3, which was excavated into a third terrace 12.2 m above low water level. This was a very rich area with intensive occupations that represents hundreds and possibly even thousands of years. Excavation 3 yielded some 32 burials (none extended), 135 hearth features, and massive amounts of mussel shell, pottery, stone tools, and lithic debris. However, discussions of the stratigraphy are limited, and considerable mixing of the different point types was apparent within the dark black midden soil that varied from ca. 30 to 150 cm in thickness. The upper ca. 150 cm yielded the greatest percentage of artifacts, although scattered materials were recovered to a depth of ca. 300 cmbs in red sandy clay. The diagnostic projectile points recovered from Excavation 3 totaled 404 arrow points and 55 dart points, which represent at least eight types and indicating occupations primarily during the Late Prehistoric period, although the Archaic period is also represented. The Harrell site is the type site for the Henrietta Focus (Kreiger 1942) of the Late Prehistoric period as well as for the Harrell arrow point type. The late lithic materials were found in association with Nocona Plain ceramics. As was common for the mid-20th century, no debitage analysis was performed for the assemblage. Furthermore, it is doubtful that any of the lithic debris was retained for curation. These efforts were also before radiocarbon dating; therefore, only relative dating was possible based on projectile point serriation from other known sites. Massive excavations (roughly 1,087 m^2) were also conducted at O. H. Hill (41YN2) by the WPA in 1939 (Fox n.d., c). The site lies on a knoll between two springs. The deposits were about 90 cm deep and consisted of red sand over red clay (Sanders et al. 1991 citing Brayshaw 1970). A variety of chipped stone tools were recovered and include bifaces, scrapers, cores, projectiles points, metates, manos, pottery, shell artifacts and bone. In addition to these artifacts, this site yielded some 21 poorly formed hearths, 1 burial, several cysts, and 1 post mold. Most cultural materials were within ca. 30 cm of the surface. The 96 diagnostic projectile points represents the Middle Archaic, Late Archaic and Late Prehistoric periods. Apparently, mixing of the deposits was indicated as there was no clear vertical separation of the point types. Subsequently, the State Department of Highways and Public Transportation (SDHPT) conducted test excavations at part of this site in 1984 (Denton 1984). Those investigations were restricted to the planned expansion of the right-of-way and limited to investigation of 5 m^2. A few chert flakes and some clear bottle glass were recovered, but no diagnostic artifacts or features.

Other excavations have been conducted at a few sites in Young County. Avocational archeologists Richard and Judy Flinn excavated the High Bluff site on and off from 1961 to 1965. They targeted cultural materials exposed on a high bluff overlooking the Clear Fork of the Brazos River near the Young and Stephens county line (Flinn and Flinn 1968). They initiated work with a limited number of test units and then opened up a block area. The black clay was so hard that the sediments were not screened, although they were carefully examined for artifacts. The recovered artifacts were mostly in the black clay that varied in thickness from roughly 20 to 40 cm. Quantities of mussel shells, some in massive lenses, were recovered in conjunction with six shallow saucer-like depressions that contained burned rock, ash and charcoal, a few butchered bones, and lithic debris. Some 1,101 chert stone tools included at least 90 dart points, 34 arrow points (including 8 Scallorn and 9 Granbury), 105 bifaces, 5 scrapers, 5 drills, edge-modified flakes, 26 hammerstones, 7 choppers, 22 ground stone tools, 8 worked mussel shells, 54 shells with holes (perforated), and 4 bone tools. Most projectile points were recovered between ca. 15 and 20 cmbs. The diagnostic points included some 33 Darl, 10 Eliasville (a provisional type similar in appearance to Godley points), 4 Ensor, 4 Marcos, and at least 2 Edgewood, all generally reflecting the Late to Transitional Archaic. Most of the Darl and Eliasville Provisional type dart points had ground stems. Seventy-three percent of the Darl points exhibit beveled blades. The sparse bone included deer and turtle, but no bison. The Archaic period materials were followed by materials left by peoples that represent the Austin phase of the Late Prehistoric period. The deposits appear to have been mixed and lacking clear stratigraphic separations. No radiocarbon dates were obtained.

The Archeological Research Laboratory, Texas A&M University, conducted a major survey of 14,973 hectares ([ha], or 37,000 acres [ac.]) for the proposed South Bend Reservoir, planned by the Brazos River Authority, in 1987 and 1988 (Saunders et al. 1992). This survey was along the Clear Fork of the Brazos and Brazos rivers. This included part of Young, Stephens, and

Throckmorton counties, just upstream from Possum Kingdom Reservoir. They also excavated 3,461 shovel tests to locate subsurface sites. In total, 541 prehistoric sites, 168 historic sites, and 522 isolated finds were documented. The prehistoric sites range in age from Paleoindian times through to the recent historic period. The Late Archaic period was the most frequently represented period based on finds of diagnostic artifacts in the proposed reservoir area. The most frequent point type was the Late Archaic Darl type (141 specimens) points. Only 22 Darl points came from the South Bend Reservoir survey and the rest were in private collections. Also, 65 Godley, 60 Ensor, 6 Darl/Godley, and 3 Frio points,which represent the Late Archaic were identified. The recorded sites included 41YN450 and 41YN452, which are reported herein.

The South Bend Reservoir survey included geoarcheological investigations that documented the alluvial terraces sequence and ages of those terraces in the sections of both valleys. In terms of subsistence resources, bison bones were only observed at two localities, one at Isolated Find 537 was an isolated skeleton, whereas at 41YN465, bison remains consisted of a worked radius. Deer bones were recovered from four prehistoric sites, which were related to the Late Prehistoric period. Mussel shells were far more prominent, with shells observed on 250 prehistoric sites and samples collected from most sites. Six taxa were identified. Mussel shells were far more abundant in the Clear Fork and its tributaries than along the Brazos River. From their investigations, Sanders et al. (1992) recommended numerous sites to be tested, including 107 prehistoric sites. The reservoir was never constructed and no further work was conducted at any of the recorded sites, until the work at 41YN450 and 41YN452 discussed herein.

The Young County Archeological Society excavated at 41YN26 (the Foster site) in 1965 (Moore 1992). A few artifacts were recovered, including at least one Harrell point, thick red pottery, various chipped stone tools, mussel shells and bone fragments. No report was written on this material. Also in Young County, the SDHPT conducted limited testing at sites 41YN9 (Moore 1992), and 41YN70 (Moore 1992). These sites yielded mostly chipped stone tools, lithic debris and burned rocks, likely that represent short-term camping localities.

A study of boat-shaped mortars was conducted in the upper end of the Possum Kingdom Dam basin by Fox (1939). This investigation included sites in Jack, Young, Palo Pinto, and Stephen’s Counties. He concluded that there is no evidence the mortars were used for grinding. Forrester (1991) presents information concerning pestles for the boat-shaped mortars collected from the surface in Texas. He provides a generalized map of Texas showing the known distribution of the boat-shaped mortars that includes parts of the southern range of the Rolling Plains. Forrester (1991) associated these types of elongated, flat pestles with Zephyr dart points of the Late Archaic based on 13 boat-shaped mortars present at 41SE17 along Big Sandy Creek in Stephens County. Forrester also indicates that Zephyr points are common surface finds along the upper Brazos River and its tributaries, as well as on the upper reaches of the Leon and Colorado rivers.

To the southeast, an initial survey of three proposed dam sites on the Brazos River in Palo Pinto and Hood counties (see Figure 3-1, Table 3-1) was conducted by Moorman and Jelks in 1954 for the River Basin Survey’s Office in Austin (Jelks 1954). Less than 25 sites were recorded through this work. Also in Palo Pinto County, Moseley (1993) conducted excavations at the Hagler site (41PP325). This site was in terrace deposits of the Brazos River. Excavations revealed deeply stratified deposits that contained possible Paleoindian through Late Prehistoric materials. The upper deposits (Zone A) yielded Late Prehistoric materials with Scallorn, Perdiz, Rockwall, and Cuney arrow points, hearths, debitage, shells, and bones. Zone B yielded Lange and Darl points and basin hearths. Zones C/D yielded no diagnostic artifacts, although debitage, mussel shell and burned rocks were recovered. The materials extended to some 320 cmbs.

Immediately south of Young County, in Stephens County, Forrester (1994) excavated two small sites (41SE18 and 41SE19) on opposite sides of the Clear Fork of the Brazos River in 1939 and in 1964. Both sites yielded cultural assemblages that represent the Henrietta Focus. The remains from 41SE19 included a suite of small Harrell points, side- and basal-notched arrow points, Fresno points, and scrapers. Site 41SE18 yielded Fresno, Harrell, Cliffton, "Lusk" or Bulbar Stemmed, and side-notched arrow points of the Late Prehistoric period, plus one Zephyr dart point, scrapers, and one pottery sherd (Forrester 1994). Both sites yielded considerable quantities of mussel shells. No radiocarbon dates were obtained. A human cemetery was 75 m east of 41SE19. Three skeletons were excavated from shallow graves without burial offerings, though one burial was lined and covered with sandstone slabs and a Washita point of the Late Prehistoric was in one grave of a female.

During the era prior to radiocarbon dating, which began in the mid 1950's, discussions and comments concerning chronology were based on the stratigraphic positions of projectile point types. Once radiocarbon dating became available to researchers, it was expensive, and because limited funds were available for most archeological projects, few samples were run even from multiple-component sites. Therefore, excavations were conducted throughout Texas without the support of many radiocarbon dates to document the absolute ages of cultural manifestations linked to specific projectile point types. Those dates that were obtained were not often directly associated with a single point type, but the radiocarbon dates merely provided an indication of the time for one specific feature or a general stratigraphic position. As the discipline became more sophisticated, researchers were inclined to obtain more radiocarbon dates, but often the context of the dated materials or the associations of the materials is not clear. More and more researchers are paying closer attention to associations of the dated materials and the material associations of those radiocarbon dates. As archeologists continue to become more precise in all aspects of our work and pay closer attention to the complex associations, context, and stratigraphy, the prehistory of Texas will become clearer to all.

Sanders et al. (1992), in the report of the South Bend Reservoir, made the comment that the Lower Plains Region is not well documented. Excavated sites are few and most lack radiometric dates. As a reflection of this fact, the 1995 synthesis of archeological research for the State of Texas did not contain a discussion of the Lower Plains region or north-central Texas in which Young County is situated (Perttula 1995).

3.2 PREVIOUS REGIONAL INVESTIGATIONS AND REGIONAL CHRONOLOGIES

Site 41YN452 yielded cultural materials that date no earlier than the Late Archaic period, or more specifically, between 2,000 and 900 years or the very last part of the Late Archaic and possibly into the Late Prehistoric period. Therefore, the following discussions will concentrate on the last roughly 1,000-year period of regional prehistory. As indicated above, the immediate area and, in general, the broader region surrounding this project, has received relatively limited in-depth archeological research. Consequently, the region still lacks well established cultural chronologies as a result of the paucity of radiocarbon dates from tight, well defined components. Given the location of this project in a transition zone between at least two archeological regions (see below), combined with lack of recent excavations with multiple absolute dates from tight contexts, it is unclear which regional cultural chronology could be best applied to this specific project. As in most archeological regions across Texas, details concerning the chronology are still being adjusted as more radiocarbon dates are derived from well defined contexts, and in direct association with diagnostic artifacts.

As indicated in the environmental background section, Young County is along a transitional vegetation zone or ecotone between the western edge of the Western Cross Timbers and the mixed grasslands of the Rolling Plains to the west. Young County is in the broader north-central Texas archeological region, but most investigations in that region have been conducted further east, in and around the Upper Trinity River area and the Dallas region. To the west is the west central or Lower Plains archeological region. A few reservoir surveys have been conducted in the Lower Plains region (see Figure 3-1 and Table 3-2), but this region also lacks intensive and well-reported excavations with solid radiocarbon dating. To the south is the more intensively investigated central Texas archeological region. Considerably more research has occurred there, and many more radiocarbon dates are currently available from the central Texas region. Therefore, the following background provides a brief overview of selected investigations and the established current chronologies for those three adjacent archeological regions to better contextualize the cultural materials derived from 41YN452.

3.2.1 The North-Central Texas Archeological Region

Early on, extensive excavations (1938-39) at the Harrell site provided a sizable sample of diagnostic projectile points and ceramic types for making comparisons with assemblages (mostly projectile points) from adjacent regions. Hughes (1942) made some general observations such as noting the similarity between sites east of Elm Fork of the Upper Trinity River and sites in east Texas, but the sites west of Elm Fork showed closer similarities with those along the Brazos River (see Figure 3.1). He also noted that much of the Harrell site assemblage resembled materials found along the Red River to the north. Hughes (1942) suggested that the stemmed dart points and the barbed dart points, plus the burned rock features, were similar to those observed in central Texas. In general, Hughes recognized that some of the latter barbed points and other stone tools resemble aspects of the assemblages from the Plains region to the west, whereas the earlier dart points resembled those from central Texas. His insight may be the first observation that this region was occupied by different groups from, with affinities to different regions over time.

The most recent attempt to synthesize the north Texas region was by Prikryl (1990). His work focused on a relatively small area of less than 200,000 ha (500,000 ac.) in the northwestern Dallas area in parts of Denton, Tarrant, and Dallas counties (see Figure 3-1, Table 3-1). This area included Lake Lewisville along Elm Creek and Lake Grapevine along Denton Creek in the Upper parts of the Trinity River, mostly in the Eastern Cross Timbers ecotone. The Trinity River is the next major river system east of the Brazos River, and flows to the southeast parallel to the Brazos River. Prikryl's work was based primarily on surface collections from 238 sites and he used projectile point types to place the sites within broad and/orrelatively narrow time periods. His work generally lacked radiocarbon dates to support much of the chronology he was proposing, and it relied heavily on radiocarbon dates extrapolated from adjacent regions. The lack of large-scale excavations and radiocarbon dates in north-central Texas area dictated the use of these surface collections and extrapolated dates to develop relative chronologies.

Prikryl (1990) restudied all the stone tools that Crook and Harris (1952) originally used to define Archaic Period occupations in the Trinity River basin and their published notions on the Archaic Trinity aspect.

Table 3-2. Summary Overviews of Investigations across Central and North-Central Texas

Project Name	Effort	Year	Discussion	References
Possom Kindom Reservoir	Survey	1937	N/A	No final report
Harrell Site (41YN1)	Major Excavations	1938-39	Three excavation blocks, two thick zones defined, quantities of artifacts, mixed deposits, mostly counts of artifacts, shell tempered ceramics called Nocona Plain, 555 arrow points, Herrell points defived here, many human burials, 135 features, quantities of mussel shells, Middle Archaic -Late Prehistoric.	Hughes 1942; Krieger 1946
South Bend Reservoir	Survey	1987-88	Surveyed 37,000 ac, identified 541 prehistoric sites, 168 historic sites, dug 3,461 shovel tests. About 3000 tools, 47 sherds, with Darl point most dominate at 141, Late Archaic sites most frequent.	Sanders et al. 1992
Root-Be-Gone (41YN452)	Tested, Excavated	2006, 2007	Testing included 6 trenches, 5 50x50 and 6 1x1 test units. Buried component with features identified. Data recovery included 144 units or 50.5 m3 from Late Archaic components.	Matchen et al. 2007; This volume
Palo Pinto Reservoir	Survey	1953	N/A	No final report
Lake Granburry/DeCordova Bend	Survey, 5 tested	1968	Three separate surveys along 33.5 miles of river. 51 prehistoric sites, No C14 dates, structures in 3 sites, all shallow deposits.	Jelks 1954; Skinner 1968, 1971; Lorrain 1967
Whitney Reservoir	Survey	1947	61 prehistoric sites recorded, minor testing at 23 sites, survey not sytematic	Stephenson 1947, 1970; Skinner and Harris 1971
Stansbury Site	Excavations	1950	Flechado village of Tawakoni	Stephenson 1970
Pictograph Shelter (41HI53)	Excavations	1950	Site 80 cm deep, 6 strats, multiple occupations, 19 features, abundant mussel shells, no dates. 50 dart points, Darl and other dart points in Stratum II & III 78 bones, no bison. 126 arrow points Austin and Toyah	Stephenson 1970
Buzzard Shelter (41-26D7-12)	Excavations	1950, 1957-58	Three occupations, 5 features, all Toyah, 166 arrow points, few Scallorn points, 6 dart points, no dates. Caddona pottery, abundant mussel shells,	Stephenson 1970
Steel Site (41HI38)	Excavations	1950	deep deposits, 15 ft., stratified, 12 features, no bone, abundant mussel shells in Archaic, no dates, 75 dart points, some Darl and Ellis dart points,	Stephenson 1970
Blum Shelter (41HI8)	Excavations	1952	Austin materials, a C14 date of 1410 ± 120 B.P. (TX-10) from deepest part of Austin occupation.	Stephenson 1970, Jelks 1953, Stipp et al. 1962

Table 3-2, continued

Project Name	Effort	Year	Discussion	References
Kyle Shelter	Excavations	1959-60	Mixed, 6 strats, 10 features, Late Archaic = 47 darts, 381 arrow points, Austin, Toyah, three C14 dates, 7 Godley point type named, Granbury arrow point named, biface types = Friday, Covington, and Cleburne, 1389 to 389 B.P. 1192 bones,	Stephenson 1970, Jelks 1962
Forrester Cave	Excavations	1957-58	Shallow, 31 arrow points, mostly Scallorn	Stephenson 1970
Little Buzzard Shelter	Excavations	1950	Shallow, mixed deposits, 114 arrow points, mainly Perdiz and Scallorn points, 38 dart points	Long 1961, Stephenson 1970
Sheep Shelter	Excavations	1957-58	Multicomponent, Late Archaic Darl, Scallorn, Toyah artifacts, no dates.	Stephenson 1970
Bear Creek Shelter (41HI17)	Excavations	1976, 1978	Deposits 4 m deep with 25 features with Middle, Late, Transitional Archaic and Austin and toyah phase materials. 12 C14 dates ca. 4200 to 300 B.P. Two zone of Transitional Archaic but with multiple point types (Darl, Kent, Ensor, Ensor, and Ellis).	Lynott 1978
Aquilla Reservoir	Survey	1972	125 sites recorded	Skinner and Henderson 1972; Lynott and Peter 1977
	Testing	1975	29 sites investigated	Lynott and Peter 1977; Skinner et al. 1978
	Excavations	1978--82	23 sites investigated, 11 limited assessments,	Brown et al. 1987
McDonald (41HI105)	Excavated	1978-80	20 units in Area A, alluvial terrace, 4 m deep, *Amblema plicata* dominated in lower levels, good stratigraphy, Late Prehistoric best defined with 83 arrow points, 12 darts with 1 Darl in level 17, 2 Godley points, 12 dates, 6 on charcoal and 5 mussel shells, Late Archaic -Late Prehistoric times.	Brown et al. 1987
McKenzie (41HI115)	Excavated	1978	Alluvial terrace, 280 cm deep, 80% *Amblema plicata,* likely single component, 1 stratum of mussel shells, few lithics. Five C14 dates, 2 on mussel shells, 3 on soil humates range from ca 1000 to 2300 B.P. No diagnostic artifacts.	Brown et al. 1987
Pilgram (41HI124)		1978	Upland, 1 Darl point	
Sour Mash Site (41HI34)	Burial Excavation	1964	Loosely flexed female burial, covered with rock slabs, 40 to 45 years of age at 121 cmbs, with two Gary points in grave fill near knees, and broken stem embedded in right tibia. Long bones dated to 2060 ± 210 B.P. (Tx-not given). Many point types collected from surface.	Chandler 1985
Lake Waco	Survey	1950	Shoreline survey after reservoir built recorded 23 sites	Duffield 1959; Story and Shafer 1965; Prikryl and Jackson 1985
Baylor Site (41ML35)	Tested, Excavated		Testing in alluvial terrace with cultural materials to 3.6 m. Austin and Toyah phase materials to 80 cmbs, Late Archaic artifacts to 100cm, Middle Archaic artifacts to 180 cm. Multiple occupations with multiple dates and quantities of artifacts. Austin dates but no Scallorn points. Mixing in lower levels.	Story and Shafer 1965; Scott et al. 2002; Mehalchick and Kibler 2008

Table 3-2, continued

Project Name	Effort	Year	Discussion	References
Britton Site (41ML37)	Tested, Excavated		Tested an alluvial terrace with 5.5 m thick deposits. Stratified deposits to 3 m dominate by Late Archaic artifacts and features. Thick deposits dominated by Late Archaic artifacts including Darl, Godley, Ensor dart points with 4 dates between ca. 1890 to 1550 B.P. Quantities of mussel shells and 110 features. Ran 44 dates on feature contents.	Story and Shafer 1965; Scott et al. 2002; Mehalchick and Kibler 2008
Fort Hood	Testing	1993-94	Assessed 57 prehistoric sites with 186 trenches, 212 test pits that yielded 78,000 artifacts. At least 16 sites with 13 charcoal dates between 1000-1500 B.P. with and without diagnostics associated.	Abbott and Trierweiler 1995
	Testing	1994-95	Assessed 56 prehistoric sites with 187 trenches, 158 units that yielded ca. 81,000 artifacts. Ran 74 radiocarbon dates, 65 on charcoal, 8 on landsnails, and 1 on bone. 29 dates fall within the Late Archaic and 20 in the Late Prehistoric. 10 dates between 1140 and 1410 B.P. 13 Darl/Mahomet points in 7 sites.	Trierweiler 1996
	Testing	1996	Assessed 42 prehistoric sites with 140 trenches, 188 test units that yielded 14,211 artifacts and 74 features. At least 7 Analytical Units with Darl /Zephyr points and 4 features with C14 and Darl points in association. At least 4 Analytical Units with Scallorn points with one C14 date in association.	Kleinbach et al. 1999
	Testing	1997	Assessed 52 prehistoric sites with 124 trenches, 84 shovel tests, 96 test units, that yielded 14,211 artifacts, and 21 features. Zephyr points were in 2 sites, (41CV382 & 41CV1329) with one dated to 1900 ± 120 B.P. (Beta-119135) and 1840 ± 60 B.P. (Beta-119137).	Melhalchick et al. 2000
Belton Reservoir	Survey	1949, 1950, 1962	Stephenson recorded 38 sites, then Miller and Jelks recorded 12 sites, followed by Shafer et al. who recorded another 30 when the reservoir was raised another 10 m.	Stephenson 1949; Miller and Jelks 1950; Shafer et al. 1964
North Fork Reservoir	Survey	1978	Park and recreation areas surveyed. 44 sites were recorded.	Patterson and Moore 1976; Patterson and Shafer 1980, Moore et al. 1978; McCormick 1982a
	Testing	1976	9 prehistoric sites tested, no C14 dates.	Hays 1982; McCormick 1982b
41WM328	Testing		Twin Sister components, Area B = Darl in Features 15, 16, 17, with 2 C14 dates, 1460 and 1610 B.P. (UGA-2481 & 2483). Austin phase = Features 2 & 9, Feature 2 C14 date of 1290 ± 100 B.P. (UGA-2470) with scallorn point.	Peter et al. 1982
41WM53	Data Recovery		Area B yielded 6 Darl points in Level 4 associated with two Features, 3 and 4, a C14 date of 1260 ± 150 B.P. (UGA-2484) from Feature 3; 1155 ± 95 B.P. (UGA-2471) from Feature 4. Mixed Scallorn, Darl, Fairland/Ensor in Levels 3 & 4.	Peter et al. 1982

Table 3-2, continued

Project Name	Effort	Year	Discussion	References
Granger Reservoir	Survey	1963, 1968, 1976, 1978	22 sites in reservoir. Another 29 site recorded in park and recreation areas. No C14 dates	Shafer and Corbin 1965; Eddy 1973; Patterson and Moore 1976; McCormick 1982a; Hays 1982
Hoxie Bridge (41WM130)	Excavated	1977	Multicomponent site with Late Archaic - Late Prehistoric deposits. From ca. 1740 - 700 B.P. based on 4 dates. 48 features were present. One Darl point was directly associated with a date of 1740 ± 100 B.P. (Tx-2731) in from Feature 16. Bones of turtle, deer, large mammal.	Bond 1978
Loeve-Fox (41WM230)	Tested, Excavated	1972-73, 1978	Stratified site in Alluvial deposits, with Darl component that lacked bison bones but had turtle, deer, and gopher bones. Stratum 2 contained only Darl points (12), 15 features, basin hearths, ash pits, mussel shells cache, 1 date of 1640 B.P. from F44, over 30 to 90 cm thick zone. A suite of stone tools.	Prewitt 1974, 1982
J. B. White (41MM341)	Data Recovery	2002	Well preserved stratified components of Late Prehistoric occupations from 650 to 1150 B.P. The 208 m2 yielded 303 chipped stone tools, massive faunal remains and burned rocks. Ran 34 dates on feature contents.	Gadus et al. 2006
Smith Rockshelter (41TV42)	Data Recovery		Early to Transitional Archaic, Late Prehistoric. No dates. 16 Darl & 2 Ensor points in Layer I (lowest, 66 to 103 inches). Bison bones in layer I with turtle, and deer bones.	Suhm 1957
Proctor Reservoir	Survey	1959	40 sites identified, most shallow and extensively disturbed	Prewitt 1964
Terri Site (41CJ2)	Testing	1963	In sandy soil, poorly stratified, to 120 cmbs, 288 artifacts, 34 arrow points, few dart points.	Prewitt 1964
Lightfoot Site (41CJ23)	Testing	1963	Artifacts mixed, no features, no dates, Archaic = 17 darts with 2 Darl, Late Prehistoric with Scallorn and others, Henrietta focus.	Prewitt 1964
Upper Clear Fork Survey	Survey			Wulfkukle 1986
Stamford/Paint Creek/Oak Creek	Survey			Jelks and Mooreman 1953
Brazos Natural Salt Pollution Project	Survey			
Truscott Brine Control Lake	Survey		At least 10 Late Archaic sites, at least 11 Terminal Archaic sites, points include 2 Darl, 2 Elam, 1 Yarbrough, 1 Kent, 4 Ellis.	Etchieson et al. 1978
Crowell Reservoir	Survey	1977	Tributary of Pease River, 184 sites identified, 12-14 Late archaic sites, 9 Terminal Archaic, 67 dart points recovered.	Etchieson et al. 1979
	Testing	1995	22 sites tested	Peter et al. 1997
Bridgeport Reservoir	Survey		NA	No final report
Grapevine Reservoir	Survey	1948	9 prehistoric sites recorded, no further work.	Stephenson 1948, 1949a, 1949b;

Table 3-2, continued

Project Name	Effort	Year	Discussion	References
Prickryl's M.A. Thesis	Survey	1968	Reanalysis of previous sites and collections from 238 sites.	Prickryl 1991
Lewisville Reservoir	Survey	1948	27 sites recorded during reconnaissance. No major excavation before inundation.	Stephenson 1948, 1949a, 1949b;
Ray Roberts Reservoir	Survey & Testing	1972, 1973, 1980, 1981,	25 prehistoric sites recorded. The 1980-81 survey recorded 90 prehistoric sites. Testing occurred at selected sites.	Bousman and Verrett 1973; Skinner & Conner 1979; Raab 1982; Skinner et al. 1982; Skinner & Baird 1985; Skinner 1985
	Test Excavations 41CO141	1986	Exhibits stratified deposits, buried soil with C14 date of 1750 ± 92 B.P. Late Archaic artifacts, Gary, Gary-like, and Ellis/Ensor points, & features in lower part of buried soil, single human burial is same component,	Prikryl and Yates 1987
Lavon Reservoir	Survey	1948	25 sites recorded during reconnaissance	Stephenson 1948, 1949a, 1949b; Lynott 1975
Benbrook Reservoir	Survey	1948	No sites recorded during reconnaissance	Stephenson 1948, 1949a, 1949b; Brown & Lebo 1991; Lebo & Brown 1990
Richland Chambers Resersvoir	Survey		447 prehistoric sites recorded	Bruseth & Martin 1987; McGregor & Bruseth 1987
Bird Point Island	Excavated		Excavation of Wylie focus pit revealed three stratigraphic zones. The bottom zone (3) yielded human burials, hearth, roast pit, a Gary point, and three dates on human bone; 2057 ± 239 B.P. (SMU1173), 1914 ± 203 B.P. (SUM-1180), and 1810 ± 110 B.P. (Beta-5598). Middle zone (2) yielded 3 small pits, human cremations dated to 1230 ± 140 B.P. (Beta-8388) and 1250 ± 100 B.P. (Beta-5593), 2 Scallorn, 2 Alba, 14 Gary, 2 Dason, 1 Yarbrough points.	Bruseth & Martin 1987

Prikryl concluded that most collections represent temporally mixed assemblages and that the Carrollton focus previously assigned to the Middle Archaic (Crook and Harris 1952:38; Lynott 1977:82) and the Late Archaic Elam foci (Crook and Harris 1952) are invalid taxonomic units. An earlier investigation from Richland Creek Reservoir in Navarro County indicated that the Late Prehistoric Wylie focus of north-central Texas was also invalid (Bruseth and Martin 1987:284). Story (1990:229) proposed that the pit features from the area that had been labeled "Wylie focus pits" would better be called Wylie pits.Prikryl's (1990) work created a general chronological framework that divided the known prehistory into six periods. The diagnostic projectile points that represent the last three periods are depicted in Figure 3-2. Several of Prikryl's general statements are important to this particular study. His re-evaluation placed the Late Archaic between 3500 and 1250 B.P., followed by the Late Prehistoric I period to about 750 B.P.

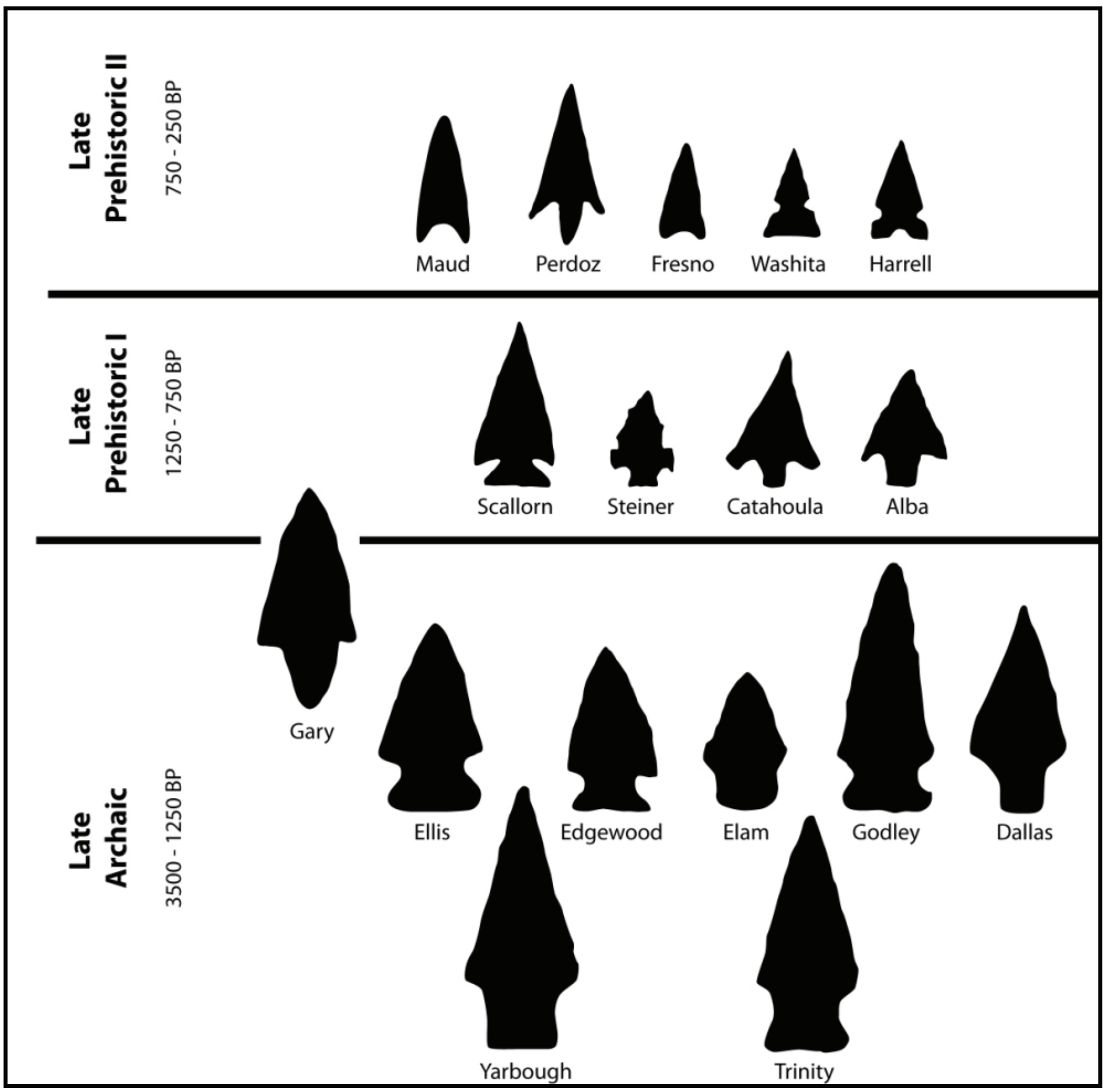

Figure 3-2. North–Central Texas Diagnostic Projectile Points Over the Last 3500 Years (after Prikryl 1990).

This Late Archaic period is represented by the greatest site density in the region, more than 3.5 times that of the earlier Middle Archaic. Prikryl sees the Gary point as the most common diagnostic projectile point of the Late Archaic point styles. Other common point types include the Dallas, Trinity, Godley, Ellis, Elam, and Yarbrough.

Figures 3-3 and 3-4 provide a general horizontal distribution across Texas for point types recognized. Prikryl (1990) believes these point styles indicate cultural affiliations with areas to the north and east. He sees a definite lack of Late Archaic points or styles indigenous of central Texas.

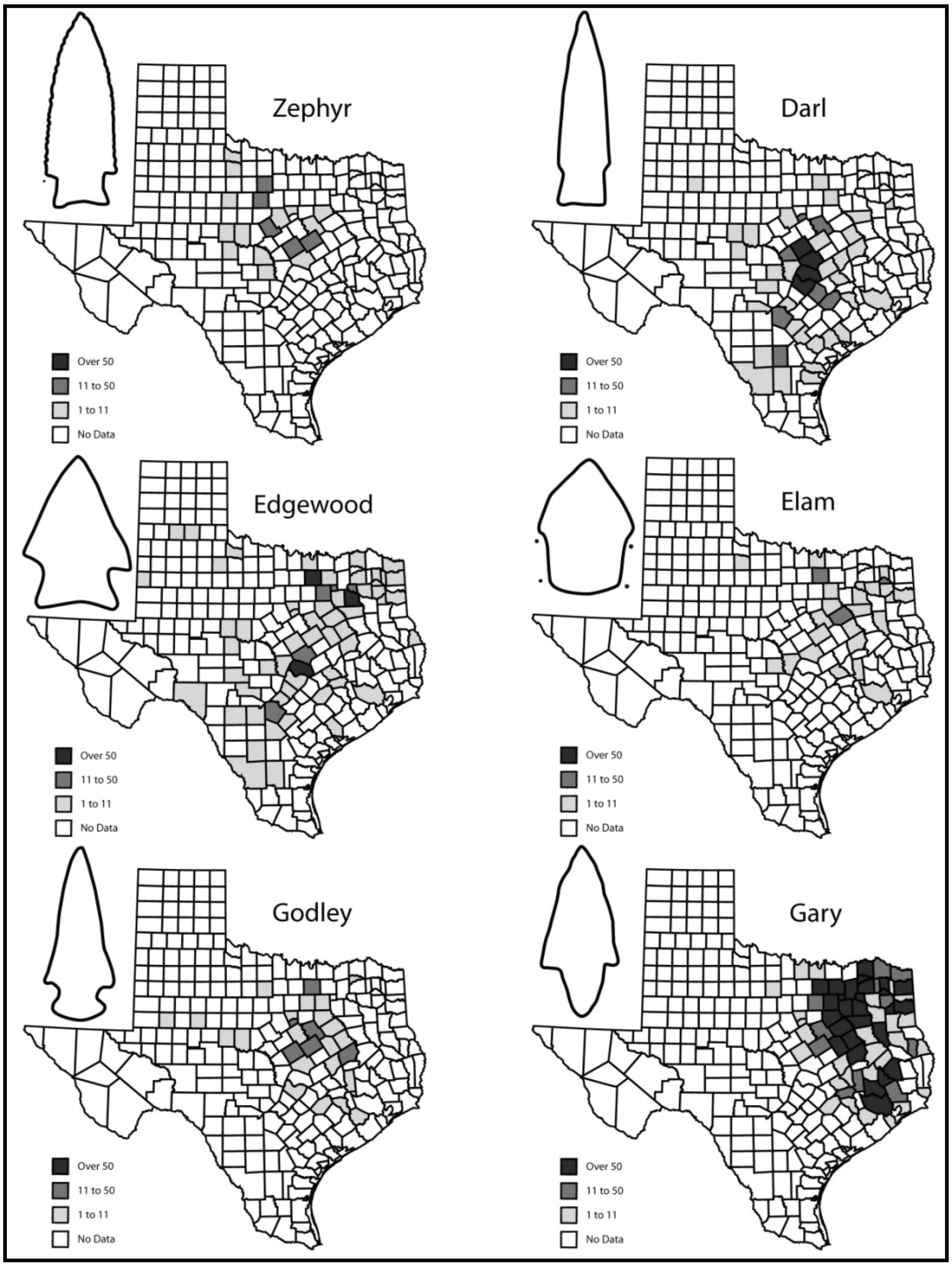

Figure 3-3. Diagnostic Project Point Distributions (adopted from Prewitt 1995).

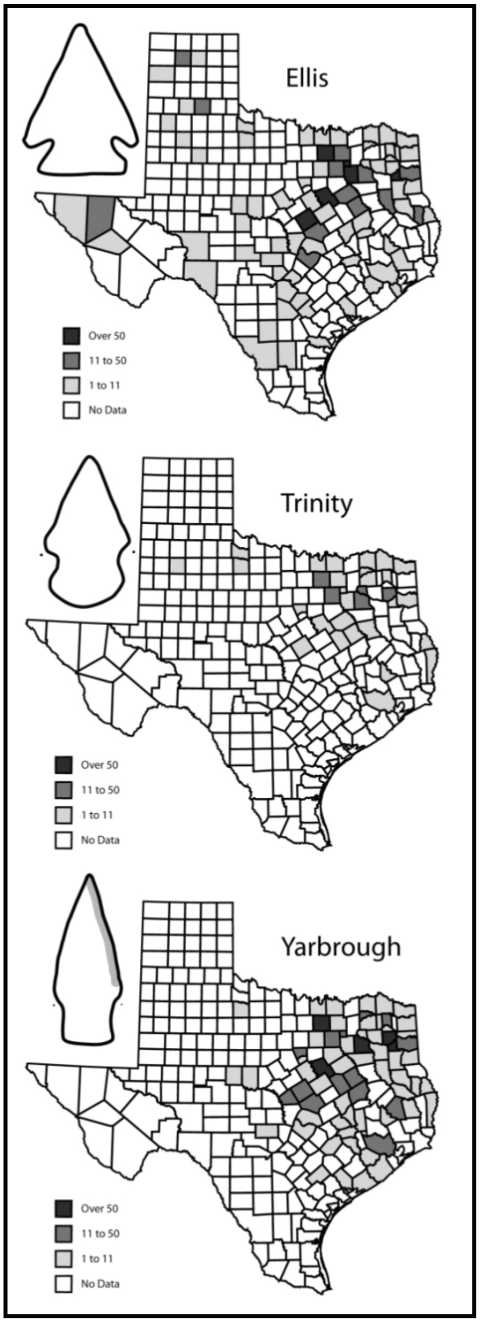

Figure 3-4. Diagnostic Project Point Distributions for Ellis, Trinity, and Yarbrough (adopted from Prewitt 1995)

This period also experienced a dramatic increase in the use of local quartzites in the production of chipped stone tools. Generally, twice the amount of tools were made from quartzites as were made from chert. As many before him (Skinner 1981; Story 1981; Prewitt 1981; 1985), Prikryl interprets the increased number of Late Archaic sites to a population increase. One of the concluding remarks by Prikryl (1990) is that despite all the surface investigations in the north-central Texas region, understanding of the prehistoric record continues to suffer from the lack of well-reported, large-scale excavations. Even the few radiocarbon dates available lack tight association with diagnostic artifacts, and generally occur with multiple point styles.

3.2.1.1 Radiocarbon Data from Late Archaic Sites in North-Central Texas

One of the few dated Late Archaic sites in Prikryl's study area was the stratified site of 41CO141 on the Elm Fork floodplain in the Ray Roberts area (Prikryl and Yates 1987; Prikryl 1987, 1990). There, a Late Archaic component yielded four cultural features, diverse faunal remains, and three diagnostic projectile points in a paleosol. A radiocarbon date on composite charcoal of 1750 ± 90 B.P. (Beta-16417) was obtained from 138 to 148 cmbs. This Late Archaic component was near the base of the paleosol. This same component also yielded one Ellis/Ensor, a Gary, and a Gary-like point directly associated with the radiocarbon date (Prikryl 1987:83). With so few radiocarbon dates, it is not clear when the starting and ending dates of the Late Archaic occurred.

Since Prikryl (1990) proposed his chronology, five sites have been tested and reported upon along Elm Creek in 1988 in the Lewisville Lake area (Brown and Lebo 1991; Ferring and Yates 1998). These sites contained Early/Middle Archaic to Late Prehistoric II occupations. They also provided a few charcoal radiocarbon dates and important information on the use of the raw materials employed by the site inhabitants. These sites provide some information pertinent to this project and are briefly discussed here.

Site 41DN20 was a buried site contained within a sandy colluvial sediment as a relatively thin occupation zone. It yielded a suite of projectile point styles that included Palmer, split-stem, straight stem, Tortugas, Kirk, Wells, Trinity, and side notched forms, which are postulated to represent the Early to Middle Archaic periods. The sandy sediment did not foster preservation of bone or charcoal. The site lacks radiocarbon dates to document the absolute age of the deposits, but is one of the few intact sites of this age in the region (Ferring and Yates 1998:59).

Site 41DN26 yielded diagnostic projectile points and ceramics that indicate occupations during the Late Archaic, Late Prehistoric I and Late Prehistoric II periods. The site was repeatedly occupied without clear definition between occupational zones in the ca. 140 cm of sandy loam colluvial deposits. These deposits also suffer significantly from bioturbation. Two radiocarbon dates on scattered flecks of charcoal are uncorrected 620 ± 60 B.P. (Beta-32533) from level 5 and uncorrected 480 ± 70 B.P. (Beta-32534) from level 10. However, the projectile point assemblage is dominated by Gary dart points. Ferring and Yates (1998:68) indicate that Gary points were associated with Scallorn, Bonham-Alba and Catahoula forms that have been dated to ca. 850 to 900 B.P. at Lake Ray Roberts (Ferring and Yates 1997; Lynott 1981). The authors speculate that the Gary dart points were being scavenged and used as blanks for arrow points (Ferring and Yates 1998:71).

Site 41DN27, also in a sandy colluvial-slope context, yielded a well preserved Late Prehistoric II occupation that overlies a poorly preserved Late Archaic occupation in ca. 60 cm of bioturbated deposits. Some 24 cultural features, which represented at least five functional types, were identified in Block 1. At least two hearth features (undated) were thought to represent the Late Archaic period and the other the Late Prehistoric occupations. Two radiocarbon dates on scattered flecks of charcoal, one uncorrected date of 500 ± 80 B.P. (Beta-32536) from Feature 12, and an uncorrected date of 680 ± 90 B.P. (Beta-32535) indicate Late Prehistoric II events. Gary and Godley type dart points were common throughout the upper levels together with late arrow points that included Washita forms. Thus, the points were not in any stratigraphic order as one might hope, and apparently reflect mixed deposits (Ferring and Yates 1998).

Site 41DN372 is on a flat Pleistocene terrace, which again does not contain any recent deposition. Thus, the superimposed cultural materials were subjected to mixing through bioturbation. The deposits were roughly 100 cm deep with no obvious stratification to the deposits, and no vertical separation was detected in the cultural materials encountered. However, intact cultural features were encountered and documented in the sandy deposits. A single radiocarbon date on charcoal from near the middle of the deposits (level 7) yielded an uncorrected age of 610 ± 90 B.P. (Beta-32980). The site yielded a relatively high frequency of dart (N = 33) and arrow (N = 134) points representative of the Late Archaic, and the Transitional Late Archaic to Late Prehistoric periods (Ferring and Yates 1998). The dart points included 12 Gary, 4 Godley, 2 Elam, 2 Darl, 2 Dallas, and 4 Kent specimens. Although a relatively significant faunal assemblage was recovered, the bones were vertically dispersed with no obvious vertical segregation indicative of specific time periods.

Site 41DN381 is on a gentle colluvial slope with roughly 80 cm of sandy deposits. Cultural materials, including a relatively large number of features (hearths and pits), a diverse stone tool assemblage, ceramics, faunal remains, and dart and arrow points were, once again, scattered throughout the deposits. One radiocarbon date on scattered flecks of wood charcoal and one charcoal sample came from Feature 8. Both dates, 790 ± 70 B.P. (Beta-32981) and 490 ± 70 B.P. (Beta-32531), document at least two Late Prehistoric occupations and the age of those specific features, but not an associated artifact assemblage. The Late Archaic component is in the lowest part of the site and may represent multiple occupational events.

The data obtained from these five tested sites in the Lewisville Lake area are good examples of the problems related to defining an absolute cultural chronology for the north-central Texas archeological region. Archeological sites within colluvial slopes and Pleistocene terrace deposits are typical of north-central Texas. These less-than-ideal settings have been extensively bioturbated, thereby providing poor contexts for associating the dated materials and the recovered artifact assemblages. Poor associations in these contexts make it nearly impossible to gain clear and meaningful understanding of the cultural entities/assemblages.

Trinity River Basin

Testing at 41TR174 in Tarrant County, along the West Fork of the Trinity River in Arlington, yielded important information concerning the Late Archaic period. Analytical Zone II consisted of a 40 cm thick zone of moderately dense cultural materials that included six hearths and discard features, and sparse artifacts. Five radiocarbon dates on mussel shells (*Quadrula houstonensis*) from four features (Features 3, 4, 6, and 8) cluster between 1840 ± 40 B.P. (Beta-180118) and 2000 ± 60 B.P. (Beta-180121) (Lintz et al. 2004). These cultural features and associated materials were near the middle of a nearly 200 cm thick buried paleosol. Unfortunately, this isolated Late Archaic component yielded no diagnostic projectile points and very limited quantities of other materials in association with the intact cultural features. Again these results are typical for the region. Radiocarbon dates were obtained from good contexts on mussel shell, but the deposits lacked projectile points and charcoal to compare with the mussel shell dates.

Another example was the testing investigations conducted at 41TR170 in alluvial terrace deposits of the Clear Fork of the Trinity River in Tarrant County (Lintz et al. 2008). Late Archaic cultural remains dating to roughly 1360 to 1570 B.P. were encountered in stratified deposits within the West Fork paleosol. The West Fork paleosol occurred between 59 and 152 cmbs and was radiocarbon dated through bulk sediments to between 2300 ± 50 B.P. (Beta-205062) and 860 ± 70 B.P. (Beta 205060). Nineteen cultural features that represent multiple types were encountered and included burned rock scatters/dumps (*N* = 8), burned rock pit hearths (*N* = 5), a burned rock midden, one dark organic stain, one rock oven, one possible burned rock griddle, and three unknown. In contrast to most sites in this region, these features yielded charcoal, but in only limited amounts. In this unique situation the meager wood charcoal was sufficient to provide a series of radiocarbon dates from four features. The five feature dates cluster between 1310 and 1570 B.P. Quantities of mussel shells were present (*N* = 2,254) at this site, but not in identifiable clusters, although shells occurred with 18 of the 19 features. As in other sites in the region, the manual excavations of 30 m^3 yielded a meager stone tool assemblage that included some 219 pieces of lithic debitage, and 5 formal and 9 informal tools, both indicating a very low artifact density. However, four dart points were recovered and include one Trinity, one Yarborough, one possible Dallas, and one unidentifiable point. The Trinity point appeared to be associated with burned rock oven Feature 17, which yielded a wood charcoal date of 1310 ± 40 B.P. (Beta-213099). The Yarborough point was associated with Features 9, 11, and 13. Feature 13 was radiocarbon dated to 1360 ± 40 B.P. (Beta-213094). Here, the Yarborough and Trinity points both were associated with radiocarbon dates that place them into the Transitional Late Archaic period. Another unusual aspect was that the artifacts were made from chert gravels and not quartzites. The subsistence data indicate that mussel shells were important with turtle, deer and rabbits also present. The site was used intermittently during a 260 year period of the Transitional Archaic from 1310 to 1570 B.P. and was interpreted to reflect short-term, probably specialized extraction or processing activities (Lintz et al. 2008).

Another important factor considered Prikryl (1990) is Ferring's (1986) earlier model for terrace development in the Upper Trinity River basin, which included the development of the West Fork paleosol in floodplain settings. The initial radiocarbon dates obtained for this paleosol yielded $\delta^{13}C$ corrected ages of 1410 ± 105 B.P. (Beta-14904) and 1300 ± 63 B.P. (Beta-14908; Prikryl 1990). Subsequently, Ferring (1987) reported a date of 1060 ± 50 B.P. (Beta-16416) for the upper part of this same paleosol and a sediment date of 1050 ± 70 B.P. (Beta-180122) was obtained from the top of the massive paleosol at 41TR174 (Lintz et al. 2004). Bulk sediment radiocarbon dates that were $\delta^{13}C$ corrected from 41TR170 indicate the paleosol began to accumulate around 2300 B.P. (Beta-205062) and ended about 1240 B.P. (Beta-205063), or even perhaps as late as 860 B.P. (Beta-205060; Lintz et al. 2008). The four mussel shell dates from four features in a Late Archaic component in the middle of the West Fork paleosol at 41TR174 mentioned above average to 1910 B.P., combined with the sediment date of 3470 ± 50 B.P. (Beta-180123) at the bottom of the paleosol, provide a general time period for the development of the West Fork paleosol in this region. The West Fork paleosol contains Late Archaic components (i.e., Prikryl and Yates 1987; Lintz et al. 2003; Lintz et al. 2008) and ranges between 3500 and 1000 or ca. 860 B.P. The identification of the paleosol indicates a slow, gradual aggradation of limited sediment on the floodplain over time and is a cumulic, over-thickened A horizon soil. The attributes contributing to the development of the West Fork paleosol, such as physical landscape, vegetation, climate, etc., no longer occur in this location. These conditions potentially reflect a wetter environment. If so, this may have facilitated a westward expansion of the Western Cross Timbers. This, in turn, may have increased the number of the plant and animal resources across this general region.

It should be pointed out that the West Fork paleosol was defined from exposures along the West Fork of the Trinity River in central Tarrant County (Ferring 1986:93). However, this same paleosol is basin-wide (Ferring 1987). A similar cumulic paleosol is reported from late Holocene floodplains throughout the Southern Plains. It was first recognized and documented by Hall (1977, 1978, 1982, 1988, and Hall and Lintz 1984) and labeled as the Copan paleosol. The West Fork paleosol is equivalent to the Copan paleosol, the Navarro paleosol (Bruseth et al. 1987), and the Asa soil (Waters and Nordt 1995). This wide spread buried soil is a reflection of general climatic conditions across the region. This generally thick soil developed during more mesic conditions with thin or relatively slow deposits of alluvium. As a result, freshly deposited sediments were incorporated into the A horizon allowing the soil to accumulate deposits and continually build or thicken.

Although bone preservation is quite poor throughout much of the north-central region, Lynott (1979) asserts that bison populations were present in the region during prehistoric times. He suggests that bison density increased in north-central Texas during the Late Neo-American period (now referred to as Late Prehistoric period) (750 to 350 B.P. or A.D. 1200 to 1600). He lists at least 15 sites along the Brazos River, downstream from Young County, that have yielded reported bison remains, including the Harrell, Pictrograph, Kyle, Hamm Creek, and Bear Creek sites. When present, bison would have served as one of the many resources targeted by the prehistoric populations, and one not likely to have been overlooked. However, if turbation was as extensive as perceived, this fact may be skewing our understanding of bison presence in one particular period. The authors link the presence of bison during the Late Prehistoric period to increased moisture.

Although not many human remains have been recovered and/or assigned to the Late

Archaic period for which much is known, the burial from 41OC141 did provide interesting information. The body was that of a 40 to 50 year old women about 160 cm tall, in a generally healthy state, with a diet that emphasized plants over animals (Prikryl and Yates 1987).

3.2.2 The Central Texas Archeological Region

The archeological record in central Texas has grown tremendously over the last three to four decades. As the amount of archeological data has increased, various researchers have provided updates to the earlier archeological record by providing reviews or syntheses (Suhm et al. 1954; Suhm 1960; Johnson et al. 1962; Johnson 1967; Weir 1976; McKinney 1981; Prewitt 1981, 1985; Black 1989; Johnson and Goode 1991; Ellis et al. 1995; Collins 1995a, 2004). The goal is to provide a brief overview of the latest understanding of the last 2,000 years of central Texas archeological chronology. The actual sequence of the projectile point styles through time was established early on through such sites as the Smith (Suhm 1957), Blum (Jelks 1953), and Kyle rock shelters (Jelks 1962), sites at Canyon Reservoir (Johnson et al. 1962), Youngsport (Shafer 1963), and Landslide and Evoe Terrace (Sorrow et al. 1967). This is further supported by many excavated, stratified sites (i.e., Loeve-Fox [Prewitt 1982a, 1982b], Mustang Branch [Ricklis and Collins 1994], Wilson Leonard [Collins 1998], Rainey [Henderson 2001], Culebra Creek [Nickels et al. 2001], 41MM340 [Mahoney and Tomka 2000; Mahoney et al. 2003], and McKinney Roughs [Carpenter et al. 2006]) (see Figure 3-1 and Table 3-1). However, during the 1975 symposium concerning the Texas Archaic, Shafer (1976) stated, "We are still trying to build chronologies in certain areas… and there are yet areas where we need much tighter time control for the archaeological data." We have been gradually filling in the gaps of our knowledge and better defining the region chronology, but this is still an ongoing process.

3.2.2.1 Cultural Periods and Associated Time Frames

Most likely, many archeologists would acknowledge that the beginning and ending dates for particular cultural complexes are still being determined and, consequently, most authors offer only estimates of those beginning and termination dates. As Collins (1995a, 2004) points out in his abstract, the accomplishments in the archeology of central Texas "are notable and diverse, but scientific maturity has not been achieved." Collins (1995a, 2004) stresses the nature of the region's archeological record and critiques the practice of archeology in central Texas, provides a brief summation of what is known, and suggests some ways to significantly improve knowledge. The goal is not to cover all that is known, but rather to focus primarily on the Late Archaic period, which is the period of the principal component investigated at 41YN452. A couple of points worth mentioning are that Collins stresses the importance of *gisements*, a French word that means a discrete stratum within an archeological site. He also stresses that gisements can be isolable components that provide optimum conditions for isolation of discrete assemblages of cultural material, and also that it is advisable to apply interdisciplinary analyses when investigating these isolable components.

In terms of the Late Archaic, Collins (1995a, 2004) follows Johnson and Goode (1994) and sees this as a relatively long period beginning roughly around 4000 B.P. and lasting until ca.1200/1300 B.P. (2000 B.C. to A.D. 650/750), although Johnson and Goode place the end the Late Archaic at around 1350 B.P. (A.D. 600) (Figure 3-5). It should be pointed out that Johnson and Goode present true calendar ages that have been calibrated via Stuiver and Reimer (1993), unlike most reported ages found in the archeological literature, which are often presented as uncalibrated B.P. ages. Researchers must be careful when citing ages in print and even using the generic time periods (i.e., Late Archaic) as time markers, now that Johnson and Goode (1994) have proposed significant changes to this specific period, linked to the more general terms of Middle and Late Archaic.

This is especially true when reading the older literature. The most recent synthesis by Johnson and Goode (1994), which is followed by Collins (1995a, 2004), do not use the term Transitional Archaic as used by Johnson et al. (1962) and employed for years. However, this term does occasionally show up in the literature to indicate the last phase or complex proceeding the use of the bow and arrow.

The different dart points that are generally linked to the Transitional Archaic include the Darl and Provisional Type II (now often referred to as Figueroa). In fact, Weir (1976:11) indicted that dart points may have persisted after the introduction of the bow and arrow. In Weir's (1976) proposed chronology, his Twin Sisters phase, which included Ensor and Frio points, is estimated to fall between 2000 and 700 B.P.

He also says that the Darl and Fairland dart points commonly precede components bearing arrow points. Weir (1976) sees the Frio as the oldest of the other Late Archaic points in his Twin Sister phase and the Ensor as the last dart point associated with bison hunting. He also documents that the intensity of unifacial tool use drops sharply. In terms of subsistence, Weir sees a very diffuse economy relying on small game and a variety of plant resources. However, he has little direct evidence for this pattern.

Weir's (1976) Late Prehistoric period, marked by the introduction of the bow and arrow, was postulated to last from 1500 to 400 B.P. This projected time frame denotes obvious overlap of the two hunting technologies, the atlatl and bow and arrow. He also sees a continuation of the previous Archaic subsistence pattern.

Collins (1995a, 2004) breaks the Late Archaic into six stylistic intervals (an obvious change from the previous use of named phases of Weir [1976] and Prewitt [1981, 1985]) based on differences in projectile point styles. These are similar to what Prewitt (1981, 1985) referred to as his key index markers. In a major departure from Prewitt (1981, 1985), Johnson and Goode (1994) interpret the Late Archaic period to begin with Bulverde points; followed by the Pedernales and Kinney; then the Lange, Marshall, and Williams group; then the Marcos, Montell and Castroville group; into the latter part of this period with the Ensor, Frio and Fairland group; and ending with the Darl type/style (see Figures 3-3, 3-4, and 3-5 for distribution of these point types).

Archeological Periods	Years B.P.	Diagnostic Artifacts
Historic		
Late Prehistoric	-1,000-	Perdiz Scallorn, Edwards
Late Archaic	-2,000- -3,000-	Darl Ensor, Frio, Fairland Marcos, Montell, Castroville Lange, Marshall, Williams Pedernales, Kinney
		Bulverde
	-4,000-	

Figure 3-5. General Central Texas Chronology over the Last 4,000 Years with Diagnostic Point Types (Collins 2004; Johnston and Goode 1994)

Therefore, at least 12 diagnostic projectile points (styles) are being considered as part of a lengthy Late Archaic period. Although the diagnostic projectile names are similar to Prewitt's (1981, 1985), their assignment to the eras have significantly changed from Prewitt's. Collins follows Johnson and Goode (1994) in placing the earlier styles, including Bulverde, Pedernales, Marshall, Williams, and Lange points, within the Late Archaic period. The reader is referred to Johnson and Goode (1994) for details of their argument for this assignment. Prewitt (1981, 1985) had assigned these later index markers to the Middle Archaic. Collins (1995a, 2004), like Johnson and Goode (1994), dropped the use of the named phases (i.e., Marshall Ford, Round rock, San Marcos, Uvalde, Twin Sisters, Driftwood) that Weir (1976) and Prewitt (1981, 1985) identified and that had been in use for over 30 years.

Johnson and Goode (1994) divided the Late Archaic into subperiods I and II, with the Castroville style being the transitional type at ca. 2600 B.P. They used the production technique in the manufacture of projectile points as the critical means of separating the Late Archaic subperiods. According to Johnson and Goode, the projectile points from Late Archaic I, which include the broad bladed Pedernales, Marshall, and Montell point types, were all made using precise billet thinning (Johnson 1995). They believe this same billet thinning strategy was used in the manufacture of oval knives that occur contemporaneously. Collins (1995a, 2004) did not employ this subdivision in his short synthesis.

Johnson and Goode (1994) see the Late Archaic II subperiod as extending from roughly 2550 to 1350 B.P. (600 B.C. to A. D. 600). They provisionally terminated the Late Archaic at that time because of the appearance of arrow points, with the Sabinal and Edwards styles entering the region from the eastern part of the Edwards Plateau. This termination time is based on the Rainey site (41BN33) data from west of San Antonio in Bandera county where Edwards points were associated with a radiocarbon date of 1410 ± 90 B.P. (calibrated to A.D. 672; Beta-37292; Henderson 2001). This site is towards the southern margin of the Edwards Plateau, just west of San Antonio. If the date is accepted, this may indicate where the bow and arrow using populations first entered the region. However, there is some question concerning the radiocarbon dates derived from this site (Henderson 2001). Johnson and Goode (1994:40) point out that the ending of the Late Archaic II subperiod is most subjective and "bothersome."

Collins (1995a, 2004) states that the Late Archaic is well represented by excavated sites, but then only lists three sites (Loeve Fox – 41WM230, 41TG91, and Anthon - 41UV60) as having high integrity and a couple of other sites (Bullpin and Youngsport) as having moderate integrity. He states that only a few have good stratified contexts and the earliest Late Archaic style (Bulverde) is not known from well stratified components.

Radiocarbon Dates from Archeological Sites of the Late Archaic Period in Central Texas

More recently, data recovery excavations at the stratified McKinney Roughs site (41BP627) along the lower Colorado River in Bastrop County southeast of Austin revealed an intact Darl component (Carpenter et al. 2006). This Darl component was radiocarbon dated by two charcoal samples from intact cultural hearths (Features 3 and 7) to 850 ± 110 B.P. (Beta-169225) and 940 ± 70 B.P. (Beta-195847). Although many researchers would consider these two dates much too young for Darl, the authors of that report accept them and support them by providing a few other recent dates in association with Darl points. Also in support of these two dates were older dates (2080 ± 40 and 1840 ± 40 B.P.) associated with older Ensor dart points from some 70 to 100 cm stratigraphically below the Darl Dates.

Test excavations at the Shepherd site (41WM1010), a large prehistoric camp in Williamson County just outside Austin, revealed several "Driftwood phase" Late Archaic components (AU1b; Dixon and Rodgers 2006). Intensive radiocarbon dating (*N* = 39 dates) of the many cultural features revealed charcoal derived ages that are only slightly older than those obtained from the McKinney Roughs site just mentioned. At least four Darl dart points were in direct association with wood charcoal dates ranging from roughly 1370 to 1240 B.P. At least 31 features were assigned to the Driftwood phase, including most surface hearths, three basin hearths and one earth oven (D56). Limited cultural debris besides the features was recovered. In this site, younger dates ranging from 770 to 1170 B.P. were associated with the relatively recent Scallorn arrow points (Dixon and Rodgers 2006). At least one of the Darl components was in a buried soil.

Johnson and Goode (1994) interpret the climate to have been relatively mesic throughout the Edwards Plateau and relate this to the aggradation of floodplains in the region (Figure 3-6). The middle part of Late Archaic subperiod II of Johnson and Goode (1994) is marked by the corner-notched Marcos points, which are similar to corner-notched styles from the Southern Plains that pertain to about this same time. This style is followed by Frio and Ensor, which are, in turn, followed by the Darl point. Weir (1976:118) pointed out that the Darl and Fairland components commonly preceded components bearing arrow points. Prewitt (1981, 1985) separated the Darl point (his Mahomet type) from the similar but much older Hoxie type, and placed it in the Driftwood phase that he showed was slightly later than the Twins Sisters phase. In summarizing 119 tested sites in Fort Hood, Quigg (1996) determined that there was a near absence of Fairland and Frio points in the Late Archaic period in that region. He also speculated that people using those styles were near their northern or eastern distributional limits (see Prewitt 1995). Also, the Twin Sisters phase, characterized by Ensor points, was well represented by 13 absolute assays in the Late Archaic site sample at Fort Hood. However, the last part of that Late Archaic sample was best represented by 13 Darl/Mahomet points and 10 radiocarbon assays.

The latter 10 assays from that sample indicated a use of the Darl point between 1140 and 1410 B.P. (Quigg 1996). It is not clear what effect the gradual drying across the region had on the area's populations during the earliest part (Subperiod I) of the Late Archaic. Johnson and Goode (1994) indicated that the climate was dry, and labeled this dry period the Edwards climatic interval, which peaked around 4000 B.P. The later part of the Late Archaic became more mesic. This later time also became much more complex in terms of cultural interactions. They point out that influences from religious practices in the eastern part of the continent and population increase may have contributed to cultural complexity.

Prehistoric Use of Biotic Resources in the Late Archaic as Evidenced in Archeological Contexts

The regional data document the use of diverse plant and animal resources, and demonstrate that burned rock features continued to be used for cooking. During this general Late Archaic period, the use of burned rock middens continued from the Middle Archaic (see Weir 1976; Prewitt 1981, 1985; Black et al. 1997) and this cooking process continued into the Late Prehistoric period (i.e., Quigg and Ellis 1994; Ricklis and Collins 1994; Black et al. 1997; Mauldin et al. 2003). Many researchers see the large rock ovens and large middens that represent the cooking of bulk plant resources such as sotol or lechuguilla that require long periods of heating to make consumption possible.

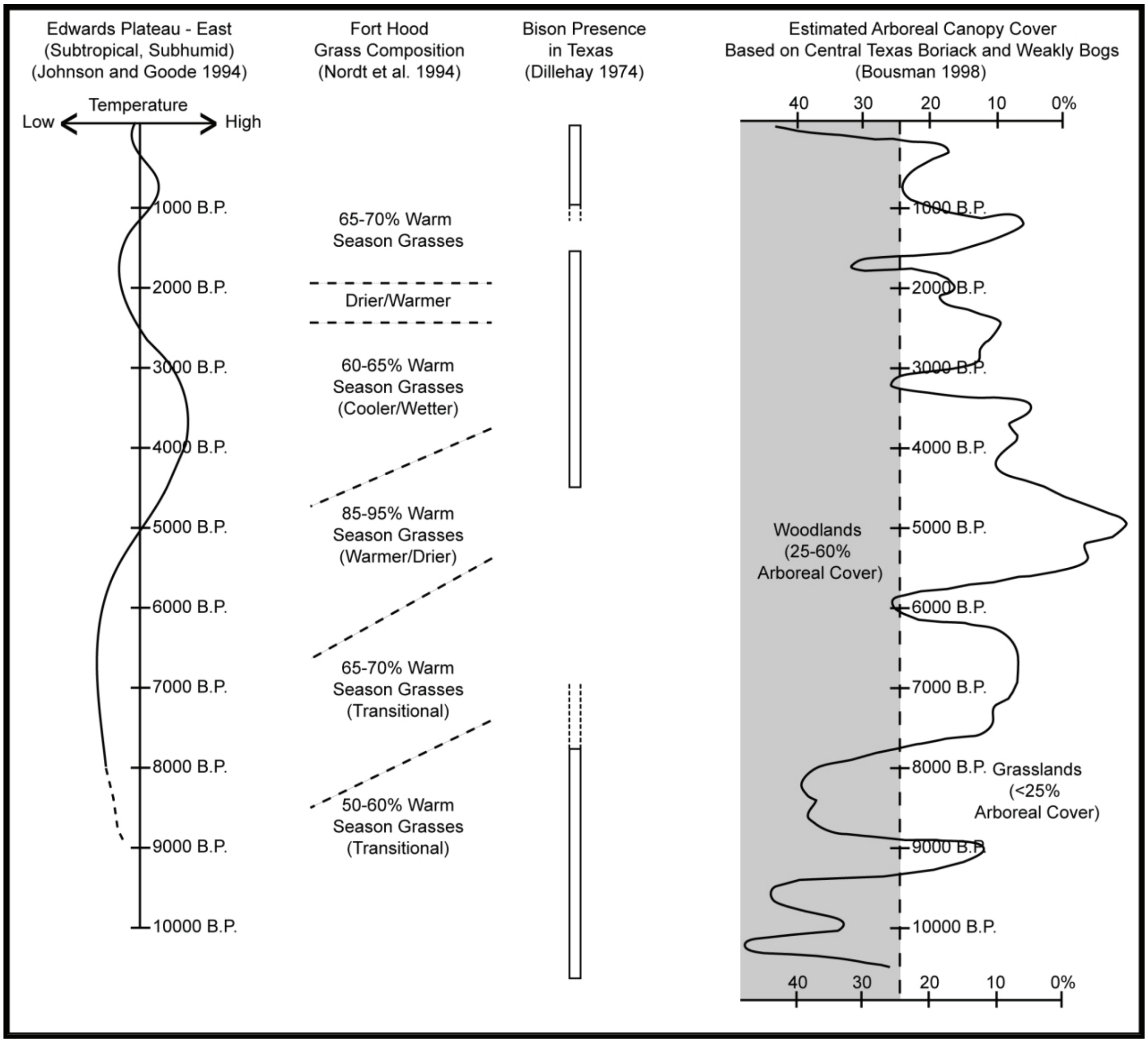

Figure 3-6. Interpretations of Changing Environments in Central Texas based on Different Data Sets

An alternate hypothesis based on the broad distribution of oak trees and burned rock middens is that these burned rock features were used to process acorns (Creel 1986, 1991). However, Black et al. (1997) doubt that acorns were processed in these large oven/middens. More recently it has been directly demonstrated by the identification of burned plant parts that geophytes (tubers, bulbs and roots) were also cooked in burned rock middens (Dering 1997, 1998, 2003a, 2003b, 2004, 2006; Mauldin et al. 2003; Mahalchick et al. 2004; Quigg et al. 2005; Dixon and Rogers 2006). Chemical residue analysis on burned rocks from a central cooking feature assigned to the Darl interval, located at Mustang Branch midden in Hays County along the

Balcones Escarpment, revealed that animal residues were present (Loy 1994). At other Late Archaic sites in the region, lipid residues from burned rocks have revealed that diverse foods were cooked with hot rocks. These include the preparation of plant foods of medium fat content, fish or other aquatic foods, and combinations of large herbivores and low fat plants (Malainey 2004). Other smaller burned rock dumps, scatters, basins, and flat hearths have been recognized for the Late Archaic at various sites.

The summary of 119 sites at Fort Hood that were assigned to the Late Archaic period (following Prewitt's [1985] terminology and chronology) between 2230 and 1140 B.P. revealed a very diverse faunal assemblage, with some 12 taxa represented and deer and turtles being the most abundant (Quigg 1996:673, Table 11.9). Individual sites/components such as 41MM340 (Mahoney et al. 2003) and Analytical Unit 3 at 41MM341 (Gadus et al. 2006:148-149) also reflect similar broad subsistence patterns that utilized both terrestrial and aquatic resources.

Buffalo were also part of the subsistence base for specific periods within the Late Archaic, principally in association with Montell points ca. 1500 to 2500 B.P. Bison bones from the Barton site yielded bone collagen radiocarbon dates between about 1,800 and 2,150 B.P. (Ricklis and Collins 1994). This is the same period that bison were also present in the Texas panhandle region (Hughes 1977, 1989; Quigg 1997a, 1998; Quigg et al. 2010). Bison were widely distributed across much of Texas during specific times in the Late Archaic. However, at some Late Archaic sites in the region, for example the Little River site (41WM340) dating roughly from 3400 to 2400 B.P. (Mahoney et al. 2003) and McKinney Roughs site (41BP627) dating to ca. 900 B.P., mussel shells dominated the faunal assemblages (Carpenter et al. 2006), though it is unlikely that mussel meat was dominant in the diets. In the latter two sites, bison bones were very limited or not even present in the faunal assemblages. Deer continued to be a part of the consumed resources, as were riverine resources such as mussels and fish. The Late Archaic is generally viewed as involving a continuation of a generalized subsistence strategy, with population densities increasing from the proceeding period.

Cemeteries were in use in central Texas during the Late Archaic, as indicated at sites like Olmos Dam (41BX1, Lukowski 1988), Loche Farm (41CM25, Huebner and Comussie 1992), Bering Sinkhole (41KR241, Bement 1994), and possibly the Pat Parker site (41TV88, Greer and Benfer 1975). At Olmos Dam, some, if not all, of the 13 documented burials date to this period. At least two infant burials, one flexed and associated with grave inclusions, including white-tailed deer antlers, traces of ochre, and chert cobbles, were associated with charcoal radiocarbon dates of 2200 ± 70 B.P. (Tx-3989) and 1920 ± 160 B.P. (Tx-3993, Lukowski 1988). At Loche Farm, 19 burials were recovered in 1936 (Woolsey 1936). Based on grave-associated artifacts found with some of the individuals, which included a boat stone, a stone gorget, conch columella and whorl pendants, a large biface, and red ochre, these burials were tentatively assigned to the Late Archaic Period. Isolated burials are also present, as indicated by a semiflexed male skeleton buried 2.2 m deep in an alluvial terrace in Llano County (Bement 1994). This body was associated with a complete Ensor dart point near the dorsal side of the spine opposite the lower thoracic vertebrae, which might have been the cause of death. The most recent component(s) at the Bering sinkhole, Unit I, are radiocarbon dated to between 2610 ± 280 B.P. (Tx-6525) and 990 ± 140 B.P. (Tx-6167), which are in part assigned to the San Marcos and Twin Sisters phases of the Late Archaic. Unfortunately, no diagnostic projectile points were in direct association with these dates. Two adult burials were within the Twin Sisters phase. The Bering Sinkhole reveals a definite pattern of reuse over the long Archaic sequence and a similar use history is evidenced in other sinkholes as well (Bement 1994). Thus far, no individual burials have been directly dated to the Driftwood phase, nor have any been recovered with Darl points.

Late Prehistoric Period in Central Texas

Late Prehistoric period sites in the Central Texas archeological region have been identified in many investigations over the years that has involved numerous and extensive surveys, site testings, and numerous major excavations. As a result of continuous investigations across this broad region, data concerning the Late Prehistoric has accumulated faster than most researchers can document. After Johnson et al. (1962) put forth a sequence of point types, Weir (1976) and much later Johnson and Goode (1994) omitted discussion of the Late Prehistoric period. In fact, Prewitt's (1981, 1985) work was the last major attempt at a synthesis for this period. Collins (1995a, 2004) discusses a few key characteristics in only a single page of text. However, Collins (1995a:376, 2004:113) does indicate a relatively high number of investigated sites dating to the Late Prehistoric period with high integrity (*N* = 8), and at least seven with moderate integrity. The hesitation by researchers to try and synthesize the Late Prehistoric may stem from the fact that relatively few well stratified sites, specifically those that contain Scallorn points, have been reported in detail in the literature.

Collins (1995a, 2004) points out that the break between the Late Archaic and the Late Prehistoric period (ca. 1200 B.P. or A.D. 750) is somewhat arbitrary in central Texas. Two subperiods, early and late (Collins 2004), are currently identified for the Late Prehistoric period (Johnson et al. 1962; Prewitt 1981, 1985). The first period, or Austin phase/interval, saw the appearance of the bow and arrow represented by Scallorn arrow points, following the use of dart points with the atlatl during the Archaic period. This is a quite generalized and highly normative perspective, in which dart points (and their presumptive corollary, the dart-atlatl weapon technology) persist until the end of the Archaic, to be replaced by arrow points (and bow and arrow technology), thus marking and defining the beginning of the post-Archaic, Late Prehistoric cultural period. Various other technological and/or technoeconomic innovations that mark the transition from "Archaic" cultural patterns to post-Archaic patterns in North America (e.g., various "Formative" cultures, *sensu* Willey and Phillips 1958), such as horticultural food production, residential sedentism, and/or ceramics, either did not appear in central Texas, or were introduced considerably later than the bow and arrow. Ceramics, for example, became part of the material culture repertoire in central Texas ca. A.D. 1300, whereas arrow points become common in the archeological record by ca. A.D. 700-800, if not somewhat earlier. Therefore, perhaps as much by adherence to intellectual tradition as anything, central Texas archeologists find themselves using terms like "Archaic" and "Late Prehistoric" to denote a change in a single technoeconomic aspect of culture—the shift in use from the dart-atlatl to the bow and arrow, which in itself may only signify that prehistoric hunters changed the kinds of tools they made and used to procure game animals and, effectively, represents little if any other changes in overall lifeways and/or adaptive strategies. Thus, the truly profound cultural changes that were originally implied by the defined shift from the "Archaic" to what followed (however defined, e.g., various "Formative" patterns, such as Woodland cultures of eastern North America), did not mark the Archaic-Late Prehistoric chronological interface in central Texas. Human lifeways and adaptive strategies continued to be based on mobile, nonsedentary hunting and gathering, and indeed it seems entirely possible that people's ways of doing things changed less during this time interval that they may have at various other times within the long preceding Archaic continuum or during the subsequent Late Prehistoric period. Thus, the reader is hereby alerted to the fact that simply by reason of archeological tradition, our use of the terms "Archaic" and "Late Prehistoric" signify, in the final analysis, nothing more than a distinction between hunting-and-gathering peoples who used the dart-atlatl technology and hunting-and-gathering peoples who employed the bow and arrow. The idea that the Archaic-post Archaic shift was of this sort of functionally limited nature in this region is, in fact, reinforced by some of the data discussed further on.

Moreover, even this restricted distinction is not necessarily hard and fast in chronological terms, since it is entirely possible that the replacement of the dart-atlatl technology with the bow and arrow may have been gradual rather than especially rapid. While it seems reasonably clear that arrow points appear in the central Texas archeological record by ca. A.D. 700/800 (or even somewhat earlier), it cannot be stated with any certainty just how long the transition from one hunting technology to the other may have taken. Did the bow and arrow replace the earlier technology relatively quickly (e.g., within a single human generation or so), or was it a more gradual process that may have lasted for one or more centuries? Did specific groups of hunter-gatherers abandon the dart-atlatl quickly, once they adopted the bow and arrow, or did they continue to use it over an archeologically significant period of time, perhaps for certain types of hunting activities for which they still felt it to be as effective, or even more effective, than the bow and arrow? To date, the archeological record is fairly mute on these questions, largely, as pointed out in the discussions to follow, because known site components either represent extended periods of time or because they are too "mixed" to allow for isolation of discrete artifact assemblages that represent time frames sufficiently limited for discernment as to whether *either* dart points *or* arrow points are represented, or alternatively, *both* are represented within a distinctly limited time interval. In other words, archeological materials/deposits that represent a single, discrete occupational episode are very difficult to identify with absolute confidence, thus leaving clear answers to these questions just beyond our reach. It is our contention, nonetheless, that the findings at the Root-Be-Gone site comprise a reasonably good candidate for just this sort of component: the Terminal Archaic component at the site represents a short-term, functionally limited occupation, and those projectile points we assess to be directly associated are Darl or Darl-like dart points (for reasons offered elsewhere, the few arrow points recovered are thought to come from different stratigraphic positions than do the Darl/Darl-like points, or to be intrusive due to vertical displacement by natural agencies). Although we do cannot and do not assert that this is unequivocally the case, we do see justification for suggesting that this component represents the continued use of dart technology by one specific group of people at a time when the bow and arrow had already become widely adopted in the larger containing region, presumably by various other contemporaneous groups.

Prewitt (1981, 1985) identifies the earliest arrow point type in the central Texas region as the side/corner-notched Scallorn point. He does not address the Sabinal and Edwards styles (Turner and Hester 1999; Johnson and Goode 1994:39) that occur more often across the southern margin of the Central Texas archeological region. These latter two types are more prevalent further south, with the Sabinal points occurring mainly along the southwestern margin of the Edwards Plateau (Prewitt 1995:128) and the Edwards generally more abundant to the south of the Plateau (Prewitt 1995:102). As indicated above, the Edwards points appear around 1410 ± 90 B.P. (sometime between A.D. 500 and 600) at the Rainey site (Henderson 2001). This date is one in a series of dates from near the bottom of the deposits, which yielded no recognizable dart points. Thus, the Austin phase/interval does not account for the early Edwards points (ca. 1410 to 900 B.P.) along the southern margin of the Edwards plateau and Central Texas archeological region.

Johnson and Goode (1994) emphasize that some cultural and considerable economic continuity tied the end of the Late Archaic directly to the subsequent Late Prehistoric period. As an example, the J. B. White site (41MM341) in Milam County demonstrates the economic continuity from the Late Archaic (their Analytical Unit 3) into the Austin phase (their Analytical Unit 2) of the Late Prehistoric (Gadus et al. 2006). There, the Austin phase of the Late Prehistoric was represented by multiple, short term hunter-gatherer camps where mussels and fish from the river were collected at the same time the occupants hunted a variety of game, especially deer, and collected plants such as hardwood nuts, wild onion, and false garlic bulbs (Gadus et al. 2006). The subsistence activities of these Austin phase populations were nearly identical to those of the earlier Late Archaic component (Analytical Unit 3). Therefore, while hunting was conducted with the new technology of the bow and arrow, dietary patterns did not undergo any major changes. It is assumed that the environment did not change significantly enough to have greatly altered the food resource base.

The Austin phase at J. B. White (41MM341) is radiocarbon dated from 850 to 1150 B.P. (ca. A.D. 800 to 1150) through 34 samples. Underlying the Austin phase component, or Analytical Unit 2, was Analytical Unit 3, which encompassed a minor Late Archaic component. This latter analytical Unit 3 yielded two radiocarbon dates on charcoal from two separate mussel shell features. Feature 20 in level 9 yielded an $\delta^{13}C$ corrected date of 1360 ± 40 B.P. (Beta-176626), whereas Feature 24 in level 10 yielded an adjusted dated of 1390 ± 40 B.P. (UGA-12496; Gadus et al. 2006). These two dates were generally associated with four Darl, one Ensor, and four Scallorn arrow points. However, the split between Analytical Units 2 and 3 was based on a cluster of radiocarbon dates and not stratigraphic information. The association of the arrow and dart points is not clear. Which point type was directly associated with Features 20 is also unclear, and their apparent association may be the result of mixing. Feature 24 did yield a nearly complete Darl point and is slightly lower than most Scallorn points and the younger dated features.

Moving further north and closer to Young County, the Kyle site at the Whitney Reservoir in Hill County provides considerable information concerning the Late Prehistoric period (see Figure 3-1 and Table 3-1). The Kyle site was excavated in 1959 and 1960 and yielded stratified remains, with the most recent projectile points toward the top and the oldest toward the bottom. This site is primarily associated with what is presently known as the Late Prehistoric Austin and Toyah phases (Jelks 1962).

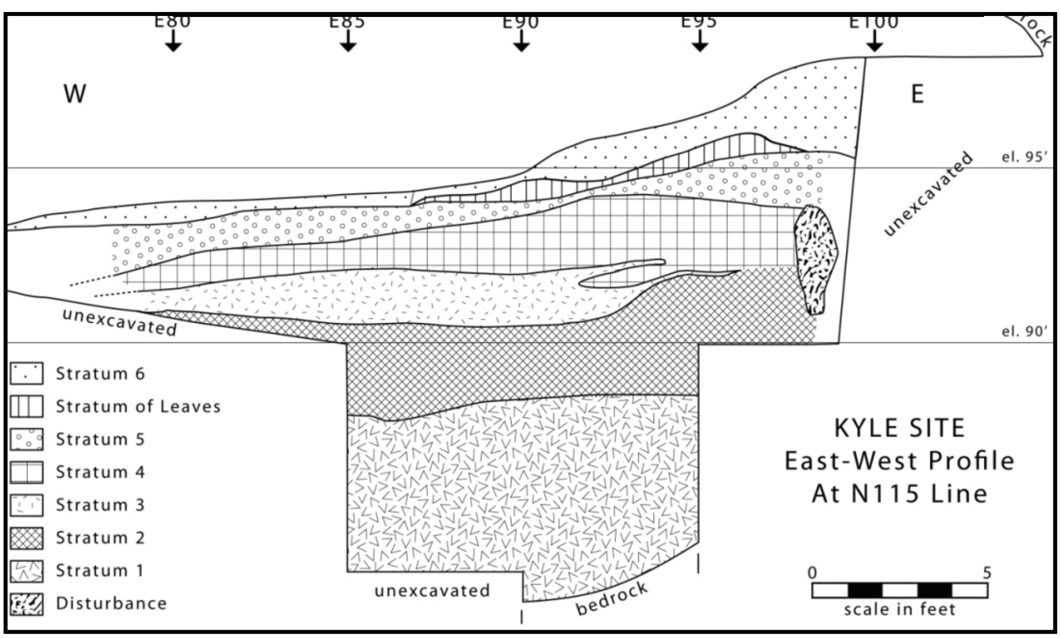

Figure 3-7. Profile of the Kyle Site Deposits at N115 (after Jelks 1962)

Although stratified, each identified type of projectile point did not occur within a discrete and thin zone. Some 11 dart points, or 20 percent of the total diagnostic projectile points, and some 45 arrow points were recovered from Stratum 1 at the bottom of the shelter (Jelks 1962). Stratum 1 (the lowest stratum) varied in thickness from 35 to 200 cm and contained several thin layers of cultural debris.

The thin layers observed towards the bottom of the deposits were not individually analyzed, but were lumped into a much broader and more general Stratum 1 (Figure 3-7). The dart points from Stratum 1 included Wells, Castroville, Trinity, Pedernales, Palmillas, Darl, and the then newly identified Godley point. In combination, these dart points represent at least 2,000 years of culture history (see type age ranges, Turner and Hester 1999). Even Stratum 2, a ca. 30 to 90 cm thick zone, contained 15 dart points mixed with 141 arrow points, the latter primarily of the Scallorn and Granbury types. It is apparent that at least one, if not multiple, Late Archaic components were present in the lower part of the shelter and that mixing had occurred within these deposits. No single Stratum contained arrow or dart points exclusively, or even a single arrow point type. Two radiocarbon dates were obtained on charcoal from Stratum 1. These dates include one from the lower portion that dated to ca. 1150 ± 150 B.P. (S-MC C-6) and one from the upper portion that a dated to ca. 980 ± 170 B.P. (S-MC C-4.

Charcoal from Stratum 2 yielded a date of ca. 1390 ± 150 B.P. (S-MC C-2). This date is out of sequence and is an indication of mixing. Since multiple arrow and dart point types are present in Stratum 1, it is not clear to which point type the date of 1390 B.P. is associated. Prewitt (1985:205) assigns this date to the Austin phase, but dart points are present and the date is out of sequence creating some doubt as to its true assoication. He also assigned the date of 1150 B.P. to the Austin phase even though it was derived from charcoal from the lower part of Stratum 1 where dart points were present. Stratum 4 and 5 contained primarily Perdiz and Cliffton point types. One charcoal sample from the middle part of Stratum 4 yielded a date of ca. 660 ± 150 B.P. (S-MC C-1). Two samples of charcoal from Stratum 5 yielded a date of ca. 680 ± 165 B.P. (S-MC C-8) from Feature 3 on the contact zone between Stratum 4 and 5 and a date of ca. 390 ± 130 B.P. (S-MC C-5) from the middle to lower part of Stratum 5 (Jelks 1963). Two relatively distinct components, Toyah overlying Austin, were generally well separated at Kyle Rockshelter, with some overlap in projectile points and radiocarbon dates.

Another site at the Whitney Reservoir location is Bear Creek Shelter (Lynott 1978). Hand-excavations of 15 units that totaled 31 m^3 exposed cultural material to at least 4 m in depth with generally stratified deposits. Five natural depositional units were identified. The multiple cultural occupations included one Middle Archaic, one Late Archaic, two Transitional Archaic, one Austin, and one Toyah phase. However, clear separation of the cultural zones were not detected or observed. The analyses included radiocarbon dating of 12 charcoal samples. Inconsistencies in the assay results were attributed to a high level of bioturbation observed and detected in the deposits.

Twenty-five cultural features were assigned to five classes; burned rock concentrations, a sheet midden, a human burial, mussel shell concentrations and snail shell concentrations. The two Transitional Archaic zones could not be clearly separated from one another or the overlying Austin Phase (Lynott 1978:85). These two zones contained at least five burned rock features with burned soil concentrations, and one human interment. Transitional II varied from 50 to 70 thick and yielded expanding stem dart points similar to Ensor and Ellis types. Transitional I varied from 30 to 50 cm thick and yielded both Scallorn arrow points and dart points similar to Ensor, Darl, and Kent points. The Austin phase zone contained mostly Scallorn arrow points, together with at least two dart points. Obviously some mixing of the artifacts has occurred and no clear, well defined boundaries of the estimated zones existed.

Attempts to Differentiate Late Archaic from Late Prehistoric

Prewitt's 1985 synthesis associates the last part of the Late Archaic, the Driftwood phase, with the Darl (Mahomet in some references) point type, which is the key diagnostic artifact. This cultural phase dates between 990 and 1380 B.P. (A.D. 570 to 960), if all his dates are accepted. Some dates he assigns to this phase are not directly associated with Darl points, nor is it clear with what they are associated. For the Austin phase, Prewitt (1995) assigned radiocarbon dates that fall between 540 and 1410 B.P. (A.D. 540 to 1410). Obviously, the early dates overlap with the dates assigned to the Driftwood phase. Even the dates he assigned to the Austin and Toyah phases actually overlap in time. Prewitt (1985) sorted these dates by area and came to the conclusion that there must have been movements of these styles from north to south and that this accounted for the overlapping dates. Clearly, more radiocarbon dates from single occupations in good context need to be obtained to help clarify the chronological sequence in central Texas and in adjacent regions.

3.2.3 The West-Central Texas Archeological Region

For the west-central archeological region (Rolling Plains) of Texas, the progress of understanding the prehistory has been slow, with few major excavations and detailed reports. The relatively few investigations across this broad region have involved mainly reservoir surveys, with few excavations, along a small number of specific water courses (see Figure 3-1 and Table 3-1). In the upper Brazos River drainage, archeological surveys such as the Brazos Natural Salt Pollution project (Thurman et al. 1981), the Upper Clear Fork Survey (Wulfkuhle 1986), the Truscott Brine Control Lake (Etchieson et al. 1978), Crowell Reservoir survey (Etchieson et al. 1978), Stamford/Paint Creek survey (Jelks and Moorman 1953), and Justiceburg/Lake Alan Henry (Boyd et al. 1989; Boyd 1997) have recorded many surface sites. Most prehistoric sites recorded have yielded relatively few time-diagnostic artifacts and limited information concerning the specific ages or functions of sites. These investigations have not contributed significantly to identifying and understanding specific cultural assemblages for specific times. These surveys provide little information for chronology building. It is not until intensive excavations, combined with multiple radiocarbon dates on single-component or well-stratified sites are carried out that any clarity can be obtained on the details of culture chronology.

3.2.3.1 Synthesizing the West-Central Texas Archeological Region

As was the case for the north-central region, the Rolling Plains was not addressed in the latest synthesis of Texas prehistory (Perttula 1995, 2004). Again this background will only deal with the pertinent time periods of interest concerning the Root-Be-Gone site, which focuses on the Late Archaic component and its late date that falls during what many would assume is a Late Prehistoric time period. Boyd (1995, 1997, 2004) does address the Palo Duro Complex, which is a Late Prehistoric complex that was strongly influenced by the Jornada Mogollon culture of south central New Mexico. The Palo Duro complex may have begun during transitional Archaic times around 2000 to 1500 B.P. (A.D. 0 to 500), but was definitely present by 1500 B.P. (Boyd 1995, 2004). Our current knowledge of the Archaic period in the Rolling Plains is limited by a lack of data from major excavations.

The extensive testing and data recovery conducted at the Justiceburg Reservoir/Lake Alan Henry has yielded the primary data sets that have provided chronological information concerning the canyonlands or western margin of the broad Rolling Plains region (Boyd et al. 1989; Boyd et al. 1990; Freeman and Boyd et al. 1990; Boyd et al. 1992; Boyd et al. 1993; Boyd et al. 1994; Boyd 1995). Following many seasons of intensive excavations at Lake Allen Henry, a synthesis report was produced (Boyd 1997) that provides the foundation of the current knowledge of this region following upon J. Hughes' (1991) earlier synthesis that focused on Texas High Plains. Boyd's (1997) synthesis generally addresses the last 4,000 years, and it provides much of the basis for the following overview, which is supplemented by information from smaller site specific-investigations, where needed.

Another archeological investigation involved site-eligibility testing conducted as part of the Red River Chloride Control Project within the proposed Crowell Reservoir. This work provides some useful information as well (Peter et al. 1997). Extensive trenching in the flood plain area failed to reveal buried sites or significant cultural materials in isolable contexts.

3.2.3.2 The Late Archaic Period

Boyd (1997) sees the Late Archaic or Little Sunday complex present across the region by around 4000 to 1500 B.P. (ca. 2000 B.C. to A.D. 500) based on radiocarbon dates from a handful of sites. Eight dates are from four bison kill sites in the Texas panhandle region and another 46 dates are from eight Texas sites. Many radiocarbon dates are from poor or mixed contexts and most often are associated with multiple projectile point types. Consequently, the cultural chronology for this period across the Rolling Plains and much of the Texas panhandle is not well defined. At least one radiocarbon date on bison bone collagen from the Strong kill site places a kill event at about 1000 B.P. (RL-572). This kill is considered part of the Late Archaic period, but the date and assignment may be considered problematic because no diagnostic projectile points were recovered from the Strong site and the bone date was not adjusted for the $\delta^{13}C$. However, a bone collagen date of 1120 ± 100 B.P. (RL-570) from the Twilla kill (D. Hughes 1977, 1989; Lintz et al. 1991) is not a lot older, and is associated with large corner-notched dart points. This second date lends support for Late Archaic bison hunting even at this late time along the headwaters of the Red River in the Texas panhandle.

Diagnostic Artifact Frequency and Distribution

Although many Late Archaic sites have been identified based on projectile point types across the Rolling Plains and Texas panhandle region, very few habitation sites have been intensively investigated or radiocarbon dated. Even though several sites in the Justiceburg Reservoir/Lake Alan Henry contained evidence of Late Archaic events, no well-defined Late Archaic components were excavated (Boyd 1997:249). Because of the lack of good contexts and sparse data, it is assumed that large, broad-bladed, corner- to side-notched points, and even a few straight- to expanding-stem dart points are associated with this period. These ranges of hafting variation show outlines that resemblance at least seven named dart point types such as Ellis, Marcos, Castroville, Palmillas, Williams, Trinity, and Ensor, which are types found in adjacent regions. The age relationship between these dart points and the groups that produced them has yet to be determined. The use of point type names has not been applied evenly across the region by researchers and numerous inconsistencies in typology exist.

A few Late Archaic sites have been tested to one degree or another, but most have never been adequately reported. Many tested sites reflect poor contexts and mixed assemblages that contained both Archaic dart points and Late Prehistoric materials. Often these contexts are shallow, less than 1 m thick, and are in upland settings. The radiocarbon dates obtained from these contexts contribute little towards refining the time for a particular unmixed assemblage. Boyd (1997) goes into considerable detail about individual sites and problems relating to those sites. Nonetheless, the cultural patterns associated with the Little Sunday complex that represents the Late Archaic period are not well known.

The Use of Biotic Resources in West Central Texas during the Late Archaic Period

What is apparent is the heavy reliance on bison as a major food resource during the Late Archaic period just east of the Caprock escarpment. At least four Late Archaic bison-kill sites are known in that part of Texas (D. Hughes 1977, 1989; Lintz et al. 1991). Unfortunately, these kill sites have received limited excavation, associated cultural assemblages are small, radiocarbon dates are few, and the bone collagen dates were not corrected for their $\delta^{13}C$ values. The few investigated Late Archaic campsites have also yielded bison bones (i.e., Quigg 1997a, 1998; Quigg et al. 2010). At least a few campsites, the Pipeline site (41PT185/C, Quigg et al. 2010) and the Sanders site (41HF128, Quigg 1997a, 1998), exhibited excellent context with good associations indicative of bison exploitation during the Late Archaic period from ca. 2400 to 1600 B.P.

Another aspect of the Late Archaic period is human burials, which have not been properly excavated or reported. Again, most burials have not been radiocarbon dated and are only assigned to the Late Archaic period based on the recovered cultural assemblage (mostly lunate stones) associated with the bodies (Boyd 1997:253-256). Lunate stones have often been associated with corner-notched dart points, thus their assignment to the Late Archaic. Much is speculated upon concerning these human remains, despite the fact that their specific ages are not well documented.

Although it may be too early to fully support, an emerging idea is that settlement-subsistence patterns involved a tendency for habitation sites to be located in the canyonlands along the eastern Caprock, whereas the bison kills sites are prevalent in the Rolling Plains to the east (Boyd 1997:266) in the vicinity of the headwaters of the Red River. The canyonlands may have served as wintering areas, whereas during the long warmer seasons the populations were scattered out across the Rolling and High Plains region, as suggested by Wedel (1975:273).

3.2.3.3 The Late Prehistoric Period

The Late Prehistoric in the west-central Texas archeological region is, as in other adjacent regions, marked by the introduction of bow and arrow hunting technology evidenced by the presence of small arrow points. The production and use of ceramic vessels is also thought to emerge during the Late Prehistoric Period. These apparent changes in technology, however, do not appear to have to been acquired consistently by groups across the Southern Plains, or throughout North America, for that matter (see Blitz 1988). The reasoning behind when and how these changes occurred across Archaic settlements is not clear, but may have involved, for example, the adoption of a new weaponry system by indigenous peoples or an intrusion of outside groups and technology. The mechanisms (immediate or gradual adoption, intermixing, or replacement) for how Late Archaic populations transitioned into the Late Prehistoric period, are unknown. It is doubtful, however, that the atlatl and associated darts were immediately and completely replaced. Likely, a gradual experimentation with the new bow and arrow system occurred while the atlatl was still in use. Possibly the two weapon systems served in different situations as indicated by the occurrence of large dart points at bison kills that date to periods when arrow points were in common use at other sites.

Several archeological sites and components across the region reveal a possible overlap of the use of arrow and dart points in radiocarbon dated contexts (i.e., Willey and Hughes 1978a; Thurmond 1989; Quigg et al. 1993). In several instances, the apparent association is due to questionable context (i.e., mixing), but this is not so in all cases. These new traits are recognized in the region as occurring by roughly 1850 B.P., but at least three sites, which include the Sandy Ridge site in the Texas Panhandle, one in southeastern Colorado, and one in central Oklahoma, have yielded small corner-notched arrow points in limited quantities from contexts dating to between 2500 and 2200 B.P. (Quigg et al. 1993:462-466).

There are also scattered instances of early ceramic sherds across regions adjoining north-central Texas. At the Sanders site (41HF128) in the northern Texas panhandle, a single smoothed-over cordmarked sherd tempered with crushed bone and quartz sand was recovered from a well defined, isolated Late Archaic bison processing/camp site radiocarbon dated to ca. 1870 B.P. (Quigg 1997a, 1998). In addition, the Late Prehistoric period also involved an adaptive transition from highly mobile Late Archaic hunters and gatherers to the more semisedentary village and hamlet dwellers of the Late Prehistoric II who relied on hunting and gathering and possibly limited practice of horticulture. Boyd (1997) states that the Late Prehistoric I period occurred from ca. 1500 to 1000 B.P. (A.D. 500 to 1100/1200).

Differences in the arrow point hafting characteristics, ceramic vessel variations including surface treatment, manufacturing characteristics, subsistence practices; and architecture have allowed archeologists to delineate contemporaneous and sequential regional complexes during the Late Prehistoric I and Late Prehistoric II subperiods. Each complex has a reasonably well recognized set of cultural traits, as discussed below. It is possible that the regional complexes of the Late Prehistoric I and II overlapped in time and space across the Rolling Plains.

The Late Prehistoric I complexes are characterized by the presence of small, corner-notched or barbed arrow points and pottery. Two contemporaneous cultural complexes have been defined, at least along the western margins of the Rolling Plains and, potentially, in adjacent regions, based on different ceramic technologies and projectile point types. The Palo Duro complex dominates the southern parts of the Texas panhandle south of the Canadian River and along the Caprock escarpment or western part of the Rolling Plains (see Figure 3-1; Boyd 1997, 2004). The Lake Creek complex is more prominent north of the Canadian River, and has affinities with similar complexes found in northwestern New Mexico, eastern Colorado, Kansas, and Oklahoma (J. Hughes 1991; Boyd 1995, 1997, 2004). The boundaries of these two Late Prehistoric I complexes across the Rolling Plains in northwestern Texas are not well established and it is quite likely their ranges overlapped at times. This overlap may reflect gradual expansion of one complex over the other, or the use of the region in a seasonally overlapping pattern. Each complex is discussed below, beginning with the Palo Duro complex.

The Palo Duro Complex

Palo Duro complex sites are typically found in the broken canyon lands below and east of the eastern escarpment of the Llano Estacado along the headwaters of the Brazos and Red rivers, with a northern boundary that potentially extended into the breaks of the Canadian River (J. Hughes 1991; Boyd 1997). The Palo Duro complex was first recognized during excavations of the Deadman’s shelter (41SW23) in Mackenzie Reservoir in Tule Canyon of Swisher County, a major tributary of Palo Duro Canyon in Swisher County (Willey and Hughes 1978).

Diagnostic artifacts of the Palo Duro complex include plain brown pottery, Deadman’s arrow point, and occasionally, shallow pithouses. Boyd (1997) observed that ceramic materials are absent or rare in most Palo Duro sites. Few sites of this complex have been sufficiently excavated to define the frequency of pithouse usage. In the absence of these two principal characteristics, the ceramic material and pithouses, site/component recognition and assignment are quite difficult. The assemblage variations of the same complex undoubtedly reflect different site types and functions. Most observed traits in the Palo Duro complex appear with no obvious local development, which implies the complex represents an infusion of new peoples into this area. The Deadman's arrow point is also distinctive. These points are deeply notched from the base creating a relatively long, slightly expanding stem and slender barbs, which currently have no known predecessor in the Late Archaic complexes of the region.

The Palo Duro complex has been redefined since Willey and Hughes (1978a) reported on Deadman's Shelter with the addition of more recent site excavation data from additional sites assigned to this complex (Boyd 1997). Boyd (1997) presently views this complex to represent semisedentary peoples who maintained some mobility, subsisting on a variety of wild plants and small animals. Domestic crops have not yet been identified in the excavated sites that represent this complex. The presence of storage pits in at least one site, Sam Wahl (Boyd et al. 1994), implies food products were retained for periods of time. Ovate and rectangular pithouses have been reported at only two Palo Duro complex sites: Kent Creek (41HL66) and Sam Wahl (41GR291). These structures tend to be relatively shallow, rectangular in outline, 8 to 14 m^2 in size, and with or without rock lined fireplaces and extended ramp entryways. Although these structures are regarded as pithouses, they exhibit considerable variability in their sizes, shapes, and interior features. Storage pits, rock hearths, rock-basin baking pits, and unlined hearths are present at these sites (Cruse 1992; Boyd et al. 1994). The baking pits are assumed to have functioned as plant cooking features (Boyd 1997). To complicate matters further, suites of radiocarbon dates from various features exposed at the Sam Wahl site may indicate that multiple components existed during the general time span of Late Prehistoric I (Boyd et al. 1994; Boyd 1997). Thus, the diversity of features of different ages at Sam Wahl might reflect various occupational functions and an overprinting of site patterns.

Radiocarbon dates from several sites that Boyd (1997) assigned to the Palo Duro complex range from 1880 to 850 B.P. The current data reflect an intrusive Jornada Mogollon culture from eastern New Mexico that moved out across the plains region to the eastern side of the High Plains. It appears this population brought with them plain brownware ceramic vessels and a specific ceramic technology, as well as a technology for building pithouses. Apparently, these populations did not bring horticulture with them, but more site investigations may change this current view. Reasons for the disappearance of this culture have yet to be determined. In moving eastward across the Llano Estacado to the Rolling Plains and possibly northward into the region of the Texas panhandle, they may have encountered Woodland groups from the north and east. Some have speculated the Palo Duro culture might have been the forerunners of Toyah phase, a Late Prehistoric II culture that later resided in central, west-central and southern Texas (Shafer 1977; Johnson 1994; Boyd 1997). This speculation has yet to be tested and minimal evidence currently exists to rigorously support this idea.

The Lake Creek Complex

Boyd (1997) discusses a transition from the Late Archaic into the Late Prehistoric I period. He (1997) redefined the Lake Creek complex and, following J. Hughes (1962, 1991), equated this complex with the Plains Woodland. The diagnostic materials of the Lake Creek complex include small corner-notched (Scallorn) arrow points; thick, large, wide-mouth conical vessels with boldly impressed cordmarked exteriors tempered with liberal quantities of coarse crushed rock; and an essentially Late Archaic assemblage of large corner-notched dart points (J. Hughes 1991; Boyd 1997). The similarity of the Scallorn points to earlier Late Archaic dart point forms such as Ellis and Marcos suggests to some researchers that assemblages that include Scallorn-like arrow points represent indigenous peoples who acquired pottery and bow/arrow technologies. Thus, there has been the notion that the artifact inventory of Lake Creek is "basically similar to the late Archaic inventory (Hughes 1991:26)."

Only a limited number of Woodland period sherds have been recovered across the Rolling Plains and Texas panhandle, and those few sherds reveal variability in temper, with scoria, basalt, and bone all identified (Perttula and Lintz 1995). Diagonal incising is the only apparent decorative element represented in the Lake Creek complex in the Texas panhandle (Perttula and Lintz 1995). Other cultural materials include disarticulated burned rock features and boiling stones, and abundant stone grinding implements. Not much is known about the nature of possible house structures, although it is generally assumed that structures of some kind were used. J. Hughes (1991) thought the Lake Creek complex was primarily confined to the Canadian River valley, although Boyd (1997) extended the boundaries much further to include all of the Texas panhandle and into western Oklahoma. It is not clear if this complex extends across the Rolling Plains to the east or not, as archeological investigations in that region are minimal. Boyd (1997:273, Figure 84; Boyd 2004:300, Fig. 10.3) depicts no known cultural complexes across much of the Rolling Plains east of the Palo Duro complex. In western Oklahoma, Thurmond (1991:120) notes that "it is generally not possible to differentiate Late Archaic and Woodland components on the basis of small artifact collections."

It is apparent from the reported archeological investigations further west, that the timing of the transition from the Late Archaic into the Late Prehistoric period is variable across different parts of Texas or is currently too poorly defined to fully discuss. Obviously, the Late Prehistoric cultures further west (e.g., Palo Duro complex at least) were employing smaller arrow points and pottery, potentially as early as ca. 1900 B.P. and definitely by 1500 B.P. It also appears reasonable that the use of the two delivery systems, atlatls with darts and bows with arrows, overlapped in parts of the Texas panhandle as evident at a few sites across the broader region (e.g., Deadman's Shelter [Willey and Hughes 1978], Canyon City Club [Hughes 1969], the Sandy Ridge site [Quigg et al. 1993:117-214]). However, the context at those few sites can be questioned. Thus, solid evidence from a single intact occupational surface is still required to support that possibility. What happened during the transition between the Late Archaic and the Late Prehistoric period in the Rolling Plains is currently unknown as this region lacks intensive archeological investigations, even more so than the adjacent archeological regions.

Boyd (1997, 2004) presents at least 35 radiocarbon dates for the Palo Duro complex sites, with at least five of eight charcoal dates from solid contexts at Kent Creek and San Wahl sites with uncorrected dates older than 1100 B.P. These two sites were clearly not occupied by Late Archaic populations.

A large arrow point with a neck width of 8 mm, discovered in a burial context at the Sam Wahl site in the Justiceburg Reservoir/Lake Alan Henry, was radiocarbon dated to ca. 1535 to 1694 B.P. (A.D. 256-415; Boyd et al. 1994; Boyd 1997:268; Boyd 2004:306). These dates are earlier than several dated Late Archaic projectile points across the region. Boyd's redefined Palo Duro complex may have begun around 2000 to 1500 B.P. (A.D.1 to 500) and continued to about 850 B.P. (A.D. 1100). These dates appear to support the notion that at least two cultural groups occupied the Rolling Plains region during the same general time period. A clue to what may have occurred during this transitional period (ca. 2000 to 1000 B.P.) may come from the sparse human remains recovered. Boyd (1997:266, 2004:309-310) points out that at least 9 of the 11 individuals from four radiocarbon-dated terminal Archaic burials probably were killed in conflicts. If nothing more, this demonstrates that violence was prominent at that time and that confrontational cultural interactions occurred.

3.2.4 Summary

In overview, it appears that Young County may have been influenced over the last 2,000 years from at least three directions: east, west, and south. As most cultures in the region over that time were mobile hunter-gatherers, different groups from all three adjacent regions may have used this region, at least temporarily or seasonally. The fact that the project area is near the juncture of two major rivers, the Salt Fork and the Clear Fork of the Brazos, which flow southeastward across the state to link the northwest to the southeast, plus the fact that this is a vegetational transition zone with considerable ecological diversity, may have been significant influencing factors that drew various groups, at various times, to this region.

It is quite apparent from this brief review that there is a great need to discover and excavate single component prehistoric sites in excellent contexts. Hopefully these types of components would yield large cultural assemblages combined with numerous radiocarbon dates, followed by detailed analyses to address artifact chronology and associated assemblages.

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4.0 RESEARCH DESIGN FOR ANALYSIS AND FINAL REPORT, 41YN452, YOUNG COUNTY, TEXAS

Robert A. Ricklis, Paul M. Matchen, and J. Michael Quigg

4.1 INTRODUCTION: RESEARCH PARAMETERS

Data Recovery excavations were carried out at 41YN452 by TRC Environmental Corporation, Inc. during 2007, under contract with the Texas Department of Transportation (TxDOT). An Interim Report on this work, describing archeological and geoarcheological methods and findings, was prepared by Quigg et al. (2007) and submitted to TxDOT for review. While the work and results discussed by Quigg et al. (2007) need not be reiterated in detail here, it is worthwhile to briefly summarize key findings, as follows:

> The site yielded evidence of a discrete cultural component assignable to the Terminal Archaic period of culture history in north-central Texas. The relevant materials include an artifact assemblage comprised of Darl-like dart points, chipped stone bifaces, expedient flaked-stone tools, lithic debitage, sparse faunal bone, and abundance of fresh-water mussel shells, several discrete features (hearths, burned rock and mussel shell discard piles), and scattered fragments of burned sandstone.
>
> These materials were found primarily within buried A horizon soil that was identified within the cumulic alluvial sediments that comprise the site matrix, and which form a terrace adjacent to the Clear Fork of the Brazos River.
>
> A total of eight radiocarbon dates were obtained on samples of wood charcoal associated with the above-listed materials. The majority (5 of 8) of these samples were associated with discrete features. Although the dates range through the periods defined as the later part of the Late Archaic, the Late Prehistoric, and the Historic era, it is significant that one-half of the assays produce calibrated age ranges that cluster tightly between 950 and 1150 B.P. (ca. A.D. 800 and 1000; with significant overlapping that indicates statistically identical age ranges). It is our intention to demonstrate, on the basis of stratigraphic and horizontal distributional data, that this tight cluster of radiocarbon results represents a discrete Terminal Archaic archeological component that contains a set of functionally related features and Darl dart points.

4.2 THEORETICAL FRAMEWORK

Based on our discussions with archeological staff at TxDOT, it is apparent that the desired approach to analysis and reporting should be based on sound and appropriate theoretical orientations. We also note that our contract with TxDOT calls for the use of Middle-Range Theory to guide this effort. We understand the term “Middle-Range Theory” to refer to an approach to archeological interpretation formulated by Lewis R. Binford (1977; 1983), though we also note that this approach is only generally defined and is not universally applied in American archeological research.

At the outset, then, we state that our over-arching theoretical approach to interpreting the findings at 41YN452 is that of human ecology (*sensu* Butzer 1981). Since this body of theory is to a significant degree influenced by ecological conceptualizations employed in biology, it is sometimes simplistically thought to be overly focused on questions of how a specific organism (in the present context, humans), interacts with (adapts to) its biophysical environment in order to survive. In archeology, this translates to a primary concern with the ways in which past peoples mapped onto their natural environments by exploiting available resources according to their spatial and temporal distributions. While this is in fact a primary interest in human-ecological research centered upon the study of how economic and techno-economic patterns enable human individuals and groups to survive, human ecology, by virtue of being the study of *human* adaptations, also involves the wide range of behavioral and cognitive patterns involved in social organization, group-level decision making (i.e., political structure), and the relations and interactions of a human population with other human groups. Humans, as creators and bearers of culture, live and act within cognitive, social, and political environments, in addition to the biophysical environment they share with other species.

The "human ecosystem" involves, therefore, more than merely the techno-economic relations that people have with their "natural" environment. In actuality, it includes the ongoing interplay between individuals and subgroups within a given society, with other groups that form distinctly different societies (however defined), as well as the cognitive dimension of the cultural system as expressed in ideological patterns, belief systems, and culturally carried information of all kinds, including cognitions/perceptions of social identity, or ethnicity.

The concept of the human ecosystem has fundamental implications in terms of how one views human behavior, culture, and adaptation. The key term here is "system", which is understood as a continuously dynamic and complex set of interactions (via multiple feedback loops) between both its internal components, or subsystems, and with extra-systemic factors (e.g., a human group/society adapted in a definite way to its own environment, interacts via trade, conquest, or exchange of ideas, with a different groups or societies). Ultimately, through historically oriented analyses, it may be possible to define the *state* of a given human ecosystem (e.g., something approaching a steady-state, wherein the basic patterns and structures of cultural behavior remain more or less unchanged for an extended period of time, or a dynamic-equilibrium state wherein such patterns are undergoing progressive directional change, or a meta-stable state in which the system reaches a level of complexity that engenders instability that can lead to systemic reorganization or catastrophic simplification). The elucidation of state changes in past cultural systems is one end result of archeological investigations that has involved the accumulation of information concerning long-term processes. It might be hypothesized, for example, that the shifts/transitions from one stage or phase of cultural manifestation to another could be illuminated if sufficient information were available as to how the human ecosystem during Phase X actually worked, and also how the system operated in subsequent Phase Y and in what ways it differed from the processes that operated in the previous phase. Clearly, the range and detail of information available on such "phases" will affect our ability to model fundamental change and, as any practicing archeologist is likely to attest, obtaining the requisite breadth and depth of information is a fairly daunting task.

Defining the details of how things worked in now-extinct cultural systems brings us to the issue of Middle-Range Theory. In proposing the idea that archeologists should strive to develop reliable middle-range theories, Binford (1977, 1983) was tackling precisely the problem that archeological data tend to be interpreted as post-hoc results of a priori assumptions embedded in any given macro-theoretical perspective. In other words, Binford believed that interpretations too often only "affirmed the consequent". In order to break the cycle of circular reasoning that this entails, he argued for developing a body of archeological concepts, based on rigorous empirical observations that would effectively define what patterns of past human behavior are represented by the material patterns observable in the present reality that is the archeological record. His ethnoarcheological studies of present-day hunter-gatherer discard patterns (Binford 1983), for example, were undertaken to develop a consistent idea of how distributions of debris might represent the observable discard patterns among past hunter-gatherer groups. This example is, in fact, the form of middle-range research that is most commonly employed, as has been done recently in Texas, at the Darl/Terminal Archaic component at McKinney Roughs site in Bastrop County (Carpenter et al. 2006).

4.3 Research Questions

We propose to address a set of specific questions in analyzing the findings at 41YN452, which we believe can be answered with reasonable confidence within the limits of the data that can be generated from the excavated materials and field notes. These key questions are:

4.3.1 Question 1

Is a discrete and isolable Terminal Archaic component identifiable at the site? As noted above, the presently available data indicates to us that at least one discrete component is, in fact, identifiable, namely, the Terminal Archaic, or "Darl" Component, which is marked by Darl-like dart points and which has a chronological position, judging from the currently available radiocarbon assay results, of 950 to 1150 B.P. (ca. A.D. 800 to 1000), calibrated. Six arrow points were found as well (generally above the targeted zone in the buried A horizon), that indicate either distinctly postArchaic occupation(s) of the site, or alternatively, the possibility of contemporaneous use of both darts and arrows. At least two radiocarbon assays on charcoal produced calibrated date ranges that fall within the conventionally accepted limits of the Late Prehistoric (date ranges of A.D. 1031 to 1134 and 1475 to 1606, calibrated). It is possible, though not presently demonstrable, that these dates represent the occupation(s) that left behind the several arrow points. Based on our presently available information, we believe that the relatively early cluster of radiocarbon dates (those calibrating in the A.D. 800 to 1000 range), the few Darl and Darl-like points and other artifacts, the limited sample of faunal materials, and the features found within the buried A horizon, are all directly associated within a discrete Terminal Archaic component (see attached Figures 4-1 and 4-2, which show the cluster of the pertinent date ranges and the vertical clustering of dates, features and Darl artifacts in the North Block excavation area, where stratigraphy was clearest).

At the same time, we also believe that additional clarity in separating the Terminal Archaic and Late Prehistoric components is desirable and possible. One way to address the problem is to run additional assays on more charcoal samples to find out if the results produce a second clustering of date ranges that is later in time than the one we believe correlates to the Darl component, at 950 to 1150 B.P. (A.D. 800 to 1000), calibrated. While such a cluster would not necessarily provide a more precise temporal range for the arrow points, per se, it would support the idea that there is, in fact, a second definable cultural component at the site that represents the Late Prehistoric period and that can be assumed to pertain to the occupations(s) that left behind the several recovered arrow points.

4.3.1.1 Analytical Techniques

Radiocarbon Dating To Determine Age Range of the Materials:

- Selection of a number of charcoal samples from identified features or near features in good context for radiocarbon dating;

- Selection of charcoal from outside or on top of the targeted buried A horizon for radiocarbon dating to explore whether the Late Prehistoric period is represented.

4.3.2 Question 2

What was the nature of the Terminal Archaic occupation at 41YN452, in terms of: a) on site activities and their spatial organization (here drawing upon Binford's

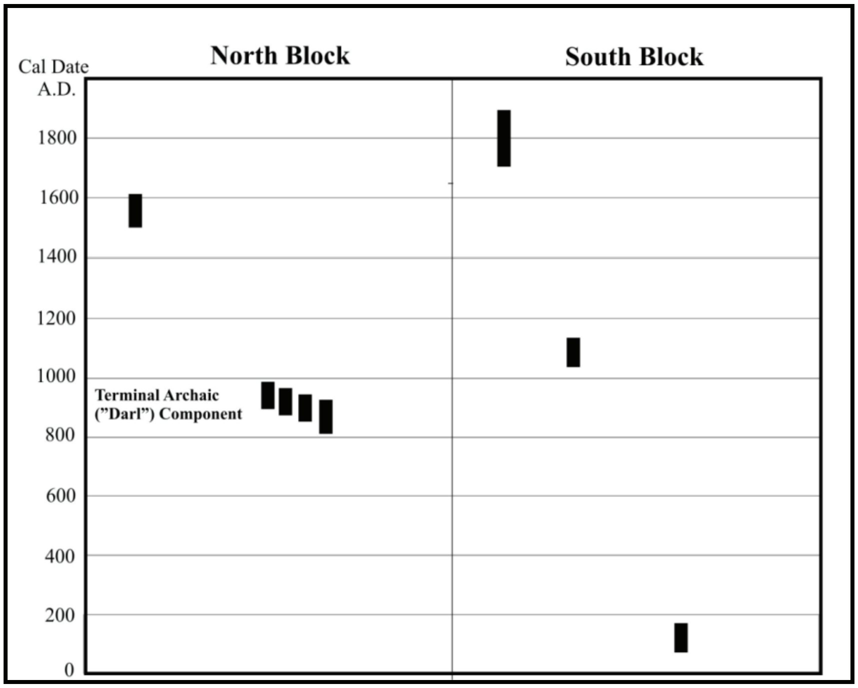

Figure 4-1. Diagram Showing the Calibrated Date Ranges (1-Sigma) Obtained from Original Eight Radiocarbon Assays on Wood Charcoal Samples from 41YN452. Note the tight clustering of four of the dates in the North Block, believed to represent a Terminal Archaic (Darl) Component.

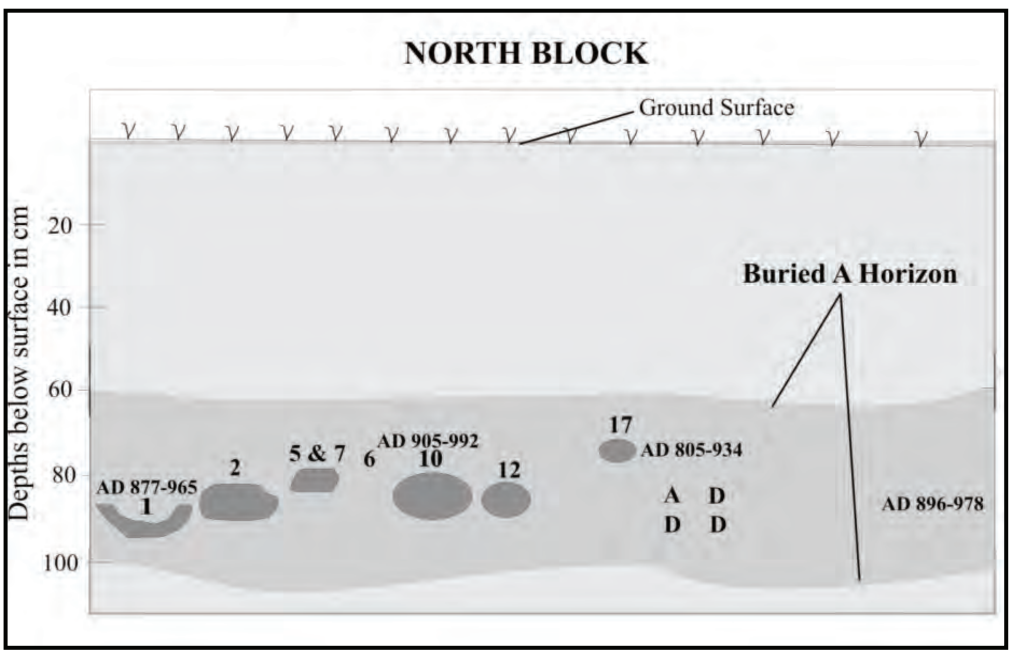

Figure 4-2. Diagram of Stratigraphic Profile of the North Block Excavation at 41YN452,Showing Features, Calibrated Date Ranges on Charcoal Samples, and Vertical Positions of Darl Dart Points (D) and a Single Arrow Point (A), all Back-Plotted onto the profile. Note that the arrow point is believed to be displaced from a higher position in the profile, based on the fact that it was found oriented vertically, rather than lying flat, indicating downward translocation in a shrink-swell crack in the fine-grained sediments.

ethnoarcheological data for interpretive support, in conjunction with the horizontal distributions of various classes of features and debris); b) functions of features (e.g., was a given feature used for cooking and, if so, what kind(s) of cooking [e.g., stone boiling, roasting, etc.], and what kinds of food resources were cooked based on possible macrobotanical or plant micro-fossil data); c) the range of on-site activities represented by the recovered sample of artifacts (e.g., dart points used for hunting, the use of expedient tools for functions to be ascertained through use-wear analysis, and the predominant stages of lithic reduction at the site, as revealed by debitage analysis) and, finally, d) the relative duration of occupation (here turning especially to seasonality studies to determine if occupation was within a single season or spanned multiple seasons)? The materials to be analyzed for seasonality will include fish otoliths and if present in faunal samples, season-diagnostic bone elements (e.g., remains of fetal/newborn deer or fawns). Fish otoliths have been used in many archeological contexts in Texas (e.g., Smith 1983; Prewitt et al. 1987; Ricklis 1996; Wilson 2002; Mokry 2002) to determine the season(s) of fishing activity. We propose to perform such analysis on the several freshwater drum otoliths recovered at 41YN452, in order to determine whether or not fishing was a seasonally restricted subsistence activity or was carried out over various seasons. This is expected to contribute to an understanding of the duration of occupation of the site during the Terminal Archaic. Given the general sparseness of cultural debris in this component, we infer that a relatively short-term occupation or several very short occupations are represented. If the latter scenario is supported by otolith seasonality, there are significant implications for the degree of mobility in the adaptive system.

4.3.2.1 Analytical Techniques

To Determine Feature Function(s):

- Identification and classification of features based on morphology and contents;
- Diatom analysis to determine if burned rocks were used in conjunction with water, as in stone boiling;
- Starch grain identifications to determine what, if any, plant materials were processed within a given feature;
- Identification of macrobotanical remains from features, again to ascertain what plants were used and/orprocessed.

To Identify the Spatial Arrangement of on-Site Activities:

- Patterning in the distribution of features;
- Patterning in the distribution of classes of cultural debris (such as faunal bone, debitage, formal tools, and burned rocks);
- Spatial patterning of concentrations of organic matter at three specifically sampled different types of features at close intervals, as revealed by horizontal variability in phosphorus content and magnetic sediment susceptibility with three feature matrices;
- Identification of macrobotanical remains to assess the role of plants in the site-based subsistence economy;
- Use-wear studies on lithic tools (including expedient tools such as utilized flakes) to help define the range of on-site activities;
- Functional identifications of formal stone tools (e.g., dart points, grinding stones, etc.), also to

elucidate the range of on-site activities;

- Debitage analysis to help in identifying possible specific locations of lithic reduction activities (e.g., possible clustering of primary and secondary flakes vs. tertiary retouch flakes);

- Interpretation of identified patterns as representative of on-site behavioral patterns, using ethnoarcheological information presented by Binford.

4.3.3 Question 3

Was the subsistence economy represented in the Terminal Archaic component relatively focused or relatively diverse? Ecofactual data will be generated in order to assess the range of resources utilized by the site occupants during the Terminal Archaic. This effort will rely upon identification of exploited faunal species represented by the small sample of bone material, as well as analyses of macrobotanical and plant microfossil samples (e.g., starch grains, phytoliths) associated with features and stone tools.

4.3.3.1 Analytical Techniques

The following techniques will be employed on the various data sets collected above.

- Zooarcheological analysis of faunal remains from 41YN452 (taxa identifications, determination of MNI of various taxa);

- Macrobotanical assemblages from Darl components; identification of taxa represented;

- Starch grain and phytolith identifications on burned rocks from specific features and ground stone tools will contribute to knowledge of plant usage.

4.3.4 Question 4

How does the Terminal Archaic component at 41YN452 compare with other known Terminal Archaic sites in the surrounding region? Comparisons will be made with sites and/or site components that are characterized by a preponderance of Darl type dart points, including sites in the immediate area such as Harrell (Kreiger 1948) and High Bluff (Flinn and Flinn 1968), as well as sites farther a field that afford insights into the culture/human ecology of this period (e.g., the Darl component at McKinney Roughs site [Carpenter et al. 2006). Comparisons will be made with an eye to defining variability in occupational intensity, site functions, and subsistence patterns during the pertinent time period across central and north-central Texas. This will contribute toward a definition of the variability in adaptive behavior during the Terminal Archaic period.

4.3.4.1 Analytical Techniques

To Compare Similarities with other Known Sites:

Selection of a number of known sites (Harrell site - Kreiger 1948; High Bluff site - Flinn and Flinn 1968; McKinney Roughs site - Carpenter et al. 2006) in good context and review published assemblages.

4.3.5 Question 6

Was the bow and arrow adopted simultaneously by all groups in the general central north-central Texas region, or was it adopted sooner by some groups and later by others? Also, is there a need for revision of the accepted date of this technological shift (and the concomitant shift from the Archaic to the Late Prehistoric, given that the shift from dart and atlatl to bow and arrow technology effectively marks the end of the Archaic and the beginning of the Late Prehistoric)?

The absolute dates from 41YN452 suggest that the site occupants were using Darl-like dart points beyond the time range previously defined for this point type (e.g., Prewitt [1985] places the shift at 1200 B.P. (ca. A.D. 700), whereas the dates for the Terminal Archaic at 41YN452 suggest that Darl points date later, at 950 to 1150 B.P. (ca. A.D. 800 to 1000). A similar time range is indicated for Terminal Archaic Darl component at the McKinney Roughs site in central Texas (Carpenter et al. 2006).

We believe that these findings have potentially significant implications for a critical reappraisal of the timing of the Archaic to Late Prehistoric shift in the greater region. While Prewitt places his Driftwood Phase, the taxonomic home of Darl points, within a remarkably narrow time slot (ca. A.D. 600 to 700; see Prewitt 1985:212), based on the 10 calibrated radiocarbon dates he ascribes to this period, only three of his dates have centroids that actually fall within the suggested 100 year duration of the Driftwood Phase (see Prewitt 1985:212 and Table 1). Apparently, Prewitt pushed the ending date of this phase back in time to make room for the many dates that he ascribes to the subsequent Late Prehistoric Austin Phase, which he defines as beginning at 1250 B.P. (ca. A.D. 700). We believe it is possible that this masks a later persistence of Darl dart points (and therefore, of the Archaic, as currently defined in Texas archeology), a persistence to be reflected in the data from 41YN452 and McKinney Roughs. Alternatively, it is possible that the shift to the bow and arrow (as marked by the appearance of Scallorn arrow points) occurred over a period of several centuries, in which case the Driftwood to Austin phase shift did not occur uniformly and suddenly, but was more of the nature of a temporally variable transition over several hundred years. Since this possibility has significant implications for gaining insight into how prehistoric hunters accepted and employed the new technology (i.e., gradually vs. abruptly), we propose to revisit this question by reviewing and reappraising all extant radiocarbon data for the relevant period in central and north-central Texas, including the data from 41YN452, the Darl component at McKinney Roughs, and the various other sites considered to fall into this period by Prewitt. This will include consideration of stratigraphic/sedimentary contexts from which the dated samples were extracted in order to (re)evaluate their contextual integrity and reliability.

4.3.5.1 Analytical Techniques

Reappraisal of extant radiocarbon data for the appropriate period at documented sites (e.g., McKinney Roughs) in central and north-central Texas.

Examine stratigraphic and sedimentary contexts from which dated samples originated to assess archeological integrity.

4.3.6 Question 6

Did groups of the Terminal Archaic generally practice a diversified economic pattern based on a broad-based resource collection strategy? Organic remains recovered from 41YN452 indicate a diffuse resource-procurement strategy, wherein no one resource is represented with relative predominance. The recovered assemblage suggests hunting of both large and small game, collection of freshwater mussels, limited fishing, and plant gathering. This diversity suggests that no one resource served as the predominant factor that influenced site location. An examination of other contemporaneous sites in this region will be performed to look for comparative subsistence data with which to corroborate or nullify the hypothetical suggestion that the Terminal Archaic was characterized by a wide-ranging diversity in resource use and a broad-based adaptive strategy.

4.3.6.1 Analytical Techniques

Assessment of organic remains, such as faunal and macrobotanical, from 41YN452 and other contemporaneous sites for comparable subsistence data in the examination of diversity in resource use was performed.

4.3.7 Summation of Analyses to be Undertaken

In sum, in order to address the above-listed questions, we propose to carry out the following set the specific analyses:

1. Radiocarbon dating of additional samples of charcoal. Samples will be selected from the contexts of; a) the Darl component (features within the aforementioned buried A horizon, and potentially from matrices in the immediate vicinity of such features, and b) from sediment matrices that overlay the Darl component and thus can be expected to relate to subsequent occupation(s) of the site during the Late Prehistoric period.

2. Zooarcheological analysis, to include taxa identifications of mussel shells and faunal bone fragments and estimations of minimum numbers of individuals (MNI) for identifiable taxa. Based on the MNI data, estimates of the approximate edible meat weights and caloric values of the different taxa will be made.

3. Seasonality analysis of fish otoliths.

4. Taxa identification of macrobotanical materials as well as plant microfossils (pollen, diatoms, phytoliths) associated with features to identify what plant resources were used and, by association, what plants may have been processed in thermal features.

5. Use-wear analysis on stone tools to determine tool functions and thereby increase our insight into the range of on-site activities.

6. Debitage analysis, involving a) quantifications of debitage by flake types to determine the predominant stages of lithic reduction activities carried out at the site, and b) comparisons of debitage and flaked-stone tools with samples of locally collected stone to determine if knapping activities on site involved primarily or exclusively local raw materials.

7. Spatial analysis of the distributions of debris of various classes (i.e., burned rocks, debitage, formal and expedient tools, faunal bone fragments, mussel shells) to identify the ways in which on-site activities were organized within the excavated portion of the Terminal Archaic component. Results will be related to Binford’s model of drop/toss-zone discard patterns to the extent that is feasible.

8. Archeo-chemical and Microfossil Analyses. These will include:

    a. Starch grain identifications on burned rocks and stone tools.

    b. Diatoms: determination of presence/absence as well as species.

    c. Phosphorus and Magnetic Sediment Susceptibility: To identify relative concentrations of organic constituents between two or three intensively sampled features within the excavation blocks, in order to help determine feature function and intactness. This will be performed using small sediment samples recovered at tightly recorded intervals during field work.

5.0 APPROACH AND METHODS TO ARCHEOLOGICAL ELIGIBILITY ASSESSMENT AND DATA RECOVERY AT 41YN452

J. Michael Quigg and Paul M. Matchen

5.1 INTRODUCTION

As a response to TxDOT's proposed replacement of a bridge and the addition of new right-of-way (ROW) and temporary construction easement along the Farm to Market road at Gages Creek, Mr. Dennis Price, staff archeologist, and Dr. James Abbott, staff geoarcheologist, from the Environmental (ENV) Affairs Division of TxDOT, conducted a survey in that immediate area (Abbott 2005; Price 2005). Their archeological and geoarcheological investigations included 41YN450 and 41YN452 on either side of the current bridge (Figure 5-1). These sites and many others were initially recorded during the 1987 and 1988 South Bend Reservoir survey by archeologists from Texas A&M University (Sanders et al. 1992). The TxDOT investigations at 41YN450 included the excavation of three backhoe trenches and one 50-by-50 cm unit. At 41YN452, they excavated two backhoe trenches, 4 and 5, into the site deposits, but no hand-excavations. The results of TxDOT investigations revealed 41YN450 and 41YN452 as potentially eligible for listing on the National Register of Historic Places (NRHP) and as State Archeological Landmarks (SAL), and Price (2005) recommended significance testing in the APE for both sites.

Figure 5-1. View of Current Bridge over Gages Creek with 41YN450 in Foreground and 41YN452 on Far Side of Bridge.

Following the investigations of Abbott and Price, a NRHP eligibility assessment was performed on sites 41YN450 and 41YN452 (Figure 5-1) to assess whether either of these recorded prehistoric sites contained characteristics worthy of their listing on the NRHP. The eligibility assessment of 41YN452 documented a buried and intact cultural component with chipped stone tools, features, and organic preservation.

This component contained the potential to contribute significant information concerning the prehistory of the region, indicating this site as potentially eligible for nomination to the NRHP and recommending it for further investigations (Matchen et al. 2006). Only site 41YN452 was recommended as eligible for listing on the NRHP and/or for designation as a SAL per the requirements of Section 106 and 110 of the National Historic Preservation Act and other related legislation, following the assessment phase. Details of the approach and methods employed during the eligibility assessment were documented in an interim report submitted to and accepted by TxDOT (Matchen et al. 2006). That interim report is included as Appendix G.

Subsequently, site 41YN452 was approved by TxDOT and the Texas Historical Commission (THC) for data recovery. Since TxDOT archeologists determined that avoidance was not possible given the sites position within the current and proposed new right-of-way immediately next to the bridge, the documented Late Archaic component at 41YN452 was subjected to more intensive excavation to retrieve a sample of the cultural information present before its destruction. The methods discussed in this chapter pertain primarily to the data recovery conducted at 41YN452.

5.2 REVIEW OF ARCHIVAL DOCUMENTS

Before TRC entered the field for the site eligibility assessment, TxDOT provided TRC with copies of archeological and geoarcheological survey reports conducted by Mr. Dennis Price and Dr. James Abbott, respectively, of TxDOT ENV (Abbott 2005; Price 2005). Their work included investigations at 41YN450 and 41YN452 and surrounding sites 41YN447, 41YN448, and 41YN451. These two documents were reviewed and used as a basis to formulate a work plan for the assessing both sites.

In January 2006, before conducting the assessment fieldwork, a review of existing documentation was performed using the

THC's online Texas Archeological Sites Atlas to locate archeological information on previous cultural resource investigations conducted in the vicinity of this project, and any previously documented cultural resource properties near the APE. Those records indicated that in 1987 and 1988, the large South Bend Reservoir survey had been conducted in this immediate area. It was during that South Bend Reservoir survey that 41YN450 and 41YN452, and many other cultural resource sites, were recorded (Sanders et al. 1992). The review also revealed that relatively few other surveys or excavations had occurred in the area (see Chapter 3.0 for more details on investigations in the region).

5.3 TRC FIELD ASSESSMENT METHODS

Initial field assessment methods involved the mechanical excavation of four trenches on site 41YN452 with the use of a Gradall® furnished by TxDOT. These trenches exposed the natural stratigraphy at each location, which were then documented by geoarcheologist Eric Schroeder and used to help identify specific target areas for test unit placement. Each trench was excavated to a depth of approximately 1.5 meters (m) below surface (bs) using a 175 centimeter (cm) wide bucket. These trenches varied in length from 5 to 10 m long (Table 5-1). Trench placement was generally arbitrary to sample the length of the APE with a focus towards the western side of the APE away from the current pavement. However, a small diameter, buried water pipeline crossed back and forth from the old to the proposed new right-of-way and generally parallel to the pavement; this line created some problems and influenced trench placement.

Next, five 50-by-50 cm units were placed on the sides of five selected trenches to sample the entire 150 cm impact zone to determine the vertical locations and frequency of cultural materials (Figure 5-2). These units were excavated in 10 cm arbitrary levels with thesediment screened through 6.4 millimeter (mm) (1/4 inch [in]) mesh screens. A buried paleosol or 2Akb soil horizon was visible in all the trenches. The majority of clustered cultural materials (i.e., mussel shells and burned rocks) were recovered from within this visible and distinguishable buried paleosol.

Table 5-1. Mechanical Trench Size and Cultural Observations at 41YN452

Mechanical Trench No. (North to South)	Size (Meters)	Depth (cmbs)	Cultural Material Observed	Top of 2Akb (cmbs)
1*	? X .75	150	1 uniface, mussel shell fragments	?
3 N to S	7.5 x 1.75	150	3 burned rocks side by side, Feature 1	60-64
3 E to W	5 x 1.75	150	burned rocks, mussel shell concentration, Feature 2	ca. 60-65
4 N to S	9 x 1.75	150	7 mussel shells, 3 burned rocks	ca. 50
4 E to W	4 x 1.75	150	12 mussel shells, 2 burned rocks, 1 bone	ca. 50
2*	? X .75	150	mussel shells, charcoal, burned rocks	?
5	6 x 1.75	150	mussel shells, burned rocks, Feature 3	ca. 60-65
6	10 x 1.75	150	1 mussel shell at 115 cmbs	ca. 48
* Excavated by TxDOT in 2005, originally labeled as 4 and 5 respectively (Abbott 2005)				

When clusters of cultural materials were detected in the trenches, 1-by-1 m units were placed to target these clusters and potential features. To expedite the recovery, the mostly noncultural bearing deposits above the buried 2Akb horizon were removed by the Gradall® to concentrate the hand efforts toward the cultural materials in the buried paleosol. This created a working platform below the original ground surface to explore the clustered materials. Discussion of the trenches and units opened at Root-Be-Gone is presented below.

Figure 5-2. A 50-by-50 cm Unit Excavated on Side of Trench

5.3.1 Mechanical Trenching of Site 41YN452

Trenches 1 and 2 were excavated during initial investigations conducted by TxDOT archeologists in the fall of 2005. Price (2005) and Abbott (2005) referred to these as Trenches 4 and 5 and presented these trenches as a continuation of work initiated at 41YN450 where Trenches 1, 2, and 3 were excavated. TRC approached the efforts at 41YN450 and 41YN452 as individual sites and not by project. So, the initial trench excavations at 41YN452 performed by Price and Abbott are presently referred to as Trenches 1 and 2. TRC began the 2006 assessment investigations by numbering trenches in sequence starting with Trench 3 and continued through 6 (Figures 5-3, 5-4, and 5-5).

5.3.1.1 Trench 3

Trench 3 was excavated in two parts; the north-south trending fence line positioned between the two parts created an "L" shaped trench. Trench 3 was approximately 7 m south of Trench 1 (originally Trench 4 as designated by Price (2005) and Abbott (2005). The east west trending section was positioned a meter east of the waterline flag in the proposed new right-of-way. However, as digging of the trench commenced, the water line was uncovered (7.5 cm plastic pipe) in the western end. No breach of the pipe was observed, so work proceeded carefully to the east of it towards the fence line. The fence line was left intact. This east west section was 5 m in length, 175 cm wide and 1.5 m deep. A 50-by-50 cm unit (Unit 2) was hand-excavated towards the middle of the trench on the southern side. A thin zone of burned rock and mussel shell was observed on the northern side of the trench within a buried A horizon that started at about 60 cmbs. The overlying sediments were mechanically stripped down to the top of the buried A horizon at which point the hand-excavations began. Units 7 and 8, both 1-by-1 m in size, were placed side-by-side over this concentration (Feature 2) that was towards the middle of the buried A horizon.

The north to south section of Trench 3 was excavated in the current right-of-way on the opposite side of the barbed wire fence that denotes the existing TxDOT right-of-way. This section was approximately 7.5 m long, 175 cm wide and 150 cm deep. A concentration of three burned rocks was observed in the eastern wall towards the northern end. Again the Gradall® was employed to remove the sediments above the observed cultural concentration to the top buried A horizon that contained those materials.

Figure 5-3. View of Gradall® Excavating Trench 4 E/W in proposed New ROWMonitored by TRC Archeologist.

Figure 5-4. View of Trench Backdirt Piles Distributed along TxDOT ROW Containing 41YN452.

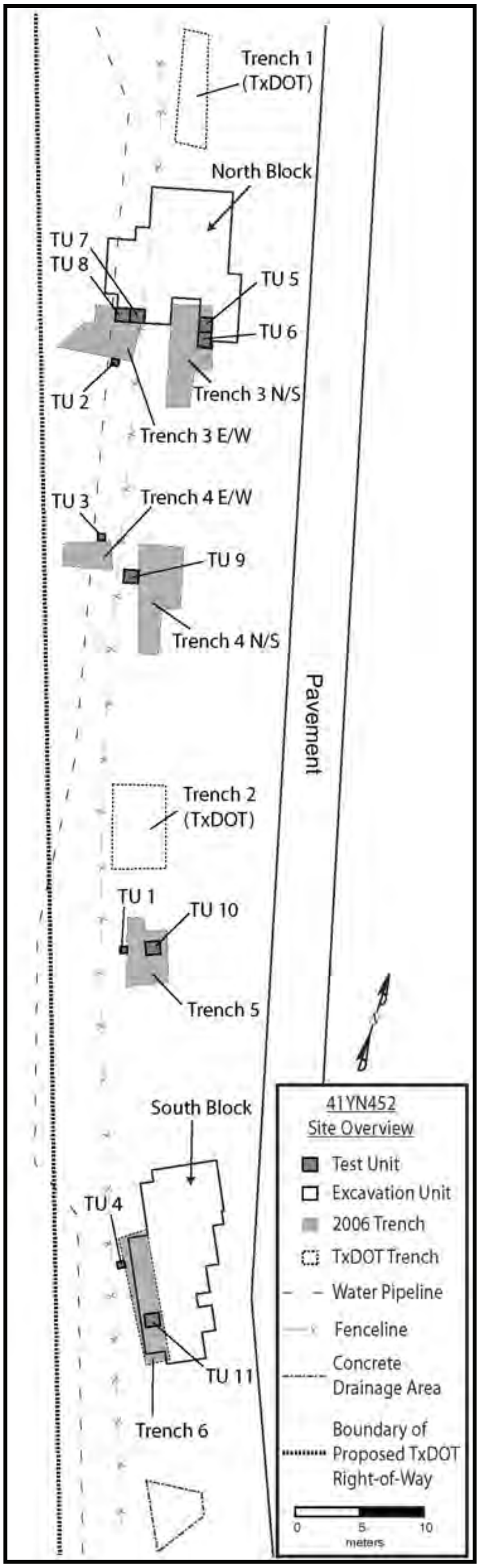

Figure 5-5. Plan Map of 41YN452 Showing Areas Investigated

Units 5 and 6 were then placed side-by-side over the cluster (Feature 1), and hand-excavated through the feature and to the bottom of the A horizon.

5.3.1.2 Trench 4

Trench 4 was located approximately 10 m south of the north-south section of Trench 3. Trench 4 was again excavated in two parts with the north-south fenceline again separating the two parts, which ended in an "L" shaped trench. The east west section was mechanically excavated on the west side of the barbed wire fence in the proposed new right-of-way and perpendicular to the fenceline. This section was nearly 4 m in length, 175 cm wide and 150 cm deep. Caution was used during the excavation in anticipation that the existing waterline might be present. The water line was not encountered in the trench. Unit 3, a 50-by-50 cm unit, was hand-excavated from the surface to 150 cmbs.

The second part of the "L" was positioned on the opposite side of the current fenceline in the existing right-of-way, and parallel to FM 3109 in a north-south line. This section of Trench 4 measured about 9 m long by 175 cm wide and 150 cm deep. Unit 9, a 50-by-50 cm unit, was hand-excavated from the surface to 150 cm deep. No obvious concentrations of cultural material were observed in either section of Trench 4.

5.3.1.3 Trench 5

Trench 5 was excavated within the existing right-of-way on the roadside about 13 m south of the north-south section of Trench 4 and projected about 3 m south of Trench 2 (originally labeled as Trench 5 by Price (2005) and Abbott (2005)). Trench 5 was measured approximately 6 m long, 175 cm wide and 150 cm deep. Again, a buried A horizon was observed at approximately 60 cmbs. No definite artifact concentration was observed in the profile. An area on the eastern side of the trench was mechanically removed down to about 55 cmbs, and a 1-

by-1 m unit, Unit 5, was excavated through the buried A horizon.

5.3.2 Trench 6

Trench 6 was positioned parallel to the current roadway and inside of the existing right-of-way about 13 m south of Trench 5. It measured approximately 10 m long by 175 cm wide and 150 cm deep. The buried A horizon was also visible in this profile. Scattered mussel shell and burned rock were present throughout this profile. Unit 4, a 50-by-50 cm unit, was excavated from the surface to 150 cmbs. During the mechanical excavation of this trench a mussel shell concentration was encountered towards the southern end; excavation was stopped and the shell concentration was left in place. Unit 11, a 1-by-1 m unit, targeted this shell concentration.

5.4 DATA RECOVERY OBJECTIVES AND METHODS

5.4.1 Introduction

TRC's 2007 investigations were undertaken as part of the Secretary of Interior's Standards concerning historic properties (48 FR 44720-44721), generally referred to as mitigation or data recovery of the Section 106 Process (36 CFR 800.3-800.13). Specifically, the intentions of these archeological investigations were to recover and document a portion of site 41YN452 by excavating the deposits that contained significant cultural materials prior to destruction by TxDOT development activities associated with the planned bridge replacement activities over Gages Creek.

The previously identified, 30 to 60 cm deep buried 2Akb horizon (Figure 5-6), which was 30 to 40 cm thick and contained at least one Late Archaic cultural component, was the target zone of this data recovery. The TRC assessment investigations documented two horizontally separated and similar activity areas that contained intact cultural features in the buried A horizon.

Both areas were targeted through large block excavations during the data recovery investigations. The target amount of deposits to be investigated was established by TxDOT at 50 m^3.

Figure 5-6. Trench Profile Showing Buried 2Akb Soil Horizon. Dashed line marks the top of this soil horizon.

5.4.2 Data Recovery Field Methods

To initiate this data recovery, Mr. Tom Stacy from the Wichita Falls TxDOT District office, under the direction of TRC archeologist, mechanically stripped 30 to 60 cm of sediment above the top of the buried 2Akb horizon (the target zone) in two separate areas, some 63 m apart, designated as the North Block and the South Block. The South Block was mechanically stripped to between 30 and 40 cmbs, but the buried 2Akb horizon was difficult to discern (Figure 5-7). The North Block was mechanically stripped to roughly 30 to 40 cmbs, and stopped short of the target depth since suspected cultural materials were observed at that depth (Figure 5-8).

The data recovery investigations were conducted during the winter months of January through March. TxDOT allowed for tents to cover the excavation block in case inclement weather occurred during the field session (Figure 5-9). The large tents permitted block excavations to continue through rain and snow. However, most screening of sediments was completed outside the tents.

The two target areas were to focus on activity areas around the previously investigated features and thereby, document human behaviors in two separate areas of the site. The South Block was laid out inside the old right-of-way west of the pavement, between the sloping shoulder of the pavement and the original right-of-way fence line (see Figure 5-5 above). The rain and snow did come, and one or two field days were lost (Figure 5-10); this was due to the State Highway Patrol's instructions not to travel on the highway because of icy road conditions, which inhibited travel to the site.

The rain and the melted snow did create wet conditions, both inside and outside the tents, which slowed and hampered the speed and efficiency in which activities were conducted.

Once each block was stripped, a separate 1-by-1 m grid system was laid out across each block. These two arbitrary grid systems were laid out parallel to previously excavated Gradall® trenches where cultural features had been excavated during the assessment phase.

The grid system was laid out parallel with the eastern edge of Trench 6, and extended eastward approximately 7 m toward the pavement hoping to capture more of the mussel shell labeled Feature 3 documented in Unit 11, inside Trench 6 (Figure 5-11).

Figure 5-7. Gradall® Stripping South Block

Figure 5-8. Gradall® Stripping North Block

Figure 5-9. Tent Covering North Block

Figure 5-10. The Snow Came, North Block on Right.

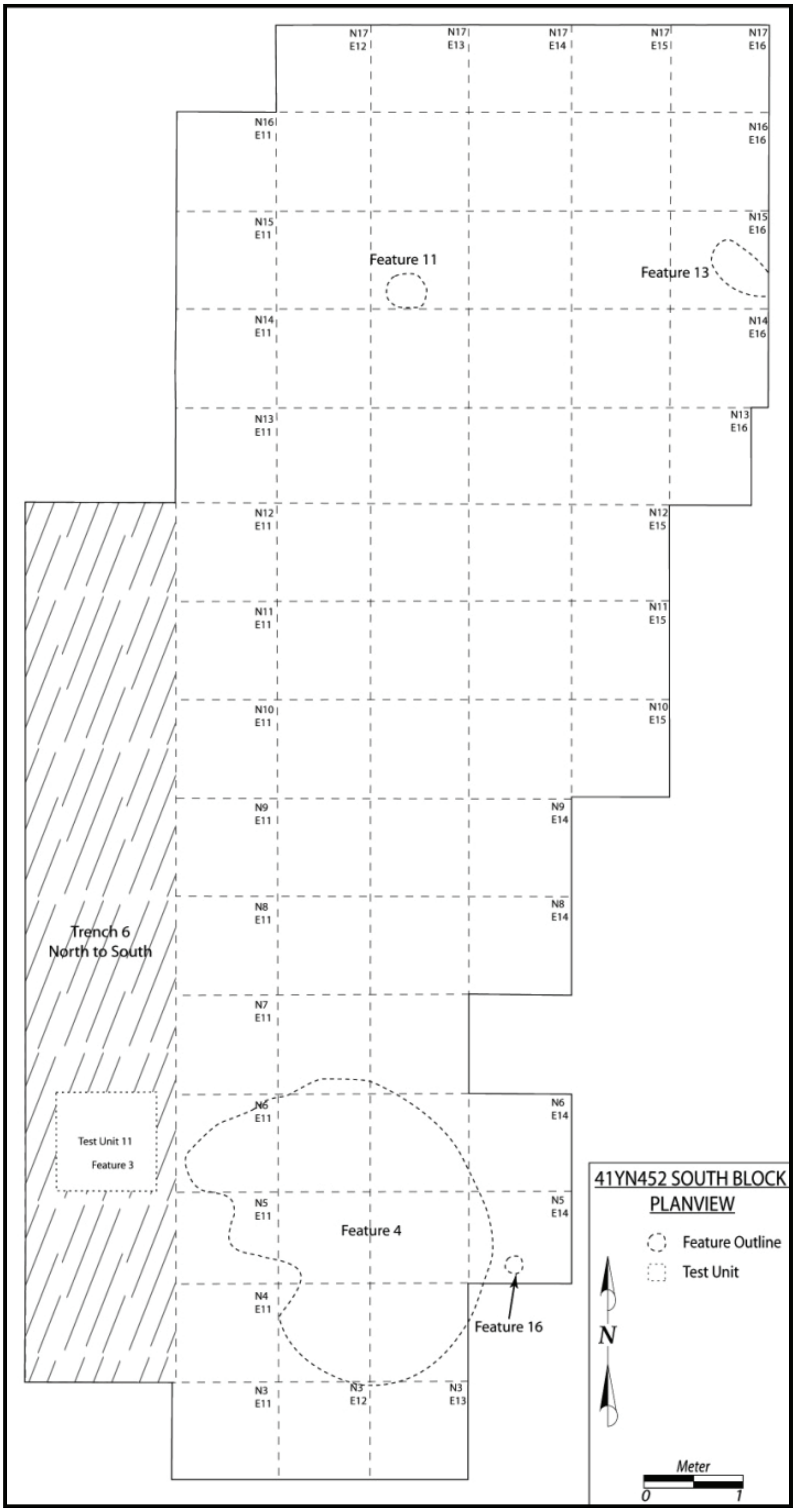

Figure 5-11. Plan Map of the South Excavation Block at 41YN452

The grid number N0, E0 was arbitrarily assigned to a point southwest of Trench 6 and outside the stripped block. The northeast corners of the units were then designated by the grid number. The South Block had excavation units from N3 to N17 and E11 to E16, roughly 69 m^2 or 21.6 m^3 hand-excavated.

Once the grid was established, hand-excavations began at roughly 30 cmbs over much of the South Block. The mechanical stripping was not perfectly flat and some units began slightly higher and others slightly lower. The mechanically stripped surface was deepest in the southeastern corner (ca. 40 cmbs) and highest in the northwestern corner (ca. 30 cmbs). Unfortunately, the buried 2Akb horizon was very faint or not visible with the varying moisture conditions that existed at the time. No visiblesediment variations except moisture were present at that time and these were not used to guide the excavations. Roughly 3 m south of this block, and directly south of N3 E11, a short 280 cm long and 120 cm deep trench (Trench 7) was mechanically excavated to facilitate the examination of a complete vertical profile for geoarcheological investigations and sample collection.

The North Block was also laid out from the pavement westward to the current right-of-way fence, which potentially included the existing water pipeline. The 1-by-1 m grid was laid out parallel to the north to south section of Trench 3 and northward from hearth Feature 1 (Figure 5-14). The arbitrary grid number N100, E100 was assigned to a point in the southwest corner of the block.

Figure 5-12. Small Backhoe Used to Remove Sediments Overlying the Paleosol in North Block.

Figure 5-13. Profile of Trench 7 Revealing Column Sample Intervals.

The northeast corners of the units were then designated by the grid number. The North Block had excavation units from N102 to N12 and E101 to E111, with roughly 75 m^2 or 28.9 m^3 hand-excavated. Once the grid was established, hand-excavations began at a depth of roughly 30 to 40 cmbs starting near the southern end of the block.

Unfortunately, much of the original mechanical stripping stopped too short of the target zone and roughly 20 to 40 cm ofsediment above the buried 2Akb horizon still covered much of the target zone. A small backhoe was brought in to help remove more deposits from above the buried 2Akb horizon (Figure 5-12). Still, some sediment above the 2Akb horizon was removed by hand before screening began at approximately 60 cmbs. The buried 2Akb horizon was generally visible across most of the North Block and moisture did not affect the visible identification here.

Approximately 6.5 m north of N112, E107, a short 280 cm long north-south and 120 cm deep trench (Trench 8) was mechanically excavated to again facilitate the geoarcheological examination of a completesediment column from the original surface to below the buried 2Akb horizon for documentation and sample collection.

The project geoarcheologist, Charles Frederick, collected a vertical sediment column consisting of 25 and 35 samples from Trenches 7 and 8, respectively, from the southern and northern end of the two block areas (Figure 5-13). Sediment samples were collected in roughly 5 cm intervals from the ground surface to just below the buried 2Akb horizon at roughly 110 cmbs.

These column samples were used for technical analyses such as magnetic susceptibility, grain size, and stable isotope analyses (see 6.1 below). The information obtained from these analyses contributes significantly towards interpreting the overall depositional environment throughout the cultural occupation period targeted in each of the two excavation blocks.

A total of 144 individual 1-by-1 m units, totaling 50.5 m^3 of removed material, were hand-excavated across the two blocks (Figure 5-14). Grid units were excavated by pick, shovel, and trowel in 10 cm arbitrary levels to the bottom of the 2Akb horizon in the North Block and arbitrary depths in the South Block (Figure 5-15). Vertical control and measurements were taken from below surface using a string and line level. Subdatums were established across each block and checked with the transit at various times to insure correlations of depths. The depth of individual units varied from 20 cm in the South Block to 50 cm depths in the North Block.

The sediments from the hand-excavations of 1 m units were screened through 6.4 mm (¼ in) hardware cloth, although hard clay and sometimes wet mud made this nearly impossible in some instances. Recognized cultural materials were placed in resealable plastic bags by excavation unit and level, class of material (i.e., debitage, burned rocks, mussel shells, etc.), and appropriately labeled with provenience information on field tags that were placed in each bag.

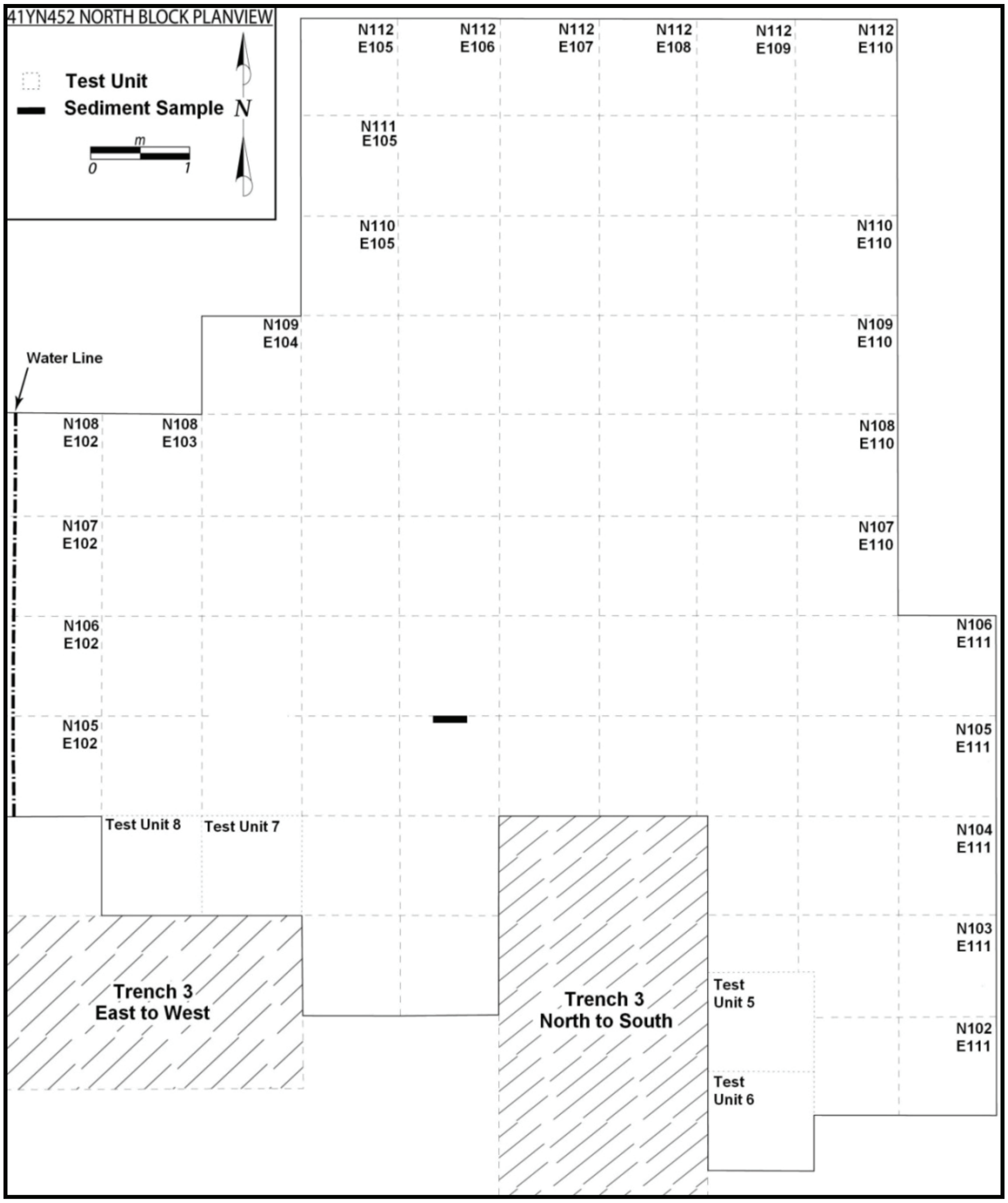

Figure 5-14. Plan Map of the North Excavation Block at 41YN452

Boxes of material were returned to the TRC Cultural Resources Laboratory in Austin, Texas, for processing, analysis, and temporary storage before curation. Information concerning each individual excavation level was recorded on TRC level forms. These forms included the site and unit number, who and when the level was excavated, the types of conditions involved, observations concerning the sediments, and the type and number of artifacts recovered.

A replica of the excavation unit was also on the level record, which was used to plot encountered materials.

When sizable pieces of cultural material were encountered *in situ* during the hand-excavations, these items were often piece plotted on the excavation level records. Most pieces plotted also had their bottom elevation taken and recorded to specifically document where that object was encountered in the level.

v

Figure 5-15. General View of Hand-Excavations in North Block

This type of piece plotting is extremely important when closely space occupations are potentially present.

When multiple pieces of cultural material were in a cluster, these clusters were designated as cultural features. Once features were encountered and recognized, the excavation and recording methods changed in order to collect more observations and extract more data for interpretations. With small features less than 1 m, the feature was isolated from the rest of the level for more precise excavation and documentation, keeping feature material separate from nonfeature materials. In most instances, the internal matrix of the small feature was removed and bagged without screening for refined screening/flotation in the laboratory. Most features were cross sectioned at least once to expose the profile and examine for possible basins, and to determine the vertical extent of the feature materials. Once exposed in the unit, the feature was drawn in plan view and profile if necessary, photographs were taken, and a TRC feature form was completed. The form included information on the size, shape, various construction elements, and contents. Contents of the features (i.e., burned rocks, mussel shells, lithic materials, and sediment) were bagged separately from the rest of the unit materials, boxed, and returned to the Austin laboratory. TRC began numbering features with “1” during the eligibility assessment phase. During that phase, three cultural features were identified (Features 1, 2, and 3) and investigated. The vertical positions of Features 1 through 3 were within the buried A horizon and provided the stimulus for TRC’s decision to target this buried A horizon during data recovery. TRC’s hand-excavations during the data recovery encountered and documented Features 4 through 17. Feature 18 was observed in the cutbank of Gages Creek and was not excavated or investigated in detail. Features were assigned numbers as they were encountered and not sequential in the investigated blocks or assigned by block.

In three selected features (Features 4, 10, and 11) a more detailed and focused geoarcheological sampling occurred through the extraction of small sediment samples in small 1.5 cm plastic squares and various lengths of micromorphology columns. Close interval sampling (20 cm) of feature sediments through the use of small plastic cubes was conducted across parts of Features 4, 10, and 11 for analyses to gain a greater understanding of the chemical contents and formation processes at these three different types of features (Figure 5-16). Short column samples of 15 to 25 cm tall were also collected from these same three features. The sediment columns were used to examine the microstratigraphy within these features for clues to function, intensity, and construction differences. Feature 4 was a massive mussel shell lens; Feature 10 was a mussel shell and burned rock dump/discard area, whereas Feature 11 was a small intact heating element. Differences in these three features were expected.

Feature types and definitions used in this report are as follows. The term heating element is used instead of the general term hearth. This is a location where an *in situ* fire occurred and should contain at least a few elements such as a basin, charcoal, rocks, oxidation, burned clay nodules, and/or dark stained sediment.

Many differences occur in the constituents of heating elements and all these listed characteristics may not be present in all heating elements. A mussel shell discard feature may be any size, but is dominated by discarded shells, and may contain a few other artifact classes (i.e., debitage, burned rocks, etc.) in low frequencies. A burned rock dump or discard is a locality dominated by relatively small burned rocks in no apparent pattern, lacking structure, without any indication of *in situ* burning, but may have small bits of charcoal or other artifact classes in association. A general discard pile would not have any one class of artifacts such as shell or burned rocks clearly dominate, but quantities of multiple classes present in relatively equal numbers, and lack those characteristics of an *in situ* heating element. Post holes are a relatively small, generally less than 30 cm in diameter, with dark stained fill that is roughly round in plan view and relatively straight vertical in profile. Sometimes these holes contain other classes of materials such as bits of bones, charcoal, or small rocks.

A few selected units from each of the blocks had one wall of the unit profiled. The problem was that the top of the profiles had been removed during the mechanical stripping. During the data recovery, the side walls were slopped, mostly buried, and not accessible. In some instances, small sediment samples were collected from selected proveniences for use in a variety of analyses. Potentially, these sediment samples would be used for phytolith, radiocarbon dating, chemical, and/or isotope investigations.

Figure 5-16. Charles Frederick Extracting Samples from Feature 11 at Close Intervals

Artifacts classified as burned rock were generally counted and weighed in the field by predetermined size classes and discarded. This information was recorded on the appropriate level record. Selected samples of burned rocks from various levels and units were collected and returned to the laboratory for potential analysis and assessment. Bulk sediments for fine-screening and/or flotation in the laboratory were collected from selected features and context. Macrobotanical, charcoal, and other samples were collected from recognized features and other contexts during hand-excavations.

During the field session, a small collection of chert cobbles was made from the Clear Fork of the Brazos in three different places along the river. It was apparent that chert cobbles were available in the river gravels. Two collections were made at the mouth of Gages Creek and one further downstream. These chert cobbles were collected for comparison purposes. Another sample of rocks (chert and other types) was collected from a Pleistocene gravel outcrop in an upland setting on the north side of Gages Creek and above site 41YN450. A small collection of modern mussel shells was made from the river margins at the month of Gages Creek and a sandbar further downstream on the Clear Fork. Again, these were done for comparative purposes. A bison mandible was collected from about 330 cmbs along the cutbank of the Clear Fork of the Brazos on the north side of the mouth of Gages Creek.

5.4.3 Initial Feasibility Studies

Following the data recovery investigations, TxDOT requested feasibility studies be conducted on the different analyses that TRC was going to propose for data to address research questions. TRC staff proposed six analytical techniques that would be used to address research questions, therefore, a few samples were selected to conduct exploratory analyses on to provide future direction for subsequent analyses. TxDOT believed these feasibility studies were necessary to determine if certain types of technical analyses would yield sufficient and interpretable results to contribute towards addressing questions developed in TRC's initial research design. It was anticipated all these analyses would be implemented during the subsequent data analyses phase. TxDOT agreed to the allocation of limited funds for each of the following technical analyses. These analyses were conducted by individuals and institutions that provided their expertise and recommendations stemming from their results in the attached appendices.

5.4.3.1 Macrobotanical Analysis

The eligibility assessment and data recovery excavations yielded few chunks of charcoal or other obvious macrobotanical remains. Bulk sediment samples from identified cultural features were also collected for potential analysis for macrobotanical remains. Initially, 20 charcoal samples from 11 features and some outside features were selected for identification following the end of the data recovery phase. These samples were submitted to Dr. Phil Dering of Shumla Archeobotanical Services in Comstock for identification. From this small suite of samples, at least four species of wood were represented. The tiny size of the charcoal recovered prevented positive identifications in seven instances.

Subsequently, another 45 individual point- or screen collected Macrobotanical samples, mostly from identified cultural features, were sent for identification by Dr. Phil Dering. This group of sample represents most of the macrobotanical samples that appear to be of sufficient size to allow identification and represent 11 different the features. The identified wood species contribute to our general understanding of the woods selected for fuel and enlighten us as to the immediate environment surrounding 41YN452. The presence of charred plant remains would reveal the use of selected plants by the inhabitants. In addition to the individually collected samples, 13 flotation (i.e., sediment) samples from 10 different features were sent for processing, sorting, and identification. These sediment samples were those collected from specific locations within the apparent heating elements (i.e., Features 1 11, and 15) and discard/dump areas (i.e., Features 2, 4, 5, 7, 8, 10, and 15). Dering's procedures, identifications, and comments are presented in Appendix D.

5.4.3.2 Starch Grain Analysis

Starch grains are microscopic granules that serve as the principal food storage mechanism of plants. They are found mainly in roots, tubers (e.g., crow poison, rain lilies, false garlic, wine cup, and spring beauty), seeds of legumes, and grasses, where they are often produced in abundant numbers. Starch grains from different plants possess a large variety of forms that have been recognized for some time. Distinctive features of storage starch grains are genetically controlled and when carefully observed, can be used to identify plant taxa. At least 300 species and varieties of important economic plants from around the world have been described. In recent years there has been widespread acceptance that these materials do survive (Piperno and Holst 1998); Piperno et al. 2000). Since then, researches from around the world (particularly in the neotropics and in Australia) have been using these techniques with excellent results (Perry personal communication 2007). Specifically, starch grain remains have significantly increased the knowledge of plant domestication and crop plant dispersal in various regions (Perry et al. 2006:76-77). Researchers have employed starch grain analyses to study diet, plant processing, plant domestication and cultivation, and tool use, and in ceramic residue analysis. Starch grains have been extracted from soil samples, ceramics, and chipped and ground stone tools to address questions of resource procurement and preparation of foods. Intact starch grains have been extracted from formal and informal chipped tools, both washed and unwashed (Perry personal communication 2007). Story starch grains have survived on tools from the Central American tropics for at least 7,000 to 8,000 years (Piperno and Holst 1998). Starch grain presence in soil depends on preservation. Heat alone does not destroy starches as they are found in vessels, thus burned rocks have the potential to yield starch grains also.

Following data recovery and for the interim report, 10 samples including five burned rocks from cultural Features 1, 10, 11, and 15; three chipped stone tools (a bifacial chopper, a side scraper, and a broken biface); one ground stone mano; and one sediment sample from the buried 2Akb horizon were selected and sent to Dr. Linda Perry to determine the presence/absence of starch grains. Perry obtained 50 percent positive results for storage starch grains. Storage starches were detected on chipped stone tools, a couple of the burned rocks and in the sediment. These positive findings led to the submission of more samples of different classes of materials following the data recovery effort to help address specific research questions concerning the subsistence resources and site function. In total, 28 burned rocks, 11 chipped stone tools, 4 sediment samples, and 3 ground stone fragments were selected for and analyzed. The burned rocks were selected from identified cultural features, generally three to four samples per feature and random pieces. Differences in feature type were sampled as well as features from both excavation blocks. What appeared to represent heating elements (Features 1, 11, and 15) were sampled together with apparent discard features including Features 4, 5, 7, 10, and 14, which exhibited different horizontal patterning. Any artifact that resembled a ground stone was included as these were very few. The 11 stone tools represent diverse classes, shapes, and presumed functions with bifaces, scrapers, graver, and a chopper all sampled. Projectile points were not sampled as their presumed function was not orientated towards plant products or plant processing activities. Dr. Perry's extraction procedures, results and interpretations are presented in Appendix B. This includes the analysis of all the samples processed by her.

5.4.3.3 Fatty Acid Analysis

Previous research has demonstrated that organic residues (fatty acids) can be extracted from burned rocks used by prehistoric peoples to process foodstuffs (cf. Malainey and Malisza 2003, 2008; Malainey and Figol 2010; Quigg et al. 2001, Quigg et al. 2008, Quigg et al. 2010). These organic residues provide a generalized understanding of the foods, at least at the level of plant or animal products, which were exploited by the prehistoric populations. This proxy line of investigation is critical when environmental conditions are not conducive to the preservation of primary organic data, such as macrobotanical remains (charcoal, nuts, and seeds) and faunal bone. It has been demonstrated through fatty acid analysis on burned rocks that even though large quantities of bison bones were present in a Toyah assemblage, the majority of the rocks analyzed yielded plant residues (Malainey and Malisza 2008; Quigg et al. 2008).

Following data recovery, fatty acid analysis was conducted on 15 burned rock fragments by Dr. Malainey (Figure 5-17). Chunks of the burned rocks, weighing from 11 to 37 g, were broken from the parent rock for submission. The parent rock was retained and is curated for future reference. The selected burned rocks were from 11 different burned rock features that are directly radiocarbon dated.

Seventy-three percent yielded positive and interpretable results. Those results showed at least nine burned rocks to have decomposed residues of plant foods with very high fat content such as seeds and nuts. The remaining two show possible plant residues with different levels of isomers.

Although this analysis yielded positive results, TxDOT archeologists decided not to go forward with any further lipid residue analysis on this or other projects. This analysis was proposed by TRC in the initial and final research designs, but was removed from consideration by TxDOT (see TxDOT editorial note, below).

Figure 5-17. Dr. Malainey's Laboratory

However, at no cost to TxDOT, Dr. Malainey has graciously provided a more advanced analysis through the incorporation of high temperature gas chromatography and gas chromatography with mass spectrometry plus the addition of the detection of biomarkers, which was not available at that time. Dr. Malainey presents the background to identification of fatty acids, and presents these new findings and interpretations on the original 15 burned rock samples from 11 different cultural features in Appendix H. This data can be used in conjunction with the other microfossil results to help interpret the foods cooked by these burned rocks. Her new results have been incorporated into the appropriate sections within the body of the text.

(*TxDOT editorial note: This is an inaccurate and incomplete characterization of TxDOT's position on this issue. In the past, TxDOT supported lipid residue analysis on a number of projects run by the senior author. We are not biochemists, and are not qualified to evaluate the results of lipid analysis or similar types of residue studies directly. Nevertheless, we note that soil biochemistry is enormously complex, and all of the rocks used for analysis were excavated out of a soil matrix. It follows that the technique is neither straightforward nor free of potential pitfalls.*

We note that the direct dating of organics in the body of burned rocks—another of the senior author's research initiatives which we have supported and continue to support—has yielded results that are both independently evaluable and decidedly hit-or-miss. With AMS dating, it is possible to make that judgment, because one can independently evaluate the results against other data (e.g., other dates, stratigraphic contexts, associated time-diagnostic artifacts). Lipid analysis samples are a subset of the same general types of infiltrated organic remains that are the target of AMS radiocarbon on burned rock, but there is no comparable means to cross-check the results of individual samples. The complexity of interpreting lipid analyses is a major source of our unease, but it is not why we have stopped approving TRC's requests for additional analyses. Rather, our primary issue is with the subsequent treatment of the data.

When lipid analysis first began to the utilized on Texas archeological sites, there was little alternative to simply reporting the results of those analyses. However, as a result of their work for TxDOT and other clients, TRC has gradually assembled a considerable body of lipid data on burned rock features in Texas. As this body of data accumulates, it becomes increasingly possible to examine it for trends that may or may not support the viability of the technique and to search for patterns that move the analysis beyond simple description.

A number of questions could be addressed regarding the validity of the technique through this comparative work. For example, how does feature morphology and rock type co-vary with lipid results? How consistent are the results from individual features? What are the expectations for residue introduction through different types of use—roasting features, boiling dumps, etc.—and how do those compare with the results of lipid studies? We have repeatedly suggested to the senior author that reporting of such studies needs to include these types of considerations drawn from the larger data set. TRC has not yet availed themselves of these opportunities. Instead, the results of the studies continue to be reported as if they were simply gospel.

Other means of evaluating results are also available. Evaluation of control samples drawn from "off-site locations" would provide another partial solution to this issue. Where available, rocks of the same material could be obtained from local, non-archeological contexts and submitted for analysis. Comparison of the archeological and non-archeological samples would help to identify sources of background noise in the analysis.

In addition, a number of questions have yet to be addressed regarding the significance of the lipid analysis results, if they can be accepted as valid. The senior author's work on other recent projects (e.g., the Landis Property [Quigg et al. 2010]) provided intriguing accounts about the use of particular features, based in part on lipid analyses. Such observations, however, have yet to be organized into a coherent interpretive framework. Why might processing of plants and animials in burned rock features vary among feature types or among sites? What quantitative expectations can be derived from theory concerning human subsistence practices? Zooarcheologists, for example, have successfully employed optimal foraging theory to derive expectations for the kind of faunal remains that should occur at archeological sites under different circumstances. They have worked hard to refine their analytical methods to permit use and evaluation of this theory. Similar linkages between lipid analysis results and higher-level theory do not yet exist.

We recognize that the burden of developing such linkages is the burden of all archeologists and does not solely belong to TRC. Nevertheless, we have to make choices regarding the allocation of scarce resources to the analysis of sites such as this one. Our general preference is to devote those resources to approaches that have the *most obvious payoff in terms of generating data of use elsewhere.*

These objections could be addressed through the development of a research design that explicitly considered the effects of variation in formation processes and variation in human adaptation on the lipid analysis results. We have provided these objections to TRC on several previous occasions. The lack of such explicit consideration in TRC's work is the source of our dissatisfaction with the lipid residue analysis sponsored by TRC, and it is the genesis of our position on funding in the future. The ball is in their court.)

5.4.3.4 Phytolith Analysis

Phytolith studies are important in reconstructing an approximate profile of vegetation presence in the local setting through time. The Opal silicate bodies that compose phytolith entities form within plant cells. The distinctiveness of various types of bodies varies within cellulose structure. In grasses, however, phytoliths exhibit diversity and distinctiveness per grass species. The presence of certain phytoliths (e.g., panicoid, festucoid, and chloridoid) in the paleoenvironmental record can direct researchers to general vegetative conditions such as forested habitats versus those of open grassland prairie, and the general make up of the grassland community. In order to provide background and support to this research program, preliminary assessments of phytolith presence were conducted on six samples. Sediment samples from five cultural features (Features 1, 4, 10, 11, and 10/17) and one from the buried 2Akb horizon were analyzed by Dr. Bozarth. He provided his presence-absence findings and recommendations. Based on his findings and recommendations that phytolith preservation was more than adequate for a meaningful analysis, further phytolith analysis was conducted following the data recovery phase.

An additional seven sediment samples from mostly feature context (Features 1, 2, 7, 10, 15, and 17), with one sample (#820-004-1b) from the buried 2Akb horizon at the same elevation (87 to 88 cmbs) as the cultural features, were subjected to detailed phytolith analysis. The focus was on contrasting the feature contents with the natural background of the site environment to determine if the feature sediment contained any additional or different constituents. The samples were submitted to Dr. Byron Sudbury in Oklahoma for analysis. The processes, results, and interpretations are presented in Appendix E. The noncultural sample helped to establish what the site setting/environment was like. That data will be used in conjunction with the wood types identified to postulate the environment at the time of the occupation.

5.4.3.5 Diatom Analysis

Diatoms are single celled algae with a siliceous cell wall. They grow in a wide range of aerophilous habits, including damp soils, wet plants and rocks, marshes, wetlands and mudlands, as well as in all types of aquatic habitats. Their silica cells are often preserved in sedimentary deposits. Because individual taxa have specific requirements and preferences with respect to water chemistry, hydrologic conditions, and substrate characteristics, the presence of diatoms in archeological context can provide information about the nature of the local environments. Diatoms, when present, provide a proxy measure of water quality/degree of pollution and ultimately paleoenvironmental conditions.

Following the eligibility assessment, phase 10 samples were selected and submitted to Dr. Barbara Winsborough for detailed analysis, identification and interpretations. These included pairs of samples, a burned rock and sediment from cultural Features 1 and 10, to investigate and contrast the differences between the rocks and sediments. In total, three burned rocks and seven sediments samples were analyzed. This included a natural sediment sample from the top of the buried A horizon at about 68 cmbs to compare with cultural samples.

Dr. Winsborough‘s results from these initial 10 samples demonstrated that diatoms were present on eight of the ten samples (Winsborough 2007). All three burned rocks yielded diatoms with one yielding a very high quantity. The diatoms were found in the organic coatings. The diatoms from the burned rocks demonstrated the presence of whole, not transported aerophilic species that characteristically bloom and producer large numbers of cells after a brief wetting. The general lack of a substantial aquatic diatom component in the overall assemblage indicates the environment was only wet or damp for a brief period. The aerophilic diatoms recovered from the burned rocks and probably grew on the wet rocks (Winsborough 2007). There is a possibility that species of diatoms are somehow related to the cooking process or the presence water used in a cooking process. Therefore, diatoms not only contribute to the understanding of the water quality but also to the possible cooking events and/or post cooking events.

Following the data recovery, another 11 samples that included six burned rocks and five sediment samples were submitted for diatom analysis, and again pairs of burned rocks and sediment from specific features were targeted along with another control sample. It is anticipated that the comparisons between the control samples and the cultural samples will enlighten us as to possible site and/orcooking processes with water. Dr. Winsborough’s methods, results, and interpretations from all the samples are presented in Appendix F.

5.4.3.6 Pollen Analysis

Pollen spectrums can be derived from cultural and noncultural settings when reconstructing plant communities. Changes in pollen profiles can often be interpreted reliably as corresponding to changes in general character of an area’s vegetation. Pollen may represent both cultural and the natural environment and lead to discussions on the overall environment at the time of the occupation. In general, pollen in Texas sediments is poorly preserved. A suite of five sediment samples including one from the buried 2Akb horizon, one from under a mussel shell valve from Feature 4, one from under a shell valve from Feature 10, and one modern surface sample from under the trees along the high terrace overlooking the Salt Fork of the Brazos River were submitted to Dr. Bozarth to determine presence or absence of pollen. His results and recommendations are presented in Appendix I. The four nonmodern samples yielded fair preservation and he recommended pollen analysis be conducted at this site. However, it was decided that pollen was not significant in this site environment to pursue during this final analysis.

5.5 LABORATORY METHODS

5.5.1 Treatment of Cultural Materials

All materials collected during the eligibility assessment and data recovery excavations were transported back to TRC’s laboratory facilities in Austin, Texas, for processing, cataloging, analysis, and temporary curation.

In general, artifact processing entailed washing, sorting, and labeling most of the cultural material recovered including lithic debitage, stone tools, bones, and mussel shell. Washing involved removing the dirt from artifact surfaces using tap water and soft bristled toothbrushes, and arranging wet artifacts to dry on fine mesh screen lined drying trays. Fragile materials such as mussel shells and charcoal were not washed. In addition, stone tools identified in the field for potential use-wear and bagged without handling were not washed. On these unwashed tools, a small spot on one surface was cleaned so that a permanent label could be placed on the tool. A subset of these tools was submitted for use-wear analysis and others were set aside for long-term curation with only minimal handling by laboratory and analytical personnel. Nitrile gloves were used when handling these unwashed tools.

Individual artifacts and artifact lots from within single provenience units were assigned unique provenience numbers (PNUM). TRC's cataloging system assigns strings of numbers to artifacts that encode information on provenience, artifact class, a unique identifier, and samples taken from the artifact or lot for specialized analyses. Unique provenience numbers (PNUMs) were assigned to lithic debitage, stone tools, burned rocks, sediment, burned clay, faunal bones, ceramic sherds, historic artifacts, and mussel shells. PNUMs are sequential integers that designate the overall provenience unit (i.e., excavation unit, backhoe trench, modern ground surface) and level, or depth, within that provenience unit by reference to a master list of PNUMs. All of the cultural material recovered from a single excavation level within an excavation unit was assigned a unique PNUM designation (e.g., #1261). Within each PNUM, artifact classes were assigned a secondary designation (i.e., lithic debitage [001], faunal bone [002], burned rock [003], soil [004], feature [005], shell [006], macrobotanical remains [007], ceramic sherds [008], and historic material [009]) referred to as the artifact class number. Individual tools and other unique items were assigned individual artifact numbers starting with the number 10 within the same unit and level designated by the PNUM. Thus, individual tools and other unique objects were assigned a PNUM and an individual unique number appended to the PNUM (e.g., #1261-010, #1261-011, and #1261-012).

In many cases, individual samples were removed from larger bags for specialized analyses (e.g., radiocarbon dating, wood identifications, and starch grain analysis). For example, if a single burned rock was extracted from the collection of burned rocks designated as #1261-003 for starch grain analysis, then that burned rock would be designated as #1261-003-1 to indicate it constituted the first sample from that provenience. In another words, a catalogue number such as #1261-003-1 would identify that specific burned rock as the first sample (1) taken from the burned rock class of artifacts (003) within a specific provenience unit (#1261). If burned rock #1261-003-1 was subdivided into two pieces for different types of analyses, such as lipid residue and starch grain analyses, then lower case letter designations (i.e., a and b) would be added following the last number in the sequence (e.g., #1261-003-1a and #1261-003-1b) to signify that two parts (part a and b) were taken from burned rock #1261-003-1. The complete two or three part number sequence assigned to each object or class of objects constitutes the catalog number. This process allows individual pieces of large collections of various materials to be individually handled and tracked.

Approximately one in ten items (10 percent) occurring in bulk classes (e.g., chert debitage, faunal bones, and mussel shells) within specific provenience units (e.g., a level) was individually labeled. Size of the object was also a major consideration for labeling purposes, as lithic debitage pieces less than 1 cm were not labeled. Artifact labeling consisted of inscribing the State of Texas Archeological Site Trinomial (41YN452) and the catalog number on designated artifacts using black indelible ink. After the ink was dry, the artifact labels were coated with clear acetone to preserve the inscriptions.

Permanent paper bag tags were included with each individual artifact or class of artifacts collected from a single provenience. These tags include the site trinomial, provenience information (unit and depth), the class or type of artifact(s), the date of excavation, the excavator's initials, and the quantity of items in the bag. These permanent tags were printed on acid free, 30.4 kg (67 lb.) card stock and filled out using No. 2 pencils.

All stone tools, samples of lithic debitage, samples of sediment from features, samples of burned rocks, all field records, and photographs from both field phases are to be permanently curated. A small suite of burned rocks from selected burned rock features will also be curated. Individual artifacts and artifact lots, including all stone tools, lithic debitage, burned rocks, faunal bones, and mussel shells, are in clear, seal top plastic bags according to provenience. Small samples of sediment from various proveniences are stored in a similar fashion. Each polyethylene bag contains an archival quality, acid free curation tag that lists the site number, provenience data, and date of excavation, excavator name, artifact type, and quantity. Digital photographs printed out on a color printer were placed in curation approved, acid free plastic preservers for curation. All original field records are on acid free paper and placed in acid free reinforced file folders for curation.

Cultural materials were labeled according to the 2010 curation standards of the Texas Archeological Research Laboratory (TARL) of The University of Texas at Austin. The collected materials will be housed and maintained at that facility.

5.5.2 Flotation

Thirteen bulk sediment samples (19 bags) totaling 63 liters, including sediment samples from 10 feature proveniences, were sent to Dr. Dering for flotation. The light and heavy fractions were collected separately and dried. The light fraction, tiny burned organic remains such as seeds and charcoal, was carefully analyzed by Dr. Dering and identification made where possible. Dr. Dering's flotation techniques, analytical procedures, results, and interpretations are presented in Appendix D.

The heavy fractions were returned to TRC in Austin. These heavy fractions were spread out on clean white paper and sorted with the aid of magnification into material classes such as flakes, shells, burned rock fragments, charcoal, bone, etc. Results are incorporated into each of the feature discussions.

5.5.3 Analytical Methods

Artifacts were subjected to different metric, nonmetric, typological, and other special analyses, including use-wear. In some instances, artifact quantities in specific classes were so high that only a sample of the class could be subjected to more detailed analyses. A set of predefined attributes for each material class was first encoded on paper, then entered into TRC's electronic database management system based on Microsoft's (MS) Access 2007 software. This MS Access 2007 database constitutes the master database for the eligibility assessment and data recovery investigations at site 41YN452. A copy of this database is provided on the CD-ROM attached to the back cover of this report. The specific data recorded for each class of artifacts are presented below. Analytical methods pertinent to each data class and secondary suites of software used for specialized analyses are discussed in detail in the appropriate parts of this report. The materials and data collected from the eligibility assessment and data recovery were integrated into a comprehensive database.

5.5.4 Chipped Stone Artifact Analysis

Analysis protocols concerning debitage and chipped stone tools were generated by TxDOT archeological staff in an effort to standardize the ways in which data is collected and presented in analytical and interpretive chapters of archeological reports sponsored by TxDOT. Although this protocol had not been finalized at the onset of this project, TRC has made an effort to conform with the general structure and goals of this protocol (TxDOT 2010). When possible, terminological and taxonomic considerations have been made in this presentation that would allow for this assemblage to be comparable to future analyses operating within TxDOT protocol guidelines. Data entry forms were created to record qualitative and quantitative attributes of chipped stone artifactsfor analytical and interpretive insight. A morphological typology (based on Andrefsky and Bender (1988); Andrefsky et al. 1994; TxDOT 2010) was used that allowed lithic analysts to classify and sort chipped stone artifacts first into debitage versus tools then into more specific

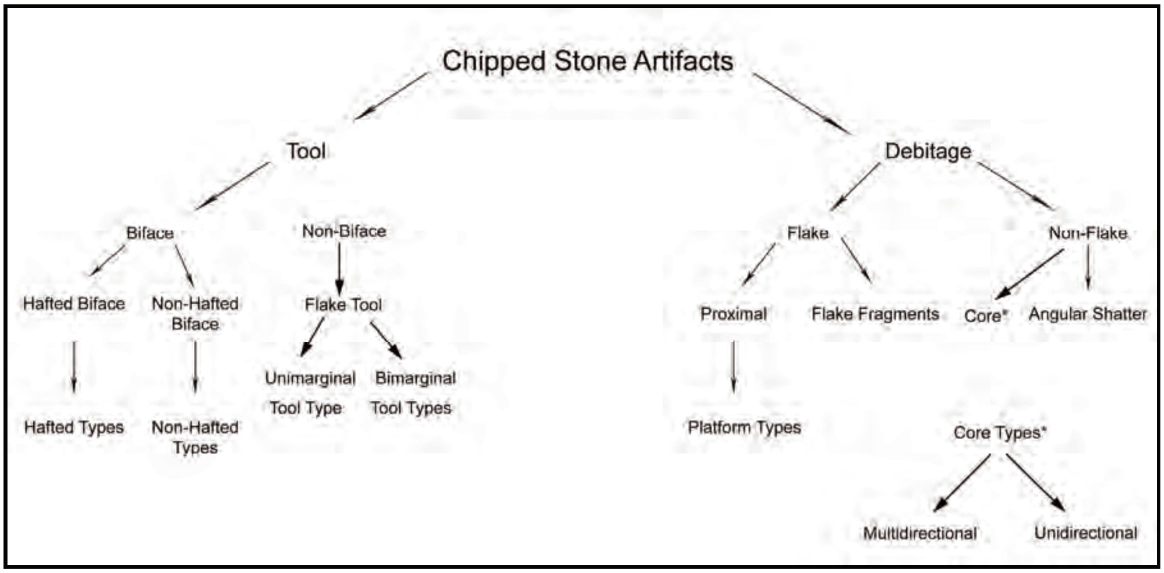

Figure 5-18. Chipped Stone Artifact Analysis Flowchart

categories (Figure 5-18). The edges and surfaces of each piece of chert were macroscopically examined for signs of use as a tool (in the case of debitage, potential utilization is indicated by contiguous or discontinous, minute flake scars along one or more edges). If worked areas were identified, the artifact was assigned to a morphological and/or technological category based on general form and inferred function. Sets of observations were recorded for all tool classes recovered. The following subsections provide definitions of major tool classes.

5.5.4.1 Tools - Bifacial

Bifaces

Bifacial tools are those worked pieces, whether finely or crudely produced, in which the manufacturing process has apparently been brought to completion, as evidenced by secondary retouch, edge straightening, hafting preparation, notching, and similar characteristics. Bifaces are defined based predominantly on morphological characteristics, but they may also have functional associations (e.g., cutting, piercing, chopping, drilling). Bifacial tools exhibit purposeful, usually patterned flake removals on both faces of the object. Most or all of each face may be covered with flake scars, and in some cases one face may be completely modified, whereas the opposite face exhibits only partial modification. Bifaces may be fashioned either from large bifacial cores or from flakes. However, if only the margin of a specimen exhibits modification rather than most or all of at least one face, then the tool was classified as an edge-modified flake tool. Included within this overall morphological category are diverse functional groups such as projectile points and drills (see below). Data on 25 distinct dimensions of variability were recorded for bifaces. Attributes included nonmetric observations concerning the completeness of the specimen, overall morphology, manufacturing characteristics, and manufacturing stage based on morphological classes adapted from Callahan (1979). Metric measurements of length, width, thickness, and weight were also recorded for each specimen even if it was broken.

Projectile Points

Projectile points are a functional subset of the biface class specifically designed to be hafted to the distal end of a shaft used in stabbing, throwing, or shooting to penetrate animal hides and flesh. Projectile points are bifacial tools formed by fine secondary retouch, usually with basal modification in the form of notching, stemming, or thinning of the proximal end for purposes of hafting. Dart points, arrow points, and indeterminate dart/arrow points are all classes of projectile points. Dart points are those employed to tip hand held darts or spears; arrow points are used to tip arrows; and indeterminate points are, as the name implies, of uncertain usage. Whereas dart points are usually manufactured from bifacial preforms, arrow points are often manufactured on thin flakes.

Projectile points were assigned to recognized types whenever possible. In traditional archeological literature, projectile points are normally referred to by their typological designation, which are usually based on a set of morphological characteristics (that generally focus on the hafting modification) shared in common by groups of similar points. Initial point classifications were attempted by TRC's archeologists in reference to established point typologies in use in Texas archeology (Suhm et al. 1954; Prewitt 1985; Turner and Hester 1999). However, a portion of the recovered dart points from 41YN452 did not exhibit characteristics similar to those published types that allowed their assignment into previously named north-central Texas types. Therefore, some of the dart points recovered from the Terminal Archaic component at 41YN452 were not assigned to existing types and form a recognizable group on the basis of characteristic corner-notches.

A comprehensive suite of 44 metric and nonmetric observations was recorded for the projectile points recovered (Figure 5-19). Nonmetric attributes recorded include descriptors of overall morphology and manufacturing characteristics. Some 21 metric measurements also were recorded. Metric measurements of length, width, thickness, and weight were recorded for each specimen even if it was broken.

Drills

Drills are another function specific subset of the biface class. Drills generally consist of two sections—the distal bit (or working edge) and the stem or proximal end section. Distal bits are typically long, tapered, and bifacially flaked, and reflect a diamond shaped cross section that distinguishes this type of tool. The bit is usually relatively thick and is designed to produce a stable base for rotary motion. Drills are usually presumed to have been used on hard substances, such as wood, shell, or bone, and spun in a rotating fashion to penetrate the material; therefore, drill tips usually exhibit heavy rounding and/or polishing of bit edges.

Drills are often subdivided into specific types, such as T-butt, irregular, or notched, but this typology was not employed in this analysis. Twenty-five metric and nonmetric observations were recorded for drills. Metric measurements of length, width, thickness, and weight were recorded for each specimen even if it was broken.

5.5.4.2 Tools-Non Bifacial

Unifaces

Unifaces are those tools that exhibit flake scars on one face only. Like bifaces, unifaces are defined based predominantly on morphological characteristics, but they also tend to have functional associations (e.g., scraping, planing, cutting, engraving). Unifacial tools exhibit purposeful flaking across most or all of one face, whereas the opposite face most often remains flat and unmodified. Unifaces may be fashioned from cobbles or flakes. This category includes such functionally diverse groups as scrapers, gouges, edge-modified flakes, gravers, and spokeshaves. One or more edges of a unifacial tool may exhibit manufacture and/or use related flake removals that may be patterned or random. To some degree, unifacial tools form a continuum from formal tools exhibiting intentional, patterned, manufacture related

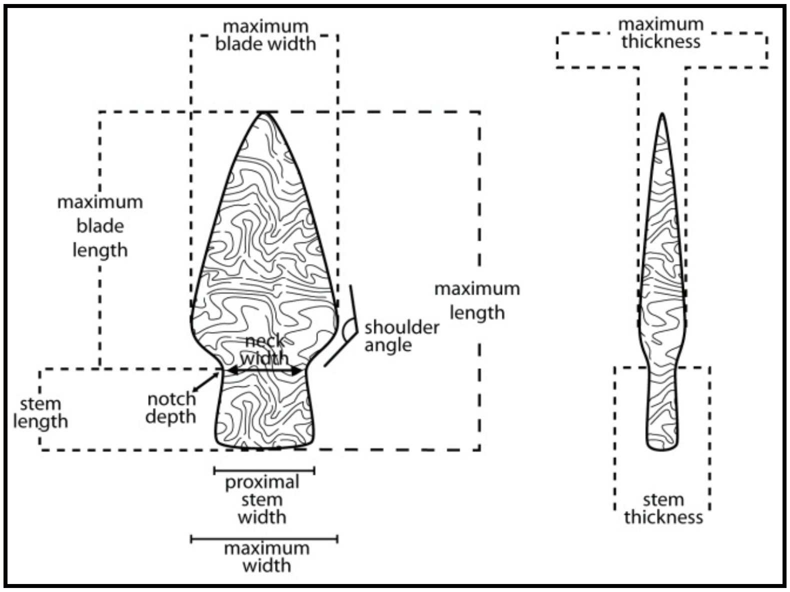

Figure 5-19. Projectile Point Terms and Metric Measurement Locations

edge flaking to informal, ephemeral tools that show only use related edge scarring. The former tend to fall within the scraper and gouge categories, whereas the latter are generally classified as edge-modified flakes.

Scrapers

Scrapers are a specific type of unifacial tool that have at least one intentionally modified working edge. In some instances, bifacial modification may be present, but in such cases the intentional retouch tends to be located on the dorsal flake surface whereas the ventral surface tends to exhibit primarily use related flake scars. Based upon the location of the primary working edge, scrapers are subdivided into end, side, or combination types. End scrapers are pieces with retouch, restricted primarily to either the distal or proximal end of the flake blank, generally producing a convex working edge. The opposing end of the piece may bear some minimal retouch, presumably to facilitate hafting. Side scrapers are pieces with retouch present on one or both lateral edges of the flake blank. Working edges may be convex, straight, or concave. On combination scrapers, marginal retouch may appear along the end as well as along one or more lateral edges of the blank. As implied by the name of this tool, the primary function of scrapers is presumed to relate to scraping relatively soft materials such as animal hides or vegetable matter, or slightly harder materials, such as wood or possibly antler or bone.

Twenty-eight metric and nonmetric attributes were recorded for scrapers. Many measurements relate to the number, location, and characteristics of the working edges on the tool. Metric measurements of length, width, thickness, and weight were recorded for each specimen even if it was broken.

Edge-Modified Flakes

Edge-modified flakes are minimally modified flakes, flake fragments, or pieces of angular debris that are characterized by one or more areas of flake scarring along margins. The edge flaking may be patterned or unpatterned, continuous or discontinuous, and may result from intentional pressure retouching to prepare an edge for use or may result exclusively from use related activities. Many edge-modified flake tools exhibit combinations of these characteristics, and most have more than one working edge. The modifications, however, usually are restricted to the edges of the piece and do not significantly alter the original flake form. Edge modifications may be either unifacial or bifacial. Edge-modified flakes are usually considered to be “expedient” tools, or pieces of raw material that are picked up, utilized for a short-time with or without first having been minimally modified, and subsequently discarded at the location of use, or soon after use. Twenty-one metric and nonmetric attributes were recorded for edge-modified flakes. Metric measurements including length, width, thickness, and weight were recorded for each specimen even if it was broken.

Gravers and Spokeshaves

Various types of specialized working edges are often found on tools otherwise identified as scrapers or edge-modified flakes. While it is possible that only one such specialized bit may exist on a tool, these types of tools are considered to primarily fall within the appropriate scraper or edge-modified flake category, while the specialized working edge would be classified as one of the working edges. Types of specialized working edges that are often recognized include perforators or borers, graver spurs, spokeshaves or notches, and burins. For purposes of this analysis, graver spurs and borers are combined into a single category, as are spokeshaves and notches.

Graver spurs, or gravers, are additional carefully flaked, prominent, sharp protrusions formed on scrapers or edge-modified flake tools by the creation of adjacent shallow concavities or notches. Graver spurs may be quite short, only a millimeter or two in length, or rather prominent, in which case they grade into the category of tools often referred to as borers or perforators. Graver spurs may exhibit alternating edge retouch, but this is usually present only on longer specimens. The function of graver spurs is assumed to be engraving relatively hard substances such as wood, bone, and antler.

Spokeshaves, or notches, are working edges on scrapers or edge-modified flakes formed by the removal of numerous small flakes in a limited area along the lateral edge of a piece to form a single, relatively deep, concave area. Such notches may be relatively small or quite large, and shallow or deep. The function of spokeshaves is assumed to relate to scraping or planing relatively hard substances, such as wood, bone, and antler, that are either tubular in shape or for which a convex outer surface is a desired result (e.g., dart or arrow shafts).

By definition, graver spurs, spokeshaves, and burins are considered to be specialized tools made on objects that may otherwise be classified as scrapers or edge-modified flake tools. As such, the metric and nonmetric data encoded regarding that working edge would follow the procedures used for scrapers or edge-modified flakes, as appropriate.

5.5.5 Ground Stone Tool Analyses

This broad artifact class includes pieces of rock that have been modified by grinding, pecking, or battering, either to intentionally shape an implement or as a by-product of use. Ground stone tools are recognized by the presence of intentional abrasions, grooves, and striations and/or smoothing. Significant rounding, flattening, and/or pitting of utilized surfaces can also be identified. Categories of ground stone tools include hammerstones, manos, and metates (milling stones or grinding slabs).

The edges and surfaces of each piece of rock were macroscopically examined for signs of use as a tool. If battered, smoothed, unnaturally flattened, pitted, ground, striated, incised, or pecked areas were identified, then the artifact was assigned to a morphological and/or functional category based on general form and inferred function. Sets of observations were recorded for the tool classes recovered. The following subsections provide definitions of major tool classes.

5.5.5.1 Manos and Metates

Manos and metates are generally used together to grind friable materials (nuts, seeds, other vegetal matter, pigments) into powder. A mano is a hand held grinding stone, generally characterized by a round to ovate shape, usually of a hard, dense siliceous rock such as quartzite or sandstone. One or more surfaces exhibit a smooth or polished, and/or possibly flattened area caused by grinding against another hard surface (the metate). In some instances, the edges exhibit crushed or pitted areas indicating possible use as hammerstones as well. Generally, these are water worn cobbles that exhibit no other alterations to the natural cobble.

A metate is often a large slab of a dense siliceous rock such as sandstone, which has functioned as the base on which the mano is used to grind materials. The grinding action most often creates a shallow concave face that is smoothed and/or polished. Extensive and continued use creates a deeper concave surface and in some instances both faces may have functioned as a base for grinding. The deep, oval, basin like or elliptical grinding surfaces on metates from the Great Basin region, or the long, rectangular trough characteristic of metates of agricultural cultures of the Southwest United States, are not recovered from the Plains hunter-gatherer sites. Occasionally the edges of Plains metates are artificially shaped. Metric and nonmetric observations were recorded for manos and metates. Measurements of dimensions were recorded only when the dimension in question was completely represented and/or could be reasonably estimated.

5.5.5.2 Hammerstones

A hammerstone is a hard nodule of lithic material, usually dense siliceous rock such as quartzite, used for direct percussion fracturing of tool stone during lithic reduction. These pieces usually exhibit limited or extensive areas of battering, crushing, and/or pitting on one or more surfaces of the natural cobble. In some cases, small flake scars may form as the result of hard hammer percussion, creating an appearance similar to a tested cobble core. Metric and nonmetric observations were recorded for hammerstones. Measurements of dimensions were taken only when the dimension in question was completely represented and/or could be reasonably estimated.

5.5.6 Lithic Debitage Analyses

Chipped stone debitage is the unmodified debris that results from lithic reduction activities associated with the manufacture and maintenance of stone tools. Lithic debitage lacks any macroscopic indications of use or modification. Pieces that exhibit any sign of use-wear or intentional modification are placed in the appropriate tool category. All debitage was counted and weighed. The debitage collection from each excavation block was subjected to detailed analysis, with individual pieces sorted into the reduction classes listed below. The debitage attributes recorded for this analysis were modeled closely after those provided in the TxDOT Protocol for debitage analysis (TxDOT ENV 2010:23-30).

Besides the total count, the pieces were classified by completeness/type of debitage represented (whole, proximal fragments, distal fragment, shatter/blocky debris); size grade into 6.4, 12.8, 19.2, and 25.6 mm groups; cortex percentage (0, 1 to 25, 26 to 50, 51 to 75, and 76 to 100 percent); platform type (indeterminate, cortical, flat, complex, abraded, faceted, multifaceted, and rejuvenated after Andrefsky [1998:93-96]); observed purposeful thermal alteration; technique used in reduction (indeterminate, hard hammer, soft hammer, indirect, pressure, and bipolar); and raw material type.

5.5.6.1 Core Reduction Flakes

This category includes flakes, flake fragments, and pieces of angular debris associated with initial core preparation activities, such as test flakes that were removed to determine the quality of raw material within a cobble as well as to decorticate a cobble for further reduction. Items in this category tend to have cortex covering more than 50 percent of their dorsal surfaces. By definition, most of these items tend to be relatively large (smaller flakes with dorsal cortex often fall within other categories, such as early and late-stage biface flakes or indeterminate flakes, depending on their diagnostic characteristics). Core preparation flakes may or may not exhibit pronounced platforms, bulbs of percussion, or ventral concussion rings, though most do have one or more of these characteristics.

5.5.6.2 Biface Thinning Flakes

Biface manufacture flakes were classified based on the presence of multifaceted striking platforms, multidirectional dorsal flake scars, parallel to slightly expanding flake margins, and slight to moderate longitudinal curvatures. This category was subdivided into early and late-stage biface manufacture flakes. Early stage biface flakes tend to be somewhat larger than late-stage biface flakes, have fewer and larger dorsal flake scars, and may retain a considerable amount of cortex on their dorsal surfaces. As employed in this analysis, early stage biface flakes correlate roughly with Callahan's (cf. 1979) revised Stage 1, 2, and 3 bifaces ("blank," "rough out," and "primary preform" stages) while late-stage biface flakes correlate with Callahan's revised Stage 4 and 5 bifaces ("secondary preform" and "final preform" stages). In practice, Stage 1 ("blank") flakes are more likely to fall within the core preparation flake category due to the lack of clear diagnostic characteristics on many such specimens. Final percussion thinning, pressure thinning, and retouch flakes that do not clearly exhibit biface manufacture characteristics due to their small size would likely be included in the tertiary thinning/retouch flakes category. The early and late-stage biface flake categories may contain complete flakes, proximal and distal flake fragments, and/or small pieces of angular debris that exhibit clear characteristics of the biface manufacturing process (in practice, the latter type of debitage—angular debris bearing bifacial traits—is rare in the biface manufacture flake categories).

5.5.6.3 Tertiary Thinning/Retouch Flakes

This category includes flakes and proximal and dorsal flake fragments resulting from the final stages of tool manufacture, including final percussion thinning and any subsequent pressure retouch. By definition, flakes in this category tend to be quite small, and it is difficult to distinguish whether they result from biface manufacture, uniface manufacture, or resharpening.

5.5.6.4 Cores

A core is a cobble, pebble, or other mass of lithic raw material that exhibits one or more platforms and flake scars resulting from the systematic removal of flakes by flint knappers (Parry and Kelly 1987). Technically, any chipped stone tool may properly be classified as a core as it is the object created through the removal of flakes from the exterior surface of the original mass of lithic material. In common terms, however, cores are generally considered to be those masses of material from which one or more flakes were removed. In other words, cores do not exhibit any intentional or use-related flake scarring along any of their edges, though scars resulting from platform preparation may be evident, and a core might be expediently used as a tool (e.g., extensive crushing damage along one or more thick edges of a core would probably result in classification of the object as a chopper).

Various types of cores are recognized according to the degree of knapping and the flake removal strategy. The four basic types of core are unidirectional, bifacial, multidirectional, and blade core. The last named type often has a distinctive conical polyhedral shape, the result of the repeated, parallel removal of long, narrow flakes known as prismatic blades.

A unidirectional core is one that exhibits flake scars removed from only one face. The flake removals may be in various directions and exhibit no pattern or structure to the removals. There are usually only one or two platforms.

A bifacial core exhibits flake removals from both faces and again these may be in multiple directions. The parent or objective rock is generally a cobble that exhibits two detectable faces. The flakes were driven from the lateral edges, thus the platforms are along the edges.

The multidirectional core is generally a chunk of raw material that does not necessarily exhibit two obvious faces. Generally, there are several platforms from which flakes were removed. Most often the flakes are removed in different directions.

Blade cores are chunks of raw material intentionally prepared to facilitate the removal of a specific kind of desired flake. These generally exhibit two or more parallel scars driven from the same platform in the same direction with the same overall shape.

Twenty metric and nonmetric observations were recorded for cores. Metric measurements of length, width, thickness, and weight were recorded for each specimen even if it was broken.

5.5.6.5 Angular Debris

Angular debris, or "shatter," includes angular pieces of lithic raw material that break away from the core as flakes are struck. In contrast to flakes, angular debris does not generally retain any diagnostic characteristics of the flint knapping process (i.e., platforms, bulbs of percussion, concussion rings, and definable dorsal or ventral surfaces). In this analysis, those few pieces of angular debris that exhibit characteristics diagnostic of biface manufacture were included in the appropriate biface manufacturing category (i.e., early versus late-stage biface flakes).

5.5.6.6 Indeterminate Flakes

This category includes flakes and flake fragments that lack diagnostic traits that would permit their placement into one of the other categories. Generally, these flakes are small fragments of flakes and/or thin pieces of angular debris that do not display clear evidence of a platform, concussion rings, or flake scar patterning on their dorsal surfaces. This category also includes a small number of potlid flakes and fractured heat spalls resulting from thermal alteration of raw materials.

5.6 ANALYTICAL TECHNIQUES

The following analytical techniques were conducted in order to better understand the diverse materials recovered, and to generate data for interpretation. When these specific technical analyses yielded positive and interpretable results, they also contributed towards addressing specific research questions developed in the final research design (see Chapter 4.0). The archeological testing results provided guidelines for the data collection strategies employed during data recovery. These same technical analyses were again implemented to selected data sets in the subsequent data recovery analyses. The testing results have been incorporated into each of the appendices were appropriate, and integrated into the body of this document.

The technical analyses were conducted by highly skilled individuals who have applied their expertise and offered interpretations based upon the obtained results. Their specific reports are attached as appendices that provide the details of their methods, studies, analytical results, and interpretations. The results of these diverse technical studies, coupled with analyses of cultural materials obtained during both eligibility assessment and data recovery investigations, are incorporated throughout the body of this report. The combined results are used to address research questions presented in the Research Design for 41YN452 (see Chapter 4.0).

5.6.1 Radiocarbon Analysis

In addition to the other technical analyses conducted by outside laboratories, 38 samples that represent seven different material types (charcoal, bone, burned rocks, sediment, fish otoliths, and mussel shells) were carefully selected, and justifications presented to TxDOT for radiocarbon dating. Once the individual samples were approved by Dr. Abbott at TxDOT, the initial 21 samples following the eligibility assessment were delivered to Beta Analytic Inc. (Beta) in Florida for dating through TxDOT. The Beta laboratory pretreated each sample before dating. The dates are reported as radiocarbon years before present (B.P.), with the present being A.D. 1950, using the Libby ^{14}C half life of 5,568 years. Each sample was measured for carbon 13 verses carbon 12 ratios ($^{13}C/^{12}C$) expressed as the delta (δ) 13 carbon ($\delta^{13}C$) and calculated relative to the international standard Cretaceous Belemnite Formation at Peedee, South Carolina (PDB or VPDB).

During the final analyses another 27 samples were submitted to University of Georgia (UGA), Center for Applied Isotope Studies for analysis through TxDOT. The radiocarbon results are incorporated throughout the text and provide a clear indication of the absolute age of the components and reveal the differences in the dating of different classes of materials. The detail laboratory reports concerning each sample are presented in Appendix A.

At the UGA laboratory, each sample was pretreated prior to dating. For the fish otoliths, the collagen was targeted with the use of alkali, whereas the organic rich sediments were washed with acids. Insufficient collagen was recovered, but carbonates were sufficient to provide a date. After consideration of possible dates on carbonates, it was decided not to pursuer dates on the carbonates from the fish otoliths as their precision would not sufficient to provide the precise results necessary to assigned materials to two closely related time intervals. The dates are reported as radiocarbon years before present (B.P.), with present being A.D. 1950 using the Libby ^{14}C half life of 5,568 years. Each sample was measured for carbon 13 verses carbon 12 ratios ($^{13}C/^{12}C$), expressed as the delta 13 carbon ($\delta^{13}C$), and calculated relative to the internationally standard Cretaceous belemnite formation at Peedee, South Carolina (PDB or VPDB).

5.6.2 Use-Wear Analyses

High-powered, use-wear analysis was conducted on a suite of tools to help interpret their function and potentially, what those stone tools were used on. The chipped and ground stone tool assemblage was not extensive from 41YN452. A total of 35 samples that encompassed various classes of stone tools associated with the Terminal Archaic component 1 and 2 were selected for high-power use-wear and organic residue documentation. These samples were submitted to Dr. Bruce Hardy, an expert in this field.

Most tools selected were minimally handled in the field and not washed in the laboratory. In order to track individual items, a small spot on one face of the artifact was cleaned and a label applied in ink. All chipped stone tool classes represented in the recovered assemblage were sampled and submitted for analysis. This included five dart points, three scrapers, one unifaces, nine bifaces, and 16 edge-modified flakes. Edge-modified flakes were intensively sampled as they presumably functioned in a variety of tasks and on a variety of materials. Therefore, it was thought that the greatest functional diversity would be apparent in the edge-modified flake tool class. The edge-modified flake tools included a variety of edge shapes and sizes in anticipation of identifying a wide range of functions such as cutting, graving, shaving, scraping, and whittling. Dr. Hardy's detailed methods, individual tool results with pictures, and interpretations are presented in Appendix C.

5.6.3 Mussel Shell Analysis

Freshwater mussel shells and shell fragments were the dominate artifact class (over 9,000 pieces) recovered from this alluvial setting. Those pieces recovered from the 6.4 mm screens consist predominantly of small shells that varied considerably in completeness from thin, tiny flakes of shell, to complete values. To keep shells more intact for identification, samples from various proveniences were wrapped in toilet paper to help protect and keep a shell together. Many shells were piece plotted on the level records to reflect their horizontal and vertical distribution patterns. Many of these same shells had their precise depths measured and recorded in anticipation of determining the number of events or dumping episodes that are represented. In a few instances, a small chunk of charcoal was recovered from next to or under a shell, and these tightly associated artifacts were collected and bagged together for possible radiocarbon dating. A large percentage of the shells are quite fragile, flaking and falling apart. In the field, the more complete shells and bigger shell fragments were collected and bagged, and then transported to the laboratory for analysis.

Seven mussel shells from various proveniences, both blocks and the cutbank that were directly associated with wood charcoal, were selected for radiocarbon dating. These shells were sent for dating to determine their ages in comparisons to the associated wood charcoal dates obtained. These seven samples were submitted to UGA, Center for Applied Isotope Studies for analysis through Dr. Jim Abbott at TxDOT.

In the laboratory, the shells were separated from other artifacts then the initial examination of the shells indicated that only four or five species were generally represented. TRC's extensive mussel shell comparative collection was used to directly compare to the archeological specimens recovered, and the identifications were done in house by a single individual, Emanual Moss. He used previously identified specimens on hand for direct comparisons, supplemented by the reference book on Texas mussels (Howells et al. 1996). The shells collected from each individual provenience were first weighed as a group, then the more complete shells and those with identifiable characteristics were laid out for comparisons and identifications were made. The more complete shells were identified to the species level where possible, and counts were recorded by species. Each shell was inspected to identify possible human alterations such as grinding, incising, burning, and crushing. Burned specimens were counted, and those that exhibited some other possible human modification, such as a hole or incised lines, were recorded and set aside. The larger fragments of valves were counted, and examined for signs of human modification. The counts of the species identified were recorded on paper forms for each provenience and later entered into the database. A sample of the more complete shells was measured to gain an understanding of the overall size of the shells that were prehistorically collected. The measurement was taken from the anterior to posterior margins. Most shells had broken or damaged posterior margins and could not be measured. All counts of those identified to species indicate the number of individual valves, rather than the numbers of individual animals present, as right and left sides were not identified.

Although the larger fragments and all the more complete shells were brought back to the laboratory for analysis, not all will be curated. The THC was consulted and they approved the discard of the bulk of the mussel shells. A small sample of shells (10 to 100 specimens) from selected cultural features will be curated, together with those shells that exhibit holes, obvious burning, or some other unusual characteristics. The shells to be curated were washed and 10 percent were labeled according to curation standards.

5.6.4 Faunal Bone Analyses

The recovered vertebrate faunal assemblage was meager at best. The fragmented pieces were examined to identify them to specific taxa, anatomical elements, element symmetry, element part, size, gross weight of the represented animal, skeletal maturity, presence or absence of burning, and type of human modification (cuts, impacts, and/or use as a tool). If bone tools were identified, the pertinent specimen was set aside for detailed observation and recorded as an artifact. Such items are discussed in the text under heading, "Bone Tools".

The faunal remains from each component were divided into major taxon groups based on the size and type of animal represented. The groups identified include dog/coyote (Canis) and/or deer (*Odocoileus* sp.), bison (*Bison bison*), turtles (Testudines), snakes (Serpentes), small rodents, and fish (Osteichthyes). The assignment of a bone fragment to a specific taxon was based primarily on cortical wall thickness, bone shape and structure, and other specific observed attributes. If these attributes were not sufficient to confidently assign a bone to a specific taxon or general category, the fragment was assigned to an unknown category. Bones were identified as to element and symmetry where possible, but most pieces are small, long bone fragments (LBF) that could not be identified to a specific taxon. The counts and weights of each group or taxon were recorded and are listed by taxon.

The bones were also recorded according to predetermined size categories. The categories range from 0 to 3 cm, 3.1 to 6.0 cm, 6.1 to 9.0 cm, 9.1 to 12.0 cm, and greater than 12.1 cm. Knowing the size bone fragments provides an indication of how intensively the bones were processed (e.g., highly fragmented bones may reflect bone grease rendering).

Each bone was inspected for various alterations, including burning, scrape marks, chop marks, blunt impacts, cut marks and other possible cultural modifications (Fisher 1995). The cut marks include various types such as thin and thick cut lines from stone tools made during skinning, defleshing, and disarticulation. Cut mark morphology reflects the shape of the tool's edge, the angle at which the tools was held, and the force behind the tool. Broad chop marks or percussion pits are often linear depressions that generally have a V-shaped cross section caused by larger and heavier stone tools, often during disarticulation. Impact locations are characterized by conchoidal flake scars and bone flakes, created by heavy hammerstones that indicate the point of impact where the element was struck to break the bone, as in marrow extraction.

Burning may result in a variety of observed colors that are generally related to the temperatures (degrees Celsius [°C]) that the bone was exposed too. This includes bones burned to a solid black, a solid brown, a mixture of brown and black, a calcined white, and a mixture of black and white. Generally speaking, the bones of an ungulate turn to a brown color in the temperature range around 200°C, black in the 300°C range, gray in the 300 to 400°C range, and white above about 700°C range (Nicholson 1993).

General weathering of the bones were observed, but no details concerning this process were recorded beyond its presence or absence. It should be pointed out that bone weathering is not just a direct result of time; it also reflects a combination of physical and chemical processes that result in cracking, splitting, exfoliation, disintegration and decomposition.

Root etching is a separate process that causes narrow, shallow lines and pits etched into the surface of bones by acids associated with plant roots (Fisher 1995). These lines are sinuous or wavy, have U-shaped cross sections, and are easily identified.

Element maturity estimates (i.e., element not fully developed) are based on the degree of fusion of long bone articular surfaces to the main bone shaft. Different bone elements are known to fuse at different times in an animal's life. However, very little is known about the exact timing of bone fusion rates in deer. The minimum number of individuals (MNI) by species was derived from the maximum number of recognized elements coupled with size, age, and sex estimates also taken into consideration. The faunal identifications were conducted by Mr.

Quigg using his personal comparative collection. The results are incorporated into the body of the text for each component.

5.6.5 Burned Rock Analysis

Burned rocks often account for a high percentage of the artifacts recovered from hunter-gatherer camp sites. These rocks have been heated and often rapidly cooled as the result of use in cooking or other heating activities. While it is occasionally difficult to distinguish burned from unburned rocks in the field, many burned rocks exhibit cracks, discoloration, crazing, reddening, and/or angular fragmented edges.

During excavation, burned rocks were treated as cultural artifacts. The larger pieces were often mapped *in situ* and all burned rock pieces from each hand-excavated level were collected and recorded. The collected burned rocks were then sorted into four previously established size categories (i.e., 0 to 4 cm, 4.1 to 9 cm, 9.1 to 15 cm, and greater than 15 cm) based on maximum dimensions, and then counted and weighed by size class. Most burned rocks were from feature contexts, whereas a sample of burned rocks from nonfeature contexts were collected, bagged, and returned to the laboratory for processing, cataloging, and possible analysis. Some burned rocks from features and most burned rocks from nonfeature contexts were discarded in the field after counted, weighed, and recorded. While the entire volume of burned rock encountered during the hand-excavations is known, only a small sample was retained for possible further analysis. Even a smaller sample was curated. Pieces of those rocks that underwent some specific type of analyses such as lipid residue or starch grain analyses, were curated. Larger pieces form individual features were also selected and curated.

Fifteen burned rocks were more or less randomly selected for lipid residue analysis. The selected rocks were generally the larger pieces that could be broken into multiple pieces that would allow parts of the different rock to be sent to the different analysts for their use. It was thought to be advantageous to have pieces of the exact same rock used for multiple analyses to strengthen the results and interpretations. These burned rocks represented 11 features, nine from the North Block and two from the South Block. These rocks represent the Late Archaic components. These samples were sent to Dr. Mary Malainey in Winnipeg, Manitoba for analyses. The detailed sample preparation and extraction methods, individual rock analyses, and interpretations of the lipid residues are presented in Appendix H.

Another 28 burned rocks from mostly the same features and in most instances part of the same rock that was subjected to the lipid residue analysis were also subjected to starch grain analysis. These 28 parts of burned rocks were submitted to Dr. Linda Perry of the Smithsonian National Museum of Natural History for analysis.

Parts of nine burned rocks used in the above starch grain analyses were also sent for diatom analysis. The fundamental belief is that multiple analyses on the exact same rocks would strengthen the final interpretation of the function of the rocks and/or the foods cooked by these rocks.

Four burned rocks of different colors, two from Feature 1 and two from Feature 10 were selected for radiocarbon dating. The different colors were selected to investigate if the different colors significantly affected the results of the dating. These four samples were submitted to UGA, Center for Applied Isotope Studies for analysis through Dr. Jim Abbott at TxDOT.

5.7 CURATION

Cultural materials in the Root-Be-Gone site collection were labeled according to the curation standards of the Texas Archeological Reasearch Laboratory (TARL) of The University of Texas at Austin. Individual catalog numbers were given to each unique tool identified in the overall assemblage, and each such unique object was labeled. Approximately one in ten artifacts (10 percent) occurring in bulk classes (e.g., chert debitage, faunal bones) within specific provenience units (e.g., a level) were labeled. Size of the object was also a major consideration for labeling purposes. Artifact labeling consisted of inscribing the State of Texas Archeological Site Trinomial for the Root-Be-Gone site (41YN452) and the catalog number on designated artifacts using black indelible ink. After the ink was dry, the artifact labels were coated with clear acetone to preserve the inscriptions.

Permanent tags were included with each individual artifact or class of artifacts collected from a single provenience. These tags include the trinomial (41YN452), provenience information, the class or type of

artifact(s), the date of excavation, the excavator’s initials, and the quantity of items in the bag. These permanent tags were printed on acid-free, 30.4 kg (67-lb.) card stock and filled out using No. 2 pencils.

All stone tools, samples of lithic debitage, samples of sediment from features, samples of burned rocks, all field records, and photographs from the two phases of investigations are permanently curated at TARL. Two to three burned rocks from each of the burned rock features are also curated. Individual artifacts and artifact lots, including all stone tools, sociotechnic items (e.g., bone beads and worked shells), debitage, burned rocks, faunal bones, and mussel shells, are in clear line seal-top plastic bags according to provenience. Upon completion of laboratory processing, cataloging, and analysis, these bags of artifacts were placed in acid-free cardboard boxes with lids for permanent curation. Small samples of sediment from various proveniences were stored in a similar fashion. Each polyethylene bag contains an archival-quality, acid-free curation tag that lists the site number, provenience data, date of excavation, excavator(s) initials, artifact type, and quantity. Copies of digital photographs printed on a color printer were placed in approved, acid-free plastic preservers for curation. All original field records are on acid-free paper and placed in acid-free reinforced file folders for curation.

6.0 ARCHEOLOGICAL RESULTS

The following chapter presents the results from the assessment and data recovery investigations at the Root-Be-Gone site. First, the natural and geoarcheological stratigraphy is presented to provide an understanding of the context of the cultural materials. That section is followed by a discussion of the cultural stratigraphy that places the artifacts into stratigraphic context based on associated radiocarbon dates and diagnostic projectile points. Those results provide evidence for the existence of three distinct Late Archaic components in the two horizontally separate blocks. The cultural stratigraphy section is followed by a presentation of the entire archeological assemblage by component. Each component assemblage section provides description and discussion of the cultural features, the stone tool assemblage, the vertebrate faunal assemblage, the mussel shell assemblage, the bone and shell artifacts, and the burned rock assemblage recovered therein. In the final section, archeological materials from an unassigned cultural component are presented.

6.1 NATURAL AND GEOARCHEOLOGICAL STRATIGRAPHY

Charles D. Frederick and J. Michael Quigg

The Root-Be-Gone site is situated at the western edge of the Holocene valley floor of the Clear Fork of the Brazos River immediately south of its confluence with Gages Creek. It is located upon and within the first terrace of the Clear Fork of the Brazos River. In the immediate vicinity of the site, Gages Creek flows northward for a short distance along the western side of the site before making an abrupt right angle turn to the northeast as it runs up against a bedrock outcrop of the Thrifty and Graham formations (undivided). From this point, Gages Creek flows in a straight line cutting through the Holocene deposits of the Clear Fork of the Brazos River towards its confluence. Therefore, Gages Creek forms the western and northern boundaries of site 41YN452.

6.1.1 Previous Stratigraphic Studies of the Clear Fork of the Brazos

The late Quaternary alluvial deposits of the Clear Fork of the Brazos River have been examined by two regional scale projects in the past: 1) in the vicinity of Abilene (Leighton 1936); and 2) in conjunction with archeological survey of the proposed South Bend Reservoir (Mandel 1992).

6.1.1.1 Clear Fork of the Brazos near Abilene

Leighton (1936:26-29) described and named two alluvial units from Elm Creek and the Clear Fork of the Brazos near Abilene, about 120 km southwest of this project. The Elm Creek Silts and the Durst Silts were both found to contain buried archeological sites. The Elm Creek Silts were described by Leighton (1936:8) as “a series of regularly thick-bedded and nearly uniformly textured silts and sandy silts. Sand and gravel in general is a minor constituent”. These deposits were attributed by Leighton to slack-water sedimentation. The Durst Silts are described as being buried by and separated from the Elm Creek Silts by an unconformity, and comprised of “compact pebbly silts” that have been weathered and exhibit minor amounts of secondary calcium carbonate. From field observations on the Clear Fork north of Abilene, Leighton described buried archeological sites within the Elm Creek Silts (at a depth of approximately 1.2 m at the Station 13 section) and within the Durst Silts (at a depth of approximately 7.9 m in the Station 14 exposure) and this was further supported by the observation of buried sites identified by E. B Sayles. Although Leighton (1936:34) argued that the Durst Silts were of Pleistocene age, (specifically Illinoian) these deposits are most likely of terminal Pleistocene to middle Holocene age. The

Elm Creek Silts are most likely of middle to late Holocene age.

6.1.1.2 South Bend Reservoir Studies

Mandel (1992) summarized the results of previous alluvial stratigraphic work on the upper Brazos River, and then reported on his field investigations in 10 subareas of the proposed South Bend Reservoir. One subarea (area 8) was in the vicinity of Eliasville and site 41YN452. Mandel recognized six distinct geomorphic surfaces within the late Pleistocene and Holocene valley of the Brazos River, which include two Pleistocene terraces (T_3 and T_2), a first terrace (T_1 which was divisible into three subsections from highest to lowest: T_{1a}, T_{1b}, and T_{1c}), and the modern floodplain (T_0; Figure 6-1). Mandel documented the deposits associated with each geomorphic surface through descriptions of natural and artificial (backhoe trench and core) exposures, from which a number of radiocarbon dates were obtained. In the vicinity of Root-Be-Gone site, Mandel (1992) made three relevant stratigraphic observations. First, he documented the stratigraphy beneath the T_{1b} surface at Trench 8-2, which was located slightly more than 1 km northeast of the site. In Trench 8-2 he recognized two buried soils, one at 1.16 to 1.49 m (the 2Akb horizon) that yielded a bulk humate radiocarbon date of 1340 ± 60 B.P. (Tx-6113), and another at 2.66 to 3.66 m (the 3Akb horizon) that yielded a bulk humate radiocarbon date of 1470 ± 60 B.P. (Tx-6121).

Second, beneath the T_{1b} surface at Cutbank 8-2 located 1 km south of the site, Mandel documented three buried soils in the top 4 m of the section with the 2Akb at 0.8 to 1.0 m, the 3Ab and 3Akb horizon between 1.41 and 2.68 m below the surface, and a 4Ab horizon between 3.17 and 3.42 m below the surface. A bulk humate radiocarbon sample from the upper 20 cm of the 3Ab horizon yielded an age of 1760 ± 70 B.P. (Tx-6118) and a similar sample from the lower 20 cm of the 3Akb horizon yielded an age of 2330 ± 60 B.P. (Tx-6116).

Closer to Root-Be-Gone, the cutbank bordering the channel of the Clear Fork of the Brazos River at the confluence of Gages Creek exposed what Mandel identified as a large, low-angle alluvial fan which has been cut into by the Clear Fork. Mandel (1992:72) described the cutbank immediately north of the mouth of Gages Creek (approximately 200 m northeast of the site), where he identified "three closely spaced buried paleosols in the upper 4.5 m of the section". A bulk humate radiocarbon date was obtained from the lower 20 cm of the 4Ab horizon (at a depth of 1.7 to 2.0 m). This sample returned an age of 2670 ± 60 years B.P. (Tx-5836).

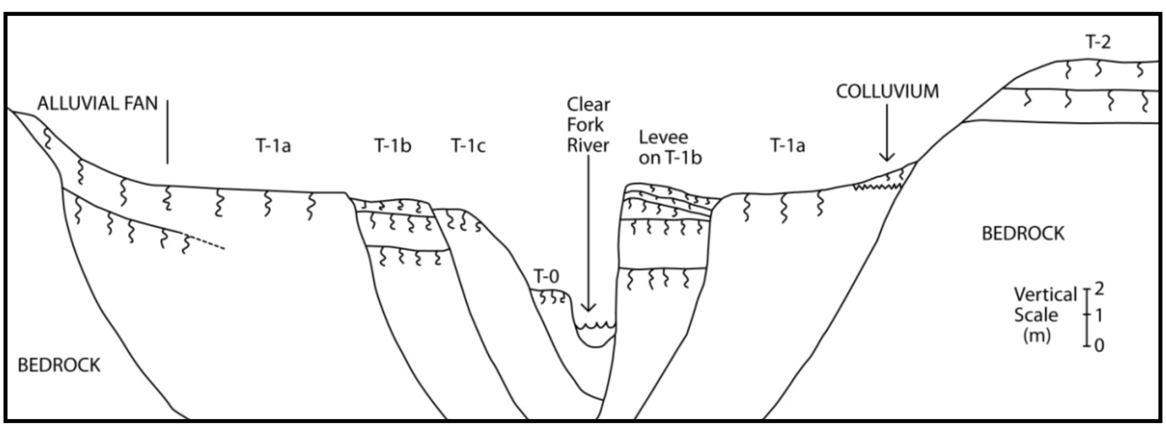

Figure 6-1. Schematic Stratigraphic Cross-Section of the Clear Fork of the Brazos Valley in the Study Area, Mandel (1992)

Given that Mandel did not map the distribution of the different geomorphic surfaces in each of the examined subareas, direct correlation with his work is somewhat tenuous. It is clear that all of the nearby sections Mandel documented contain multiple paleosols that yield humate radiocarbon dates spanning the period between 2700 and 1300 years B.P.

6.1.2 Previous Studies of the Alluvial Stratigraphy of Site 41YN452

The alluvial deposits at site 41YN452 have been examined three times, starting with a report on the Gages Creek Bridge by Abbott (2005), then in conjunction with testing of the site by TRC in 2006 (Schroeder 2006), and then during data recovery investigations (this report).

6.1.2.1 Texas Department of Transportation

Abbott (2005) examined five trenches (labeled 1 through 5) in the immediate vicinity of the Gages Creek Bridge. Two of which (Abbott's Trenches 4 and 5; currently labeled 1 and 2 at 41YN452) were placed on the southern side of the stream within the confines of site 41YN452. The strata revealed by these two trenches were similar, and both excavated to about 150 cmbs. Specifically Abbott identified current BT 2 with an Ap-A-Bw-2Akb-2Bkb profile developed in sandy clay loam to clay loam (Figure 6-2). Current BT 1 different slightly in the presence of a thin Bk horizon above the buried paleosol (Ap-A-Bw-Bk-2Akb-2Bkb). Abbott documented that the Ap horizon varied from 10 cm thick in BT 2 to 20 cm thick in BT 1, which represents fill installed during road construction. This fill capped a very dark brown (7.5YR 3/2 to 3/3), medium blocky clay loam A horizon that contains abundant woody roots. This horizon was 10 to 12 cm thick in both profiles and graded into a slightly lighter colored, weakly structured Bw horizon. In BT 1, this A horizon was 30 cm thick, dark brown (7.5YR 3/4) and weakly developed. In BT 2 the A horizon was similar in color and texture, but nearly 40 cm thick, and Abbott subdivided it into a slightly lighter colored B1w horizon with a slightly darker color and a more clay rich B2w horizon.

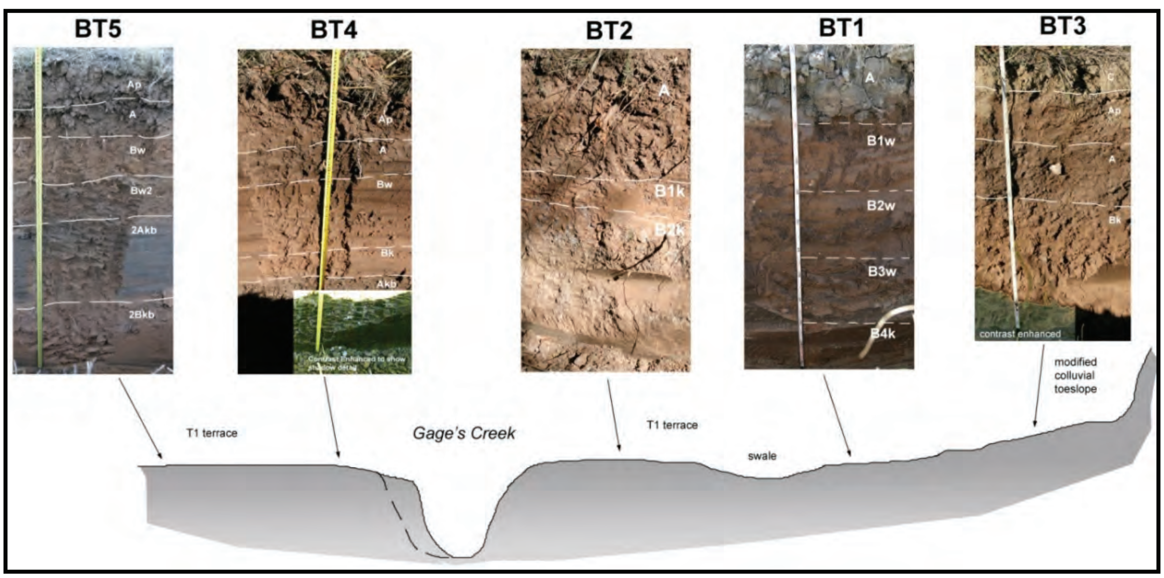

Figure 6-2. Abbott's (2005) Backhoe Trench Profiles. (Note, BTs 4 and 5 are currently labeled as BT 1 and 2 in 41YN452 with BTs 1, 2, and 3 in 41YN450)

In BT 1 the Bw horizon graded into a reddish brown (5YR 4/4) sandy clay loam Bk horizon that exhibited common carbonate filaments (Abbott 2005).

Abbott (2005) documented the lower profile by stating,

> In both trenches, this weak soil capped a more strongly developed buried calcic soil. The A horizon of the buried soil was 30 cm thick in BT 2 and more than 60 cm thick in BT 1. It is a very dark brown (7.5 YR 3/2) clay loam and exhibited a strong blocky to prismatic structure. In BT 2 this structure broke down readily with handling into granular structure, while in BT 1 the peds were quite sticky and did not readily separate, much less break down… There was abundant carbonate filaments throughout the horizon concentrated on the ped faces, and occasional small mussel shells in each trench. In BT 2, the A horizon graded into a reddish brown (5YR 4/4) clay loam Bk horizon exhibiting a moderate angular blocky structure. No Bk horizon was identified in Bt 2, as the A horizon extended to the base of the trench. A variety of buried cultural material was noted in the Akb horizon of BT 2, including mussel shell, charcoal, and burned sandstone. This material was concentrated in the upper 30 of the paleosol, although occasional mussel shells were noted up to 60 cm below the contact. In contrast, no potential cultural material except a few small fragments of mussel shell was noted during excavation of BT 1; however, one unifacial tool was recovered from the upper Akb horizon (90 cmbs) during subsequent scraping of the walls.

Abbott (2005) tentatively correlated the site deposits with Mandel's T_{1b} deposits, speculating that if this correlation was correct, the prehistoric occupation in the paleosol was of Late Archaic age.

Abbott went on to state that BTs 1 and 2 contained a discrete zone of cultural material associated with a distinct, buried paleosol. This cultural material is also exposed as an extensive shell lens in the cutbank overlooking Gages Creek. This lens appeared isolated and may have a high degree of integrity.

6.1.2.2 TRC's Eligibility Investigations

Schroeder (2006) reported on the stratigraphy of 41YN450 and 41YN452 as revealed during the NRHP eligibility testing excavations performed by TRC (Matchen et al. 2006). Schroeder's field observations at 41YN452 were in good agreement with Abbott's (Figure 6-3). It was determined that the 2Akb horizon only varied slightly in thickness across the APE (Figure 6-4). At the northern end, in Trenches 3 and 4, this buried soil was 40 cm thick, thinned to 28 cm thick at Trench 5, and was roughly 42 cm thick at Trench 6 at the southern end. This same soil horizon was only about 30 cm thick along the exposed western cutbank. Two radiocarbon dates were obtained on charcoal from 41YN452 during testing, both from Feature 1, which was located in the paleosol.

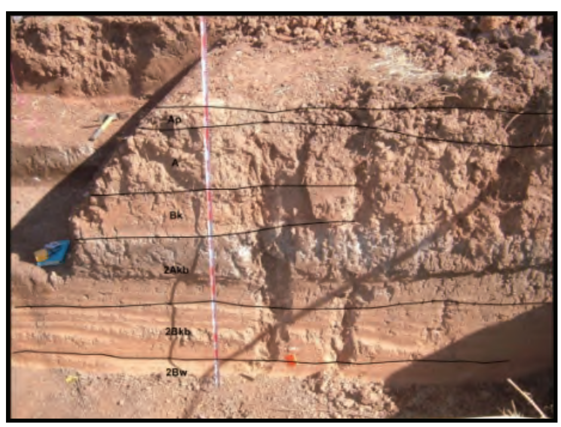

Figure 6-3. General Soil Profile for 41YN452 at Backhoe Trench 3 (view east)

Charcoal from 65 cm depth near the top of this feature yielded a date of 360 ± 40 B.P. (Beta-214362).

Both samples are younger than Mandel's results, but given that all of Mandel's radiocarbon dates on the Clear Fork T_{1b} deposits were on bulk humates, this is not unexpected. A second charcoal date from 94 cm below the surface yielded an age of 1100 ± 40 B.P. (Beta-214363).

6.1.3 TRC's 2007 Data Recovery Stratigraphic Investigations

During the data recovery investigations efforts were made to document the nature of the stratigraphy in direct proximity to the two block excavations. Previous work (described above) demonstrated that the majority of the stratigraphic variation in this area occurred parallel to the road (along a roughly north-south axis). Although it would have been desirable to document the stratigraphy along a continuous north-south oriented wall within each block, stripping of the deposits for the block excavations precluded this. As an alternative, two small trenches were excavated in such a way as to bracket the block excavations, with Trench 7 placed immediately south of the South Block and Trench 8 excavated just north of the North Block.

6.1.3.1 Methods

Two columns of soil/sediment samples were collected during the data recovery investigations as part of the geoarcheological studies. Bulk soil samples were collected from the vertical profiles of Trenches 7 and 8 at 5 cm increments, and paleomagnetic boxes of sediment for magnetic susceptibility analysis were collected at an even finer stratigraphic resolution.

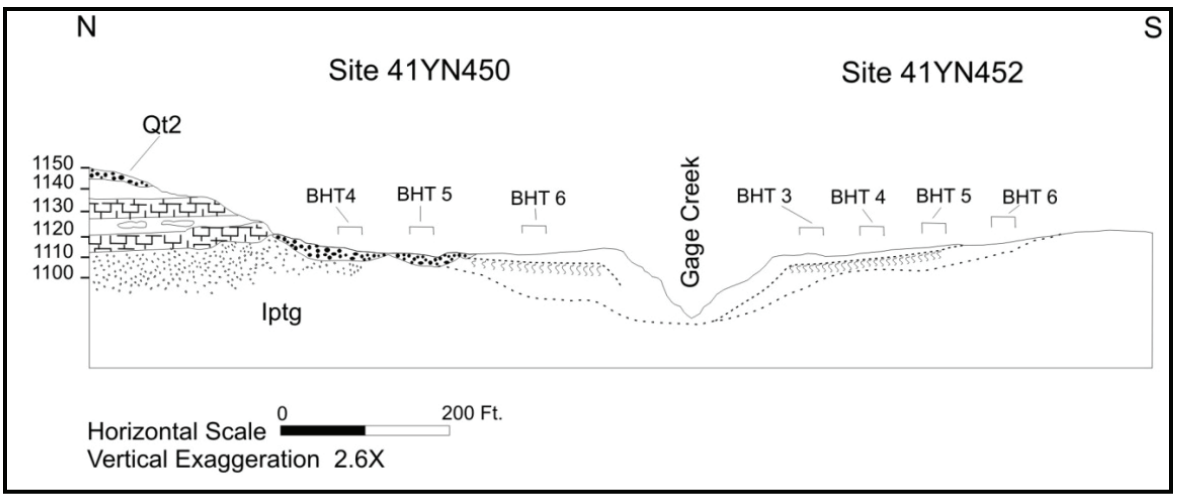

Figure 6-4. Schematic Cross Section of Clear Fork of the Brazos River Valley with TRC 2006 Terrace Locations at Gages Creek.

These soil column samples were analyzed to determine the particle size distribution, calcium carbonate content, magnetic susceptibility, organic carbon content, and stable carbon isotopic composition, in order to inform on the depositional and post-depositional alteration of the deposits and the results of these analyses are presented on Table 6-1.

The particle size analysis was done by the sieve-hydrometer method (cf. ASTM 1985; Gee and Bauder 1986; Bouyoucos 1962), and the calcium carbonate equivalent was determined on a chittick apparatus (Dreimanis 1962; Machette 1986). The low frequency (470 Hz) and high frequency (4700 Hz) magnetic susceptibility (kappa) was measured on a Bartington MS2 meter and an MS2b sensor and the mass corrected

Table 6-1. Texture Data Concerning Trenches 7 and 8.

Sample	Depth	Sand	Silt	Clay	USDA	Mean	Sorting	Skewness	Kurtosis	Organic C	$\delta^{13}C$	CCE
Number	(cm)	(%)	(%)	(%)	Texture Class	(phi)	(phi)	(phi)	(phi)	(%)	(per mil)	(%)
1	2.5	31.85	41.81	26.34	Loam	7.16	3.88	0.50	0.35	1.89	-23.44	2.42
2	7.5	23.13	43.44	33.43	Clay Loam	7.61	4.02	0.32	0.33	1.15	-21.34	5.29
3	12.5	21.72	49.59	28.69	Clay Loam	7.49	3.79	0.49	0.36	0.86	-19.57	6.96
4	17.5	23.45	48.76	27.79	Clay Loam	7.35	3.72	0.56	0.39	0.79	-19.14	6.65
5	22.5	25.09	48.10	26.81	Loam	7.27	3.72	0.53	0.40	0.85	-20.14	4.84
6	27.5	25.63	47.30	27.07	Clay Loam	7.27	3.75	0.54	0.40	0.84	-20.81	3.02
7	32.5	26.94	42.85	30.21	Clay Loam	7.38	3.98	0.45	0.37	0.76	-19.19	2.27
8	37.5	24.44	45.43	30.13	Clay Loam	7.47	3.91	0.52	0.36	0.78	-20.67	2.42
9	42.5	24.68	45.26	30.06	Clay Loam	7.50	3.94	0.48	0.35	0.80	-20.50	2.87
10	47.5	24.52	45.76	29.72	Clay Loam	7.52	3.96	0.42	0.34	0.79	-20.88	5.41
11	52.5	24.47	45.81	29.72	Clay Loam	7.44	3.87	0.42	0.36	0.67	-19.12	7.71
12	57.5	14.47	56.36	29.17	Clay Loam	7.71	3.67	0.52	0.37	0.66	-18.73	7.40
13	62.5	25.45	44.84	29.71	Clay Loam	7.46	3.91	0.42	0.35	0.67	-19.63	8.91
14	67.5	27.07	45.58	27.35	Clay Loam	7.31	3.80	0.47	0.36	0.64	-20.06	10.12
15	72.5	30.2	43.57	26.23	Loam	7.23	3.81	0.54	0.36	0.56	-18.82	11.17
16	77.5	30.2	43.65	26.15	Loam	7.24	3.80	0.52	0.36	0.52	-18.94	11.47
17	82.5	26.23	47.97	25.80	Loam	7.26	3.70	0.52	0.38	0.56	-18.74	13.14
18	87.5	22.91	51.11	25.98	Silt Loam	7.33	3.66	0.50	0.39	0.56	-20.44	13.28
19	92.5	21.63	54.57	23.80	Silt Loam	7.29	3.56	0.51	0.41	0.57	-21.21	14.03

Table 6-1, continued

Trench 8

Sample Number	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	USDA Texture	Mean (phi)	Sorting (phi)	Skewness (phi)	Kurtosis (phi)	Organic (%)	$\delta^{13}C$ (per mil)	CCE (%)
1	2.5	21.22	54.82	23.96	Silt Loam	7.28	3.48	0.52	0.41	1.86	-23.52	2.56
2	7.5	14.19	58.13	27.68	Silty Clay	7.58	3.49	0.44	0.37	1.79	-24.04	3.17
3	12.5	10.13	57.10	32.77	Silty Clay	7.95	3.61	0.36	0.33	1.84	-23.62	1.96
4	17.5	9.69	58.38	31.93	Silty Clay	7.83	3.48	0.34	0.37	1.32	-22.65	3.02
5	22.5	8.71	55.62	35.67	Silty Clay	8.08	3.70	0.33	0.30	1.02	-22.12	5.58
6	27.5	7.39	54.31	38.30	Silty Clay	8.22	3.74	0.25	0.28	1.20	-22.79	3.47
7	32.5	5.84	55.79	38.37	Silty Clay	8.23	3.67	0.22	0.28	1.01	-21.32	6.48
8	37.5	7.6	57.13	35.27	Silty Clay	8.06	3.66	0.28	0.30	0.91	-20.98	5.72
9	42.5	12.23	56.42	31.35	Silty Clay	7.87	3.69	0.47	0.30	0.96	-20.87	6.33
10	47.5	17.72	54.11	28.17	Silty Clay	7.62	3.68	0.55	0.30	0.77	-22.97	8.28
11	52.5	20.89	53.60	25.51	Silt Loam	7.35	3.52	0.62	0.38	0.69	-21.20	9.19
12	57.5	21.76	53.85	24.39	Silt Loam	7.28	3.47	0.62	0.39	0.64	-21.79	8.88
13	62.5	20.43	54.29	25.28	Silt Loam	7.30	3.47	0.58	0.40	0.68	-20.36	8.58
14	67.5	17.74	52.81	29.45	Silty Clay	7.55	3.64	0.46	0.36	0.97	-20.04	4.51
15	72.5	16.97	52.57	30.46	Silty Clay	7.65	3.70	0.43	0.34	1.10	-20.32	3.01
16	77.5	15.2	53.42	31.38	Silty Clay	7.77	3.73	0.42	0.32	1.02	-19.13	2.25
17	82.5	14.55	52.20	33.25	Silty Clay	7.87	3.79	0.37	0.30	1.01	-18.58	1.96
18	87.5	14.89	49.72	35.39	Silty Clay	7.94	3.88	0.39	0.28	1.03	-19.60	1.96
19	92.5	14.75	49.69	35.56	Silty Clay	7.95	3.88	0.33	0.28	0.99	-19.32	2.41
20	97.5	13.59	50.66	35.75	Silty Clay	7.96	3.84	0.37	0.28	0.95	-19.10	3.79
21	102.5	13.87	50.11	36.02	Silty Clay	7.94	3.83	0.33	0.28	0.86	-18.62	5.27
22	107.5	13.91	51.70	34.39	Silty Clay	7.91	3.80	0.41	0.29	0.83	-18.84	6.32
23	112.5	13.66	51.61	34.73	Silty Clay	7.96	3.84	0.42	0.28	0.73	-18.16	7.07

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Table 6-2. Magnetic Susceptibility and Elemental Data From Trenches 7 and 8, and Features 4, 10, and 11

Trench 7 Profile

No.	Depth (cm)	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)
1	5	33.2	9.6
2	10	34.8	10.0
3	15	32.6	9.7
4	20	33.6	9.2
5	25	44.0	10.1
6	27.5	44.5	9.8
7	30	49.0	37.2
8	32.5	51.2	10.2
9	35	53.7	10.5
10	37.5	53.8	10.7
11	40	53.4	11.8
12	42.5	51.6	10.3
13	45	50.6	10.5
14	47.5	48.5	11.0
15	50	47.0	10.5
16	52.5	43.7	10.6
17	55	45.6	10.2
18	57.5	39.3	10.1
19	60	46.9	10.3
20	62.5	36.7	9.5
21	65	39.9	10.3
22	70	34.0	9.7
23	75	29.7	9.4
24	80	29.3	9.4
25	85	28.3	9.1
26	90	27.3	9.2
27	95	27.1	9.6

Trench 8 Profile

No.	Depth (cm)	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)
1	5	38.1	8.3
2	10	44.5	9.1
3	15	41.6	8.8
4	20	40.5	9.2
5	25	36.4	9.7
6	30	37.4	9.6
7	35	39.7	10.4
8	40	43.2	10.0
9	45	39.1	11.1
10	50	35.3	11.3
11	55	33.3	9.9
12	60	29.2	8.6
13	62.5	30.6	-4.3
14	65	33.9	9.3
15	67.5	39.3	9.4
16	70	49.3	10.0
17	72.5	52.8	10.3
18	75	57.4	11.3
19	77.5	62.2	11.3
20	80	61.6	11.1
21	82.5	63.5	11.7
22	85	62.0	10.7
23	87.5	62.1	12.8
24	90	59.4	13.9
25	92.5	58.4	13.9
26	95	57.6	10.6
27	97.5	57.5	12.2
28	100	56.5	11.4
29	102.5	56.2	11.3
30	105	41.4	-17.7
31	107.5	53.1	10.7
32	110	51.8	10.6
33	112.5	50.3	11.9
34	115	50.2	11.4
35	120	49.4	11.5

Feature 11, Group A

No.	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)	Total P (ppm)	Bray P (ppm)	C %	^{13}C ‰ vs. PDB
1	55.40	10.66	377.1	6.4	0.67	-17.11
2	57.66	11.12	315.6	13.9	0.73	-17.87
3	55.76	10.86	369.9	5.9	0.68	-17.51
4	56.24	11.20	355.1	6.8	0.69	-17.21
5	56.24	11.49	379.5	7.1	0.67	-17.20
6	55.75	10.87	381.6	5.6	0.71	-17.70
7	59.47	11.34	387.0	6.3	0.69	-18.09
8	48.55	11.56	236.5	6.8	0.60	-18.90
9	55.89	12.30	375.5	5.2	0.68	-17.24
10	57.81	12.40	377.1	6.6	0.70	-17.71
11	58.40	10.57	391.9	6.1	0.75	-18.33
12	58.00	11.02	388.5	5.0	0.76	-18.35
13	56.50	10.82	400.0	5.7	0.69	-17.25
14	55.45	11.37	376.3	6.0	0.67	-17.22
15	56.20	11.63	383.8	6.4	0.73	-18.46
16	59.58	10.25	410.1	4.0	1.07	-21.32
17	55.85	11.66	392.1	5.9	0.67	-17.38
18	56.28	11.30	376.5	6.4	0.67	-17.35
19	56.88	11.30	385.0	5.9	0.74	-18.14
20	54.88	11.62	378.5	5.6	0.69	-17.28
21	55.09	11.74	395.9	5.6	0.68	-16.51

Feature 11, Group C

No.	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)	Total P (ppm)	Bray P (ppm)
1	55.1	10.2	na	na
2	56.8	10.3	na	na
3	54.9	10.6	na	na
4	53.9	10.8	na	na
5	56.0	10.7	na	na
6	55.1	98.2	na	na
7	58.2	10.4	na	na
8	60.2	10.2	na	na
9	54.8	10.2	na	na
10	53.2	10.7	na	na
11	55.9	10.7	na	na
12	57.4	10.2	na	na
13	53.7	10.5	na	na
14	54.0	10.0	na	na
15	56.8	10.6	na	na
16	60.9	10.4	na	na
17	62.7	10.1	na	na
18	64.0	10.3	na	na

Feature 10, Group D

No.	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)	Total P (ppm)	Bray P (ppm)	C %	^{13}C ‰ vs. PDB
1	64.3	10.6	580.7	12.4	0.81	-17.92
2	64.1	10.4	673.0	8.1	0.80	-17.85
3	61.9	10.4	536.6	14.1	0.78	-18.03
4	67.3	10.1	677.3	16.3	0.83	-17.59
5	66.3	10.4	629.6	17.0	0.80	-17.81
6	64.3	10.2	602.1	11.8	0.80	-17.69
7	65.3	9.8	634.4	11.6	0.77	-17.32
8	61.4	10.0	651.7	20.2	0.77	-17.47
9	61.1	10.2	614.6	4.1	0.80	-17.76
10	61.0	9.8	617.6	6.7	0.79	-17.98
11	62.5	10.0	595.8	11.7	0.77	-17.86
12	62.2	10.2	579.9	13.6	0.74	-17.40
13	58.8	8.5	492.0	15.2	0.69	-17.68
14	62.5	9.7	601.1	17.1	0.79	-17.53
15	62.0	9.2	618.2	15.9	0.72	-17.66
16	61.5	10.2	613.9	17.4	0.83	-18.23
17	60.1	10.0	633.7	21.6	0.77	-17.60
18	59.3	10.5	585.0	12.2	0.73	-18.05
19	59.3	9.9	597.7	14.5	0.78	-17.61
20	54.3	9.3	484.3	13.2	0.61	-17.86
21	60.6	10.5	594.3	13.6	0.78	-17.75
22	60.2	9.9	590.5	11.8	0.82	-18.94
23	60.6	10.1	580.9	14.7	0.75	-17.65
24	58.5	8.9	549.5	13.4	0.76	-18.80
25	55.1	9.1	524.2	16.2	0.67	-18.03
26	58.7	10.2	542.7	19.2	0.85	-19.25
27	59.5	10.3	532.3	12.7	0.74	-17.29
28	58.4	9.7	322.9	18.2	0.70	-18.20
29	58.0	9.9	569.9	25.4	0.69	-17.33
30	58.7	9.9	605.4	12.5	0.74	-17.65
31	59.1	10.2	581.5	13.1	0.70	-17.19
32	59.4	10.2	622.7	11.9	0.74	-17.48
33	59.3	10.3	606.7	19.6	0.71	-16.98
34	54.8	10.3	436.6	20.9	0.62	-17.65
35	57.2	9.6	571.8	13.9	0.73	-17.59
36	60.6	10.5	571.0	13.7	0.75	-17.29
37	61.9	9.9	605.8	9.7	0.74	-17.75

Feature 4, Group B

No.	Xlf $10^{-8}m^3kg^{-1}$	Xfd (%)
1	48.6	10.8
2	48.3	10.6
3	48.4	11.0
4	51.5	11.5
5	51.3	10.8
6	49.4	11.7
7	47.3	10.6
8	48.4	10.2
9	49.7	10.4
10	46.1	10.1
11	47.3	10.2
12	48.9	10.5
13	48.1	10.7
14	47.8	11.0
15	48.7	10.2
16	46.0	10.3
17	47.8	10.5
18	46.2	10.8
19	44.2	9.6
20	41.2	10.0
21	44.5	10.2
22	45.0	10.4
23	46.8	10.6
24	46.2	10.3
25	42.7	10.3
26	45.8	10.4
27	44.3	10.2
28	44.5	10.2
29	44.6	9.6
30	46.5	10.5
31	45.8	10.5
32	47.1	10.2
33	43.9	11.3
34	48.8	10.9
35	47.0	10.9
36	43.6	10.3
37	46.6	10.5
38	45.1	10.6
39	45.4	10.7
40	49.3	11.8
41	46.9	3.5
42	47.1	10.8
43	44.6	11.5
44	48.3	12.0
45	51.1	12.4

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magnetic susceptibility (chi, or c_{lf}) and coefficient of frequency dependency (c_{fd}) were then calculated (Gale and Hoare 1991; Dearing 1999). The magnetic susceptibility values are presented on Table 6-2 and are reported in SI units ($10^{-8}m^3kg^{-1}$). The organic carbon content and the stable carbon isotopic content of the samples was determined on an Europa Scientific Tracermass Isotope Ratio Mass Spectrometer at the Stable Isotope Research Unit, Department of Crop and Soil Science, Oregon State University, by Dr. Rockie Yarwood. Samples were first treated to remove calcium carbonate by means of either immersion in 1N hydrochloric acid or fumigated with concentrated hydrochloric acid. The organic carbon was determined on a Dumas combustion/reduction apparatus on a Europa Scientific ANCA SL Roboprep prep system (C/H/N) Analyzer.

6.1.3.2 Results

As previous investigations noted, two distinct alluvial deposits were distinguishable within the area of the two block excavations, with a prominent paleosol formed at the top of the older deposit and it is within this buried soil that the archeological components were identified. The older alluvial deposit, hereafter referred to as the *late Holocene Alluvium*, was draped by a northward thickening wedge of younger alluvium, here referred to as the *Recent Alluvium*.

6.1.3.3 The Late Holocene Alluvium

The prehistoric occupations excavated at Root-Be-Gone are all situated within the late Holocene Alluvium (LHA), and this deposit comprises the base of the two trench exposures (Trenches 7 and 8) described and analyzed here. The thickest section of LHA was revealed by Trench 7 at the southern edge of the South Block. This 1 m deep exposure revealed 75 cm of the LHA and the paleosol formed at the top of this deposit was approximately 30 cm thick (see Figure 6-5). The soil formed in this deposit exhibited an Akb-Bkb profile (see Table 6-3) and the alluvial deposit was a massive overbank sediment that exhibited a subtle fining upward trend. At the base of Trench 7 the deposit was a silt loam (mean particle size of ~7.3 phi), that fined upward into a loam and then a clay loam (mean particle size values ranging from 7.3 to 7.5 phi), and no trace of depositional bedding was noted within this deposit.

In Trench 8, immediately north of the North Block excavation, the LHA comprised the lower 58 cm of the trench profile, and the paleosol (the Akb horizon) had almost doubled in thickness to 50 cm. At 71 cm below the surface, the top of the paleosol was more than twice as deep as in trench 7. Although roughly 100 m apart, Trench 8 exposure of this alluvial deposit was notably finer textured (entirely a silty clay loam) and exhibited a subtle coarsening upward trend (mean values of approximately 8 phi at the bottom of the paleosol to 7.6 phi near the top), and like Trench 7, no evidence of sedimentary structures were observed.

The thickening of the paleosol observed in Trench 8 suggests that this soil is more cumulic in this location, and the finer texture implies that it was situated in such a place that the flow velocity was lower than Trench 7. Given the general stratigraphic trends documented by previous studies at the site it was anticipated that the LHA in Trench 8 would be coarser textured, and the fact that it is actually finer suggests that there is a subtle variation in the paleogeography of the LHA landscape that was not captured by previous investigations. One possible explanation is that the northern trench was situated over a broad, in-filled paleochannel, which could account for both the more cumulic nature of the soil and the finer sediment texture. But no significant evidence of such a structure was observed during the fieldwork.

The paleosol formed in the LHA (Zone 3 in Trench 7; Zone 5 in Trench 8) exhibits modest evidence of surface exposure and weathering that is, in general, consistent with the radiocarbon dates obtained from the site. Radiocarbon dates obtained from cultural contexts within the South Block excavation indicate that the paleosol formed over a period of approximately 1,000 years between 1920 and 930 B.P. During this period of time the soil acquired a modest magnetic susceptibility enhancement and the upper part of the solum had been leached of half to two-thirds of the detrital calcium carbonate that was once present in raw (unweathered) alluvium.

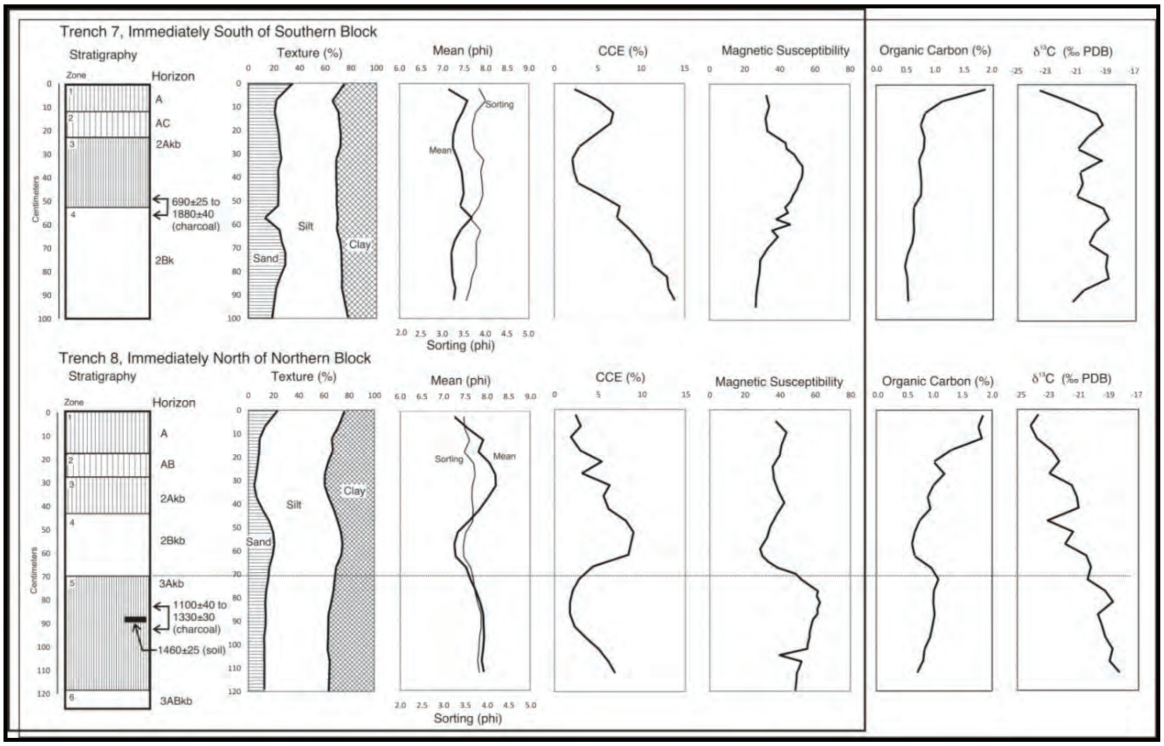

Figure 6-5. Plot of the Results of Texture Analysis, Calcium Carbonate Content and Magnetic Susceptibility for Trenches 7 and 8

Table 6-3. Trench 7 and 8 Descriptions

Trench 7

Zone	Depth	Stratigraphic Unit	Soil Horizon	Description
1	0-11	Recent	A	Dark brown (7.5YR 3/2, m) loam to clay loam, friable, moderate to strong coarse granular structure, clear smooth boundary, slightly effervescent.
2	11-22	Recent	AC	Dark brown (7.5YR 3/3, m) clay loam, friable, weak medium prismatic structure parting to moderate medium subangular blocky structure, clear smooth boundary, slightly effervescent.
3	22-53	Late Holocene	2Akb	Dark brown (7.5YR 3/2, m) clay loam, hard, moderate medium subangular blocky structure, gradual smooth boundary, slightly too strongly effervescent, common (5%) calcium carbonate filaments.
4	53-95	Late Holocene	2Bkb	Brown (7.5YR 4/4, m) clay loam, loam and silt loam, extremely hard, moderate medium to coarse subangular blocky structure, strongly effervescent, common (5-7%) calcium carbonate filaments.

Table 6-3, continued

Trench 8

Zone	Depth	Stratigraphic Unit	Soil Horizon	Description
1	0-18	Recent	A	Dark brown (7.5YR 3/2, m) silty clay loam and silt loam, friable, moderate coarse to fine subangular blocky structure, clear smooth boundary, slightly effervescent.
2	18-29	Recent	AB	Dark brown (7.5YR 3/4, m) silty clay loam, friable, moderate fine subangular blocky structure, abrupt smooth boundary, slightly effervescent.
3	29-44	Recent	2Akb	Dark brown (7.5YR 3/2.5, m) silty clay loam, friable, moderate medium subangular blocky structure parting to strong fine to medium granular structure, clear smooth boundary, strongly effervescent, few (1-3%) calcium carbonate filaments.
4	44-71	Recent	2Bkb	Reddish brown (5YR 4/4, m) silt loam to silty clay loam, friable, strong medium subangular blocky structure, abrupt smooth boundary, strongly effervescent, common (5-7%) calcium carbonate filaments, few (25%) very thin discontinuous calcium carbonate coats on peds.
5	71-120	Late Holocene	3Akb	Very dark gray (7.5YR 3/1, m) silty clay loam, firm, weak to moderate medium prismatic structure parting to strong medium subangular blocky structure, gradual smooth boundary, slightly effervescent, many (10%) calcium carbonate filaments, common (50%) thin discontinuous calcium carbonate coats on peds.
6	120-128+	Late Holocene	3ABk	Dark brown (7.5YR 3/2, m) silty clay loam, firm, moderate medium subangular blocky structure, strongly effervescent, common (5%) calcium carbonate filaments.

Although there is no clear evidence of episodic alluviation within the documented exposures of the LHA paleosol at the site, the significant increase in thickness across the two excavation blocks implies that the LHA sedimentation rate increased to the north and stratigraphic descriptions and radiocarbon dates obtained by Mandel (1992; discussed in detail, previously) in proximity to the site demonstrate that the sedimentation rate within this deposit was significantly greater immediately to the east where multiple buried soils were documented in trench and cutbank exposures. In specific, trenches excavated by Mandel (1992) on the same surface immediately downstream of the site (Trenches 8-1 and 8-2) revealed two buried paleosols that in Trench 8-1 were radiocarbon dated to 1340 ± 60 B.P. (1.16 to 1.36 cmbs; TX-6113) and 1470 ± 60 B.P. (2.66 to 2.86 cmbs; TX-6121). Closer to the site, Mandel observed three buried soils in the Clear Fork River cutbank adjacent to the confluence with Gages Creek within a deposit he described as a "large, low-angle alluvial fan" (Mandel 1992:72). A bulk soil radiocarbon date from the third buried soil in this cutbank exposure, located 1.87 m below the surface yielded an age of 2670 ± 60 B.P. (1.75 to 2.00 cmbs; TX-5836).

Direct comparison of the bulk soil radiocarbon dates obtained by Mandel (1992) with the charcoal ages derived from the site would be difficult were it not for a single bulk soil sample collected from near the middle of the north block excavation, from the middle of the paleosol at 87 to 88 cm below the surface. This bulk soil sample yielded a radiocarbon date of 1460 ± 25 B.P. (UGAMS-6669) and is stratigraphically comparable to charcoal radiocarbon dates from depths of 86 to 90 cm in the north block excavation that yielded radiocarbon dates of 1280 ± 30 B.P. (UGAMS-5168; 87 cm), 1270 ± 30 B.P. (UGAMS-5174; 90 cm), and 1110 ± 30 B.P. (UGAMS-5173; 86 cm). These data suggest that that bulk soil radiocarbon dates collected from the late Holocene alluvial deposits of the Clear Fork of the Brazos River may yield radiocarbon dates that are 180 to 350 years older than the time of deposition.

If these radiocarbon dates are used to extrapolate sedimentation rates for the LHA, it is apparent that the rate varies from a low of 0.06 cm per century in the South Block excavation to a high of 11.5 cm per century in Mandel's (1992) Trench 8-1. In light of this information, it seems likely that the two buried soils dated by Mandel in Trench 8-1 are contemporaneous with the LHA paleosol excavated at 41YN452, but that the sedimentation rate within the site is much lower than was documented by Mandel closer to the river where nearly 2 m of floodplain alluvium was deposited on the valley floor during the period of time represented by the paleosol with the site. The much higher sedimentation rates documented by Mandel for the LHA, and the existence of multiple buried soils within this deposit imply that the paleosol within the site is actually two or more short-term soils welded together owing to a slower sedimentation rate near the margin of this alluvial fill.

Analysis of the stable carbon isotopic composition of bulk organic matter in these two profiles provides some basic information on the vegetation present during the deposition of the LHA. In general terms, the stable carbon isotopic values obtained from the LHA indicate that contributions of C_4 organic matter oscillated between ca. 45 percent and ca. 60 percent during this period. The samples from trench 7, where the LHA is thickest, exhibit three such cycles, whereas Trench 8 records but one of these cycles. Samples from the paleosol in both trenches indicate that at the base of the soil C_4 plants accounted for about 45 percent of the organic matter, but there was a short interval near the top of the soil where C_4 organic matter was slightly more common (values around -19.2‰ in Trench 7; -19.6‰ in Trench 8). The carbon isotopic results support the results of the phytolith analysis from the paleosol (Sudbury, this volume) which indicate that the site was a mixed or short grass prairie during this period.

6.1.3.4 The Recent Alluvium

The recent alluvium comprises a wedge-shaped drape over the top of the LHA and the trends in physical properties of the Recent Alluvium (RA) are similar to those exhibited by the LHA. Like the LHA, the RA thickens and becomes finer textured from south to north. The RA was thinnest in Trench 7 (Zones 1 and 2), south of the South Block excavation, and nearly tripled in thickness across the two excavation blocks (it was 25 cm thick in Trench 7 and 71 cm thick in Trench 8). Likewise, the RA was finer textured in the Trench 8 exposure (Zones 1-4; typically a silt loam to a silty clay loam, ca. mean particle size of 7.3 to 8.2 phi) and coarser textured in Trench 7 (clay loam, mean particle size from 7.3 to 7.6 phi). Although in Trench 7, the RA appeared to be a single phase of sedimentation, in Trench 8, the profile exhibited evidence of two weakly developed soils separated by a transitional horizon. This was apparent in the field and supported by the magnetic susceptibility analysis, which shows evidence of two zones of slight magnetic susceptibility enhancement (Zone 1 and Zone 3) which coincide with the zones of visibly melanized (darker colored) sediment. This was also supported by the organic carbon determinations, which are highest at the modern ground surface, but exhibit elevated values in Zone 3 and Zone 5. Both A horizons exhibit significantly smaller magnetic susceptibility values than the LHA. Likewise, both apparent top soils exhibit subtle depletions in calcium carbonate content which is consistent with periods of subaerial exposure and weathering.

The stable carbon isotopic trend for the RA is recorded by both profiles, but is most detailed in Trench 8, where this deposit is thickest. In general, both profiles record a dramatic drop in C_4 organic carbon contribution to the soils, with values at the base of this deposit ranging between -20.3‰ and -19.4‰, and represent around 50 percent C_4 contribution to the organic carbon in the soil when deposition of the RA began. By the top of the exposure the values reach their most depleted (between -23.4‰ and -24.04‰) which indicate that C_4 plants contributed around one quarter of the organic matter to the soils, presumably reflecting a increase in organic carbon derived from arboreal sources throughout this period of time.

6.1.3.5 Summary

The charcoal radiocarbon dates obtained from Root-Be-Gone provide a solid basis for evaluating the age of the paleosol and the period of time necessary for its formation. Radiocarbon dates from this site demonstrate that this soil appears to form over a period of roughly 1,000 years between approximately 900 and 1900 B.P. Although this could be viewed as a period of regional stability, this is more an artifact of where the site is situated within the late Holocene alluvial fill. Work done by Mandel (1992) in the center of the valley near the site indicates that what appears to be a stable period within the Root-Be-Gone site, is in fact one characterized by episodic alluvial sedimentation by the Clear Fork of the Brazos River. The presence of multiple buried soils separated by pedogenically unaltered alluvium in the central part of the valley during the same period of time the paleosol is forming within the site suggests that the long duration of the paleosol at the site is an artifact of the alluvial architecture, and not regional stability, as appears to be the case for the West Fork Soil on the Trinity River (Ferring 1990, 1986), or the Caddo Soil in Oklahoma (Hall and Lintz 1984; Lintz and Hall 1983). For instance, Ferring's work on the Trinity documents the presence of the cumulic West Fork Soil at the top of the middle to late Holocene age Pilot Point Alloformation (Ferring 1990; 1986) and radiocarbon dates on this soil span the period between 2600 and 500 B.P. The West Fork Soil caps the Pilot Point Alluvium everywhere in the Trinity River valley, which is very different from the situation in the Clear Fork valley near the Rood-Be-Gone site.

Examination of the stable carbon isotopic composition within the bulk sediment and soils indicates that during the period that the LHA was being deposited, the site was a mixed grass prairie and that the vegetation oscillated between approximately 45 percent and 60 percent C_4 plants. This pattern changed significantly during the deposition of the modern alluvium, after 900 B.P., when C_4 contributions to the organic matter declined to approximately 25 percent, presumably reflecting an increased arboreal component to the vegetation.

6.1.3.6 Feature Specific Investigations

The major feature type revealed during the two block excavations was mussel shell discards that were also visible in the cutbank adjacent to the right bank of Gages Creek (Abbott 2005; Feature 18 this volume). Some discard features consisted mostly of shell, whereas others were more cosmopolitan and included a range of artifacts, most notably burned rock and lithic debitage. Although not numerous, small basin rock heating elements were also discovered.

A small number of soil samples were collected from three different types of features (Features 4, 10 and 11) to provide more information on their composition and formation. The basic framework for this analysis was to examine an obvious *in situ* heating element (Feature 11) and compare those results to larger, more diffuse discard features such as Features 4 and 10 dominated by mussel shells and scattered burned rocks.

Methods

Soil samples used for this work were collected from multiple points across the features exposed during the data recovery excavations in order to examine the spatial distribution of materials that were potentially contributed by the former inhabitants such as organic residues (via phosphorus analysis and carbon content and stable isotopic composition) and thermal refuse (via magnetic susceptibility). Small grids of soil samples were collected from Features 4, 10 and 11, in 2.5 cm diameter plastic paleomagnetic sample boxes, and these samples were examined for their magnetic susceptibility, and a subset was submitted to the Central Analytical Lab at Oregon State University for determination of total phosphorus (or P_{tot}, via a Kjeldahl digestion (Taylor 2000) and calcium bound phosphorus (specifically the strong Bray analysis (Bray and Kertz 1945), which extracts primarily calcium bound phosphorous (Holliday and Gartner 2007). A smaller number of oriented blocks of sediment were collected for microscopic investigation via petrographic methods, and these blocks were dried, vacuum impregnated with polyester resin, and then submitted to National Petrographic Institution in Houston for thin section preparation. They were then examined under low and high magnification in plane and cross-polarized light using a Leica S8 APO binocular microscope and a Leica DMEP polarizing light compound microscope. Data derived from the analyses of each feature is presented by feature below.

Feature 11

Two vertically separate grids of small sediment samples were collected from this small, basin-shaped heating element. The upper grid consisted of 21 samples that covered the heating element and extended about 50 cm beyond the heating element to the east. The second grid was collected from a subsequent level of excavation (10 cm lower) and comprised 18 samples. The upper level samples presumably reflect the occupation surface from which the basin was excavated, and the sediment filling in the top of the thermal feature. The upper level samples, and the analytical results on them are depicted in Figure 6-6: A through D.

The lower sample suite is shown on panels E and F of this figure. The magnetic susceptibility, total organic carbon, soil organic matter stable carbon isotopic composition, and total and bray phosphorus were determined for the upper level samples. Only the magnetic susceptibility was determined for the lower level samples.

Elemental and Fine-Earth Studies

The magnetic susceptibility analysis revealed a small positive anomaly directly correlated with the burned rocks, and a prominent yet discrete negative anomaly near a mussel shell on the northeast side of Feature 11.

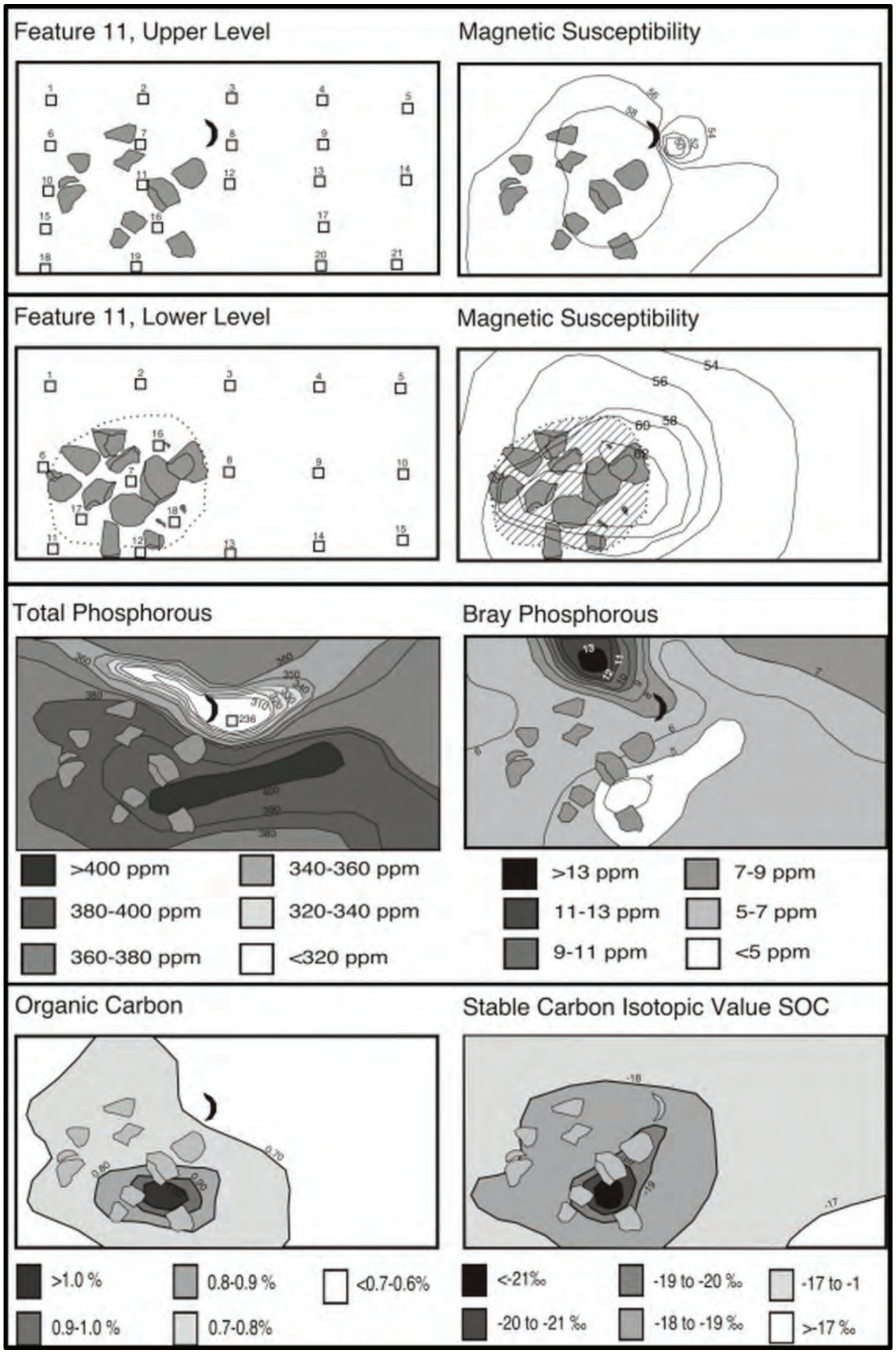

Figure 6-6. Feature 11 that Shows Analytical Results

Note: Plots A through D are from the upper level grid, and plots E and F are for the lower Grid. A. Plot of burned rocks and mussel shell of the feature with respect to the samples collected in the field from the upper grid; B. Contour plot of the results of the magnetic susceptibility analysis; C. Shaded contour map showing the spatial distribution in total phosphorus; D. Shaded contour map showing the spatial distribution in Bray phosphorus; E. Plot of burned rocks and mussel shell of the feature with respect to the samples collected in the field from the upper grid; Dashed line denotes feature margin; F. Contour plot of the magnetic susceptibility results for the lower grid samples; G. Contour plot of total organic carbon values; H. Contour plot of the stable carbon isotope values from soil organic carbon (SOC); G and H from upper level

The total phosphorus also exhibited elevated values in the feature, but this extended east away from the basin to the east. A prominent area of lower P_{tot} values was observed in the same sample that exhibited low magnetic susceptibility, but the area of this anomaly was significantly larger and extended east and west away from this single sample, fringing the northern side of the basin. The Bray phosphorus exhibited a completely different pattern, with a high value situated to the north of the basin and a low value on the southeast side.

The spatial patterns revealed by the organic carbon and stable carbon isotopic analysis of soil organic carbon revealed clear spatial correlation with the feature, as one would expect. The values of organic carbon outside the feature varied between 0.6 percent and 0.7 percent and then rose to 1.07 percent within the southeast side of the basin. The carbon-13 values of the soil organic matter outside the feature ranged between -17.1‰ and -18‰ outside the basin and decreased in proximity to the feature, presumably reflecting the use of wood as a fuel within the feature. The most negative value (-21.32‰) coincided with the most organic rich sample, which is undoubtedly attributable to preservation of wood charcoal in this part of the feature. The fact that the organic carbon and stable carbon isotopes show subtly different spatial patterns suggests that in some areas the organic enrichment associated with the combustion of fuel has been subsequently oxidized, but some portion of the stable carbon enrichment remains.

Micromorphology

A single oriented block was collected from the upper level grid near the center of the basin and this sample is shown on Figure 6-7. Figure 6-7:C included a single fragment of burned sandstone, and a mussel shell. The fine-grained matrix of this sample contained a few small (0.5 to 1 mm) rounded fragments of burnt earth, several widely spaced very small (0.1 to 0.3 mm) charcoal fragments, and a few small plate-like sandstone fragments (<3 mm long; thermal spalls?). The mussel shell situated above the large fire-cracked rocks (FCR) fragment was not thermally altered. There was no clear evidence of ash observed in the thin section, but there was considerably more secondary (pedogenic) calcium carbonate around the FCR (see Figure 6-7) in the form of thin, but nearly continuous calcium carbonate coats on the rock and lining the ped face, and this may be due to local dissolution and reprecipitation of ash which is primarily calcium carbonate. This carbonate is not present in the fine-earth matrix of this sample in similar quantities away from the FCR fragment. The amount of thermal debris in this thin section is surprisingly small given its context, but would perhaps have been more prominent lower in the feature. That said, the basin did not exhibit a prominent reddened or oxidized rim along the margins, which may be indicative of its thermal history. Most simple basin heating elements exhibit thin oxidation rims (<5 cm) owing to the fact that earth is a good insulator and that the temperature profiles decrease rapidly with depth (Courty et al. 1989:107; Raison 1979). Experimental hearths created using a variety of methods (simple hearth, and using bellows) show that single event fires create reddened rims which are generally less than 3 cm thick (Berna et al. 2007:365-366).

Extensive repeated use, and/or prolonged exposure to high temperatures (i.e., increased “soaking time”) can be expected to produce thicker rubified rims below the heat source. The absence of a reddened rim implies a short-duration use and/or a low temperature fire.

As noted previously, there is micromorphological evidence of heat altered (reddened) earth within worm casts in the center of this basin, so another possibility is that small-scale pedoturbation was sufficiently intense to disperse this material from its original context, but this, too, seems unlikely.

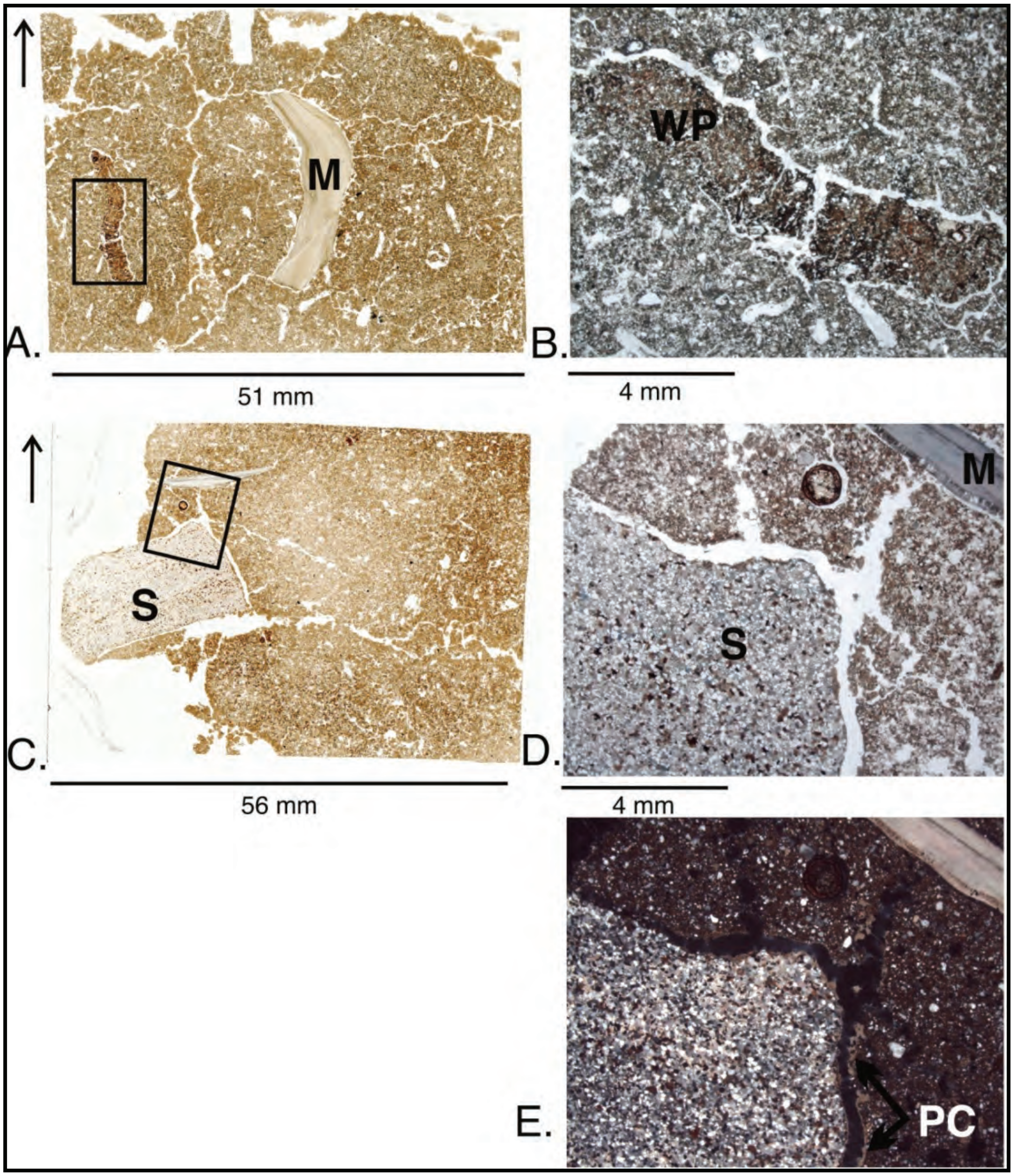

Figure 6-7. Micromorphology of Features 10 and 11

Note: Upper Panel, A, Plane light scan of the thin section made from Feature 10, arrow shows orientation towards the ground surface. Note that the mussel shell fragment (M) is oriented on edge. Small box is the area shown magnified at right (B). B, close up view of a worm passage feature (WP) containing extensive amounts of burnt earth and charcoal, but redeposited within matrix lacking such material. Lower Panel, C, Plane light scan of thin section made from an oriented sample collected from Feature 11. "S" is a burnt sandstone rock fragment. The small box shows the location of the area magnified in photos C and D. C, Plane light image of burned rock (S) and mussel shell (M). D. Crossed polarized light view of same area, but with clear expression of a thin pedogenic calcium carbonate (PC) coat lining the burned rock fragment.

Comment

Overall, the results of intensive chemical analyses on Feature 11 support the general expectations, with the basin heating element that exhibits a significant increase in magnetic susceptibility, which was best observed in the lower grid samples, and elevated concentrations of total phosphorus, carbon as well as stable carbon values indicative of wood as a fuel source. The spatial pattern exhibited by the total phosphorus is perhaps an artifact of cleaning out this feature from the east, which would scatter phosphorus-rich ash onto the occupation surface. The magnetic susceptibility would be expected to mirror this distribution if more than ash was removed from the feature, and the spatial distribution of elevated magnetic susceptibility does show a very small eastward deflection, but the correlation is less than anticipated from such a process. The amount of thermal refuse revealed by petrographic examination of soil collected from the center of the feature is less than anticipated, but indicative of minor thermal alteration of the rocks and substrate.

Feature 4

This large discard feature consisted mostly of mussel shells with infrequent burned rocks, charcoal and chert debitage. A suite of samples collected from Feature 4 was designed to examine if it was largely shell or exhibited a wider range of refuse. A broad grid of samples was collected from the feature for magnetic susceptibility analysis and the location of these samples with respect to the postulated feature boundaries at the time of sampling are shown on Figure 6-8.

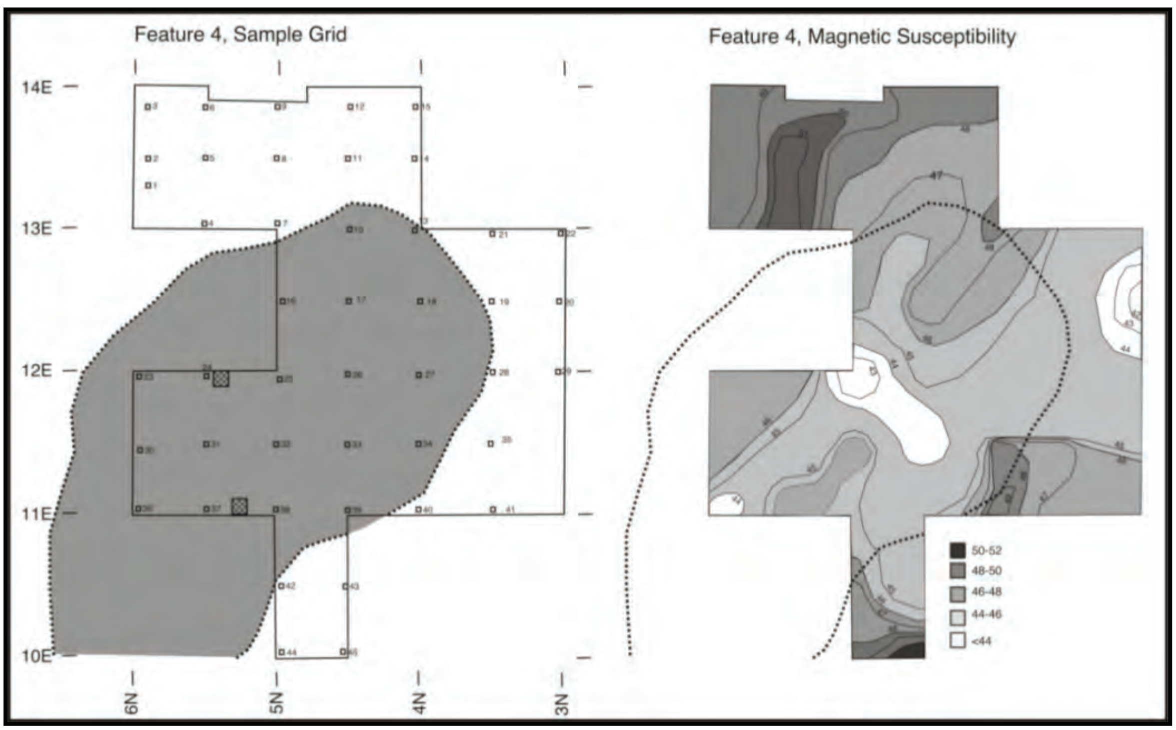

Figure 6-8. Feature 4 Showing Magnetic Susceptibility.

Note: Left side, plot shows test unit margins and approximate area of Feature 4 with respect to the bulk soil samples (small numbered boxes) and micromorphology samples (cross-hatched boxes) collected. Right side, shaded contour plot of spatial variation in the magnetic susceptibility.

The spatial variation in the magnetic susceptibility analysis shows a poor spatial correlation with the feature, which suggests that thermal refuse is not the defining characteristic. It is also possible that the calcium carbonate from the mussel shells (which is diamagnetic and generally exhibits low magnetic susceptibility values) is reflected in this pattern, but the logical test of this assumption, namely determining the spatial variation of calcium carbonate was not performed.

Micromorphology

Two oriented samples were collected from Feature 4 and a thin section was made from one of them. A low magnification scan of this slide is shown on Figure 6-9. As is clearly visible, this sample was collected from a part of Feature 4 that contained numerous mussel shells and those shell fragments consisted of a tightly intermixed suite of unburned and burned shell refuse. The mussel shells range from large shells almost 5 mm thick, to very thin shells that are < 0.5 mm. The burned shells are clearly discolored in both plane light and cross-polarized light in the photomicrographs. Figure 6-9 shows a magnified image of an area of numerous shell fragments and reveals that large unburned shells are closely packed with fragments of smaller burned shells that appear to have broken in place, and then covered by more unburned shell fragments. Hence, although these smaller shell fragments are very close together and look like they are a single discard event, given their obviously different histories, it is probable that they represent different discard events.

The dominant fabric exhibited by the fine-grained matrix is a granular microstructure composed of discrete and welded earth worm casts, which are rounded to subrounded 0.5 to 1 mm diameter aggregates of matrix. Figure 6-9:C and D show areas of the slide dominated by worm casts, and these excrement pedofeatures appear to be most common in direct proximity to the shell fragments. Very fine (0.1 mm) diameter fragments of charcoal are present in some of these worm casts, and a few larger fragments (ca. 1 to 2 mm long) appear to have escaped earthworm ingestion. No mussel shell fragments were observed within the worm casts. A few small fragments of burned earth are also present in this slide (Figure 6-9:E).

Comment

The micromorphological observations suggest that there is a considerable amount of thermal refuse within the feature (more than was observed in the thin section from the Feature 11 heating element), and that this material is intimately stratified with thermally unaltered shell debris which suggests that either thermally altered and unaltered debris was collected together and discarded, or that this feature was created by multiple discard events over a period of time. The amount of thermal debris observed in the thin section appears to be at odds with the results of the magnetic susceptibility analysis and the reason for this is not clear.

Feature 10

A suite of 37 small sediment samples were collected in an irregular grid across this amorphous shaped burned rock and mussel shell dump while excavation was ongoing (see Figure 6-10). For each sample the magnetic susceptibility, total and Bray phosphorus, total organic carbon and stable isotopic composition of the organic carbon were determined. A single vertically oriented block of sediment was collected for micromorphological examination.

Elemental and Fine-Earth Studies

Figure 6-10 presents the results of magnetic susceptibility, phosphorus and carbon analyses obtained from Feature 10. The top left panel of Figure 6-10 shows the spatial distribution of the cultural material associated with the feature at the time it was sampled (as well as the approximate feature boundary) with respect to the samples collected.

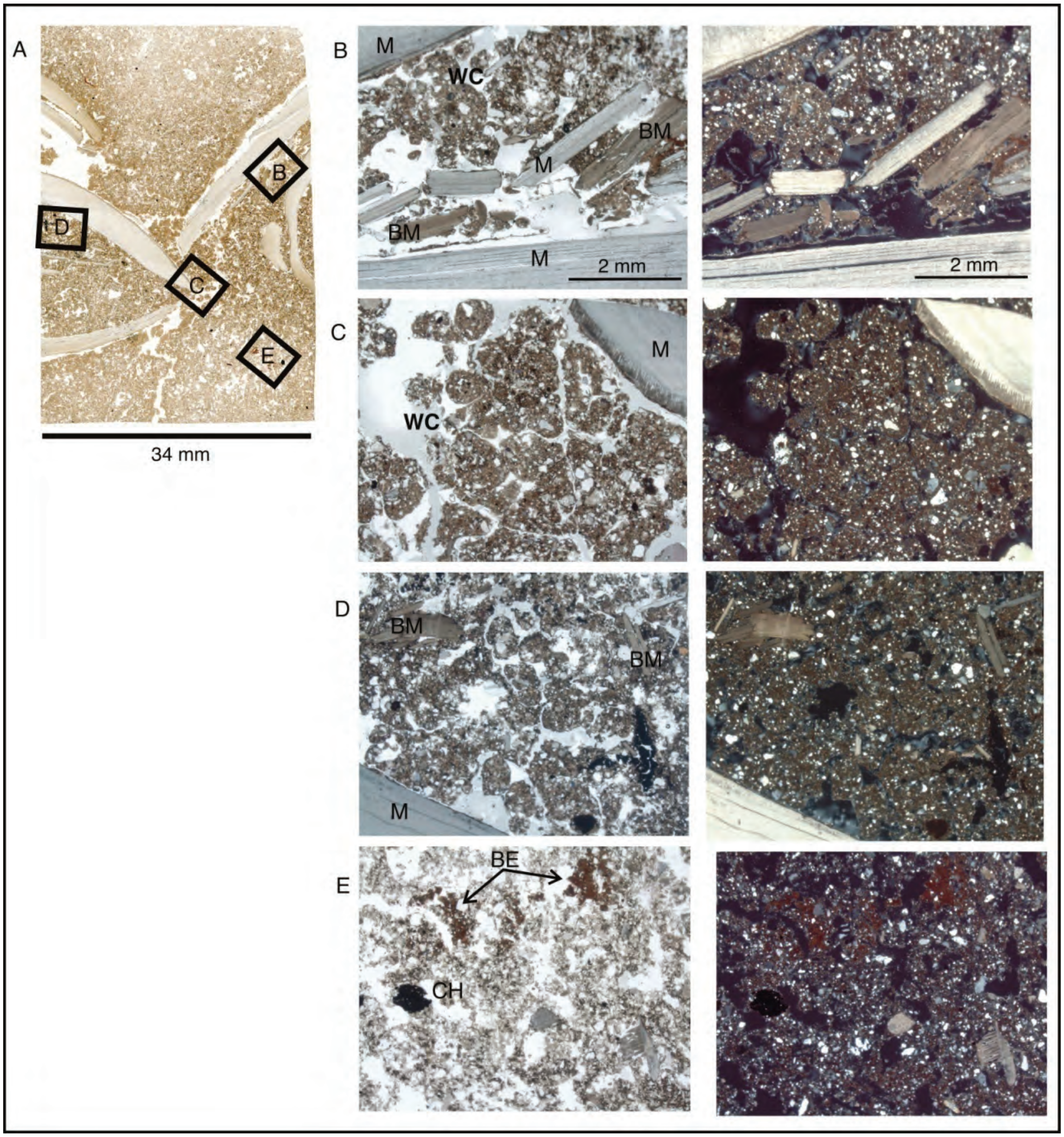

Figure 6-9. Micromorphology of Discard Shell Feature 4

Note: A is plane light scan of the thin section. Boxes show the location of magnified images B through E. B is plane light (left) and cross-polarized (right) view of mussel shell (M) and burned mussel shell (BM) and worm casts (WC). Note the close spacing of burned shell and un burned shell fragments. Scale bar on these photos are same for all of the photos in this panel. C is area of worm casts (rounded aggregates) abutting an unburned mussel shell. D is an area dominated by worm casts with dispersed small mussel shell fragments, and charcoal. E is zone of spongy microstructure with small dispersed fragments of burnt earth (BE) and charcoal.

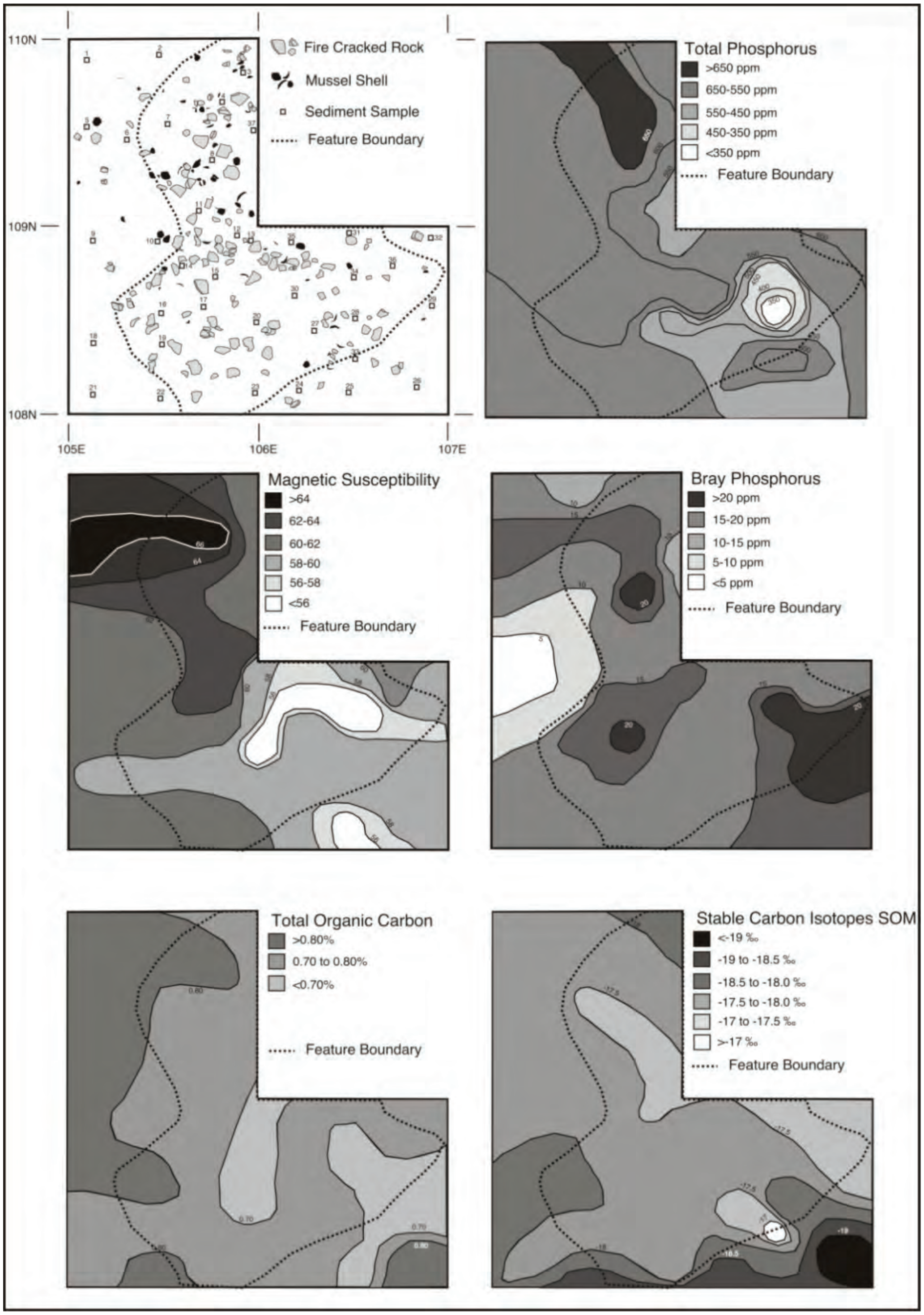

Figure 6-10. Chemical Results from Discarded Feature 10.

Note: Top left, drawing of Feature 10 at the time it was sampled showing burned rock, mussel shells, and the location of the samples collected from the feature. Top right, plot of the spatial variation in total phosphorus observed across Feature 10. Bottom left, Plot of the spatial variation in the magnetic susceptibility. Bottom right, plot of the spatial variation of the Bray phosphorus. The approximate feature boundary is shown on all of the figures to facilitate visual comparisons.

None of the fine-earth analyses exhibited a strong spatial correlation with the feature boundaries. The magnetic susceptibility samples revealed an area of higher values in the northwest part of the feature that extend beyond the limits of the feature to the margins of the sampled area. An area of slightly lower values was situated in the southeast quadrant of the feature. A similar trend was observed with the total phosphorus with an area of higher values in the north and northwest part of the feature and a prominent low in the southeast side. As with the magnetic susceptibility, both trends extend beyond the limits of Feature 10. The Bray phosphorus exhibited a different pattern, with three spatially discrete highs within the limits of the feature, the largest of which extended outside the feature boundary to the southeast.

At the outset, it was anticipated that organic carbon and possibly the stable carbon isotopic composition of the soil organic matter would exhibit a spatial correlation with the feature, but this was not supported by the analytical data. The spatial trend in organic carbon exhibits an almost inverse relationship with the feature boundary, with the highest values obtained outside the feature and the lowest values within or immediately east of the feature. The organic carbon appeared to be slightly C_3 enriched outside the feature to the south and southeast where the most depleted value was obtained (-19.25‰), and values between -17‰ and -18‰ were obtained from the majority of the feature. These values were nearly identical to those obtained outside the Feature 11 hearth.

Overall, the chemical results suggest that factors controlling the distribution of these attributes are not correlated with the thermal and heat altered refuse that defines the feature. The lack of association between organic carbon and the feature suggests that little or no organic refuse was deposited with the rocks and shell, or this material decomposed before it could be incorporated into the soil.

Micromorphology

An oriented matrix sample was collected from the northern half of Feature 10 in N109.6 E105.9. The thin section made from this sample suggests significant reworking of the original material has occurred by mesofauna, but less dramatically than observed in Feature 4. The thin section (Figure 6-7: A and B) shows strongly developed subangular blocky microstructure with a tendency towards prismatic, and the large mussel shell fragment in this photo is oriented vertically adjacent to a ped. The microstructure consists of a speckled b-fabric. There are trace fragments of charcoal in the matrix, but most sediment in this thin section lacks significant thermal refuse. The exception to this is the worm cast (or passage feature) on the left side of the thin section, which contains almost entirely burned earth and charcoal. The worm that deposited this material clearly passed through a deposit rich in thermal refuse and redeposited it here.

Considered together, the results of this microstructure and chemical work indicate that cultural refuse associated with Feature 10 was deposited on the ground surface and subsequently buried by alluvial sedimentation, and natural processes subtly reorganized these materials through time. The large items, namely the burned rock and mussel shell, have probably been moved little, although the mussel shells appear to have been slightly reoriented following initial discard. The most significant reorganization has occurred with the fine-earth fraction, which appears to have been significantly moved around by soil mesofauna such as worms. Worms appear to have caused significant displacement of the fine-earth matrix, but it is difficult to assess the extent to which this process has occurred. Hypothetically, one would expect this to be relatively small scale and not alter the broad-scale distribution of either the magnetic susceptibility or phosphorus, but worms clearly have homogenized and moved the fine-grained alluvial sediment and cultural refuse that was once present.

Conclusions

As was expected, the discrete, *in situ* heating element Feature 11, exhibited reasonably good spatial correlations between the distributions of the burned rock, the magnetic susceptibility, and carbon and total phosphorus. However, the large, irregular shaped shell and burned rock discard features, Features 4 and 10, do not share this trend. In fact, all materials assumed to be concentrated by human activity (magnetic susceptibility, carbon, and total phosphorus) had greater concentrations outside these features for reasons that are not immediately clear. The Bray phosphorus shows the opposite trend, with a poor correlation with the heating element and a relatively good correlation with the limits of one of the discard Feature 10.

Petrographic examination of these three features revealed they all contained thermal refuse, but that much of this has been moved around by worms following cultural deposition. Nevertheless, the presence of apparently similar amounts of thermal refuse should result in a better correlation between the features and magnetic susceptibility and phosphorus that was observed. The reason behind this apparent mismatch is not clear. The results clearly show that the magnetic susceptibility and total phosphorus were spatially correlated with each other, but the reason for the latter correlation is unclear.

Evidence of Shrink-Swell Activity?

Some artifacts within the site were discovered in vertical orientations (e.g., an arrow point in the North Block, and shells within various features (e.g., Feature 10) which led to the assumption that these materials may have been adversely affected by postdepositional argilliturbation. Argilliturbation, or the mixing of soils by expansion and contraction of clay minerals, generally leads to the development of macro-and micro-scale features such as pressure faces and slickensides in hand samples, and striated fabrics in microstructure visible in thin section. There was no evidence in the field of pressure faces or slickensides within either of the alluvial units present and none of the thin sections obtained from the data recovery excavations exhibit the distinctive fabrics (e.g., the vosepic fabric of Brewer 1976; the striated b-fabrics of Bullock et al. 1985) which are caused by the alignment of clay minerals during periods when the expandable clays are swelled. Indeed, most fabrics observed were speckled b-fabrics, which are thought to be associated with randomly oriented clay domains within the fine-grained matrix. The absence of such micro-scale reorganization of the fine earth fraction appears at odds with the concept that argilliturbation was responsible for the vertical orientation of some artifacts. Perhaps it is more likely that these anomalous orientations were an artifact of some other form of pedoturbation.

6.2 CULTURAL STRATIGRAPHY

J. Michael Quigg

6.2.1 Introduction

During the 2006 site assessment, the initial five 50-by-50 cm test units (Test Units 1 through 4 and 9) were followed by six 1-by-1 m test units (Test Units 5 through 8, 10 and 11; Figure 6-11). All units were hand-excavated and screened. These initial 50-by-50 cm test units, dispersed along the narrow APE, yielded information concerning the depth and density of cultural materials from the surface to 150 cmbs (Figures 6-11 and 6-12; Table 6-4). As depicted, by far the highest percentage (93 percent) of the cultural materials were detected and recovered from a buried 2Akb horizon also identified across the entire APE. This buried 2Akb horizon was not encountered at a consistent depth below the surface across the APE, but gradually sloped and appeared to thicken to the north. The thickness of this 2Akb horizon also varied slightly from roughly 30 to 40 cm. Towards the northern end of the APE, the top of the 2Akb was roughly 60 cmbs and was, for the most part, easily discernable.

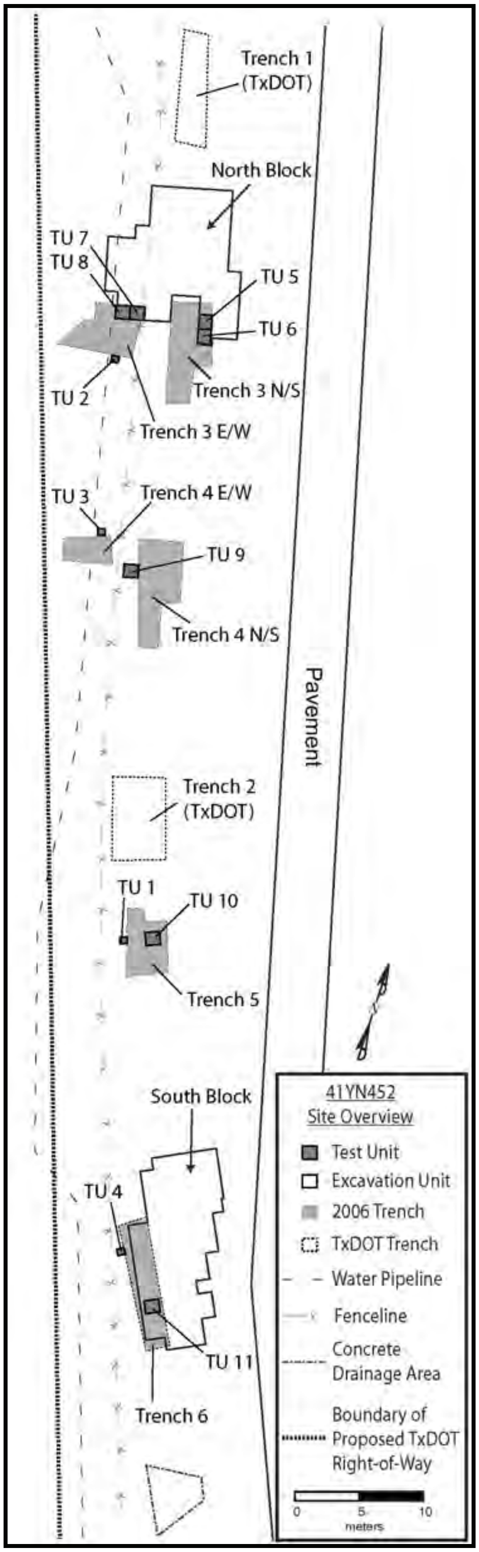

Figure 6-11. Horizontal Distribution of Trenches and Test Units across 41YN452

The lower boundary, between 90 and 100 cmbs, was diffuse and not obvious. Across the southern part of the APE, this same 2Akb was distinguishable during the assessment phase, but nearly impossible to see during data recovery. The top of this 2Akb horizon was at least 10 cm shallower across most of the southern end.

A few scattered pieces of cultural material (*N* = 10 or 3 percent) from the initial five 50-by-50 cm test units were recovered in the top 60 cm of deposits. These sparse materials came from above the top of the 2Akb horizon, or resting within, but very near the top of this horizon. These dispersed materials included 3 burned rocks, 3 pieces of debitage, 2 bone fragments, and 2 mussel shells. In addition to these meager findings, a complete Bassett arrow point (#788-10) was recovered from the surface (Figure 6-13). These few scattered artifacts hint at a possible Late Prehistoric component above the buried 2Akb horizon. No cultural features were encountered in this upper 60 cm of deposits to indicate that a lengthy campsite was represented.

Another 3.9 percent of the cultural materials came from the 50-by-50 cm units under the buried soil, below 110 cmbs in the B horizon. These materials included mostly complete mussel shells and fragmented mussel shells, similar to those in the buried 2Akb horizon. Presumably, these few small shells were displaced downward from the higher concentrations above or, alternatively, they represent a very similar and sparse occupation from an earlier event.

With the majority of cultural materials (93 percent) recovered from the buried 2Akb horizon within the 50-by-50 cm units, the six subsequent 1-by-1 m units were placed to target those detected concentrations of cultural materials. Since a majority of the observed and targetedcultural materials were in this buried soil, the 1-by-1 m units were stripped of sediment to just above the top of the buried soil to facilitate access and speed the recovery process.

Table 6-4. Cultural Materials from Test Units

Mechanical Trench No.	Test Unit No.	Unit Depth (cmbs)	Unit Size (m)	Cultural Material Class Recovered							
				Mussel Shells	Animal Bones	Lithic Debitage	Burned Rocks	Tools	Features	Feature Type	Profile
1*	NA										
2*	NA										
3 N to S	5	60-100	1 x 1	3	0	2	90	0	1	heating	yes
3 N to S	6	60-100	1 x 1	14	2	4	135	1	1	heating	yes
3 E to W	2	150	.5 x .5	71	0	13	26	1	NA		yes
3 E to W	7	60-110	1 x 1	285	0	15	178	2	2	shell	yes
3 E to W	8	60-110	1 x 1	234	4	23	121	3	2	discard	yes
4 N to S	9	150	.5 x .5	40	3	2	65	0	NA		yes
4 E to W	3	150	.5 x .5	4	0	1	14	0	NA		yes
5	1	150	.5 x .5	4	2	7	69	0	NA		yes
5	10	50-110	1 x 1	17	0	36	1323	1	NA		yes
6	4	150	.5 x .5	5	1	3	1	0	NA		yes
6	11	40-80	1 x 1 96	0	3	8	0	3	shell	yes	

* Excavated by TxDOT, originally labeled by Abbott (2005) as Trenches 4 and 5 respectively.

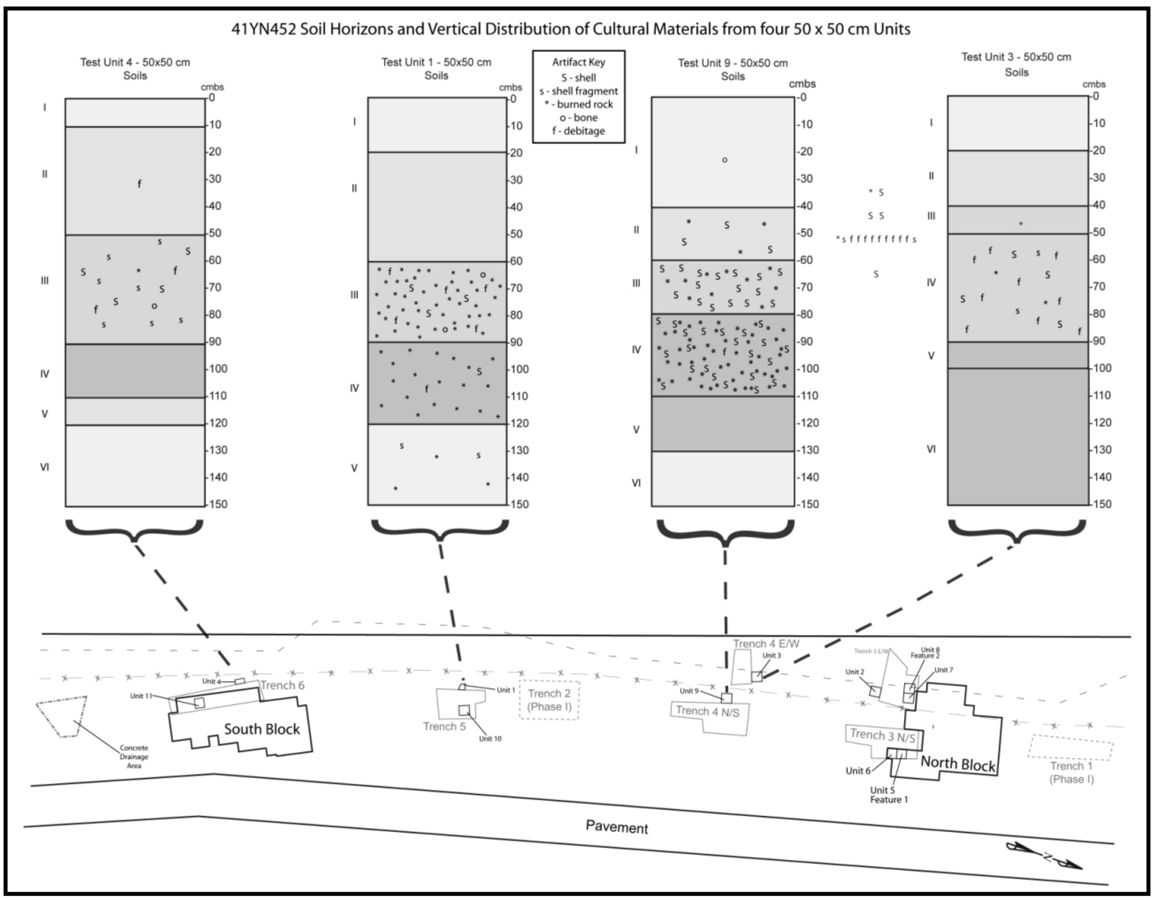

Figure 6-12. Soil Horizons and Vertical Distribution of Cultural Materials from Initial 50-by-50 cm Test Units

Figure 6-13. Unwashed Bassett Arrow Point (#788-10) from Surface. (scale in cm)

Consequently, these 1-by-1 m test units do not contribute insight into the overall vertical distribution of materials outside the buried soil. However, they do confirm the presence of, and document, a relatively dense cultural component in the lower part of the 2Akb buried soil horizon. The artifacts recovered from within the 2Akb horizon during the excavations of the six test units included a well preserved *in situ* heating element (Feature 1), one mussel shell and burned rocks concentration, one thin mussel shell concentration (Feature 3), quantities of scattered mussel shells, and the occasional piece of chert debitage. The top of Feature 1 was about 80 cmbs, with Feature 2, roughly 4 m to the west, concentrated between 78 and 87 cmbs.

Feature 3, some 85 m south of Feature 1, was concentrated between 47 and 53 cmbs, but was still in the 2Akb horizon. Figure 6-14 shows the tight vertical clustering of *in situ* materials recovered in Feature 2, as an example of the stratigraphic nature of the cultural materials discovered in the buried 2Akb horizon during the initial assessment phase.

Following the assessment phase, it was clear that the cultural component within the lower part of the buried 2Akb contained significant cultural materials and intact cultural features that could contribute to our understanding of the local and region prehistory, and therefore, eligible for listing on the National Register of Historic Places (NRHP). The features in this component appeared to be distributed in a roughly linear fashion that more or less paralleled the existing road for over 70 to 80 m north to south. This concentration of cultural materials within the buried 2Akb horizon was recommended as the target for

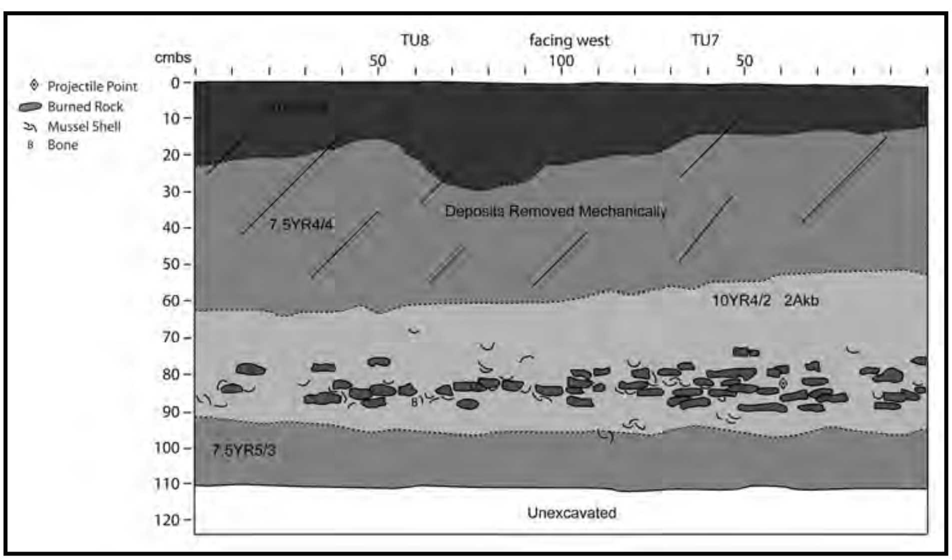

Figure 6-14. Back Plots of *In Situ* Cultural Materials Labeled Feature 2 in Test Units 7 and 8 at the Southwestern Edge of the North Block

archeological data recovery. Once this recommendation was approved by the THC, this extensive and well buried cultural component became the target zone during the data recovery phase. Given the relatively long narrow APE and the apparent horizontal distribution of the cultural features across much of the APE, it was decided to employ two spatially separate excavation blocks to extract the cultural data from the two demonstrably productive areas.

6.2.2 North Block Interpretations

The area immediately north of Feature 1 was targeted for the North Block. This northern area was mechanically stripped to roughly 50 to 60 cmbs to expedite access to the roughly 40 cm thick buried 2Akb horizon, identified as being situated primarily between 60 and 100 cmbs. The South Block was placed immediately adjacent to the shell lens, Feature 3, approximately 85 m south of Feature 1. During mechanical stripping of the southern area, quantities of mussel shell were encountered slightly higher in the profile than expected. The stripping was, therefore, stopped at around 40 cmbs. At the time of the stripping of the southern area, the targeted buried 2Akb horizon was generally not visible. Therefore, our visual stratigraphic marker was no longer present to guide the stripping or the hand-excavations.

Each excavation block is discussed separately below as slight differences were detected. The North Block will be discussed first. From the assessment and data recovery excavations, the North Block yielded a total of 14 cultural features, all within the 2Akb buried soil. These features were in the lower part of that soil horizon, and appeared at a relatively consistent level with only slight variations (Figures 6-15, 6-16, and 6-17).

The back plots reveal the nature of the vertical distribution of the cultural materials, but this visual aid compresses material from across 11 m north to south and 10 m east to west into one profile. Consequently, the cultural features appear at slightly different elevations, although they appeared to have been lying on a basically single horizontal plane during the excavations. At no time did one feature or cluster of materials appear stratigraphically above or below another feature or cluster of materials.

It was obvious that some of the smaller individual artifacts were vertically displaced above and below the main cluster of materials, an expectable situation given that turbation was likely present. Rodent action within this heavy clay was not apparent.

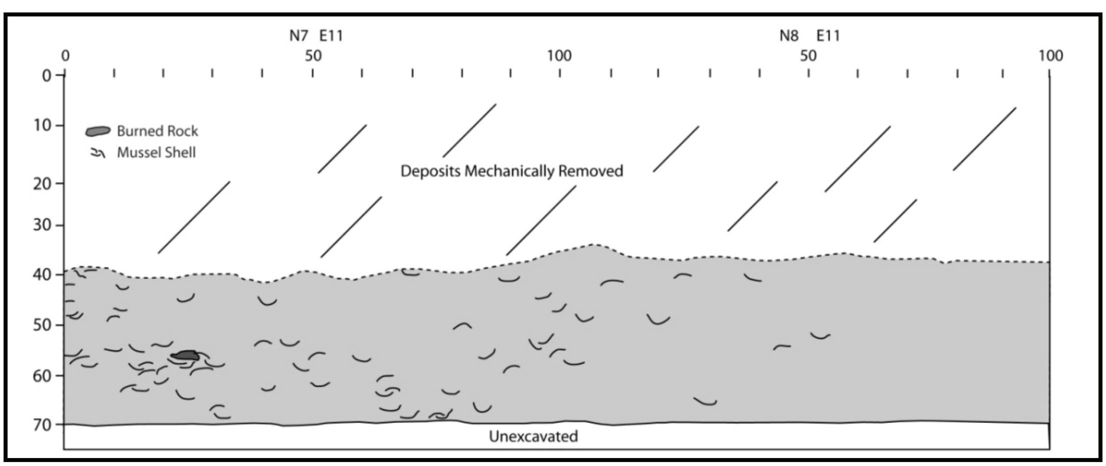

Figure 6-15. Back Plots of *In Situ* Cultural Materials in Two Units Containing Feature 10, North Block.

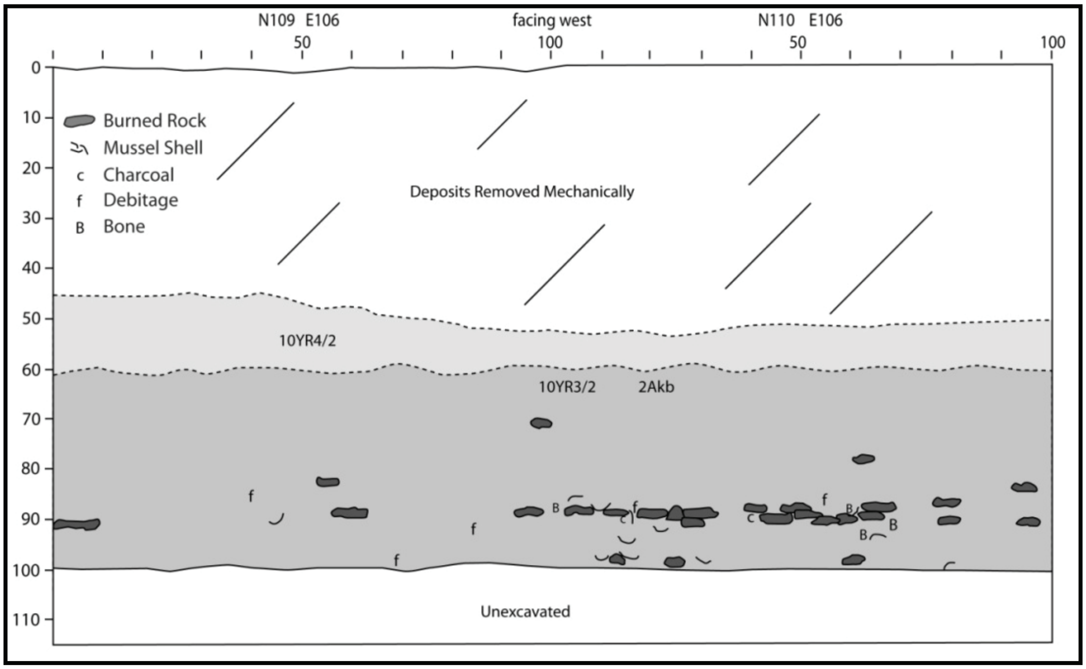

Figure 6-16. Back Plots of *In Situ* Cultural Materials in Two Units that Contained Feature 15, North Block

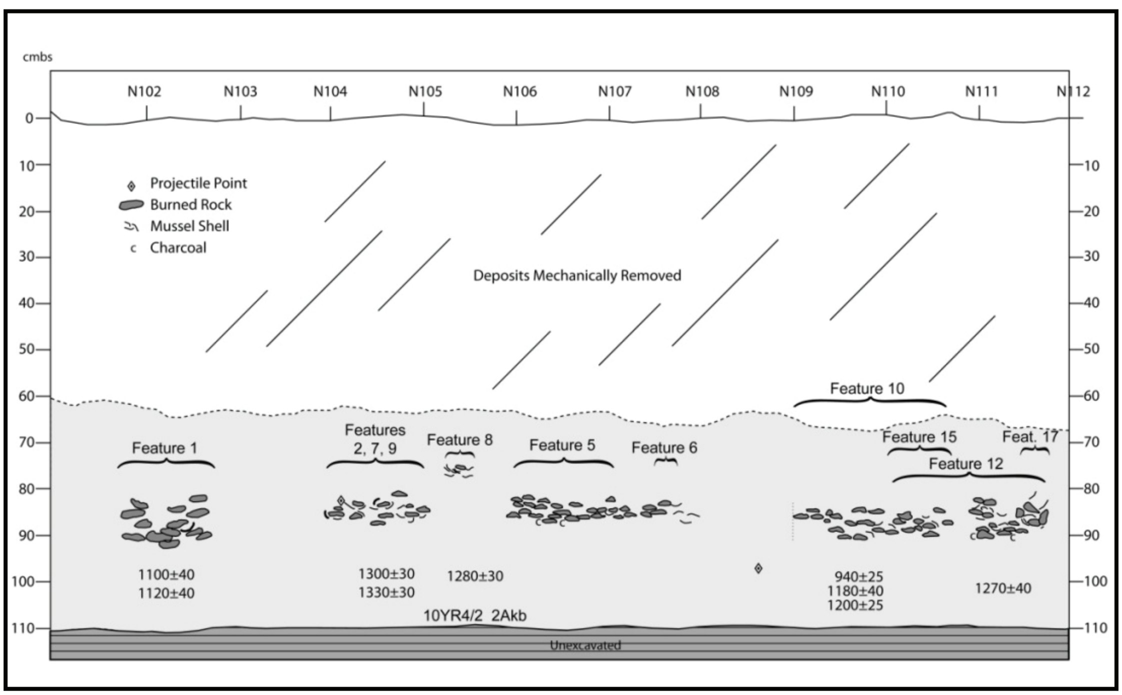

Figure 6-17. Vertical Distribution of Cultural Features across the North Block

It is assumed that some bioturbation occurred even though it was not readily visible. If so, that disturbance may have displaced some smaller cultural objects, but certainly not the cultural features themselves. Seven features in the North Block were directly radiocarbon dated (see below).

The 78.5 m^2, or 31.2 m^3, excavated in the North Block yielded only four diagnostic projectile points. One was a stemmed arrow point, most similar to the Cuney/Alba type (#459-10; Figure 6-18). This small point was vertically positioned at 84 cmbs in N102 E111, in the very southeastern corner of the North Block. Since this point was found oriented vertically in the deposits, it is assumed to have been displaced from above and not originally associated with this component.

Three dart points were recovered from this component. All three specimens appear slightly different in outline. This may indicate the range of variability within a single type or possibly some reworking (see Suhm and Jelks 1962, Plate 90 for range of variation in Darl). One complete specimen (#663-10) is Darl-like in form (Figure 6-18), and was recovered at 90 to 100 cmbs in the northwestern quadrant of N109 E104, just west of Feature 10. A second complete dart point (#695-10) appears reworked on the distal end and possibly on the proximal end, and does not resemble any existing point type.

Unlike most Late Archaic dart points, it has a pronounced concave base (Figure 6-18), and may indicate a curated item that was reworked and used during the Late Archaic component. The third complete dart (#138-10), which had weak shoulders and a slightly tapering stem, cannot be comfortably placed within any established type category. This point was recovered from Feature 2, between 80 and 90 cmbs in Unit 7. A fourth dart point (#811-10) came from the surface about 8 m northwest of Units 7 and 8 along the top of the water pipeline backfill. This point is typed as a Darl point (Figure 6-18).

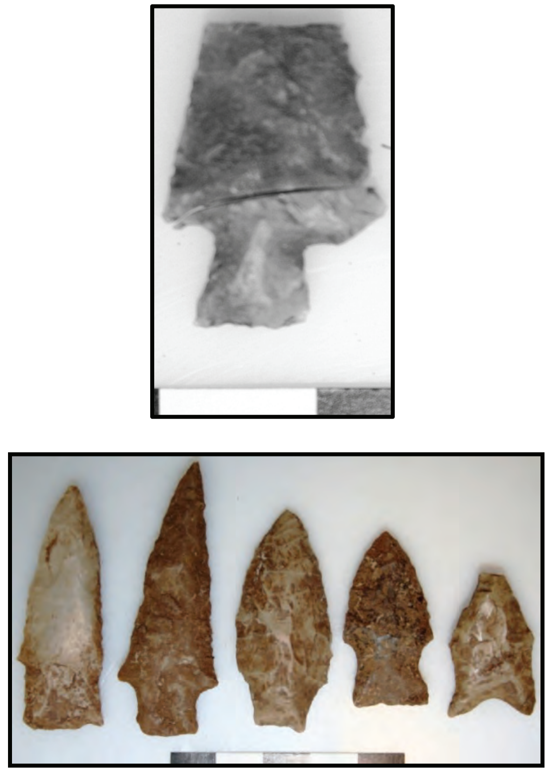

Figure 6-18. Cuney/Alba Arrow Point (#459-10); Dart Points: Darl (#811-10); Darl-like (#409-10); Darl-like (#138-10); Darl-like (#663-10); and Untyped Reworked (#695-10). Scale in cm.

The overall appearance of these four different dart points, most notably their slender blade outlines and stemmed bases, indicates a general similarity to Darl and/or Darl-like points (Suhm and Jelks 1962; Turner and Hester 1999) attributed to a very late part of the general Late Archaic period (Johnson et al. 1962; Jelks 1962; Prewitt 1985; Prikryl 1990; Collins 1995a, 2004). If this interpretation is correct, the stemmed arrow point is considered intrusive to this component.

Table 6-5. Radiocarbon Data on Charcoal from the North Block

Catalogue No.	Block	Unit No.	Depth (cm)	Component	Feature	Material Dated	Weight of Sample (g)	Lab. No.	Measured Age	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range
131-7-1a (C1)	North	6	65	TA 1		Charcoal	0.1	B-214362	350 ± 40	-26.4	360 ± 40	AD 1440-1640
128-7-5a	North	5	80-90	TA 1	1	Charcoal	0.1	B-231105	1160 ± 40	-27.4	1120 ± 40	AD 810 - 1010
133-7-1a (C7)	North	6	94	TA 1	1	Charcoal	0.1	B-214363	1120 ± 40	-24.1	1100 ± 40	AD 880-1010
561-7-4	North	N106 E105	87	TA 1	5	Charcoal	0.6	U-5168		-26.4	1280 ± 30	AD 660-800
466-7-1	North	N103 E105	80-90	TA 1	7	Charcoal	1.5	U-5169		-23.2	1300 ± 30	AD 660-770
785-7-1	North	N105 E105	84	TA 1	7	Charcoal	1.1	U-5170		-24.2	1330 ± 30	AD 650-820
671-7-1a	North	N109 E106	83	TA 1	10	Charcoal		U-5171		-26.6	940 ± 25	AD 1030-1160
673-7-1	North	N109 E106	92	TA 1	10	Charcoal	0.9	U-5172		-24.3	1200 ± 30	AD 720-890
542-7-1	North	N105 E111	86	TA 1	14	Charcoal	2.6	U-5173		-26.9	1110 ± 30	AD 880-1010
740-7-1a	North	N111 E110	90	TA 1	15	Charcoal	0.9	U-5174		-25.5	1270 ± 30	AD 660-870
748-7-1a	North	N112 E106	92	TA 1	17	Charcoal	0.1	B-230764	1150 ± 40	-24.1	1160 ± 40	AD 770-980

LP = Late Prehistoric, TA1 = Terminal Archaic Component 1, * = Reimer et al. 2004; B = Beta; U = University of Georgia AMS

To place this Late Archaic component in a more precise chronological framework, a series of radiocarbon dates were obtained. Table 6-5 presents the radiocarbon results from just the North Block. Eleven dates were obtained on charcoal from seven different cultural features. A date of 360 B.P. (Beta-214362) was obtained from a piece of wood charcoal recovered from 65 cmbs near the top of the 2Akb buried soil and directly above Feature 1. The remaining 10 dates fall during a 400-year time span between 940 and 1330 B.P. The youngest date of 940 B.P. (UGAMS-5171) in the cluster is 160 years younger than the next youngest date and appears slightly anomalous. If this anomalous date is removed from this cluster, the remaining nine dates occur in a 230 year range between 1100 and 1330 B.P. This later and narrower age range is nearly half the range if the youngest date is excluded.

Combined, these nine wood charcoal dates average to 1208 B.P. Based on the presence of three dart points in good context associated with 14 cultural features, plus a consistent and narrow absolute age range for those features, all the cultural materials within the buried 2Akb horizon are interpreted to represent a single Late Archaic component, and potentially a single habitation event.

The date of 940 B.P. (UGAMS-5171) may indicate the approximate age for the top of the 2Akb horizon. Potentially, it may also be associated with the Cuney or Alba arrow point (#459-10) recovered. It is unclear exactly what the date of 360 B.P. (Beta-214362) may reflect, as it appears too young to be associated with the Alba type, but not for the Cuney type, which is found mostly in Protohistoric and Early Historic contexts. No ceramic sherds or other artifacts that can be attributed to a Late Prehistoric component were recovered. The young date may just represent a natural burning event not associated with any prehistoric human activities.

6.2.3 South Block Interpretations

The South Block, some 70 m south of the North Block, was sandwiched between the existing right-of-way fence and waterline on the west, and the sloping edge of the current roadway on the east side. The combined assessment and data recovery investigations yielded roughly 7,000 artifacts and five identifiable features (Features 3, 4, 11, 13, and 16). These five features were apparently in the same 2Akb horizon with some slight vertical variation between the features across the 15 m long block (Figures 6-19, 6-20, 6-21, and 6-22). The five features were horizontally distributed across a north-south span of 15 m, with the vertical block plot of the entire South Block shown in Figure 6-23 and the horizontal distribution shown in Figure 6-24.

Features 11 and 13 were at least 7 m north of Feature 4 and clustered in the northern end of the South Block. The 7 m between the two groups of features yielded sparse cultural materials, and was a significant contrast with the two ends.

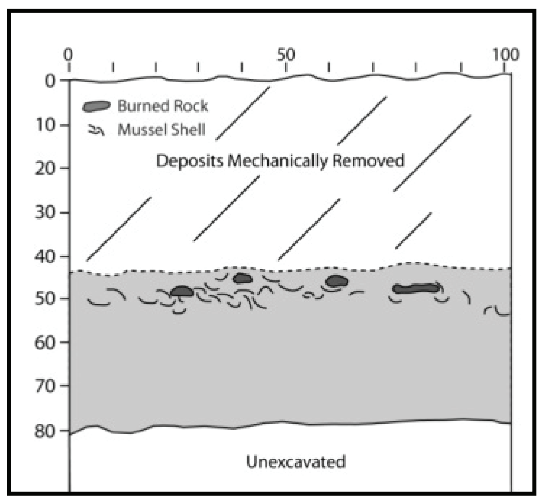

Figure 6-19. Back Plots of *In Situ* Cultural Materials Recovered From Unit 3 that Contained Feature 3, Subsequently on Western Edge of South Block.

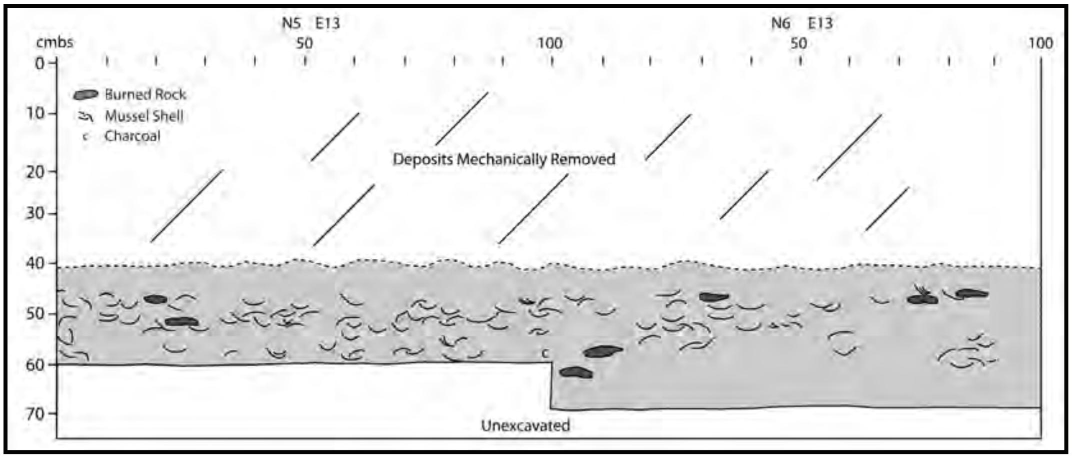

Figure 6-20. Back Plots of *In Situ* Cultural Materials from Units N5 E13 and N6 E13 that Contained Part of Feature 4 in South Block

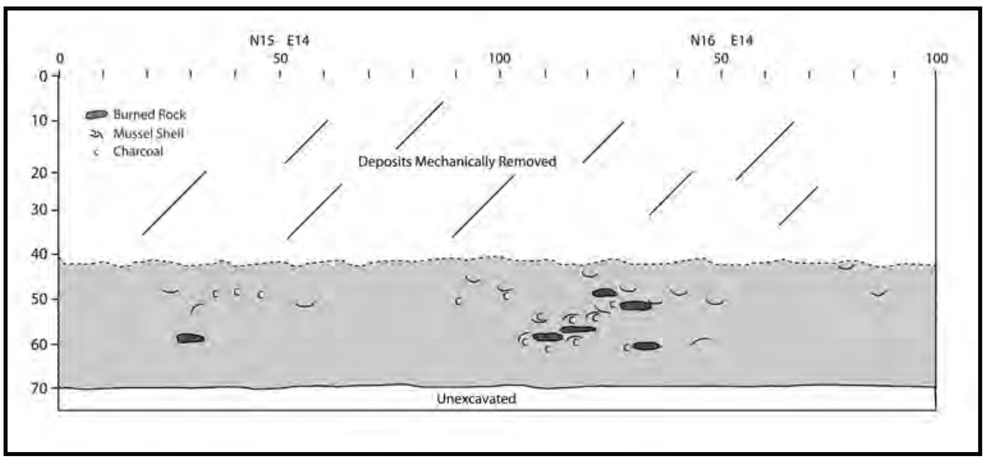

Figure 6-21. Back Plots of *In Situ* Cultural Materials from Units N15 E14 and N16 E14 across the Northern End of the South Block

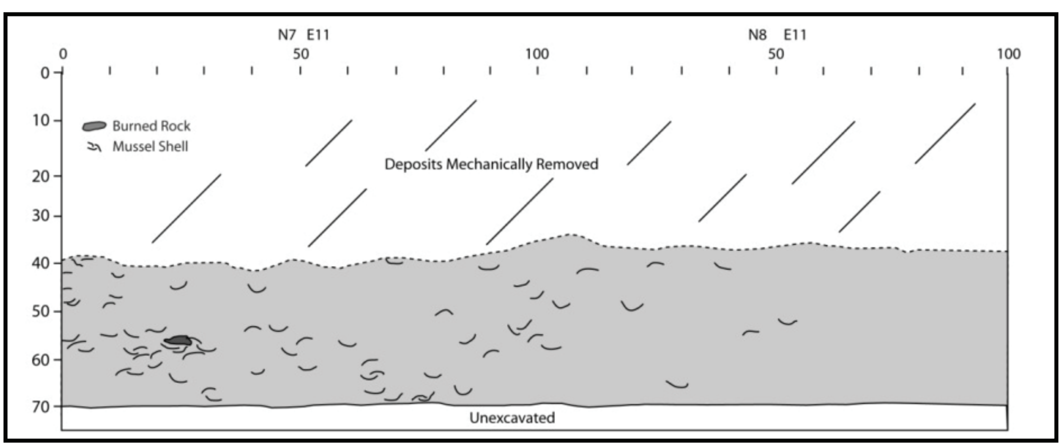

Figure 6-22. Back Plots of *In Situ* Cultural Materials from Units N7 E11 and N8 E11 that Contained Parts of Feature 4 in South Block

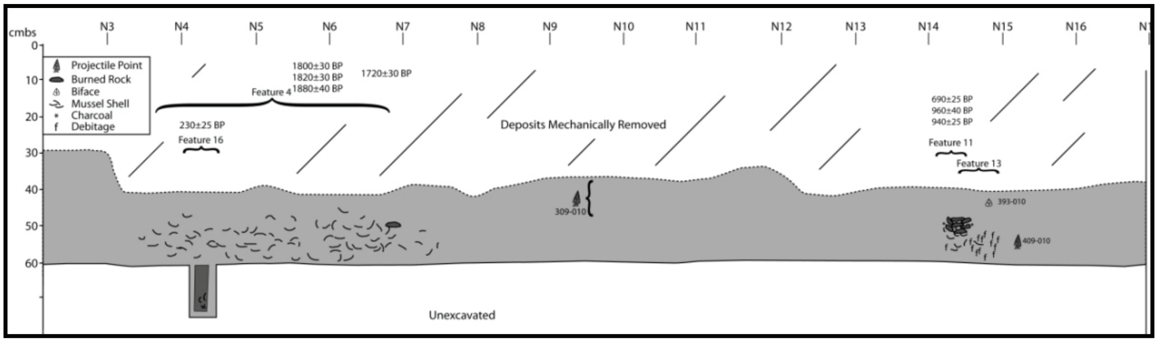

Figure 6-23. Profile of the Vertical Distribution of the Identified Features in the South Block

As depicted, Feature 4 covered much of the southern end of the South Block with Feature 16 along the southeastern margin of Feature 4 and less than 3 m from the current roadway.

Again, diagnostic projectile points were extremely scarce from the 70 m^2 or 21.8 m^3 area investigated in the South Block. Only three points were recovered. One is a complete Darl-like dart point (#409-10; Figure 6-25). This point was recovered from 50 to 60 cmbs in N15 E15, approximately 1.5 m northwest of lithic concentration Feature 13 and the same distance east of heating element Feature 11. The point appears to represent the Late Archaic period (Johnson et al. 1962; Prikryl 1990).

The second is a small, complete, unnotched arrow point typed as a Fresno (#393-10; Figure 6-26). This Fresno point came from 45 cmbs in N15 E11 on the western edge of the block about 2 m west of Feature 11. It was 5 to 8 cm above the elevation of Feature 11 and rested definitely above (at least 5 cm higher than) the Darl-like dart point (#409-10).

The third point is a complete corner-notched arrow point (#309-10; Figure 6-26) that came from between 37 and 49 cmbs in N10 E11 along the western edge of the block. Horizontally, this corner-notched point came from near the middle of the southern block. Vertically, it was at a similar elevation as the previously mentioned Fresno arrow point and, again, was found above the Darl-like dart point. It also rested slightly above the majority of mussel shell that constituted Feature 4, 3 to 6 m to the south. Most researchers would likely identify this corner-notched specimen as a Scallorn point (e.g., Jelks 1962; Prewitt 1983; Turner and Hester 1993).

To refine the age of the cultural materials in the South Block, 14 radiocarbon dates were obtained on wood charcoal from three features (Features 4, 11, and 16; Table 6-6). Three very young dates were obtained, one of modern age, 120 B.P. and 230 B.P. The modern date (Beta-230769) was derived from a tiny, single piece of wood charcoal floating in the matrix at 33 cmbs in N17 E16 in the very northeastern corner of the block. This indicates that modern charcoal reached at least 33 cm into the deposits. The date of 120 B.P. (UGAMS-5178) was from a single piece of wood charcoal from 47 cmbs in N6 E13. This piece was amongst the dense mussel shells of Feature 4.

This is not considered associated with the cultural Feature 4 (see discussions below), but rather, likely reflects the movement of small objects vertically in the deposits. Wood charcoal from 64 cmbs in the bottom of the post mold, Feature 16, within the southeastern margin of Feature 4, was radiocarbon dated to 230 B.P. (UGAMS-5181). Apparently Feature 16 represents some sort of post potentially related to the adjacent roadway, and is not directly associated with the prehistoric materials. Obviously, these 3 (21 percent) of 14 dates obtained are definitely not considered

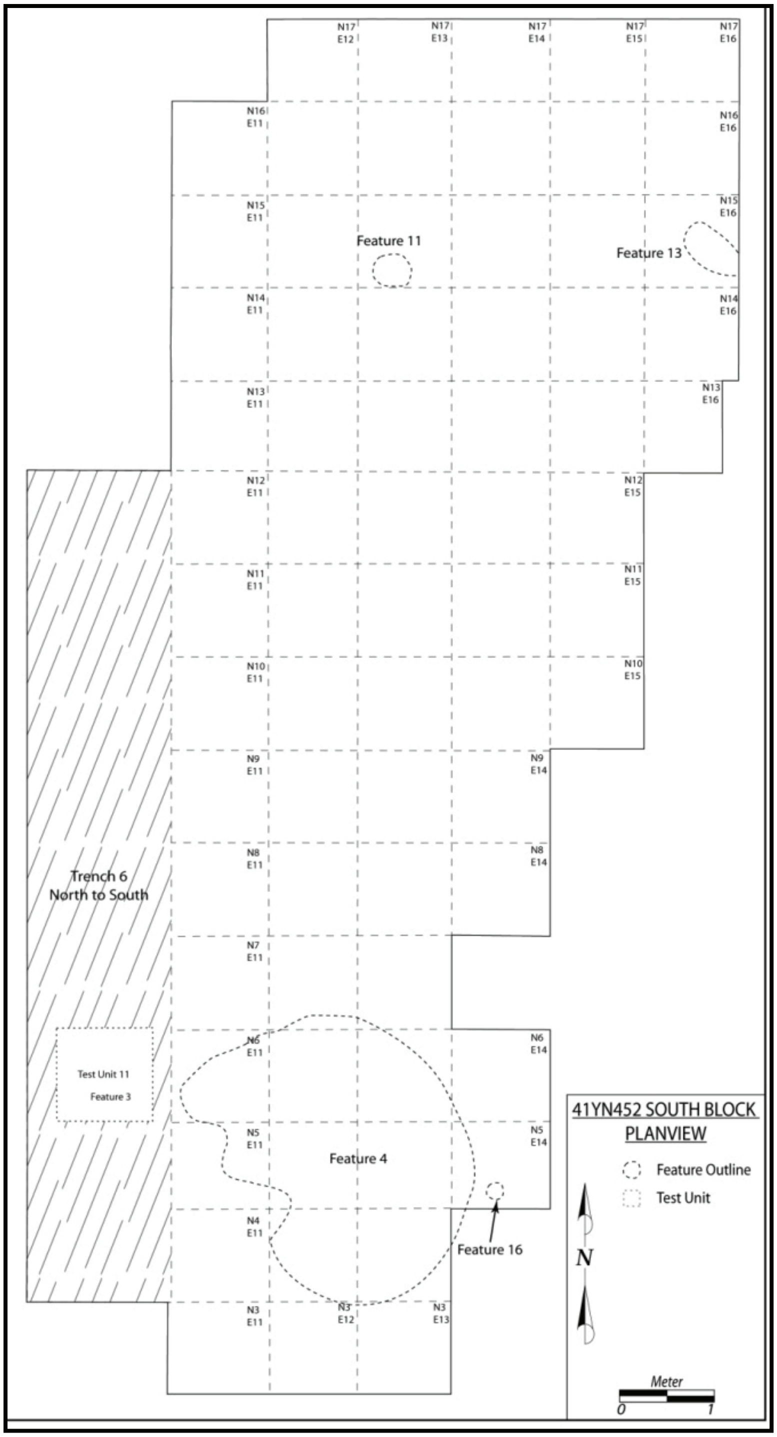

Figure 6-24. Horizontal Distribution of Features across the South Block

associated with the cultural materials recovered in the South Block. In fact, they are too young even to be associated with the two arrow points also recovered from the South Block. These three young assays reflect nonvisible turbation or movement that is present within this deposit. The remaining 11 radiocarbon dates (79 percent) on wood charcoal range in age over a period of 1,230 years from 690 B.P. to 1920 B.P. The four oldest charcoal dates cluster tightly within ca. 120 years and range from 1800

Figure 6-25. Darl-like Dart Point(#409-10) from 50 to 60 cmbs in N15 E15 between Features 11 and 13, South Block.

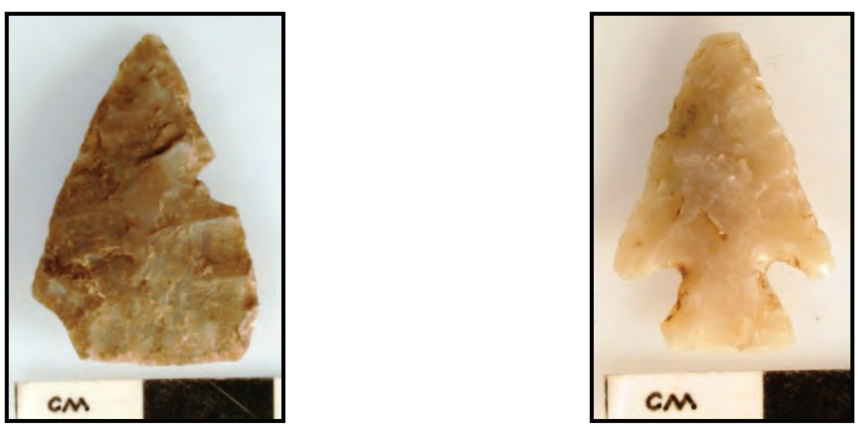

Figure 6-26. Late Prehistoric Arrow Points; Fresno (#393-10) and Scallorn Corner-Notched (#309-10). Scale in cm.

B.P. to 1920 B.P. with a mean of 1855 B.P. (Table 6-6). All four dates were directly associated with the mussel shell lens designated Feature 4, at the very southern end of the block. All four dated charcoal pieces ranged in-depth from 51 to 67 cmbs. The charcoal pieces selected for dating were generally under shells, which possibly contributed to their preservation. Because of their context under shells in Feature 4, it is believed that these four obtained dates definitely reflect the age of Feature 4. These four dates, with a mean of 1855 B.P., date this broad mussel shell lens to the Late Archaic period.

Three wood charcoal dates were obtained from the *in situ*, well-defined, and tightly clustered heating element, Feature 11 (Table 6-6). These three dates range over a 270 year period, from 690 B.P. to 960 B.P., for an average radiocarbon age of 863 B.P. The burned rocks and directly associated wood charcoal in Feature 11 were tightly clustered between 49 and 53 cmbs. Feature 11 appeared in the same general stratigraphic position as Feature 4, apparently within the buried 2Akb horizon. Obviously, Features 4 and 11 were not part of the same cultural event, as they are nearly 1,000 radiocarbon years apart. Stratigraphically, they appeared at similar depths within these deposits, with Feature 11 between 49 and 53 cmbs, and Feature 4 between 51 and 67 cmbs.

Four other direct dates were obtained on individual, wood charcoal pieces floating in matrix between Features 11 and 13 in the northern end of the South Block. The four dates are 930 B.P., 940 B.P., 1220 B.P., and 1320 B.P. The two former or younger dates are nearly identical to two of the three dates derived from Feature 11, which yielded an average age of 863 B.P. Feature 11 was less than 2 m to the southwest from these floating charcoal pieces. These pieces appear to have derived from Feature 11, therefore they are considered to reflect that same event as Feature 11 and are likely to be directly associated with that feature.

The two older dates of 1220 B.P. (UGAMS-5184) and 1320 B.P. (UGAMS-5183) fall nicely within the age range derived on wood charcoal from the North Block. These two dates were derived from wood charcoal less than a meter from the Darl-like dart point (#409-10) recovered from 50 to 60 cmbs in the adjacent unit. The dated charcoal came from 55 and 54 cmbs and appeared vertically associated with the Late Archaic Darl-like dart point. Therefore, the two dates, with an average of 1270 B.P., are believe to date this Darl-like dart point.

6.3 SUMMARY OF CULTURAL STRATIGRAPHY

The three youngest wood charcoal dates obtained from the South Block (modern, 120 B.P., and 230 B.P.) are too young to reflect the targeted cultural component in the 2Akb horizon. Apparently, these pieces of charcoal filtered downward through the sediments or were displaced to their recovered depths in the relatively thin profile from younger and historic events above the buried 2Akb horizon. A modern or recent cultural occupation/ component that might have been associated with these radiocarbon dates was not detected, unless these coincide with the development of the adjacent roadway. Clearly these three dates do not apply to the targeted prehistoric component and are thought to result from disturbances.The average of three dates obtained from Feature 11 (in the north end of the South Block) is roughly 237 years younger than the average age derived from the nine clustered dates that represent the Late Archaic component in the North Block. However, the charcoal date of 940 B.P. (UGAMS-5171), obtained from charcoal from Feature 10 in the North Block, is nearly identical to two dates on charcoal from Feature 11 and two charcoal samples just east of Feature 11 in northern end of the South Block. It is possible that Feature 11 and Feature 13 were part of the same Late Archaic component documented in the North Block.

At least two charcoal dates of 1220 B.P. (UGAMS-5184) and 1320 B.P. (UGAMS-5183) in the northern end of the South Block are of similar ages (1100 B.P. to 1300 B.P.), derived from nine radiocarbon dates obtained from the North Block component. The one dart point (#409-10) from the South Block is generally similar in style to the couple in the North Block and may also represent the same component. These key factors, the two dates and one dart, indicate that the Terminal or Late Archaic component in the North Block did extend into the South Block.

Table 6-6. Radiocarbon Data on Charcoal from South Block

Catalogue No.	Block	Unit No.	Depth (cm)	Component	Feature	Material Dated	Weight of Sample (g)	Lab. No.	Measured Age	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range
228-7-1	South	N5 E11	51	LA 3	4	Charcoal	0.4	UG-5175		-25.7	1920 ± 30	AD 0-210
236-7-1	South	N5 E12	67	LA 3	4	Charcoal	0.8	UG-5176		-26	1800 ± 30	AD 130-320
249-7-1a	South	N6 E11	56	LA 3	4	Charcoal	0.1	B-230766	1890 ± 40	-25.7	1880 ± 40	AD 50-230
255-7-1	South	N6 E12	53	LA 3	4	Chacoal	0.1	UG-5177		-25.2	1820 ± 30	AD 90-320
259-7-1	South	N6 E13	47		4	Charcoal	0.2	UG-5178		-23.7	120 ± 30	AD 1680-1950
245-7-1a	South	N5 E14	64		16	Charcoal	6.2	UG-5182		-23	230 ± 25	AD 1640-1950
400-7-1	South	N15 E13	49	LA 2	11	Charcoal		UG-5179		-24.6	690 ± 25	AD 127-1390
404-7-1	South	N15 E13	53	LA 2	11	Charcoal	0.1	UG-5180		-22.7	940 ± 25	AD 1030-1160
404-7-1a	South	N15 E13	51	LA 2	11	Charcoal	0.1	B-230768	970 ± 40	-25.9	960 ± 40	AD 1010-1170
406-7-1	South	N15 E14	49	LA 2	NA	Charcoal	0.5	UG-5181		-23.4	940 ± 25	AD 1030-1130
426-7-1	South	N16 E14	55	LA 2	NA	Charcoal	0.1	UG-5183		-25.3	1320 ± 30	AD 650-770
429-7-1	South	N16 E15	54	LA 2	NA	Charcoal	1.4	UG-5184		-24.6	1220 ± 30	AD 690-890
442-7-1	South	N17 E14	60-70	LA 2	NA	Charcoal	0.3	UG-5185		-22.3	930 ± 30	AD 1020-1170
446-7-1	South	N17 E16	33			Charcoal	0.1	B-230769	105.2± 0.4pMC	-26.7	105.6 ± 0.4 pMC	Modern

LP = Late Prehistoric, LA = Late Archaic, * = Reimer et al. 2004; B = Beta; UG = University of Georgia AMS

It is also possible that the knapping debris at Feature 13 may be related to this Late Archaic component, as the two dates and the aforementioned dart point were all from within 2 m of this debris.

Feature 4 was deposited during the Late Archaic period with a mean radiocarbon date of 1855 B.P., but was older, by some 550 years than the next-oldest cultural component, which is also apparently of Late Archaic age. Unfortunately, Feature 4 yielded no diagnostic projectile points or other formal tools that might be useful in assigning this feature to a particular cultural phase or complex. As an older component, it will be dealt with separately.

Also in the South Block, sparse cultural remains were widely scattered over about a 5 m long section (23 m^2 area) that lies between the 1855 B.P. Feature 4 mussel shell lens in the southern end of this block from Features 11 and 13 in the northern end of this block. That middle area yielded the small, corner-notched, Scallorn-like arrow point. As indicated by the depth of this point (37 to 49 cmbs), this arrow point came from slightly above the level of Feature 4 and Feature 11. It is assumed that this Late Prehistoric arrow point was associated with the very sparse cultural materials discovered above the buried 2Akb horizon during the assessment phase. This light scatter of Late Prehistoric material is further represented by cultural materials eroding from the cutbank on the extreme western edge of the site overlooking Gages Creek. There, at least one thin, short (150 cm in length) mussel shell lens, three or four occasional bone fragments, and a few pieces of lithic debitage were eroding out. Two radiocarbon dates, one on a deer bone fragment and another on wood charcoal, both from 62 to 64 cmbs, yielded Late Prehistoric dates of 720 (Beta-230765) and 750 B.P. (Beta-230773; Table 6-6). At least one widely dispersed Late Prehistoric component was present across parts 41YN452, but its horizontal distribution was not identical to the earlier Late Archaic components represented in the North and South blocks. Its vertical position was definitely above the Late Archaic component and it appears to have been situated on or above the top of the 2Akb horizon. In the North Block, and along the cutbank, this Late Prehistoric component was at roughly 60 to 65 cmbs near the top of the buried soil. However, in the South Block the few Late Prehistoric materials appeared shallower and vertically closer (5 to 15 cm) to the Late Archaic component and are perceived to have been above about 45 to 47 cmbs.

The two dates on wood charcoal of 1220 B.P. (UGAMS-5184) and 1320 B.P. (UGAMS-5183) and the dart points appear to date to a similar time as those cultural materials in the North Block. However, the close horizontal and vertical relationship with Feature 11 in the South Block, which dates roughly 400 years younger, creates some doubt about associations within the northern end of the South Block. Considering the overall shallowness of the profile, together with the presence of two arrow points just above 50 cmbs and one dart point at 50 to 60 cmbs, it must be recognized that a culturally mixed deposit is a possibility.

In discussions with TxDOT archeologists Jim Abbott and Dennis Price, it was their opinion that the radiocarbon dates from the South Block provide sufficient indications for the presence of multiple cultural components. Based on the context of those materials, TxDOT felt that it would be impossible to sort materials by component. Therefore, a detailed analysis of the entire South Block assemblage was not considered necessary. Only the materials from each individual feature (Features 3, 4, 11, 13, and 16) in the South Block were to be targeted for analyses. Consequently, because of their context the obtained radiocarbon dates from that specific area, the cultural materials in the North Block will be addressed in one section of this report, and the materials from the South Block will be addressed separately. The entire North Block is assigned to the Terminal Archaic component 1. The South Block is split between a similar, but possible separate Terminal

Archaic component 2, whereas Feature 4 will be discussed as an earlier Late Archaic component 3, dated to roughly 1855 B.P. A few scattered cultural items from above these defined components and those from the exposed cutbank where no excavation were conducted and materials that could not be assigned to any recognized cultural event, are discussed under unassigned materials and dealt with separately from the three Late Archaic components.

6.3.1 Other Radiocarbon Dates

Two dates were derived on bison bones that were collected from off-site (Table 6-7). The older bison bone (#808-2-1a), dating to 2550 ± 40 B.P. (Beta-230771), was from 330 cmbs in a reddish brown clayey alluvium exposed in the cutback overlooking the Brazos River. The younger date of 430 ± 40 B.P. (Beta-230772) was from 41YN450 on the opposite side of Gages Creek. The two bison bone dates provide direct evidence as to when bison were in this immediate area. Interestingly, neither date falls within the Late Archaic or Late Prehistoric occupation periods dated at 41YN452.

We also submitted seven carefully selected paired charcoal and mussel shell samples from 41YN452, the the goal of helping to resolve the question of whether or not freshwater mussel shells provide archeologically useful radiocarbon dates.

Dating mussel shells could be extremely beneficial at many archeological sites in this north-central Texas region and across other parts of Texas where preservation of organic remains is poor (e.g., 41CO141, Prikryl and Yates 1987; 41DL270, 41HI115, Brown 1987; Anthony and Brown 1994; 41TR174, Lintz et al. 2004). These areas, with very poor preservation of bone and/or charcoal, often yield freshwater mussel shell remains that represent prehistoric activities (see 41HI115, Brown 1987; Lintz et al. 2004 for examples, so reliable dates on mussel shells would contribute significantly toward achieving a better understanding cultural chronology in the region. Mussel shells generally yield older assays than charcoal because mussels incorporated older "dead" carbon into the process of shell growth (Keith and Anderson 1963; Bradley 1985).

The uncertainties regarding the magnitude of this "freshwater radiocarbon reservoir effect" tend to produce ambiguous dating results. Each of our paired samples came from the same provenience: five paired shell-charocal samples were extracted from within five different cultural features (Figure 6-15; Table 6-8).

Table 6-7. Radiocarbon Data from the Western Cutbank and Off-Site.

Catalogue No.	Block	Unit No.	Depth (cm)	Component	Feature	Material Dated	Weight of Sample (g)	Lab. No.	Measured Age	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range
808-2-1a		Clear Fork Cutbank	150	LA		Bison bone	14.0	B-230771	2270 ± 40	-7.8	2550 ± 40	800-730 BC, 690-540 BC
143-2-2a	BT - 5	5	43	LP		Bison bone	17.6	B-230772	170 ± 40	-9.4	430 ± 40	1500 AD 1600-1610
798-2-1a		Gages Creek Cutbank	62	LP		Deer bone	8	B-230773	670 ± 40	-20.3	750 ± 40	AD 1220-1290
800-7-1a		Gages Creek Cutbank	64	LP		Charcoal	0.1	B-230765	750 ± 40	-26.9	720 ± 40	AD 1240-1300

LP = Late Prehistoric, LA = Late Archaic, * = Reimer et al. 2004; B = Beta; UG = University of Georgia

Table 6-8. Paired Charcoal and Mussel Shell Radiocarbon Dates from 41YN452

Catalogue No.	Block	Unit No.	Depth (cm)	Component	Feature No.	Material Dated	Wt. (g)	Lab. No.	Measured Age	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range	Age Difference
800-7-1a		Cut-bank	64	LP		Charcoal	0.1	B-230765	750 ± 40	-26.9	720 ± 40	AD 1240-1300	810
800-6-1		Cut-bank	64	LP		Shell	5.1	B-230774	1260 ± 40	-8.3	1530 ± 40	AD 420-610	
249-7-1a	South	N6 E11	56	LA 3	4	Charcoal	0.1	B-230766	1890 ± 40	-25.7	1880 ± 40	AD 50-230	570
249-6-1	South	N6 E11	56	LA 3	4	Shell	15.1	B-230775	2200 ± 40	-9.8	2450 ± 40	700-400 BC	
748-7-1a	North	N112 E106	92	TA 1	17	Charcoal	0.1	B-230764	1150 ± 40	-24.1	1160 ± 40	AD 770-980	270
748-6-1	North	N112 E106	93	TA 1	17	Shell	4.9	B-230776	1160 ± 40	-8.3	1430 ± 40	AD 560-660	
128-7-5a	North	5	80-90	TA 1	1	Charcoal	0.1	B-231105	1160 ± 40	-27.4	1120 ± 40	AD 810 - 1010	880
128-6-1	North	5	91	TA 1	1	Shell	2.9	B-230778	1730 ± 40	-8.6	2000 ± 40	90 BC - AD 80	
404-7-1a	South	N15 E13	51	LA 2	11	Charcoal	0.1	B-230768	970 ± 40	-25.9	960 ± 40	AD 1010-1170	550
400-6-1a	South	N15 E13	50	LA 2	11	Shell	2.4	B-230779	1280 ± 40	-8.4	1550 ± 40	AD 420-600	
677-7-1	North	N109 E107	84	TA 1	10	Charcoal	0.1	B-230767	1090 ± 40	-25.7	1080 ± 40	AD 890-1020	460
677-6-1	North	N109 E107	85	TA 1	10	Shell	7.9	B-230777	1320 ± 40	-11.8	1540 ± 40	AD 420-610	
446-7-1	South	N17 E16	33	LP		Charcoal	0.1	B-230769	105.2± 0.4pMC	-26.7	105.6 ± 0.4 pMC	Modern	1650
446-6-1	South	N17 E16	31-37	LP	NA	Shell	3.9	B-230780	1350 ± 40	-7	1650 ± 40	AD 260-480-530	

LP = Late Prehistoric, LA = Late Archaic, * = Reimer et al. 2004; B = Beta; UG = University of Georgia

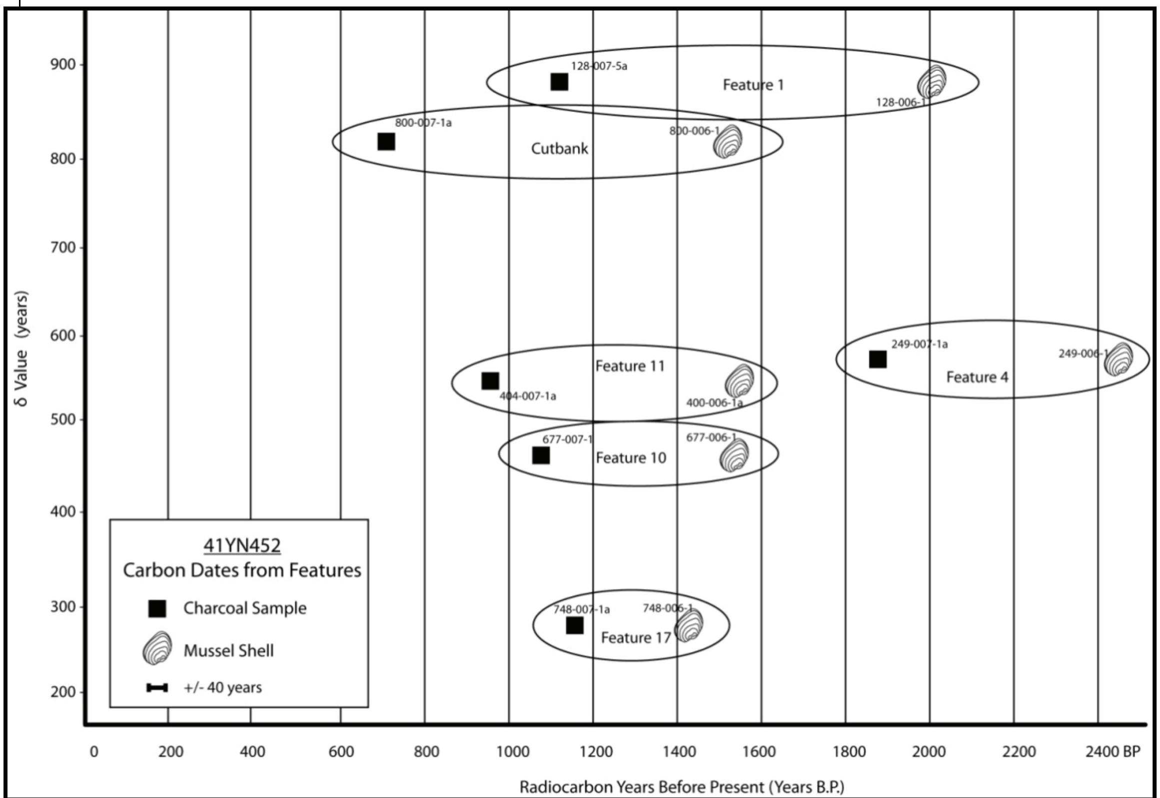

Figure 6-27. Date Comparison between Wood Charcoal and Mussel Shells from Selected Features

In most cases, the selected charcoal came from directly under the mussel shell, suggesting that the charcoal was there first and was then covered and protected by the shell. An examination of the results shows obvious age discrepancies in the two paired classes of material (Figure 6-27), with the wood charcoal ages consistently younger than the ages of the mussel shells. The age differences range from 270 to 1,650 years (see Figure 6-15). The 1,650 year discrepancy (sample #446-6-1) is extreme, an aberrant outlier explained by the fact that its paired charcoal (sample #446-7-1) produced a modern date, and can be interpreted as intrusive into the targeted Terminal Archaic component.

No consistent age difference could be detected between the charcoal and the mussel shells. The seven freshwater shell ages range from 1430 to 2450 B.P., supporting the assumption that the mussels incorporated some older carbon into the development of their shells during their lifetimes. For our current purposes, therefore, the shell dates are not acceptable as measures of the age of the targeted Terminal Archaic cultural component, since the age discrepancies are significant relative to the estimated age, and are at significant variance with the radiocarbon dates obtained on wood charcoal.

Previous attempts have been made in Texas to assess the reliability of radiocarbon dates obtained on freshwater mussel shells (Alexander 1963:510-528; Brown 1987; Quigg et al. 1996). For example, three paired mussel shell and charcoal samples from 41TG307 next to the Concho River were radiocarbon dated by Beta Analytic and adjusted for $\delta^{13}C$. These samples came from identical contexts in two different units. The mussel shells yielded $\delta^{13}C$ adjusted dates older than the associated charcoal assays by 1,320, 1,880, and 2,180 years (Quigg et al. 1996:258). In these cases it is obvious that older carbon was incorporated into the shells, and definitely not at a consistent rate. The average difference is roughly 1,790 years. However, two of the charcoal dates were in excess of 6,200 years old, and therefore the mussel shell ages provided at least an approximate age for the cultural occupations. At some excavations across north-central Texas, mussel shell dates have been obtained when no other organic remains were recovered to be radiocarbon dated (e.g., Lintz et al. 2004). However, it is unclear what the precise age of those shells is without knowing how it compares to wood charcoal results.

In central Texas, paired charcoal and mussel shell samples have provided misleading results (Brown 1987). Mussel shells were paired with charcoal and sediment at the McDonald site (41HI105) and the McKenzie site (41HI115) in the Aquilla Lake/Reservoir project in Hill County. In the case of the McDonald site, three paired samples were run by the radiocarbon laboratory at the University of Texas, and the reported ages from charcoal and mussel shells are quite similar to each other (although the reported ages were not adjusted for $\delta^{13}C$, which would have likely separated the reported shell ages from the charcoal ages). In the case with the paired samples from the McKenzie site, one shell was dated by the University of Texas (TX) laboratory, whereas the soil dates and one other shell date were obtained from Southern Methodist University (SMU) laboratory. It is not clear whether or not these were adjusted for $\delta^{13}C$, but the reported ages from these paired samples were not similar. Obviously, more paired samples should be submitted and results compared to better understand the age discrepancy that may exist between these two classes of materials.

In California, the age differences between paired charcoal and freshwater mussels were also studied. Their results showed a 340 ± 20 year correction should be applied to the conventional radiocarbon dates on freshwater shells in the Buena Vista Basin (Culleton 2006). These results again reveal that freshwater shells yield older ages than does wood charcoal, but the age differences are relatively small and shell dates could be used when no other datable materials are available.

In still another and continuing effort to increase the range of archeological materials that may provide reasonable age estimations, the utility of radiocarbon dating burned rocks was investigated by submitting four burned rocks for direct dating that were from two features that also provided wood charcoal dates. The rock itself is not being dated, but rather the targeted material is the organic residues (e.g., lipid residues and/or microfossils) within pores near the rock surfaces. It is assumed that, through cultural use of the rocks in some form of cooking process, food residues became trapped in the pores of the rocks. This may have occurred via one or more of at least three processes: organics may have been introduced into the porous rocks from liquids if the rocks were used in stone boiling, grease may have been spattered onto rock surfaces during open cooking, and/or organic substances could have been transferred from foodstuffs to the rocks by steam if the rocks were used in oven cooking. In fact, the lipid residue analysis from part of one rock (24 g of #127-3-8) yielded relatively high frequencies of very high fat residues interpreted to represent seeds or nuts (Appendix H, Lab no. 7MQ20). Previous attempts to radiocarbon date residues in burned rocks, specifically sandstone in south Texas, have provided both enlightening and problematic results of variable reliability (Quigg 2001, 2003; Quigg et al. 2002; Quigg et al. 2008).

Here, four sandstone rocks of different densities and colors, two from heating element Feature 1 and two from discard Feature 10, were selected for dating and comparison of results obtained on wood charcoal from the same two features. The two features had two and three wood charcoal radiocarbon dates respectively. Two Feature 1 wood charcoal dates of 1120 ± 40 and 1100 ± 40 B.P. (see Table 6-2) combine for an average wood charcoal age of 1110 B.P. The two burned rocks from

Feature 1 yielded radiocarbon dates of 1770 ± 30 and 1150 ± 25 B.P. (Table 6-9) for an average residues age of 1460 B.P. The difference in average ages between the wood charcoal and the rock residues is 350 years. The residue date of 1150 B.P. (#128-3-38d) was statistically identical to the two charcoal derived ages, but the other (#127-3-8d) was 660 years older. The results indicate that multiple rock residue dates are likely needed to allow for averaging of results and identification of possible outliers.

Feature 10 yielded three wood charcoal dates of 940 ± 40, 960 ± 25, and 1200 ± 30 B.P. (Table 6-9) for an average charcoal age of 1033 B.P. The two rock residue dates of 1590 ± 30 and 1880 ± 30 B.P. (Table 6-9) combine for an average residue date of 1735 B.P. The difference in average ages between the charcoal and the rock residues are 702 years. These results reveal that both rock residue ages are significantly older than the three charcoal derived ages.

The four burned rocks submitted for radiocarbon dating are depicted in Figure 6-28. The rocks were selected to sample a range of colors present within two charcoal dated features, with the underlying assumptions that colors may be visual indicators of the amount of organic residues present in the rock, and therefore, useful in helping to select rocks for dating. The dated rocks are briefly described in the hope that this may help in the future in selecting rocks for dating.

Burned rock #127-3-8d was very dense sandstone with a dusky red (10R 3/2) interior and a dark gray (5YR 4/1) exterior and yielded a date that was some 620 years older than the wood charcoal dates from this same feature.

Table 6-9. Radiocarbon Dates Obtained from Burned Rocks From Features 1 and 10

Catalogue No.	Block	Unit No.	Depth (cm)	Component	Feature No.	Material Dated	Weight of Sample (g)	Lab. No.	Measured Age	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range
127-3-8d	North	Test Unit 5	80	TA -1	1	sandstone	218	U-6665		-19.7	1770 ± 30	AD 137-345
128-3-38d	North	Test Unit 5	93	TA -1	1	sandstone	177	U-6666		-22.3	1150 ± 25	AD 781-971
677-3-10a	North	N107 E109	80-90	TA -1	10	sandstone	135	U-6667		-18.7	1590 ± 30	AD 411-542
705-3-2a	North	N110 E107	80-90	TA -1	10	sandstone	116	U-6668		-15.3	1880 ± 30	AD 66-222
820-4-1a	North	N105 E106	87-88	TA -1	NA	A-horizon soil	380	U-6669		-14.7	1460 ± 25	AD 560-646

TA -1 = Terminal Archaic Component 1; * = Reimer et al. 2004; U = University of Georgia AMS

Figure 6-28. Four Burned Rocks That Were Directly Radiocarbon Dated by AMS

Burned rock #128-3-38d was soft sandstone with a brown (75YR 5/4) interior and exterior, which yielded a radiocarbon date identical to the wood charcoal results. Burned rock #677-3-10a was soft sandstone with a grayish brown (10YR 5/2) interior. This rock yielded a radiocarbon date at least 440 years older than the wood charcoal results. Burned rock #705-3-2a was soft sandstone with a brownish yellow (10YR 6/8) interior and a reddish gray (5YR 5/2) exterior. The date from this rock was some 720 years older than the wood charcoal dates from Feature 10. Unfortunately, TxDOT archeologists are not permitting continuation of the lipid residue analyses to document the presence of lipid residues in each rock.

As with mussel shell and soil humate derived ages, the burned rock residues appear to provide a date that is the general age of the associated cultural material, but is generally older than the associated component. Therefore, shells do not provide the precise age of that event. Although the residue dates generally appear older, and may not be as accurate as wood charcoal, however dates from cooking rocks have some value and can identify a general period of use, if no other means of obtaining a radiocarbon date for a particular feature or site is available. Burned rocks are more plentiful than wood charcoal and other organic remains, they also preserve much better than charcoal, and are less likely to suffer from post depositional disturbances. As researchers are learning, even charcoal results, the most preferred organic substance for documenting the age of the hunter-gatherer sites here and elsewhere, are sometimes problematic. The old wood problem is the most obvious with old dead and dried wood used in campfires (see Smiley 1985; Shiffer 1986). Therefore, each researcher must judge individual site circumstances and decide for themselves if it is worth pursuing radiocarbon dates from burned rocks, full well knowing that the dates may provide only general times and may not be as accurate as charcoal. Currently, it is believed that organic food residues preserved in the burned rocks are being dated, but the circumstances that surround those decaying residues and other factors contributing to the final results are not well-known. Despite such unknowns, the strategy of radiocarbon dating burned rocks should be pursued and tested in other archeological sites.

6.3.2 The Cultural Assemblages

Section 6.2 above established that three Late Archaic components (components 1, 2, and 3) were represented in the two excavation blocks, based on the radiocarbon dates. These three components were horizontally distributed across the targeted excavation area. The Terminal Archaic component 1 was restricted to the North Block. A possible mixed Late Archaic component 2 was in the northern two-thirds of the South Block. The Late Archaic component 3 was in the southern third of the South Block. Below, each identified component and the scattered materials that could not be assigned to one of these three components will be presented beginning with the Terminal Archaic component 1. The different classes of cultural materials will be presented, described and discussed separately. Following the presentation of the Terminal Archaic component 1, the two other Late Archaic components (2 and 3) will be presented in the same manner. The last part of this section presents the "Unassigned" materials.

We note that "Terminal" Archaic refers, herein, to the final part of the much longer "Late" Archaic period, which in relatively recent useage has been applied to cultural patterns dated to after ca. 2000 B.C. (e.g., Collins 1995; Johnson and Goode 1994). In our current formulation, the Terminal Archaic corresponds to the Driftwood Phase (Prewitt 1981, 1985) of central Texas, as well as to inferably contemporaneous manifestations in north-central Texas.

6.3.3 Terminal Archaic Component 1

The North Block contained one Terminal Archaic component within the 2Akb soil horizon based on the documented wood charcoal radiocarbon dates obtained from investigated features across the block (see section 6.2 above). Initially, the entire hand-excavated block areas were thought to represent one broad, horizontally dispersed Terminal Archaic camp based on a few radiocarbon dates and projectile points recovered during the eligibility assessment phase. Subsequently, a more in-depth radiocarbon dating program documented age differences across our horizontal excavation areas, with the obtained dates from this North Block that appear to represent a single Terminal Archaic component (see section 6.2).

This North Block yielded a diverse cultural assemblage of features, stone tools, vertebrate faunal remains, mussel shells, and burned rocks from 78.5 m^2 of continuous hand-excavated units. Test Units 5 through 8 from the eligibility assessment phase that exposed Features 1 and 2, are within the very southern margin of this block (Figure 6.29). This well-defined component was horizontally separated from the South Block that also contained two Archaic components, labeled 2 and 3. No vertical stratification of cultural components was detected in the excavation areas, although scattered Late Prehistoric projectiles were recovered above this component and from the surface. The cultural materials from this Terminal Archaic component 1 will be used to address the research questions presented in Chapter 4, in Chapter 7.0 below.

The following sections present the recovered materials by class starting with the identified cultural features.

6.3.3.1 Cultural Features

Cultural Features 1, 2, 5 through 10, 12, and 14 through 17 were in the North Block, and were all completely excavated. All features were in the buried A horizon and are believed to pertain to the Terminal Archaic component 1 (Figure 6-29). Features were assigned numbers as they were encountered and not according to excavation blocks. Below, feature descriptions, results of specific technical analyses, and features interpretations are presented to provide an understanding of the nature and kinds of human activities represented. Table 6-10 provides a brief summary or overview of the findings for each hand-excavated feature.

Feature 1

This feature was first encountered in the profile of the east wall of Trench 3 (north to south section) towards the north end of the site and within the existing TxDOT right-of-way during the site eligibility assessment. Parts of five burned rocks and four charcoal chunks were concentrated in a 50 cm long section between 80 and 90 cmbs and within the buried A horizon. Following its discovery, the upper deposits, to about 60 cmbs (near the top of the buried A horizon), were mechanically stripped to allow quicker access to the feature and create room for hand-excavation units. Two 1-by-1 m units (Units 5 and 6) were established above the burned rocks exposed in the trench wall (Figure 6-29). Each 10 cm level in the two units was hand-excavated and the observed materials were recorded.

As the burned rocks became exposed and the margin of the feature was discernable, the entire cluster of burned rocks was pedestaled. The areas outside the clustered rocks were excavated in 10 cm intervals, leaving the feature rocks *in situ*. Once the sediments outside were excavated and materials plotted and collected, the focus turned to the feature itself. The entire feature was exposed in these two 1 m^2 units. The feature rocks were drawn on a plan view, numbered (incised on each rock), and upon removal each rock and its depth, was measured and recorded. The feature was carefully excavated in quadrants. Multiple cross sections were made in order to view and record profiles of Feature 1.

Feature 1 was revealed to be a relatively tight cluster of burned rocks (N = 46) with extensive charcoal and black organic staining/mottling directly under and between the rocks (Figures 6-30 through 6-32).

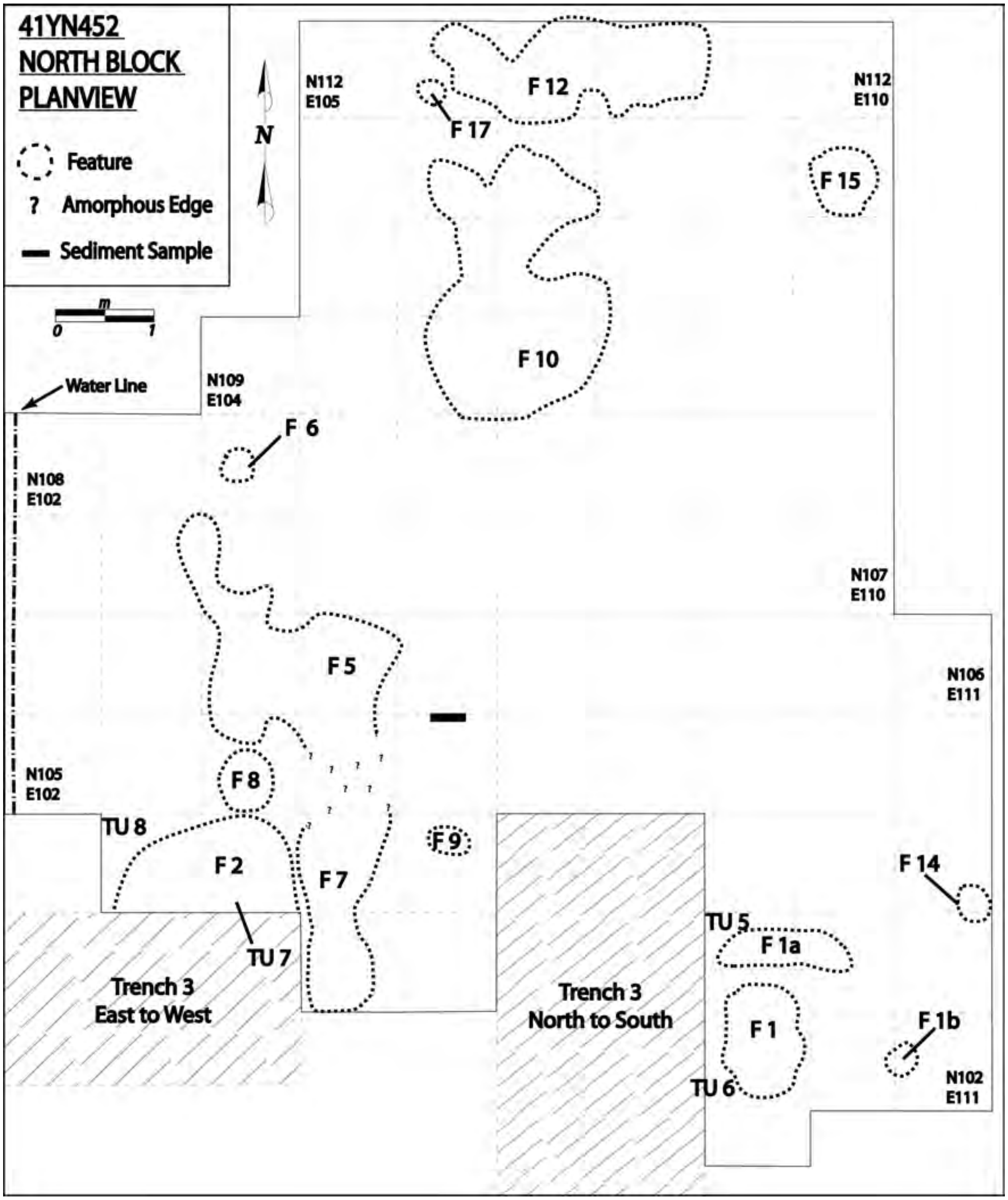

Figure 6-29. Plan Map of North Block Showing Feature Distribution and Associations

No lenses of charcoal or ash, or patches of oxidized soil, were observed. The burned rocks were in a roughly circular arrangement with relatively large, complete rocks around a more or less central opening that exhibited the densest concentration of charcoal. At the base of the apparent central opening was a lager (roughly 25 cm long) flat, decomposed sandstone slab (rock #21). A few *in situ* rocks were cracked or split indicating they had broken in place.

The circular arrangement of rocks was roughly 95 cm in diameter. The tops of the burned rocks were encountered at roughly 75 cmbs with their bases between approximately 90 and 95 cmbs.

Table 6-10. Summary of Feature Data

Feature No.	Unit	Feature Type	Feature Size	Depth (cmbs)	Conventional Age (B.P.)	Charcoal Identified (Pieces)	Lithic Debitage (Count)	Bones (Count)	Mussel Shells (Pieces Count)	Burned Rocks (Count)	Tools (Counts)	Matrix Floated (Liters)	Starch Grain Analysis on BR	Lipid Residue Analysis on BR	Diatom Analysis on BR
1	Unit 5 & 6	Heating element	90 x 90	80-95	1100 ± 40 1120 ± 40	9	no	3	19	46	no	13.6	4	2	1
1a	N103E109 N103E110	Discard	60 x 130	80-90	no	no		no	15	26	no	no	1	1	
1b	N102E110	Discard	60 x 90	83-100	no	no		no	22	36	no	no	no	1	1
2	Units 7 & 8	Discard	200 x 120	83-93	no	no		no	363	299	1	2	no	no	
5	many	Discard	100 x 160	79-88	1120 ± 40	2		1	92	131	yes	4	3	no	
6	N108E104	BR dump	12 x 16	79-85		no		no	no	4	no	no	no	no	
7	N104E105 N105E105 N103E105	BR & shell dump	150 x 100+	75-90	1300 ± 30 1330 ± 30	2		no	348	277	no	12.6	3	1	
8	N105E104	Dump	65 x 55	75-81	no	no		no	78	?? 41	yes	no	no	1	
9	N104E106	Dump	50 x 70	92-97	no	no		no	no	38	yes	no	no	no	
10	N109E106 N109E107 N111E106 N111E107	Shell & BR dump	200 x 200	82-95	940 ±25 1200 ± 30	4		12	688	932	yes	4	4	2	1
12	N111E107, N111E108, N112E107, N112E108	Shell & BR Scatter	?	82-90	no	no		no	268	194	no	no	no	no	
14	N105E111	BR dump	35 x 35	82-91	1110 ± 30	1		no	1	18	no	2	3	1	
15	N111E110	Hearth	70 x 80	88-98	1270 ± 30	1		81	28	80	biface	5.9	5	2	
17	N112E106	Dump	25 x 25	82-95	1160 ± 40	1		no	40	6	no	no	no	1	
BR = burned rock						20		97	1962	2001	1	44.1	23	12	3

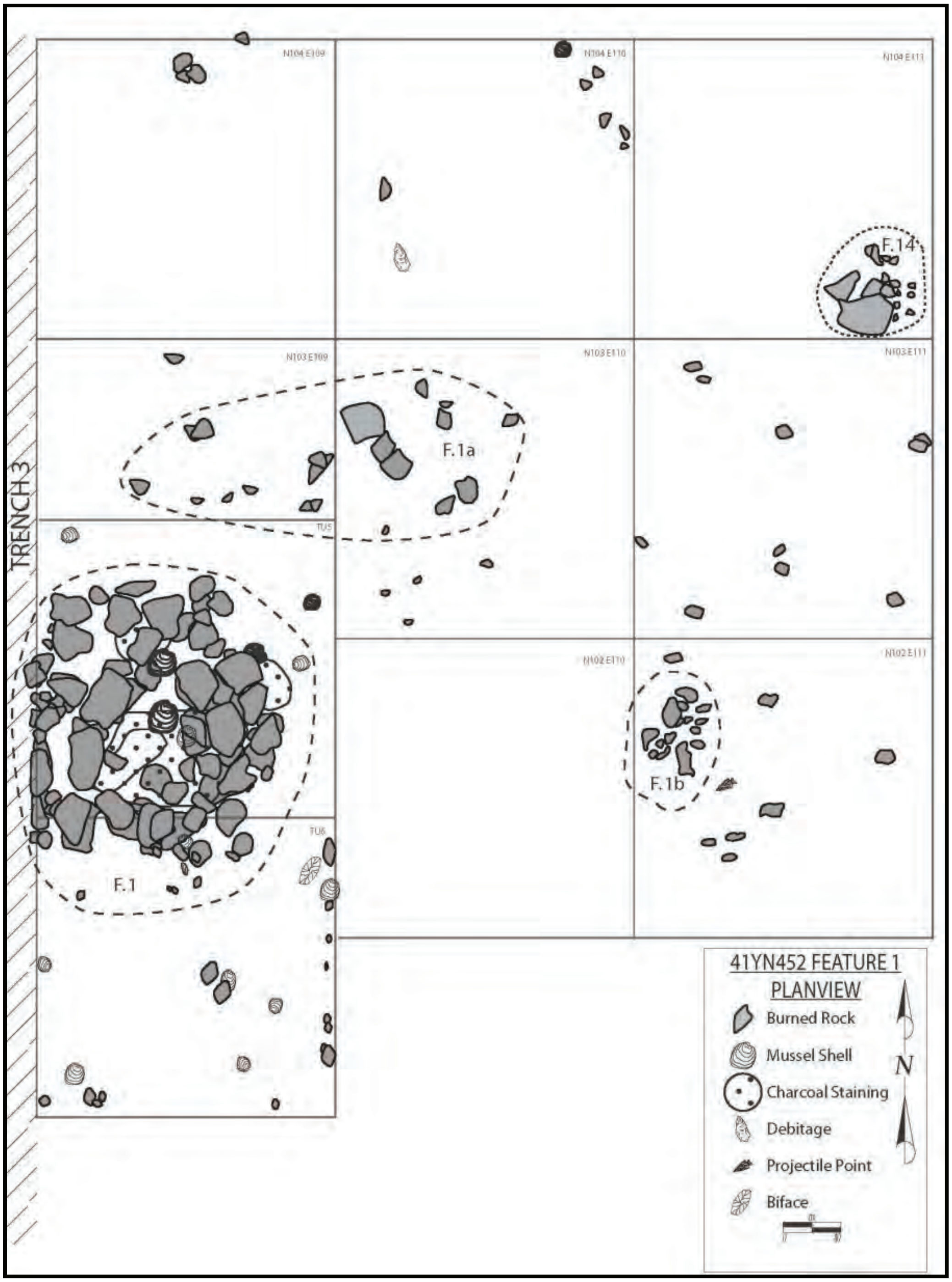

Figure 6-30. Plan Map Showing Associations of Features 1, 1a, and 1b

The arrangement consisted of about 46 sandstone burned rocks. Most rocks were pink, red, and orange sandstone, on average 13 to 20 cm in diameter. The largest piece was about 25 cm long. The rocks appeared to have been placed in a shallow basin arrangement with several larger red sandstone rocks lining the base. Near the central part and at the bottom (94 cmbs) was a decomposed and crumbly piece of gray sandstone (rock #21). This decomposed piece may have received that highest concentration of heat, which caused its deteriorated state in comparison to the other intact rocks present.

Figure 6-31. Close-up of Feature 1 Depicting Burned Rock Sizes and Positions around a Central Void

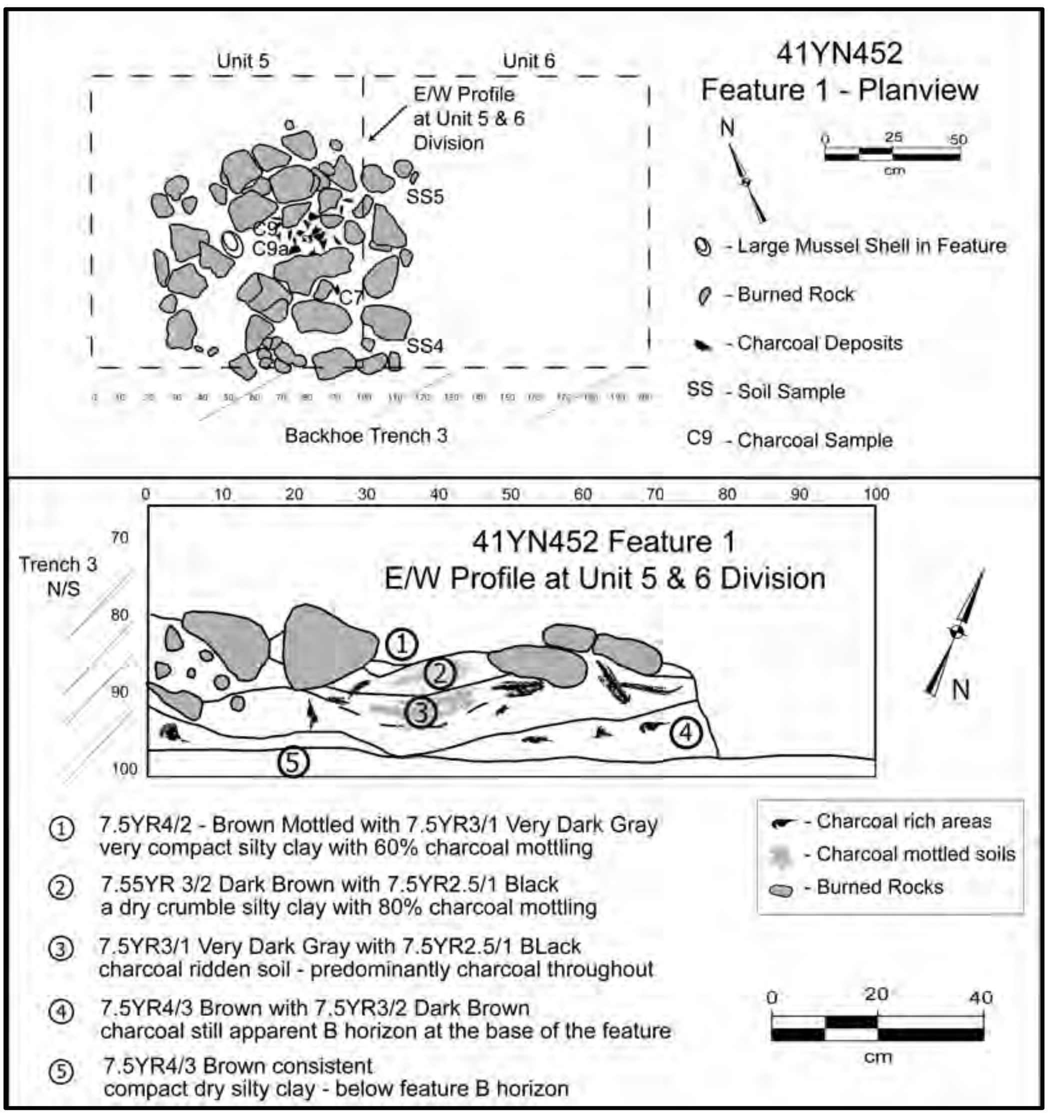

Figure 6-32. Plan View and Profile Drawing of Feature 1

One large (roughly 12 cm long) and nearly complete, but crushed, mussel shell valve (#129-006) was encountered at 91 cmbs near the center of the feature, and resting just above and between two burned rocks. Dense charcoal mottling of the sediment was observed throughout, with some larger chunks in certain areas. The charcoal-laden sediment and at least nine individual chunks of charcoal were collected for further analysis and dating. Several sediment samples (#128-004, #132-006, and #133-004) estimated at about 80 liters were also collected for further analysis and flotation. The surrounding level matrix outside the defined feature was a brown (7.5YR 4/3) silty clay that yielded seven pieces of lithic debitage, two tiny refit pieces of partially burned turtle shell, 128 pieces of small (less than 4 cm) burned rock fragments, and numerous small mussel shell fragments.

Two chunks of wood charcoal from within Feature 1, and one chunk from just above the feature were radiocarbon dated. A single chunk of wood charcoal (#131-007-1a) from the profile at 65 cmbs in Unit 6 near the top of the buried A horizon yielded a $\delta^{13}C$ corrected (-26.4‰) radiocarbon date of 360 ± 40 B.P. (Beta-214362). A single chunk of wood charcoal (#133-007-1a) from next to the burned rocks near the bottom of Feature 1 yielded a $\delta^{13}C$ corrected (-24.1‰) radiocarbon date of 1100 ± 40 B.P. (Beta-214363). The third chunk of wood charcoal (#128-007-5a) from between 80 and 90 cmbs yielded a $\delta^{13}C$ corrected (-27.4‰) radiocarbon date of 1120 ± 40 B.P. (Beta-231105). The young 360 B.P. sample was near the contact of the top of the buried A horizon and may have been displaced downward to that position. The two older dates from inside the feature are statistically identical and document the age of Feature 1 at 1110 B.P. For direct comparison, a single mussel shell from this good context inside the feature was also radiocarbon dated. The shell (#128-006-1) was from 91 cmbs of Unit 5 and within Feature 1. The 2.9 g shell yielded a $\delta^{13}C$ corrected (-8.6‰) radiocarbon date of 2000 ± 40 B.P. (Beta-230778). This is nearly 900 years older than the two accepted charcoal dates. Therefore, this shell date is not accepted to represent the true age of this cultural feature. The obtained age indicates that older or "dead" carbon was incorporated into the shell during its lifetime, making the age older than the actual cultural deposit from which it came.

Since Feature 1 provided excellent context with four different classes of materials (i.e., rocks, shells, soil, and charcoal) it was decided and approved by TxDOT archeologists that two burned rocks from Feature 1 should be radiocarbon dated to examine the variation in ages from the shell and wood charcoal dates. A 210 g sandstone rock (#127-003-8d) from 80 cmbs on one side of Unit 5 was selected and submitted. This dark rock yielded a $\delta^{13}C$ corrected (-19.7‰) radiocarbon date of 1770 ± 30 B.P. (UGAMS-6665). A 177 g brown sandstone rock (#128-003-38d) with a dark interior from 93 cmbs in Unit 5 yielded a $\delta^{13}C$ corrected (-23.3‰) radiocarbon date of 1150 ± 25 B.P. (UGAMS-6666). The obtained date of 1770 B.P. is some 660 years older than the two accepted wood charcoal dates. Consequently, this date is not accepted and does not represent the true age of this component. However, the second obtained date of 1150 B.P. is statistically identical to the two wood charcoal dates obtained, and considered acceptable. Given that both rocks yielded sufficient carbon for dating, it is again demonstrated that sandstone burned rocks can be used as a material class to gain an indication of the age of a feature/component. Sandstone rocks likely used in cooking processes do retain sufficient carbon materials introduced during their use to provide usable indications of the age of the events. Researchers should consider each individual circumstance to assess whether or not a date from a series of burned rocks is likely to provide a reliable age for a particular event/feature. If no other organic materials are available, the burned rocks should serve as a viable alternative for radiocarbon dating. It is assumed that the material dated in the sandstone burned rocks were organic remains (i.e., lipids, phytoliths, etc.) from cooking activities that the rock was subjected to during the occupation of this site.

Nine individual chunks of charcoal from within Feature 1 were sent to Dr. Dering for identification. Five samples were identified as hackberry or granjeño (*Celtis* sp.) wood, two were identified as mesquite (*Prosopis* sp.) wood, and one was identified as ash (*Fraxinus* sp.; Appendix D). One feature sediment sample was floated. Sample #133-004-1 consisted of 9.8 liters from 90 to 100 cmbs in Unit 5 along the southern margin of Feature 1 and yielded 15.7 g of light fraction, mostly unburned rootlets. The 0.4 g of charcoal recovered was mostly mesquite wood pieces (*N* = 25) together with one burned mesquite seed, and one burned mesquite pod fragment (Appendix D).

Nineteen mussel shell fragments were attributed to Feature 1 with a total weight of 15 g. These were all unidentifiable as to species, with two pieces from 80 to 90 cmbs burned to a gray color. Three pieces were the crescent shaped outer edge of the shell. Surrounding Feature 1, in the remaining parts of Units 5 and 6, were 11 fragments (14 g) of mussel shell pieces, with one identifiable Smooth pimpleback (*Quadrula houstonensis*). One small fragment was burned to a gray color.

The 46 larger burned rocks weighted a total of 14,277 g, for an average weight of 310 g per rock. These rocks fell into three size categories. Twenty-three (50 percent) were in the 4 to 9 cm group (2,673 g), 17 pieces (5,763 g) or 37 percent were in the 9.1 to 15 cm size, and six (5,841 g), or 13 percent, were greater than 15 cm.

In contrast to the Feature 1 burned rocks, those immediately outside the margins of the feature, on the northern and eastern sides in Units 5 and 6, were quite small fragments. They weighed 4,670 g, for an average of nearly 26 g per rock. These are 11 times smaller than those rocks in Feature 1.

Four burned rocks were selected and sent to Dr. Perry for starch grain analysis. Part of sample #127-003-21a yielded a single starch grain identified as wildrye (*Elymus* sp.; Appendix B). The other three rocks did not yield any starch grains. This was the bottom rock in the middle of the feature.

Parts of two of the same burned rocks sent for starch grains were also sent to Dr. Malainey for lipid residue analysis. Sample #127-003-21b yielded very high levels (55.17) of C18:1 isomers, which is an indication of decomposed residues of very high fat content such as seeds and nuts. Sample #127-003-8b yielded very similar results with very high levels (55.29) of C18:1 isomers, which again indicates the decomposed residues of very high fat content such as seeds and nuts (Appendix H). The indication that seeds or nuts from the lipid residues were present is in keeping with the recovery of mesquite seeds and pods in Feature 1. The lipid analysis also detected the presence of dehydroabietic acid, which indicates the presence of conifer products. Although the list of conifer products is extensive, the most likely species in this immediate area would be the juniper tree. Interestingly, juniper was not identified in the wood charcoal from Feature 1.

It is possible that since juniper is a soft wood that it may have been totally consumed by the fire (i.e., reduced to ash), whereas the hard wood of mesquite would be preserved longer or better, resulting in the presence of archeologically recoverable charcoal.

Following the data recovery fieldwork, a subsample of sediment (#128-004-1) was examined for phytoliths to determine if there was sufficient preservation to permit environmental interpretations. Dr. Bozarth reported that preservation was very good, with C_4 grass common, and C_3 grass also present. Subsequently, 9 g of sediment (#128-004-1) were sent to Dr. Sudbury for detailed phytolith analysis.

A total of 269.5 short-cell phytoliths were counted, with 50 percent being cool-and-moist forms (Pooid), 38 percent hot-and-dry forms (Chloridoid), and 12 percent warm-and-moist forms (Panicoid). This is the highest frequency of cool-and-moist forms on any of the seven samples. This sample contrasts with the nonfeature samples (#820-004-1b) from the 2Ab horizon in which the hot-and-dry forms dominated at 55 percent. Feature 1 also yielded the highest frequency of sponge spicules and charcoal flecks of any of the samples. It is not clear what caused the phytolith differences, but Feature 1 sediment apparently was influenced by the function of the feature. It is possible that grasses were used as part of the fuel or potentially as packing for food resources that were cooked here.

The initial assessment of the diatoms following the data recovery work revealed considerable promise for conducting more in-depth diatom analysis, which might contribute to the functional interpretation of features and potentially help determine past environmental conditions. Subsequently, two burned rocks and a subsample of sediment (#128-004-2) from Feature 1 were sent to Dr. Winsborough for diatom analysis. It was anticipated that detailed analysis of the diatoms from the burned rocks and sediment might inform as to the microscopic contents of the rocks and help in determination of the function of this feature. Very few diatoms (N = 5) were recovered from the sediment, whereas at least 500 diatoms were recovered from one of the burned rocks (#127-003-21, Appendix F). In contrast, the second rock (#127-003-38b) yielded only 25 diatoms. Sample #127-003-21 was the deteriorated rock from the middle at the bottom of Feature 1. The high frequency of diatoms is the highest count of any cultural sample analyzed from the block. However, the sediment sample (#521-004-2) from 68 cmbs near the top of the A horizon also yielded 500 diatoms and some phytoliths. Most diatoms on the rock were aerophils and most were whole and not corroded, indicating that they were not transported to the site by flood waters. These aerophil diatoms live exposed to air and are adapted to damp or dry habitats, and probably grew on the wet rock following the fire being doused with water. These diatoms probably grew on the rocks after their use in water, such as stone boiling, which provided a suitable environment.

Feature 1 represents a very shallow saucer-shaped burned rock feature that exhibited intensive charcoal mottling of the sediment below the rocks and slight elevational differences in the burned rocks. Feature 1 is interpreted as an *in situ* heating element dating to 1110 B.P., in the Terminal Archaic component 1. The data from technical analyses indicate that sandstone rocks were heated in this feature, with the hot rocks used in a boiling process for cooking. What was cooked or heated by the hot rocks from this feature is not totally clear, but most likely it included mussels. The lipid residues from two rocks indicate that seeds and nuts were the most likely degraded residues represented. The single starch grain of wildrye (*Elymus* sp.) grass recovered from four burned rocks supports the lipid residues findings of seed residues. It also supports the finding that the grass phytolith assemblage contained a high percentage of cool-and-moist forms. Even the identified macrobotanical remains indicate the presence of mesquite seed and pod fragments, which may indicate seed processing. The preservation of the wood charcoal within Feature 1 may have been facilitated by the dosing of the fire with water prior to site abandonment. Alternatively, it could be the result of a minor flood event that filled the shallow basin with water for a time.

Feature 1a

This feature is a small scatter of burned rocks and mussel shells on the north side of Feature 1 in units N103 E109 and N103 E110 (see Figure 6.30). This scatter yielded at least 26 relatively small burned rocks weighing some 3,104 g in an area that measured 130 cm east-west by 60 cm north-south. The burned rocks varied from 2 to 12 cm in diameter and were blocky sandstone. Most rocks were between 80 and 90 cmbs and at the same stratigraphic elevation as Feature 1 about 60 to 100 cm to the south. The soil matrix surrounding these burned rocks was a gray brown (10YR 3/2) and lacked any sign of charcoal. The burned rocks were collected.

About 25 rocks were assigned to this feature. They weighted 1,942 g, for an average of 78 g per rock. Fifty-two percent were in the small 0 to 4 cm size class weighing 322 g, or nearly 17 percent of the total weight. Ten or 40 percent were in the 4.1 to 9 cm size class with a weight of 1,061 g. Only two rocks were larger than 9 cm and they weighed a total of 559 g.

A part (28 g) of one burned rock (#482-003-1a) was sent for lipid-residue analysis. That analysis yielded moderate-to-high levels of C18:1 isomers (34.18) with elevated levels of C18:2 (15.38) and very long chain saturated fatty acids, which indicate a plant origin. The unusually high levels of C18:2 and C18:3ω3 (4.56) are a concern and may indicate contamination with modern lipids (see Appendix H). Conifer products were detected by the presence of dehydroabietic acid. Conifer products were also detected in the two rocks sampled from Feature 1. The most likely conifer products here would have been juniper trees. This wood would have been used as fuel with the acid becoming incorporated into the rock during the heating process.

A 116 g part of that same burned rock that underwent lipid analysis was also subjected to starch grain analysis (#482-003-1c). However, no starch grains were recovered from that section (Appendix B).

Mussel shells (62 g) were scattered across the two adjacent units. These consisted of nine fragments together with three shells identified as Smooth pimpleback (*Quadrula houstonensis*) and three Southern mapleleaf (*Quadrula apiculata*). Two fragments were the outer crescent edges of the shells. One piece exhibits a thin line, possibly cut into the shell.

Feature 1a is interpreted to reflect discarded burned rocks and shells from at least one heating and cooling cycle during the cooking process, mostly likely associated with Feature 1. The rocks in Feature 1a are roughly one-quarter the size of those recovered from Feature 1, which indicate they were likely too small to retain sufficient heat and were discarded.

Feature 1b

Feature 1b was about 130 cm due east of the heating element, Feature 1, along the western margin of N102 E111 (see Figure 6-30). This was a relatively loose cluster of burned rocks (*N* = 36) and a few mussels shells that were dispersed over an area roughly 60-by-90 cm (Figure 6.33). The rocks were between 83 and 93 cmbs and lacked any definable or recognizable pattern to their distribution. One of the upper rocks had partially disintegrated into numerous pieces, which actually increased the count of small pieces. No bones, flakes, stone tools or other cultural materials were amongst the burned rocks and shell fragments. No charcoal and dark staining was observed.

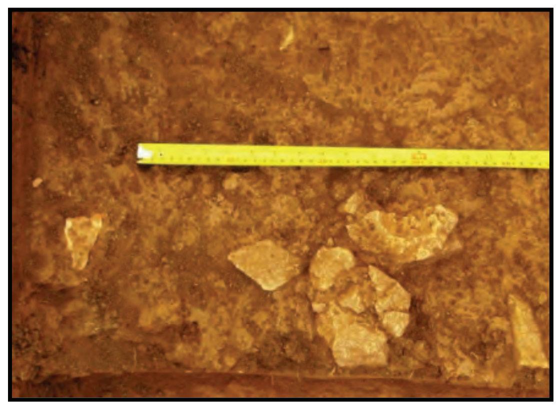

Figure 6-33. Feature 1b Overview

Fifty-three grams of mussel shells were present with 3 Smooth pimpleback (*Quadrula houstonensis*) and 2 Southern mapleleaf (*Quadrula apiculata*), plus 17 fragments. These are the same two species identified in Feature 1a.

Thirty-six rocks were in this cluster, with a total weight of 2,094 g and an average weight of 58 g per rock. Twenty-six (72 percent) were in the small 0 to 4 cm size class, whereas nine (25 percent) were in the 4.1 to 9 cm size class. The dominance of the small sizes indicates that these rocks were most likely discarded from further use in the perception that they could no longer function to the degree desired.

A 30 g part of a burned rock (#459-003-1) from 85 cmbs was submitted for lipid residue analysis. The analysts obtained very high levels of C18:1 isomers (51.93), with moderate levels of C18:2 plus very-long-chain saturated fatty acids. This high level of C18:1 is observed in the decomposed residues of foods of very high fat content of plant origins with animal products probably present (Appendix H). The presence of the decomposed fatty acids reflect more than just meat (probably mussel meat) amongst the materials cooked using this burned rock. Again, the presence of conifer products was detected, indicating that this rock was heated with the same wood as those rocks in Features 1 and 1a.

Although not directly within the clustered rocks a small Alba-like arrow point (#459-10) was recovered from 84 cmbs, adjacent to this rock cluster. This point is thin, less than 2 cm long and was vertically oriented in the soil before it was inadvertently broken with a trowel. It is believed that this arrow point is intrusive to this earlier component as evidenced by its vertical orientation and its uncharacteristic depth in comparison to the few other arrow points recovered together with relatively late radiocarbon dates from much higher in the profile (i.e., 360 B.P. at ca. 60 cmbs above Feature 1).

This restricted area of very loosely clustered burned rock and a few scattered mussel shells, located about 1 m east of Feature 1, is best explained as a dump or discard pile of previously used cooking rocks. The close proximity of Feature 1b to Feature 1 indicates that the latter feature, a heating element, was likely the location in which these rocks were heated, before their discard as Feature 1b. The relatively few rocks in this cluster may represent a single use episode of discard from the cooking facility.

Feature 2

Feature 2 was a concentration of diverse cultural materials that included dense quantities of burned rocks and small mussel shell valves, together with a few pieces of lithic debitage, and five chipped stone tools including one dart point. This concentration was first observed during the eligibility assessment phase in the northern wall of the east-west section of mechanically dug Trench 3 along the western edge of the proposed new right-of-way. These multiple classes of artifacts were observed between 70 and 80 cmbs within the buried A horizon in about a 1 m long section of the trench profile.

After observing this thin lens of cultural material in the trench wall, the upper 55 to 60 cm of overlying sediment was mechanically removed to approximately the top of the buried A horizon. Two 1-by-1 m units (Units 7 and 8) were laid out above the exposed linear concentration observed in the trench profile. Each 10 cm level in each of the two units was hand-excavated and the encountered materials were mostly plotted and all were collected. Not every artifact encountered was piece-plotted and therefore, the overall map provides only a general indication of the density of materials (Figure 6-34). The horizontal excavation of the two 1 m^2 units did not reveal well-defined or obvious boundaries of the material.

This dense concentration appeared to extend beyond the 1-by-2 m excavated area, which was truncated on the southern side by Trench 3. Roughly four 10 cm thick arbitrary levels were hand-excavated within the two units, through the buried A horizon. The excavations revealed an ill-defined top and bottom of this apparent feature. The greatest concentration of material was between 80 and 90 cmbs with a few small mussel shell fragments and burned rocks above and below this level.

The hand-excavated and screened 40 cm of vertical deposits within these two units yielded 299 burned rocks that weighed approximately 11,950 g, for an average weight of 40 g per rock. The smallest (0 to 4 cm) burned rocks averaged 10 g and comprised the majority (65 percent), with medium size (4.1 to 9 cm) pieces that averaged 64 g accounting for about 29 percent, while those in the 9.1 to 15 cm size

Figure 6-34. Overview of Diverse Cultural Materials In Feature 2 Exposed in Units 7 and 8. Note: dark spots are from moisture and not organic in origin.

class averaged 260 g and accounted for about 6 percent of the total. The burned rocks did not appear to form any particular pattern or overall feature morphology. Continued excavations to the north of this cluster during the data recovery revealed that the density of materials declined rather abruptly, but without a well-defined boundary, in N105 E103. That north unit exhibited the continuation, but light scatter of shells and burned rocks. Scattered burned rocks to the north in N105 E104 were designated as Feature 8. A loose cluster of materials further east in N104 E105 was designated as Feature 7 (Figure 6-35). The boundaries of these features were not well-defined and were difficult to isolate or define during excavations. The features may all run together, with the dense areas minimally separated by light scatters of materials.

The plotting of all the units together reveals slightly different boundaries than identified in the field. Because the materials were labeled in the field as to inside and outside, the field observations were primarily maintained and followed.

During the excavations, an irregular ovate area some 30 cm across, that appeared darker and possibly burned, was observed in the very southern margin of N105 E103. This strong brown (7.5 YR 4/6) sediment (#516-004) was considered part of Feature 2 in the field and was collected. This apparent burned area extended from about 90 to 97 cmbs in a poorly defined saucer shaped configuration. No charcoal was observed in this dark, buried A horizon. Sediment samples were collected from within the feature for further analysis and flotation. Following its excavation and bisection, combined with the subsequent drying of the sediment, this darker soil was finally considered not to be a burned area, but more likely just a natural discoloration resulting from retained moisture.

At least 363 mussel shell valves and fragments totaling 1,415 g were recovered from Units 7, 8, and N105 E103 labeled as Feature 2. Most shells were 2 to 4 cm in diameter with the largest piece just under 5 cm in diameter. Smooth pimpleback (*Quadrula houstonensis*) dominated the sample of mussel shells (66 percent of those identifiable) with at least 102 pieces identified, whereas 24 southern mapleleaf (*Quadrula apiculata*), 16 mapleleaf (*Quadrula Quadrula*), 10 pistolgrip (*Tritogonia verrucosa*), and 2 tampico pearlymussel (*Cytronaias tampioensis*) were also present. No shells showed signs of having been burned. Their overall fragile state may be influenced from exposure to heat and/or hot water. Of the 208 unidentifiable fragments at least 30 percent (62 pieces) represent the crescent-shaped outer shell margin. No obvious modifications, such as cut lines, were observed. At least three pieces reveal small diameter holes near the beaks, but it is uncertain if these holes reflect intentional drilling by humans or natural modifications caused by an unknown animal. During hand-excavation, at least 18 recognizable mussel shell concentrations, each about 12 to 15 cm in diameter were detected, plotted, and collected. The mussel shells were concentrated in clusters throughout the broader scatter and ranged in-depth primarily from 83 to 98 cmbs.

Twenty-nine pieces of lithic debitage were recovered within the excavated levels of Units 7 and 8. At least two formal tools were also recovered including one completed unidentified type of stemmed dart point discovered at 82 cmbs and a broken chert biface at 87 cmbs. The complete dart point (#138-10) is a broad bladed contracting stem dart point with a somewhat straight base and slightly rounded shoulders (see Figure 6-49). It is not identical to any named type, but has an outline similar to Dallas points of the Late Archaic period for north-central Texas region.

Two, two liter sediment samples from this feature were sent for flotation. Sample #138-004-1 from 80 to 90 cmbs in Unit 7 yielded 30 ml or 1.7 g of light fraction. The recovery was dominated by tiny rootlets with less than 0.1 g of charcoal. The three tiny charcoal fragments were too small for positive identification. The second sample (#144-004-1) from 80 to 90 cmbs in Unit 8 yielded 37 ml or 2.3 g of light fraction with no charred plant remains (Appendix D).

Because the phytolith preservation was determined to be good a 25 g of #144-004-1a was sent to Dr. Sudbury for detailed phytolith analysis. The 276 short-cell phytoliths reflect 46 percent cool-and-moist forms (Pooid), followed closely by 43 percent hot-and-dry forms (Chloridoid), with another 10 percent of warm-and-moist forms (Panicoid; Appendix E). These frequencies correspond well with the results from Feature 1. The cool season phytoliths, here and in Feature 1, may support the use of grasses for one or more cultural activities.

A subsample of sediment (#144-004-1a) from Feature 2 was sent to Dr. Winsborough for diatom analysis. Sixty-nine diatoms, some phytoliths, and sponge spicules were recovered (Appendix F). The presence of diatoms tightly adhering to the rocks indicates they were from the water in the creek, which undoubtedly became attached to the rock during the cooking process. This is direct evidence that rocks came in contact with water, most likely during cooking that involved stone boiling.

Feature 2 appears to represent part of a larger concentration of discarded burned rocks (N = 299) and mussel shells (N = 363) in a disposal area 4+ m west of heating element Feature 1. Feature 2 materials were part of the broader occupation zone within the buried A horizon that contained numerous other discard features with similar contexts. Feature 2 represents a discard area in which multiple classes of artifacts were discarded after use.

Feature 5

Feature 5 was discovered in one unit, but then expanded across a number of adjoining units that included N106 E104, N105 E104, N107 E103, N106 E105, N105 E105, and N107 E104. The boundaries of this and similar features were not distinct during the excavations and these amorphous scatters were difficult to define in the field (Figures 6-35 and 6-36). The excavation in small vertical units did not help as even plotting all the materials in adjacent units in the laboratory did not totally solve the problem of where precise boundaries might lie. This feature consisted of burned rocks and mussel shell scattered over an amorphous area roughly 170 cm east-west at the widest spot by 260 cm north-south, with no obvious recognizable shape or obvious pattern. The southern boundary is questionable as it merged into the northern edge of Feature 7. Therefore, it is possible that these boundaries are just too arbitrary to be helpful.

The cultural materials, including two edge-modified flakes, were mostly between 79 and 88 cmbs. The burned rocks (N = 131) were mostly between 1 and 9 cm in diameter and of soft sandstone. Just over half were less than 4 cm in diameter with about 49 percent in the 4.1 to 9 cm size class.

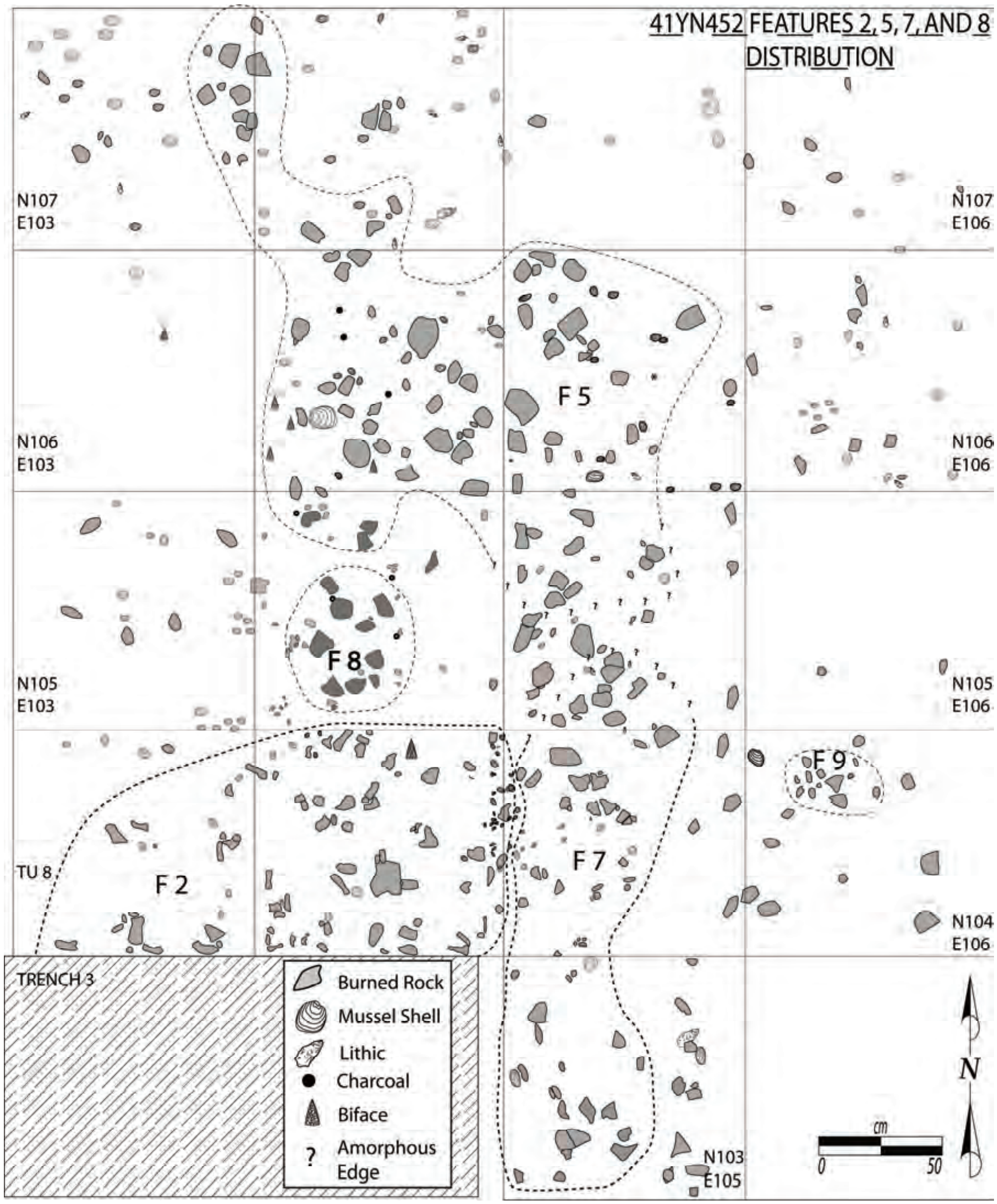

Figure 6-35. Feature 2 in Relationship to Features 5, 7, 8, and 9 along the Western Side of Block

The 131 rocks weighed 8,810 g, for an average weight of 67 g per rock. The sediment surrounding these items was a hard packed dark gray (10YR 3/2) silty clay. Chert flakes and a couple of edge-modified flakes were also scattered amongst these rocks. Small mussel shells and shell fragments were also scattered throughout. At least one tiny rabbit-size bone and one fish otolith were present. Sediment samples were collected from parts of these units.

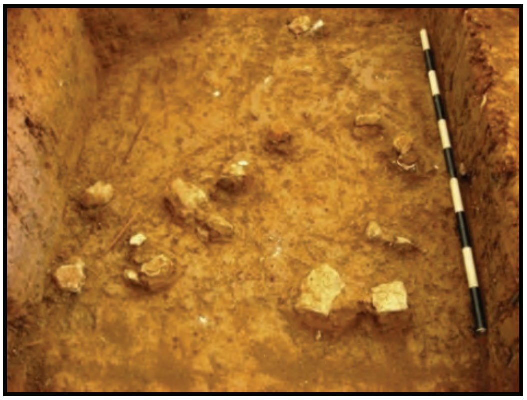

Figure 6-36. An Example of the Dispersed Nature of Feature 5 in One Unit

A single chunk of piece plotted charcoal (#561-007-1) from 80 to 90 cmbs in N106 E105 was sent for identification, but was too fragmentary for positive identification (Appendix D). A second charcoal sample (#787-007-1a) from 80 to 90 cmbs, in the area where Feature 5 and 7 come together, was identified as mesquite (*Prosopis* sp., Appendix D).

Part of an unidentified charcoal sample (#561-007-4) from 87 cmbs in N106 E105 was sent for dating. This piece yielded a $\delta^{13}C$ corrected (-26.4‰) radiocarbon date of 1120 ± 40 B.P. (UGAMS-5168). This is statistically identical to the two radiocarbon dates derived from Feature 1 3.5 m to the southeast.

A four liter matrix sample (#561-004-1) from 80 to 90 cmbs in N106 E105 was floated. The light fraction yielded 22 ml (2.4 g) of material that consisted mostly of tiny rootlets, but no charcoal (Appendix D). A subsample of sediment (#561-004-1a) from Feature 5 was sent to Dr. Winsborough for diatom analysis. No diatoms were recovered, indicating that the soil was not sufficiently moist for a long enough time to allow diatoms to grow (Appendix F).

Three bifaces (#319-11, #556-10, and #556-11) were found amongst the scattered burned rocks and mussel shells. Two are complete (#319-11 and #556-11) and the third is an edge fragment. All three fluoresce as a dark orangish color under ultraviolet light and are therefore assumed to have been made of chert from the Edwards Formation. Specimen #556-11 was complete until broken during recovery. This piece exhibits one well-executed edge that is quite thin, whereas the opposite edge still retains a part of the rounded cortex. This biface also revealed raphides and hard high silica polish on the distal end and rounded flake scar ridges on the proximal end (Appendix C). These rounded ridges indicate this biface was hafted and used to cut at least plant materials. A complete, but broken biface (#556-11) was recovered near some burned rocks at 100 cmbs in N106 E103. This biface was sent for use-wear analysis, which revealed hard high silica polish and raphides towards the distal end. It also revealed abraded flake scar ridges indicative of haft wear over the proximal half of the tool. Obviously this tool was hafted, used to cut plant products, and then discarded (Appendix C).

At least 130 g of mussel shells were recovered. Six pieces were identified as smooth pimpleback (*Quadrula houstonensis*), one as southern mapleleaf (*Quadrula apiculata*), and one as pistolgrip (*Tritogonia verrucosa*). Fourteen of the 84 fragments are crescent-shaped outer margins of the shells. None of the shell pieces exhibited any sign of burning or other human alterations.

Nearly 98 rocks, that weighed 7,000 g, were part of this cluster. The small (0 to 4 cm) and medium (4.1 to 9 cm) size classes were equally represented by 48 percent each with an additional four rocks between 9.1 and 15 cm in diameter.

Parts of three randomly selected burned rocks (#561-003-1a, #555-003-1a and #812-003-1a) from three different proveniences across this dispersed feature were sent for starch grain analysis. One rock fragment (#555-003-1a) of 153 g yielded two wildrye (*Elymus* sp.) starch grains (Appendix B). Neither of the other two rocks yielded any starch grains.

Feature 5 is interpreted to be a discard area where burned rocks and shells from cooking activities were tossed. The presence of both mussel shells and burned rocks with wildrye grass starch indicates that the burned rocks were likely employed to process both mussels and wildrye grass seeds.

Feature 6

Feature 6 was discovered in N108 E104 between 79 and 85 cmbs, within the buried A horizon towards the western side of the North Block. This feature consisted of a tight cluster of four burned rocks in an area that measured 12-by-16 cm in diameter (Figure 6-37). The burned rocks were 4 to 9 cm in diameter and weighed 300 g. This same unit yielded 20 mussel shells and 25 small burned rocks scattered around the cluster of four larger rocks. Only two pieces of lithic debitage were from this unit. Sediment (#637-004) from around the burned rocks was collected for flotation. All the clustered burned rocks (#637-003) were collected for potential analysis.

No mussel shells were in this tightly clustered burned rock concentration.

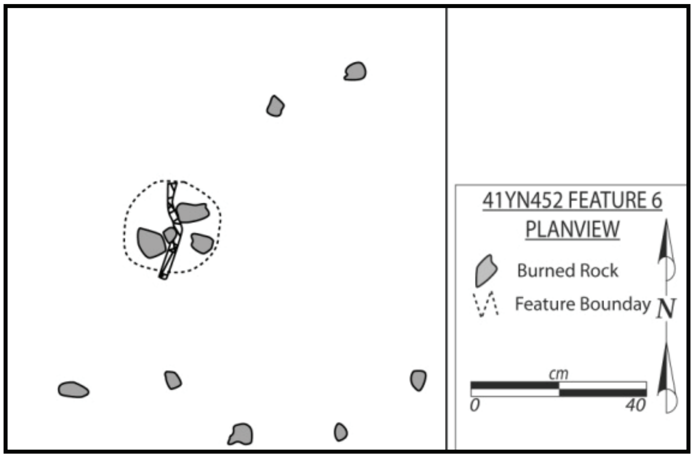

Figure 6-37. Feature 6 in the Middle of N108 E104

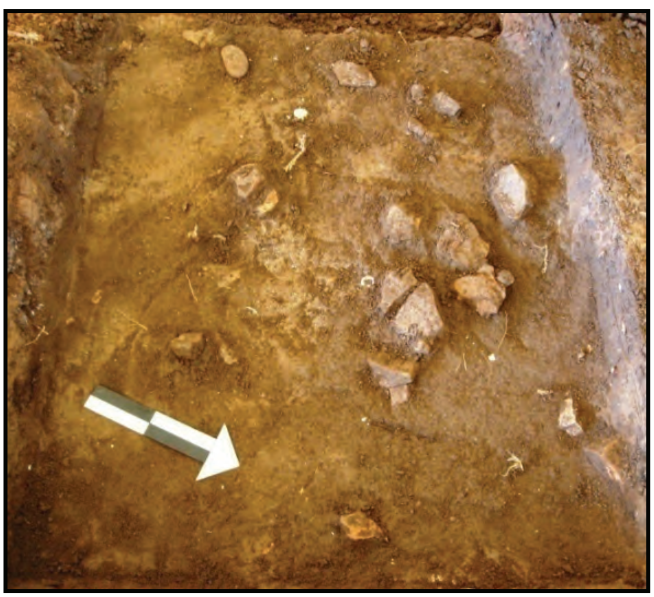

Figure 6-38. Close-up of Northern End of Feature 7 in N104 E105

However, some 267 g of shell were in this same unit that surrounded this cluster. These shells include 11 smooth pimpleback (*Quadrula houstonensis*), 4 southern mapleleaf (*Quadrula apiculata*), 3 threeridge (*Amblema plicata*), 1 yellow sandshell (*Lampsilis teres*), and 25 unidentifiable fragments. No pieces revealed any specific identifiable human alterations.

This tight cluster of four burned rocks is interpreted to be a dump pile of used rocks following their use in a cooking activity. These four rocks averaged 75 g each and may represent a single dumping episode in an area that had already received other materials.

Feature 7

Feature 7 consisted of scattered mussel shells, burned rocks, pieces of lithic debitage, and five chipped stone tools. These materials were scattered across parts of three units towards the southwestern corner of the block and just east of Feature 2 (see Figures 6-35 and 6-38). It was primarily in units N103 E105 and N104 E105 with some materials extending northward into the southern part of N105 E105. The northern margin appeared to extend into Feature 5, whereas the western margin may have merged with Feature 2. The boundaries were unclear and irregular during the excavations. A sample of burned rocks, a sediment sample, and charcoal samples were collected from this scatter.

A single chunk of charcoal from 80 to 90 cmbs in N103 E105 was sent for identification. Dr. Dering identified this piece as mesquite wood (*Prosopis* sp.) weighing 0.1 g (Appendix D). Two sediment samples were floated. A 5.8 liter sample (#491-004-1) from 80 to 90 cmbs in N104 E105 yielded 32 ml or 1.7 g of light fraction, which included 0.1 g of mesquite (*Prosopis glandulosa*) wood charcoal.

A 6.8 liter sample (#523-004-1) from 80 to 90 cmbs in N105 E105 yielded 47 ml or 2.9 g of light fraction. This included mostly tiny rootlets and 0.1 g of mesquite wood charcoal and one charred mesquite seed (Appendix D). A mesquite seed and pod fragment was also recovered from Feature 1, which may link Features 1 and 7 together (Appendix D).

Two chunks of charcoal from two different parts of Feature 7 were selected for radiocarbon dating. One 1.5 g sample of charcoal (#466-007-1) from 80 to 90 cmbs in N103 E105 yielded a $\delta^{13}C$ corrected (-23.2‰) radiocarbon date of 1300 ± 30 B.P. (UGAMS-5169). A second chunk (1.1 g) of charcoal (#785-007-1) from 84 cmbs in N105 E105 yielded a $\delta^{13}C$ corrected (-24.2‰) radiocarbon date of 1330 ± 30 B.P. (UGAMS-5170). The two dates are statistically identical and relatively close to those dates obtained from Feature 15. They both further support the age of this Terminal Archaic component 1.

Some 637 g of mussel shells were associated with Feature 7. This included at least 36 smooth pimpleback (*Quadrula houstonensis*), 12 southern mapleleaf (*Quadrula apiculata*), and 1 threeridge (*Amblema plicata*). Of the 299 fragments, at least 25 were the crescent-shaped outer edge of the shell. One piece was burned to a gray color and one has a small hole near the beak.

The burned rocks (N = 277) ranged in size from 2 to 8 cm in diameter with an average weight of 39.5 g per rock. The small-size category (0 to 4 cm) dominated, with 67 percent by count, followed by the medium-size group (4.1 to 9 cm) with 28.5 percent. The larger size group (9.1 to 15 cm) was only represented by 4.5 percent, although the weight of this latter class accounted for nearly 28 percent of the total weight.

Three burned rock fragments weighing a total of 370 g were sent to Dr. Perry for starch grain analysis. Two of the rocks yielded starch grains (Appendix B). The smallest piece (22 g, #464-003-1c) yielded a single wildrye (*Elymus* sp.) starch grain. The largest pieces (260 g, #813-003-1a) yield a single starch grain from an unidentified grass.

The positive response from Dr. Bozarth's assessment of the phytolith potential led to the submission of more sediment for phytolith analysis including a sample from Feature 7. A 27 g subsample of #491-004-1b was sent to Dr. Sudbury for detailed analysis. A total of 290 short cell phytoliths were counted (Appendix E). These short cells included 56 percent hot-and-dry forms (Chloridoid), followed by 37 percent cool-and-moist forms (Pooid) and 7 percent warm-and-moist forms (Panicoid). This assemblage appears to represent the background grass assemblage with no obvious alteration from human actions. Even the seven burned phytoliths are not proof positive that this assemblage was altered by man. These burned forms still could be part of the background aspect of the assemblage. The 19 flecks of charcoal observed in this sample may or may not support a cultural influence as some 50 flecks were observed in the sample from the 2Akb soil.

A 72 g burned rock and a subsample of sediment from Feature 7 were sent to Dr. Winsborough for diatom analysis. The sediment sample (#491-004-1a) yielded 86 diatoms, phytoliths, and sponge spicules. The rock (#490-003-1c) yielded 408 diatoms (Appendix F). The significant difference between the few diatoms in the sediment and the high frequency in the rock indicates that only the rocks came in contact with water. Most likely the rock came in contact and accumulated the diatoms during the cooking process where water from the nearby stream was used for boiling.

Three edge-modified flakes and roughly 37 pieces of lithic debitage were scattered throughout the burned rocks and mussel shells. These are indications of the knapping activities in this camp, but are considered discarded into this area. The few edge-modified tools and broken bifaces present also reflect the discard of unwanted tools into this area.

Feature 7 is interpreted as a dump of quantities of mussel shells and burned rocks following their use in a cooking activity. Lithic debitage and stone tools present were also discarded here, probably after the shells and burned rocks were discarded.

Feature 8

Feature 8 was discovered in the southern two-thirds of N105 E104, just north of Feature 2, along the southern margin of Feature 5, and just west of Feature 7 (see Figure 6-35). In fact, Feature 8 may Hve been part of one or more of the adjacent features as Feature 5 extended into the northern 30 cm of this unit. All these features appeared at the same depth in the buried soil. Feature 8 consisted of at least 43 loosely clustered burned rocks and one mussel shell in an area that measured about 65-by-55 cm. No visible sign of charcoal or stained sediment was between or around the burned rocks. The burned rocks primarily from were from 75 to 81 cmbs, although a couple were scattered below this elevation. The burned rocks ranged in size from about 4 to 15 cm in diameter with no detectable arrangement or pattern (Figures 6-39 and 6-40). The burned rocks (#786-003) and a general sediment sample (#786-004-1) from under and around the rocks were collected.

A single four liter sediment sample (#786-004-1) from 70 to 80 cmbs in N105 E104 was floated. This yielded 18 ml or 1.1 g of light fraction with no charcoal present (Appendix D).

The mussel shells and fragments weighed 292 g with two species identified. Those identified include 19 smooth pimpleback (*Quadrula houstonensis*) and 3 southern mapleleaf (*Quadrula apiculata*), with some 56 unidentifiable fragments. Three fragments were the crescent-shaped outer shell edges. None of the shell pieces were burned or visibly modified.

The burned rocks were relatively large with 21 percent in the 4.1 to 9 cm size class with a weight of 1,600 g. The small size of between 0 and 4 cm were the most numerous at 74 percent by count. In total the 43 rocks weighed 2,700 g, for an average of 62 g per rock. Feature 8 is interpreted as a dump of burned rocks following their use in a cooking process.

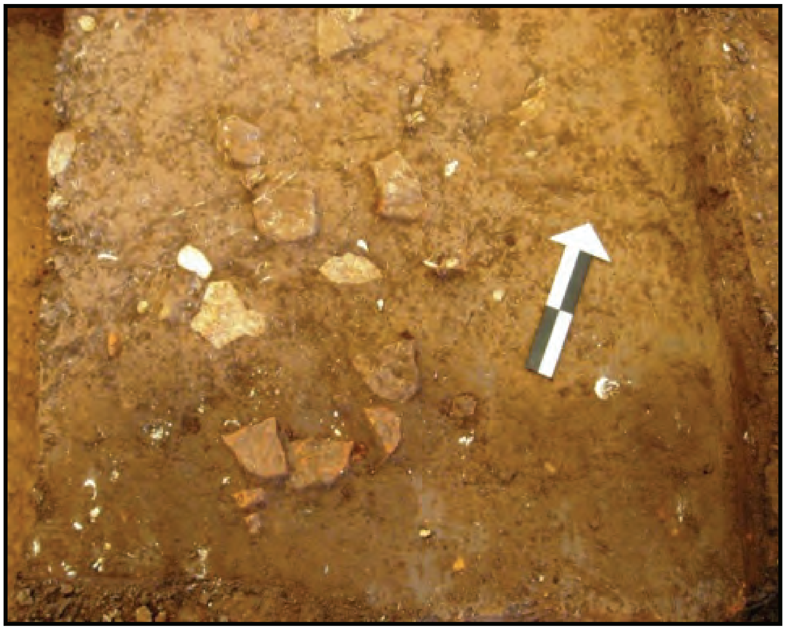

Figure 6-39. Overview of Scattered Material in Feature 8.

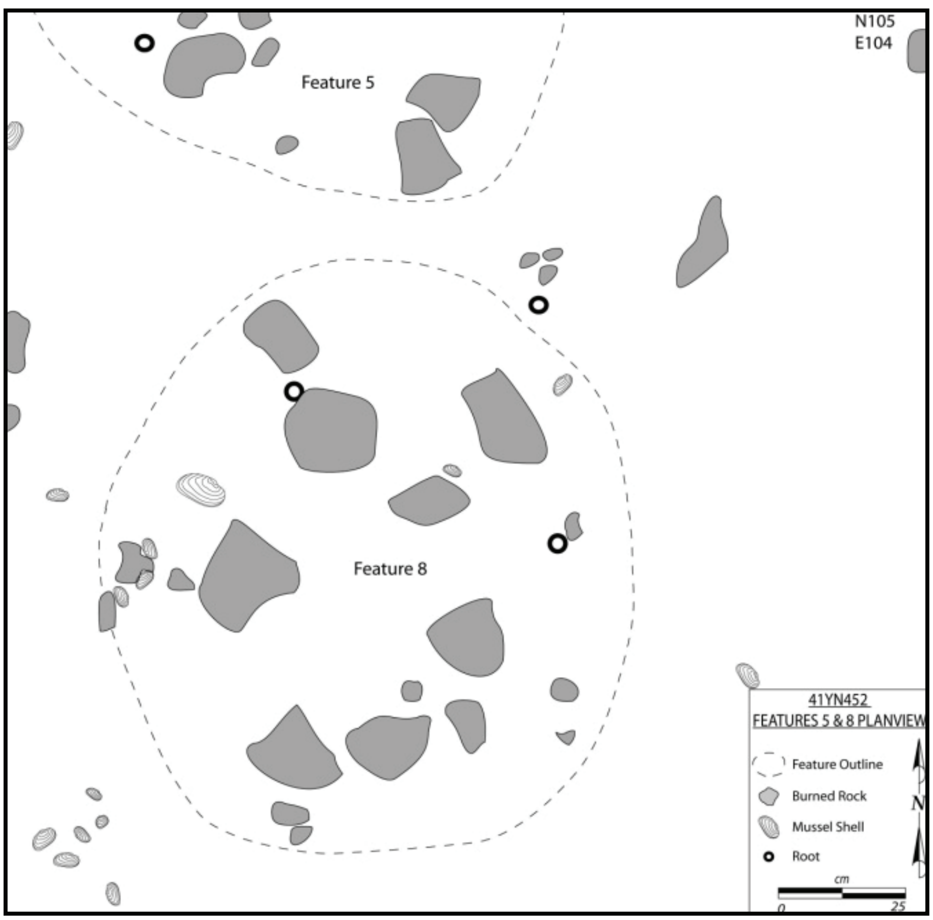

Figure 6-40. Plan of Feature 8 in Relationship to Feature 5 to the North.

Feature 9

Feature 9 was encountered in the north-central part of N104 E106 at 92 to 97 cmbs, just east of Feature 7 (see Figure 6-35). This small, loose cluster of burned rocks and mussel shells was oval in shape (Figures 6-41 and 6-42). The cluster measured about 40 cm east-west and 50 cm north-south. No charcoal, dark stained sediment, or basin was observed around or below the burned rocks. The cluster was bisected to inspect for a pit or basin, but no visible basin was observed.

The burned rocks (*N* = 38) ranged in size from 2 to 8 cm and were mostly blocky sandstone pieces. No obvious disturbance was observed. A sediment sample (#498-004) was collected from the western half of the feature.

Small fragments of mussel shell were amongst the rocks, but many more shells were outside this cluster. Some 39 g of shell (#497-006) were scattered across this same 90 to 100 cmbs level with 3 smooth pimpleback (*Quadrula houstonensis*) valves identified together with 27 fragments. Six fragments were the crescent-shaped outer margins of shells.

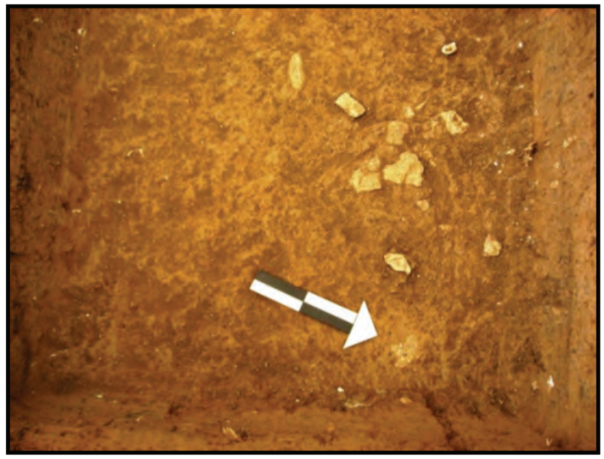

Figure 6-41. Overview of Feature 9 in N104 E106

The 38 burned rocks weighed 900 g for an average weight of 34 g per rock.

Figure 6-42. Plan Map of Feature 9 in N104 E106

Seventy nine percent were in the small, 0 to 4 cm size class, and account for slightly less than half the total weight. These rocks were of relatively soft sandstone.

Feature 9 is interpreted as a dump of burned rocks used in a cooking activity. Although no shells were directly associated with these rocks it is assumed that the rocks were part of the process used to heat or cook the mussels. This cluster may represent one cleaning and discard of cooled rocks from a cooking episode.

Feature 10

Feature 10 was scattered near the center of the northern part of the block and extended over parts of six units that included N109 E106, N109 E107, N110 E106, N110 E107, N111 E106 and N111 E107 (Figure 6-43). It consisted of great quantities of burned rocks and mussel shells, plus relatively limited quantities of lithic debitage, scattered over an area that measured roughly 260 m north-south by 175 cm east-west.

This was an amorphous area with no obvious or well-defined boundaries. This irregularly shaped scatter of materials varied in thickness form 5 to 7 cm. No discolored sediment was observed in or around the burned rocks and mussel shells (Figures 6-44 and 6-45). Most burned rocks (N = 461) were less than 4 cm in diameter and nearly all were sandstone.

Tiny chunks and flecks of charcoal were observed in limited quantities scattered across the area with a few pieces big enough to collect. Feature 10 was also systematically sampled for magnetic susceptibility, phytoliths, and internal micromorphology. All the burned rocks and the more complete mussel shells were collected together with bulk sediment samples.

A four liter sediment sample (#677-004-1) from 80 to 90 cmbs in N110 E106 was floated. This yielded 15 ml or 2.7 g of light fraction, which consisted mostly of tiny rootlets with a few flecks of charcoal. The latter flecks were not identifiable as to species of wood (Appendix D). Four individual chunks of charcoal were selected and sent for identification. Two samples (#671-007-2 and #677-007-1) were oak wood (*Quercus* sp.). The other two pieces were too small for positive identification (Appendix D).

Two charcoal samples from slightly different elevations in Feature 10 were sent for radiocarbon dating. Sample #671-007-1a from 83 cmbs yielded a $\delta^{13}C$ corrected (-26.6‰) radiocarbon date of 940 ± 25 B.P. (UGAMS-5171). The second chunk (#673-007-1) from 92 cmbs yielded a $\delta^{13}C$ corrected (-24.3‰) radiocarbon date of 1200 ± 30 B.P. (UGAMS-5172). The lower and older date of 1200 B.P. is quite acceptable with the majority of dates obtained from other features in this block. The 940 B.P. date appears at least 140 years too young in comparison to the other dates and is likely not associated with this Terminal Archaic component 1. A single mussel shell (#677-006-1) from next to one of the dated charcoal samples at 85 cmbs in N108 E107 was also radiocarbon dated. This 7.9 g shell yielded a $\delta^{13}C$ corrected (-11.8‰) radiocarbon date of 1540 ± 40 B.P. (Beta-230777). This date is 340 years older than the accepted 1200 B.P. date derived from charcoal. Although the shell date is relatively close to the charcoal date, it is not accepted as reflecting the true age of the component.

Although Feature 10 burned rocks were somewhat scattered over the area, the general association of the charcoal, shells, and burned rocks were considered quite tight. Therefore, it was decided to again radiocarbon date two burned rocks from this feature and compared the results to the charcoal dates. A 135 g sandstone rock (#677-003-10a) from 80 to 90 cmbs in N107 E109 yielded a $\delta^{13}C$ corrected (-18.7‰) radiocarbon date of 1590 ± 30 B.P. (UGAMS-6667). A second sandstone rock (#706-00302a) that weighed 116 g yielded a $\delta^{13}C$ corrected (-15.3‰) radiocarbon date of 1880 ± 30 B.P. (UGAMS-6668). Both direct dates from organic residues inside the rocks are at least 390 years older than the accepted charcoal date of 1200 B.P.

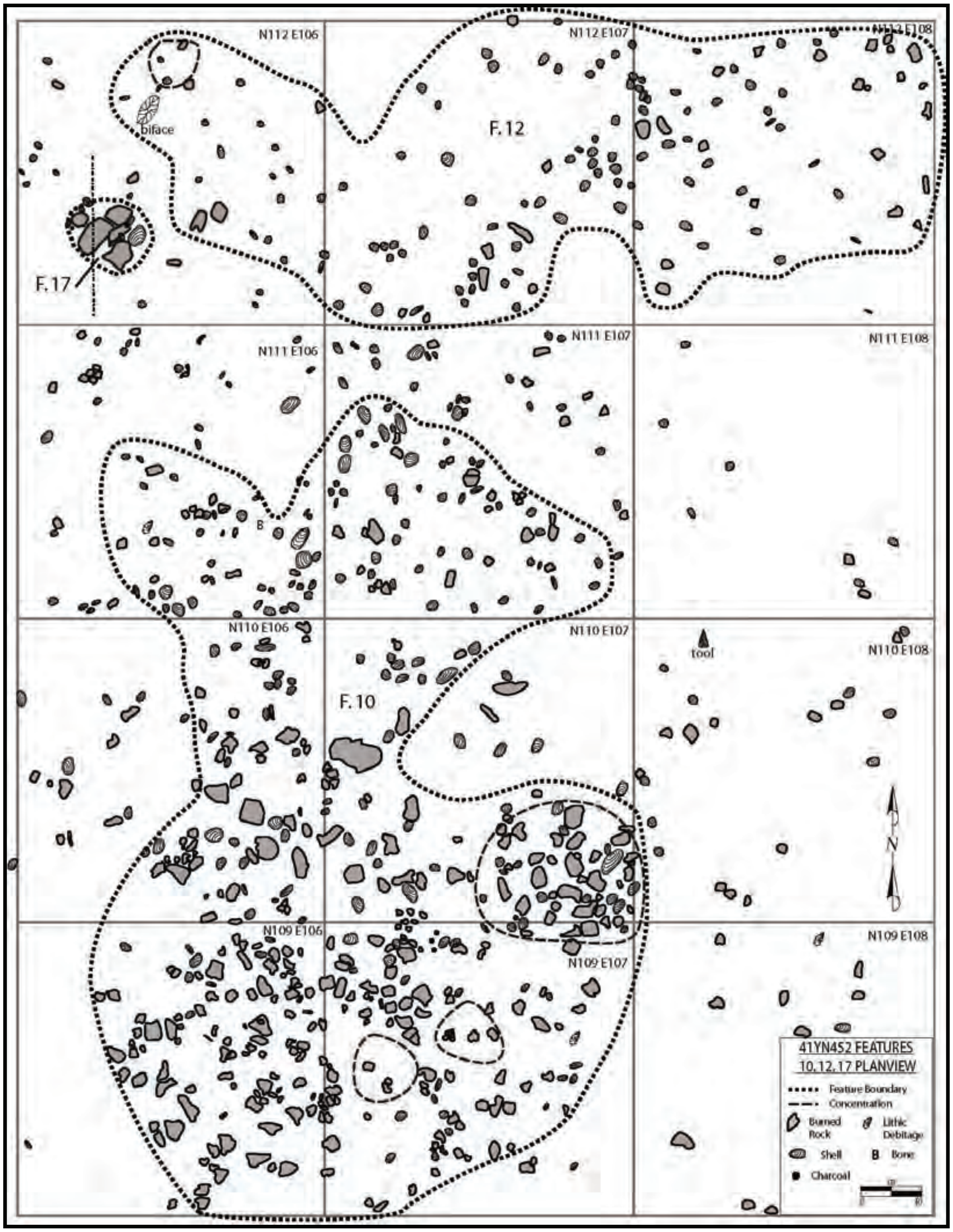

Figure 6-43. Relationships of Features 10 (lower part), 12 (top), and 17 (top left) across Northern Part of the Block

It is important to realize that the sandstone burned rocks do provide direct radiocarbon dates. Although an age discrepancy of 290 years is present in the two dated rocks and a significant deviation from the wood charcoal dates, there may be occasions (total lack of bones or charcoal), in which burned rocks can provide at least an approximately accurate for a cultural event.

Some 3,608 g of mussel shells were recovered from Feature 10. Smooth pimpleback (*Quadrula houstonensis*)

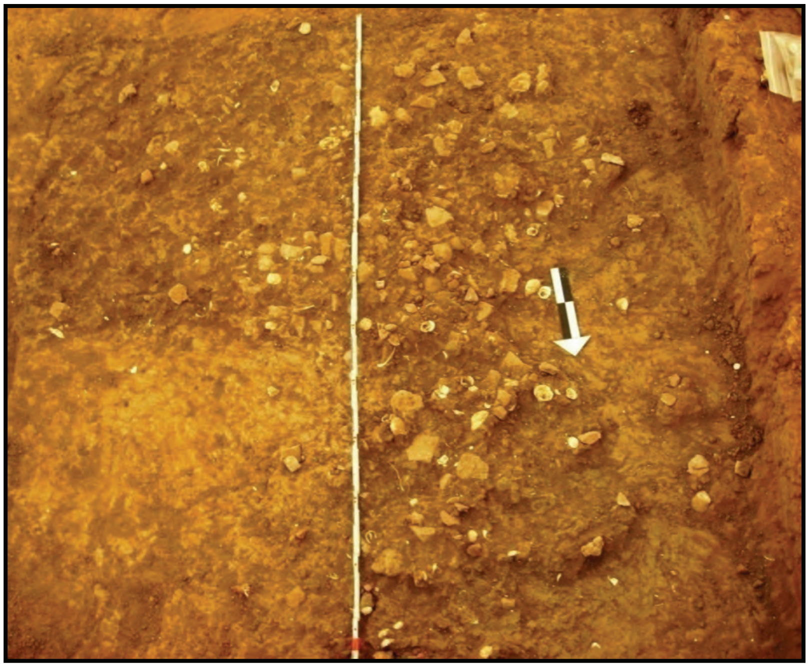

Figure 6-44. View South across the Western Two-Thirds of Feature 10

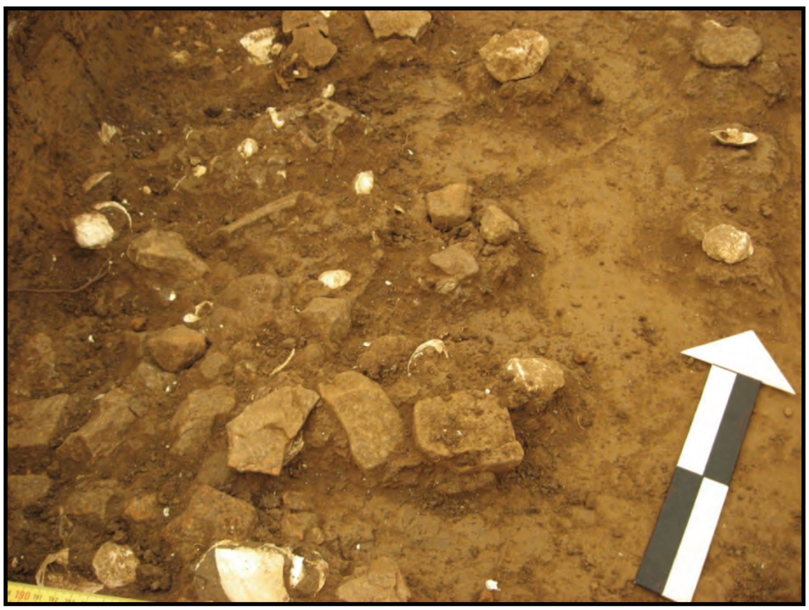

Figure 6-45. Close-Up of Part of Dump Area in Feature 10

dominated with at least 171 pieces identifiable, followed by 40 southern mapleleaf (*Quadrula apiculata*), 17 pistolgrip (*Tritogonia verrucosa*), 15 yellow sandshell (*Lampsilis teres*), 4 Tampico pearlymussel (*Cytronaias tampioensis*), 3 mapleleaf (*Quadrula quadrula*), and 1 threeridge (*Amblema plicata*).

These seven species show the greatest diversity of any feature in the block. Feature 10 contained the greatest densest and was the biggest feature in the block. Beside the identifiable pieces, 437 pieces were unidentifiable fragments with 177 crescent (40 percent) shaped outer edges. No pieces were burned or had recognizable holes, but one exhibits a thin cut line that might be a sign of cultural modification.

Units that contained Feature 10 materials yielded 932 burned rocks with a total weight of 31,082 g for an average of 33 g per rocks. Nearly 85 percent of the rocks were in the small size class of between 0 and 4 cm, which yielded only 38.6 percent of the weight. Only 1 percent was greater than 9.1 cm, indicating the near absence of large burned rocks.

Parts of three burned rocks (a total of 357 g) were selected and sent for starch grain analysis. None of the rocks yielded any starch grains (Appendix B), which may indicate that these rocks were not used to cook starchy plants. The two floated sediment samples also failed to yield any macrobotanical remains. The rocks were in direct association with large quantities of mussel shells.

Two burned rocks and a sediment sample from Feature 10 were subjected to diatom analysis. The sediment sample (#699-004-1a) yielded 49 diatoms, plus phytoliths and sponge spicules. The rock (#677-003-26c) yielded 80 diatoms and phytoliths, whereas a 68 g rock (#699-003-13c) yielded 148 diatoms (Appendix F). It is assumed that the significantly higher frequency of diatoms on the rocks relate to their immersion in local stream water when used for stone boiling to cook mussels.

Since the phytolith preservation was sufficient for environmental interpretations, a 19 g sediment sample (#699-004-1a) from Feature 10 was sent to Dr. Sudbury for detailed analysis. He counted the short-cell forms and determined that 56 percent were hot-and-dry forms (chloridoid), 38 percent were cool-and-moist forms (Pooid) and the warm-and-moist forms (panicoid) only account for 6 percent. These ratios appear to represent the natural grass background for this site with limited probability that this assemblage was significantly influenced by cultural processes. The 2.5 burned phytoliths that were observed are not sufficient to clearly indicate human activity.

A suite of 37 small matrix samples were collected in an irregular grid across this amorphous burned rock and mussel shell scatter while excavation was ongoing (see Section 6.1 above). For each of these samples the magnetic susceptibility, total and Bray phosphorus, total organic carbon and stable isotopic composition of the organic carbon were determined. A single oriented block of sediment was collected for micromorphological examination. The combined results indicate that cultural refuse within Feature 10 was deposited on the ground surface and subsequently buried by alluvial sedimentation. Subsequently, natural processes subtly reorganized these materials through time. The large items, such as the burned rocks and mussel shells, have moved very little, although the mussel shells appear slightly re-oriented following initial discard. The most significant re-organization of the feature has occurred with the fine-earth fraction which appears to have been significantly moved around by soil meso-fauna such as worms. Hypothetically one would expect this to be relatively small scale and not altered the broad-scale distribution of either the magnetic susceptibility or phosphorus, but worms clearly have homogenized and moved the fine-grained alluvial sediment and cultural refuse that was once present (see Section 6.1 above).

Feature 10 is interpreted to represent a relatively broad area where multiple classes of cultural materials were discarded. The observed tight clusters of materials with the broader area covered by Feature 10 supports the inference that multiple dumping episodes actually occurred here. The fact that lithic debitage was also present indicates stone knapping activities or perhaps more likely, waste materials from those activities were also dumped here.

Feature 12

This feature was primarily scattered across two and half to three units (N112 E106, N112 E107, N112 E108 and N112 E109) across the northern edge of the block near the bottom of the buried A horizon, between

82 and 94 cmbs (see Figure 6-43). Feature 12 consisted of scattered mussel shells (*N* = 282), small burned rocks (*N* = 194), a few pieces of lithic debitage (*N* = 32), and one broken biface (#746-10). No visible or precise boundary was observed, so the exact size and shape are questionable. In general, this scatter material measured about 265 cm east-west and 100 cm north-south, and had an irregular shape. This scattered may have been an extension of Feature 10 immediately to the south, although the excavators perceived a slight break between the two scatters.

Again, smooth pimpleback mussel shells (*Quadrula houstonensis*) predominated, with at least 65 individual shells identifiable, followed by 7 southern mapleleaf (*Quadrula apiculata*), 1 pistolgrip (*Tritogonia verrucosa*), 1 yellow sandshell (*Lampsilis teres*), and 1 threeridge (*Amblema plicata*). Combined with the 193 unidentifiable fragments and these pieces equal a total weight of 947 g. Forty-eight of the fragments represented the outer crescent edges of the shell. None of the shells were burned or exhibit holes or other modifications.

The 194 burned rocks weighed a total of 2,346 g for an average weight of 12 g per rock. As indicated by the overall average weight, the small size class of 0 to 4 cm was represented by 81 percent by count and only 36 percent by weight. No rocks were greater than 9 cm in diameter further indicating the small size of the rocks in Feature 12.

A single burned rock (#747-003-1a) was submitted for starch grain analysis. No starch grains were recovered (Appendix B).

Feature 12 is interpreted to also have represented a broad, loose scatter of mussel shells and burned rocks with a sparse scatter of lithic debitage. The burned rocks and shells likely resulted from cooking activities, whereas the lithic debitage was a byproduct of tool manufacturing, as was the one broken biface. At least a couple of small, tight clusters of materials were observed within this broader scatter and may represent individual dumps of material.

Feature 14

Feature 14 was a very tight cluster of 18 burned rocks (416 g) in the southeastern corner of N105 E111 (see Figure 6-29). This cluster measured about 35 cm in diameter and rested between 82 and 91 cmbs within the buried A horizon. Seventy-eight percent (*N* = 14) of the rocks were quite small and in the 0 to 4 cm size class, but one large piece measured about 18-by-15 cm and was slightly tilted (Figure 6-46).

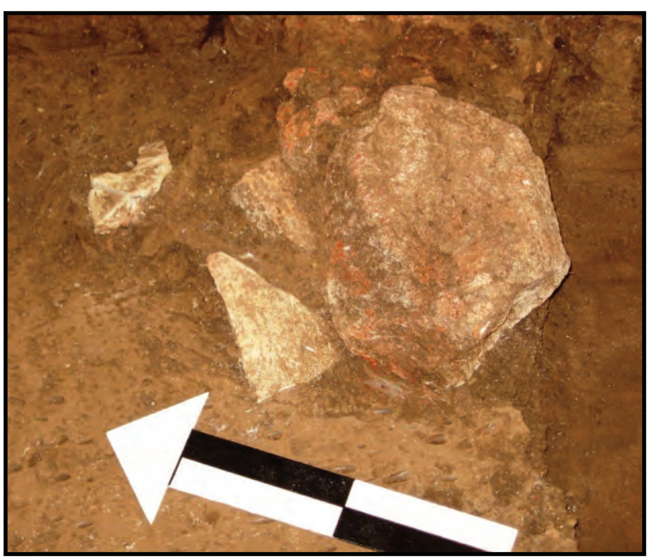

Figure 6-46. Close-Up of the Clustered Rocks in Feature 14

These rocks were all sandstone pieces, and had a total weight of 420 g. A small chunk of charcoal (#542-007-1) was recovered from under one of the burned rocks. Sediment (#542-00401) from under the cluster rocks was also collected. The piece of recovered charcoal was sent for radiocarbon dating. This chunk yielded a $\delta^{13}C$ corrected (-26.9‰) radiocarbon date of 1110 ± 30 B.P. (UGAMS-5173). This date is statistically identical to the two charcoal dates derived from Feature 1, just 2.5 m to the southwest.

Only a single mussel shell fragment (5 g) was with the burned rocks. However, another 68 g of shell that consisted of eight fragments and three threeridge (*Amblema plicata*), three smooth pimpleback (*Quadrula houstonensis*), and two southern mapleleaf (*Quadrula apiculata*) were in this unit at the same level. The sediment surrounding the burned rocks was a gray brown (10YR 3/2) with no sign of dark-staining or any indication of a pit.

Parts of three of the collected burned rocks were subjected to starch grain analysis. One 68 g rock fragment (#542-003-3a) yielded a single starch grain from wildrye as well as a fragment of unidentified starch grain (Appendix B). The other two rocks (444 g) did not yield any starch grains.

Two liters of sediment (#542-00401) from immediately around and just under the rocks at 80 to 90 cmbs in N105 E111 were floated, yielding 18 ml (2.5 g) of mostly tiny rootlets and less than 0.1 g of charcoal. The charcoal was identified as mesquite (*Prosopis glandulosa*) wood (Appendix D). Another piece of charcoal (#542-00701a) from this same unit was also identified as mesquite wood.

Diatom analysis on a sediment subsample (#542-004-1a) from Feature 14 yielded only seven diatoms, plus phytoliths, sponge spicules, and marine silicoflagellate. The low frequency of diatoms indicates that the sediment was not wet long enough for diatoms to grow. This would indicate that these clustered rocks were not accompanied by water when dumped (Appendix F). It is also possible that this tight cluster represents one episode of extracting cooled rocks from a cooking activity and dumping them here.

Feature 14 is interpreted to reflect a localized dump of rocks, presumably used in cooking. The immediate presence of one mussel shell indicates the cooking involved mussel meat. The lack of lithic debitage and the tight association of the rocks may indicate that this cluster represents a single dumping episode from one cooking event.

Feature 15

Feature 15 was discovered between 84 and 94 cmbs in N111 E110, and in the lower part of the buried A horizon (see Figure 6-29). It consisted of a loose cluster of mostly medium-size burned rocks in an irregular, unpatterened distribution. Fragmented burned mammal long bones, a fish otolith, mussel shells, chert flakes, the proximal half of a biface (#740-10), and charcoal chunks were inside or along the margin of the burned rocks (Figure 6-47). The ill-defined, irregular cluster measured about 70 cm north-south and 85 cm east-west. The middle area was nearly void of larger burned rocks, but yielded a few very small burned rocks and charcoal flecking in the surrounding sediment. The sediment in the center part of the cluster was a dark brown (7.5YR 4/2) silty clay loam. This feature was cross sectioned east-west near the middle, but no basin or pit was observed in the profile. The sediment surrounding the cluster was a gray brown (10YR 3/2) silty clay and part of the buried A horizon. A soil sample (#742-004-1) was collected from the northern half of the feature, whereas two charcoal samples (#740-007-1 and #740-007-2) were collected from across the unit. Five small clusters of fragmented burned deer-sized long bones (#742-002) were in this unit just outside the stained matrix. All these items were collected.

Figure 6-47. Overview of Burned Rock over Small Hearth, Feature 15, in North Block

One piece of charcoal (#740-004-1b) from 80 to 90 cmbs in N111 E110 was too fragmentary for identification. A 5.9 liter sediment sample (#742-00401) was floated and yielded 10 ml or 0.6 g of light fraction consisting mostly of tiny rootlets and a single charred chickweed (*Mollugo verticillata*) seed. This seed is considered to be an introduced anomaly, since it is an Old World species (Appendix D).

A 0.9 g chunk of charcoal (#740-007-1a) from 90 cmbs near the middle of the clustered rocks was sent for radiocarbon dating. This charcoal yielded a $\delta^{13}C$ corrected (-25.5‰) radiocarbon date of 1270 ± 30 B.P. (UGAMS-5174). This date supports the association of Feature 15 with the rest of the Terminal Archaic component 1 features and activities in this block.

The two levels of shells from around and just below the rocks weighted 115 g. The identifiable species included four smooth pimpleback (*Quadrula houstonensis*), and four southern mapleleaf (*Quadrula apiculata*). The 20 fragments included three crescent shaped edges. One shell had been burned to a gray color and one other piece has a small-diameter hole near the beak of the shell.

Most burned rocks encountered were from 90 to 100 cmbs with a few pieces scattered below that level. In total, this feature yielded 80 burned rocks with a weight of 2,584 g for an average of only 32 g per rock. By far the small size group (0 to 4 cm) predominated, with 56 pieces (70 percent), whereas five (6 percent) pieces were between 9.1 and 15 cm in size and account for 1,102 g, or 43 percent, of the total weight.

Parts of four randomly selected burned rocks and one sediment sample were sent for starch grain analysis. A 107 g sample of rock (#740-003-4) yielded two wildrye (*Elymus* sp.) starch grains and the sediment sample (740-003-1a) yielded 16 starch grains of wildrye grass. The pitting pattern on the grains from the sediment is different form that on the burned rock (Appendix B). The analysts observed that the material in the sediment contained the small starch grain component that occurs in this grass group, while the burned rock yielded no small-size starches. Consequently, the starch grains in the sediment have not contaminated starch-grain samples from the burned rocks in Feature 15 (Appendix B).

Following the determination that phytoliths were sufficient for environmental interpretations, a 17 g sediment sample (#742-004-1b) from inside Feature 15 was sent to Dr. Sudbury for detailed analysis. A total of 382 short-cell phytoliths were counted, and these were dominated by hot-and-dry forms (Chloridoid) at 55 percent, followed by cool-and-moist forms (Pooid) at 36 percent, and warm-and-moist forms (Panicoid) at only 5 percent (Appendix E). Seven panicoid phytoliths were burned, as were a number that in sediment samples from Features 2, 7, and 17. At present, it is not clear if the burned particles resulted from cultural processing of the grass fibers or not. The fact that not many of the short-cell forms were burned and a higher percentage of the panicoid forms were burned may lend support to the idea that these represent intentional burning during site occupation. It is acknowledged that they may also represent natural background. The finding of wildrye starch grains on one rock from this feature may support the idea that the burned phytoliths pertain to wildrye. The observed phytolith pavement of epidermal elongate cells may be cut, but currently that is open for further study.

A 49 g fragment of burned rock (#740-003-1c) plus a subsample of sediment (#742-004-1a) were sent for diatom analysis. The sediment sample yielded only three diatoms plus phytoliths and sponge spicules. The presence of diatoms, sponge spicules, and phytoliths indicates these microfossils may have resulted from the sediment being wet for a very short-time, possibly as the result of the dumping of water after a cooking event. The rock also yielded a low count of only 11 diatoms. The near absence of diatoms indicates that the rock and sediment were not moist enough to allow diatoms to grow (Appendix F). Whether or not this means that the rock was not used in a cooking activity (or at least one that did not involve the use of water) is not clear.

During the initial assessment of the materials, the lipid residues provided interesting results. A reanalysis of the two burned rock samples from Feature 15 (#740-003-1b and #740-003-2b) yielded similar results. In the case of #740-003-2b, the C18:1isomers were at very high levels (46.32), which are observed in the decomposed residues of high-fat-content seeds and nuts (Appendix H). Rendered fats of certain mammals (other than large herbivores) exhibit high levels of C18:1. Both plant and animal sterols were confirmed in this sample, but animal products dominate. Conifer products were confirmed by the presence of diterpenoid dehydroabietic acid, which likely is the result of fuel selection for heating the cooking rocks. Most likely, the conifer product in this context would be juniper (*Juniperus*) trees. Sample #740-003-1b yielded low levels of fatty acids, but both plant and animal products are confirmed, together with the presence of conifer products.

The presence of diverse classes of cultural materials in Feature 15, combined with the unstructured nature of the rocks and dispersed charcoal flecking, indicates that this was a locus of discard of diverse, unwanted materials. These different material classes probably accumulated from multiple nearby preparation processes of different foods, that included at least one large ungulate (deer/antelope-size. This cluster of materials probably represents a cleaning event.

Feature 17

Feature 17 was discovered towards the northwestern corner of the block in N112 E106, just outside the western edge of Feature 12 (see Figure 6-43). It consisted of six tightly clustered burned rocks and four to five nearly complete mussel shells, all between 82 and 96 cmbs within the lower part of the buried A horizon. These tightly clustered items covered an area about 25 cm in diameter. Other mussel shells and burned rocks were scattered around this cluster. The surrounding sediment showed no obvious dark staining or evidence of a pit below the rocks (Figure 6-48).

Two vertically oriented mussel shells were under one burned rock on the northern side of the feature. One chunk of charcoal was under a burned rock at 92 cmbs. All the burned rocks (N = 6), the mussel shells, the charcoal chunk, and the sediment from immediately under and around the cluster were collected.

Figure 6-48. Close-Up Profile of Feature 17

The single piece of charcoal (#748-007-1a) from 92 cmbs was sent for identification. Dering identified the piece as mesquite wood, which weighed 0.2 g (Appendix D). Part of this same piece of mesquite charcoal (#748-007-1a) was sent for radiocarbon dating, yielding a $\delta^{13}C$ corrected (-24.1‰) radiocarbon date of 1150 ± 40 B.P. (Beta-230764). For direct comparison purposes a single mussel shell (#746-006-1) from 93 cmbs in this tight cluster was also radiocarbon dated. The single 4.9 g shell yielded a $\delta^{13}C$ corrected (-8.3‰) radiocarbon date of 1430 ± 40 B.P. (Beta-230776). Although not identical to the dates derived from charcoal, the 280 year difference is not that much different, and may only reflect the incorporation of old carbon into the shell during the mollusk's growth.

The shells recovered from Feature 17 weighed 78 g, with three shells identified and the remaining 37 fragments unidentifiable as to species. Two fragments were the crescent-shaped outer margins of shells. The species identified include two pistolgrip (*Tritogonia verrucosa*) and one smooth pimpleback (*Quadrula Houstonensis*) mussels. None of the pieces were obviously burned or showed any signs of alteration.

The six burned rocks (#747-003) included four small (less than 4 cm in diameter) pieces that weighed 159 g, and two larger (9 to 15 cm diameter) rocks that weighed 1,995 g. The two larger pieces were both parts of rounded cobbles, whereas the smaller pieces were irregular chunks. The average weight per rock is 359 g, considerably heavier than most discarded rocks in any of the other features. The average weight is also greater than the average of 310 g for the rocks in Feature 1.

Since phytolith preservation was determined sufficient for interpretations, a sediment sample (#748-004-3b) from within Feature 17 was sent to Dr. Sudbury for detailed analysis. This sample yielded the highest concentration of phytoliths from this site. A total of 325 short-cell forms were counted, with cool-and-moist forms (Pooid) represented by 43 percent, hot-and-dry forms (Chloridoid) by 51 percent, and the remaining warm-and-moist forms accounting for 6 percent (Panicoid; Appendix E). Six phytoliths, of various types, were burned. The evidence indicates no obvious plant use at this feature and indicate that the phytoliths were part of the natural background environment. These findings reveal slightly more cooler-season grasses in comparison to most other features, and reflect the presence of a mixed-grass prairie.

A subsample of sediment #748-004B-2 and a 198 g fragment of burned rock (#747-003-1) were sent for diatom analysis. The sediment samples yielded 16 diatoms plus uncounted phytoliths. The rock yielded 142 diatoms, but no phytoliths (Appendix F). This diatom assemblage was interpreted to indicate the diatom remains were attached to the rock when it was used in the cooking process. The accumulation of the diatoms were probably introduced from the water collected from the nearby steam and used in the cooking process. This indicates that the hot rock was placed in a watery solution and used to heat/cook food, most likely mussels. The phytoliths present in the sediment likely represent part of the natural background vegetation as phytoliths were not found on the burned rock.

The tight cluster of the five shells and six burned rocks, combined with the one piece of charcoal under the rock, indicate this cluster was a small dump of unwanted materials. This small tight cluster may have represented a single dumping episode from one heating process that involved mainly the cooking of mussels. The two larger rocks were minimally fractured and appeared large enough for reuse. The presence of charcoal indicates that these rocks did not come directly from a watery cooking process, otherwise the charcoal would not have been present. Therefore, these rocks may have come directly from the heating element in which they were used to directly apply heat to open the mussels.

Feature Discussions

All 14 features presented above were within the targeted buried A horizon and are considered part of a single, discrete Terminal Archaic component 1. Based on their shapes and contents these features represented a limited suite of human activities during a radiocarbon-dated period between 1100 and 1330 B.P., based on nine assayed samples. All features are classified as *in situ* in the sense that humans created these clusters of materials, and they have not been significantly disturbed by post depositional processes. It is acknowledged that some turbatin processes in one form or another, have potentially displaced a few smaller objects within the clusters, but not to an extent sufficient to alter the original shape or contents.

The burned rocks in the recognized features account for 36.4 percent of the total by count for the block and 41.8 percent of the total by weight. The feature rocks were relatively small and averaged only 42 g per rock.

Only one *in situ* heating element, Feature 1, was identified within these 14 features. The unique characteristics of Feature 1 include larger rocks (average weight of 310 g per rock), their apparent placement in a roughly circular pattern within a restricted space, a shallow basin with a central area void of larger rocks, and an abundance of wood charcoal below and between the rocks. These characteristics indicate that wood fuel, which consisted of at least three tree species, was used to heat the rocks, which in turn were then used to heat/cook food resources. The heated rocks were most likely removed from this heating element and placed in a rawhide container that held water, to heat the water and cook the foods.

Two rocks analyzed for lipid residues yielded degraded residues that indicate the processing of a combination of plant and animal products using the rocks. One analyzed rock also yielded a wildrye (*Elymus* sp.) grass-seed starch grain. The starch grain appears to support the lipid residue finding of the presence of plant products. It is not clear whether the grass seed was intentionally cooked, part of the fuel, or was an accidental inclusion into the heating process. This C_3 wildrye is not, however, part of the background site vegetation that is dominated by C_4 grasses. Part of the macrobotincal remains from Feature 1 also include a burned mesquite seed and pod. Again, the mesquite seeds may also support the lipid residue findings, although it is not clear if the mesquite was introduced as part of the fuel or was, in fact, one the processed food resources. It seems unlikely that green mesquite wood have been used as fuel, thereby indicating the mesquite seeds were part of the food resources.

All the other 13 features (93 percent) appear to represent intentional dumping or discarding unwanted cultural debris, which no longer served its original, intended purpose. These dumps reflect a general discard of small, used burned rocks and mussel shells, both thought to have been part of the cooking conducted at this camp. Seven or 54 percent of the discard features (Features 1a, 1b, 6, 9, 14, 15, and 17) were dominated by high frequencies of burned rocks, but most also included mussel shells and a few scattered pieces of lithic debitage and the occasional chipped stone tool. The other six discard features (Features 2, 5, 7, 8, 10, and 17) were dominated by mussel shells, with burned rocks the second-most-frequent class of material. This latter group of features accounted for 86 percent of the rocks by count and 70 percent by weight. None of the discard features contained significant quantities of lithic debris and only very sparse wood charcoal.

At least six discard features (Features 1a, 1b, 6, 9, 14, and 17) appear sufficiently localized (i.e., relatively tightly clustered materials) for each to represent a single dumping episode. These tight clusters were in significant contrast to the broader scatters of multiple classes of materials in such features as Features 2, 5, 7, 10, and 12.

The types and frequencies of the mussel shells from each feature have been presented in the individual feature descriptions, above. Here, the discussion shifts to a focus on the mussel shells in the features, as a group. Just over 57 percent of the shell weight was represented in the identified features. This compares to 43.7 percent by count (N = 1,962). Only 16.7 percent of the burned shells (N = 4) were in the features. Those shells that exhibit holes were evenly split between the features and nonfeature contexts. The crescent-shaped edge fragments were more frequent (66.5 percent) in the features. Only 42 percent of the fragments were inside the features. The more numerous fragments outside the higher density features may reflect the crushing of shells from foot traffic through the area during site occupation, while individuals avoided the more clustered or concentrated clusters of shells and burned rocks in the features.

The features yielded some 64 percent of the lithic debitage from this block. No tight clusters or concentrations of debitage were observed during the excavations of these clusters. The ill-defined juncture of the northern end of Feature 7 and the southern end of Feature 5 yielded the highest concentration (N = 31) of lithic debitage

from a feature context.

Only two bifaces, both in discard features (one in Feature 2 and one in Feature 7), one dart point in Feature 2, and 15 edge-modified flakes were in the 14 features. No formal or informal tools were in the *in situ* heating element, Feature 1, so 100 percent of the chipped stone tools in features were found in the discard features. Therefore, though many of the discard features yielded a few pieces of lithic debitage, formal broken tools were not discarded together with the quantities of discarded shells and burned rocks. Apparently formal tools were not often worn out or broken at this location and therefore, few were discarded in the features.

6.3.3.2 Chipped Stone Tools

Terminal Archaic component 1 lithic artifact sample consists of materials recovered from the North Block, about 78.5 m^2 in area and between N100 through N112 and E100 through E111. Table 6-11 provides the breakdown of tool classes. Radiocarbon dates for this component range from 1100 to 1300 B.P. based on nine acceptable charcoal dates derived from various features (see Section 6.2 for discussion of stratigraphy). The following presentation discusses tool data from analysis that provides a characterization of the assemblage and contributes information with which to address Research Questions 2, 3, and 4 as presented in the research design (see Chapter 4.0).

Table 6-11. Artifact Class Frequency for Terminal Archaic Component

Component	Artifact Classes	Frequency (*N*)
TA-1	Projectile Points	6
TA-1	Bifaces	21
TA-1	Scrapers	3
TA-1	Edge-Modified Flakes	71
TA-1	Uniface	1
Total		102

The hand-excavations (the entirety of the North Excavation block plus Test Units 2, 5, 6, 7 and 8) yielded a sample of 102 flaked-stone tools. This group represents 14 percent of the overall lithic assemblage, the remainder comprises mostly debitage. Chipped-stone tool descriptions are presented below by tool class. A number of tools in each class were also selected for detailed description as representative examples of that class. Details of the quantitative and qualitative measurements of the chipped stone tool assemblage can be found in Appendix K.

Specific tools (*N* = 30 or 19 percent of total) were selected for high-powered microscopic use-wear analysis (see Appendix C). This use-wear analysis focused on identifying specific tool uses through detection of microwear on tool surfaces, as well as identifying the organic materials left on the tool presumably the result of contact with those materials. A summary of the use-wear results for each specimen is included in the individual tool descriptions below, where applicable.

Projectile Points

Projectile points comprise only 4.5 percent of the chipped-stone tool assemblage. This group includes three complete specimens (#138-10, #663-10, and #695-10) two distal fragments (#488-10 and #617-10) and one proximal/medial fragment (#459-10). The three complete specimens are discussed in detail below.

We are categorizing these items as dart points, based on their metric and morphological characteristics, and their similarity to chipped-stone bifaces generally assumed to be dart points (e.g., Suhm and Jelks 1962; Turner and Hester 1999). Nonetheless, we recognize that these specimens, as well as many other artifacts commonly identified as dart points, could have had multiple uses (e.g., as both dart points and knives). Use wear analysis of the specimens from the Root-Be-Gone site, does, indeed, indicate that these items were, at least at times, used in cutting tasks, and therefore can be identified as multi-functional tools.

Specimen #138-10 was recovered during the NRHP eligibility assessment from Test Unit 7 that was subsequently incorporated into the southwestern corner of the North Block. This specimen is currently untyped, as the overall form does not match well with currently recognized types (Figure 6-49**).** The flaking pattern on both faces is complete, yet random.

Metric measurements for this and other points are presented in Table 6-12**,** with qualitative observations presented in Table 6-13. At over 45 mm in length, this is the longest point as well as the heaviest (6.9 g).

Table 6-12. Selected Quantitative Measurements for Projectile Points

PNUM	Unit	Depth (cmbs)	Max Length (mm)	Max Width (mm)	Max Thickness (mm)	Weight (g)	Type	Completeness
138-10	TU7	80-90	45.57	20.08	7.94	6.9	Unknown dart	Complete
663-10	N109 E104	90-100	36.42	19.12	6.53	4.7	Darl-like	Complete
695-10	N110 E105	90-100	31.12	18.03	6.72	3.3	Unknown dart	Complete
488-10	N104 E105	70-80	15.98	13.79	3.83	0.7	Unknown dart	Distal Fragment
459-10	N102 E111	80-90	21.51	14.32	3.02	1	Unknown arrow	Proximal/ Medial Fragment
617-10	N107 E108	80-90	15.8	14.77	3.42	0.6	Unknown dart	Distal Fragment

Table 6-13. Selected Qualitative Observations of Complete Points

PNUM	Lateral Edge A	Lateral Edge B	Thermal Alteration	Base Type	Stem Type	Basal Grinding
695-10	Excurvate	Excurvate	None	Incurvate	Expanding	None
138-10	Excurvate	Excurvate	None	Incurvate	Contracting	None
663-10	Excurvate	Excurvate	None	Straight	Expanding	Light

It has excurvate lateral edges and an intact distal point. This is a relatively thick dart point with a maximum thickness of 7.94 mm.

Both lateral edges are excurvate, with edge angles of 60 and 62 degrees. A tool with these edge angles could be used for activities that require a sturdy blade such as heavy cutting on wood bone or wood working. This point has a contracting stem. The stem measures 13.8 mm wide just beneath the shoulders and 10.8 mm at the base. Neck width measurements fall within the range of analyzed atlatl dart points measured and statistically analyzed by Thomas (1978:469). A light degree of grinding is evident on the slightly concave base. Use-wear analysis showed evidence of raphides and high/hard silica polish in multiple places across the faces. Plant cutting is a suggested use for this tool, based on residues and observed polish (Appendix C). Hardy indicates that this tool was hafted, and that the haft extended midway up the face of the tool (Figure 6-49).

Specimen #663-10 is similar in outline to a Darl point (Turner and Hester 1999) and was recovered from 90 to 100 cm in the north-central part of the excavation block (N109 E 104). The flaking pattern on both faces is complete yet random. This point is symmetrical in shape with an expanding stem and a straight and lightly ground basal edge (Figure 6-50).

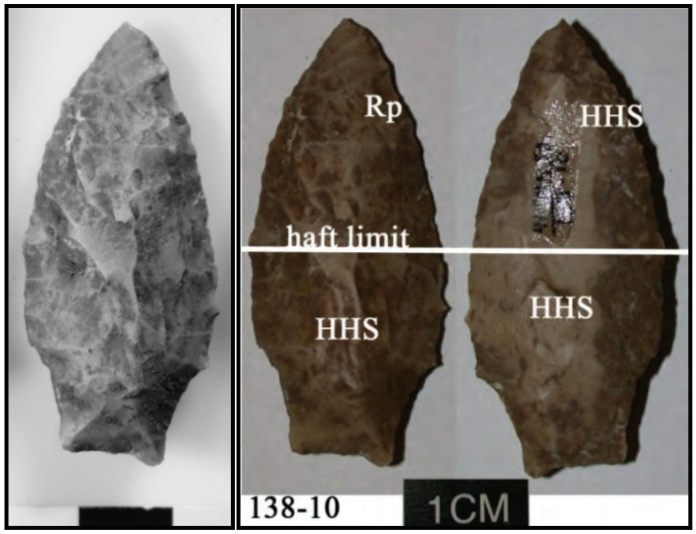

Figure 6-49. Unwashed Dart Point Specimen #138-10 on Left and Use-Wear Results on Right. Scale in cm.

The lateral blade edges are excurvate and the average edge angle values are 69 and 57 degrees. Generally, tools with steeper edge angles can be used for scraping, heavy cutting, as well as wood and bone working (Miller 1979:402-405).

The neck width is 15.97 mm at the base and 13.7 mm at the distal end. As with specimen #138-10, the measured neck widths are consistent with atlatl darts examined in Thomas' (1978) research, which was designed to statistically differentiate arrow points and dart points.

Use-wear analysis revealed hard high silica polish as well as soft-polish striae on a large part of the tool surface (see Appendix C: Figure C-4). Due to the combination of raphides and striae on the medial/proximal area of this point, Hardy has interpreted this specimen as having been hafted. However, no clear determination of tool function could be made.

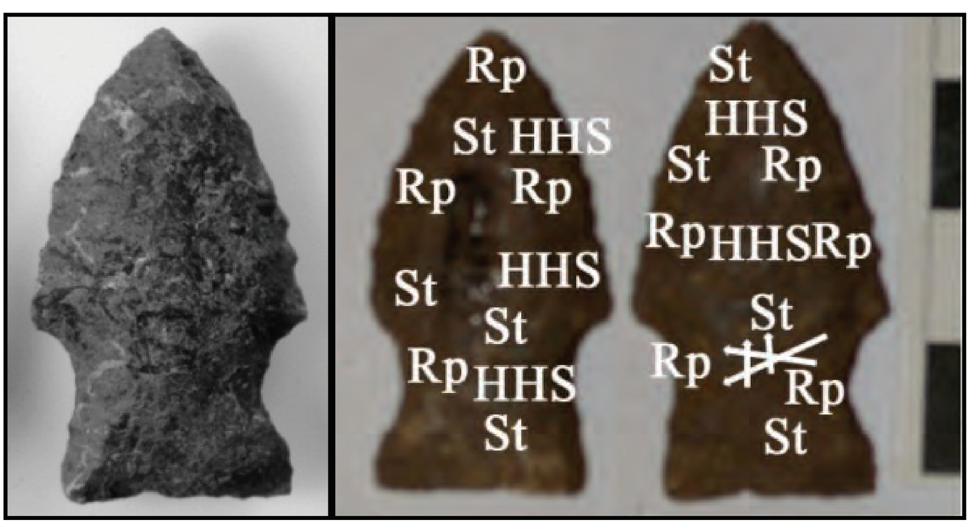

Figure 6-50. Unwashed Dart Point #663-10 on Left with Use-Wear Results on Right

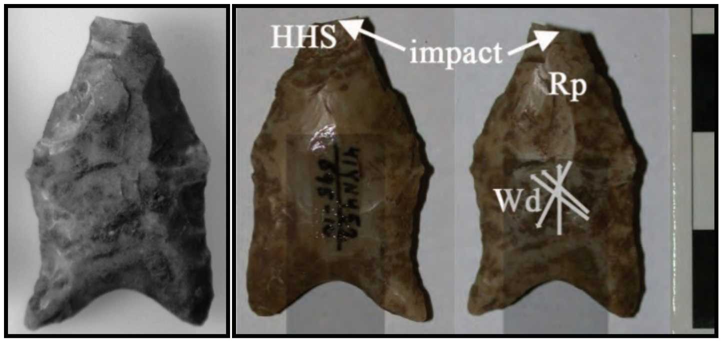

Figure 6-51. Unwashed Dart Point #695-10 of Left and Results of Use-Wear on Right. Scale in cm.

Specimen #695-10 is an irregularly shaped, stemmed point recovered from N110 E105 between 90 and 100 cmbs (Figure 6-51). This complete point appears to have been heavily reworked on the distal end (possibly due to a prior distal tip break) and then subsequently broken again by impact. The attention given to this point in terms of reworking/rejuvenation differentiates it from the other specimens in this class. The lateral edges are excurvate and asymmetrical due to the impact fracture at the distal end. The lateral edge angles, 54 and 55 degrees, denote a tool that may have used for cutting and scraping on items of medium hardness such as dry hides, fish, and soft stone.

The neck widths are 18.09 mm just below the shoulder and 17.12 mm at the base. Again, these measurements coincide with what has been demonstrated for atlatl dart points (Thomas 1978).

The deep concave base does not show any evidence of grinding. Basal concavity is quite pronounced, with a width of 14.88 mm and a depth of 4.21 mm. The completely different basal edge shape (concave) compared to most Late Archaic points may indicate this was an earlier type that was collected, curated, and reworked. Residue analysis found evidence of hafting (wood fibers) on the medial portion of the face, as displayed in the figure. In addition, both hard high silica polish and raphides are present near what had been the distal end (tip). Uses for this tool are hypothesized to include contact with a hard material. The impact fracture on the tip also indicates it hit a hard surface (i.e., possible bone or rock).

In summary, these three complete dart points were subjected to a range of quantitative and qualitative measurements (Tables B and C; Appendix K). Their overall shapes are quite different, but generally fit within the broad range of Darl as originally presented by Suhm and Jelks (1962). They all fit within the dart point range in terms of form and measurements. Based on their different forms they are not of the same types, though any attempt to force the specimens in this small sample into formal types would probably be unproductive. The mean point length among the complete specimens is 35.25 mm, while the mean width is 17.15 mm. The average thickness is 6.16 mm.

Bifaces

The 21 bifaces comprise 12 percent of the chipped-stone assemblage, the second largest tool class represented (see Table 6-11). Five specimens are complete, 2 are distal fragments, 4 are distal-medial fragments, 2 are medial fragments, 2 are proximal-medial fragments, and 6 are indeterminate fragments. A sizeable percentage (42 percent) came from between 80 and 90 cmbs. All specimens in this group were fashioned from Edwards chert. Descriptions of selected bifaces are presented below with metric attributes presented for each in Table 6-14. Also included are supplemental data derived from use-wear analysis performed by Bruce Hardy.

Specimen #519-11 is a small, complete biface recovered within N105 E104 near the boundaries of Features 8 and 5. This biface appears to have been manufactured from a flake with a hinge termination (Figure 6-52). Given its small size, the edges and tool faces were probably flaked with an antler tine using a pressure flaking technique. Its overall appearance is relatively crude, given the asymmetrical edges and diversity of flake-scar size and patterning. Some areas on the tool face bear potlids (indicators of thermal alteration). Use-wear analysis revealed hard high silica polish on/near the distal (pointed) end. Raphides were also observed near the distal end. This small biface also shows signs of having been hafted, based on abraded ridges on the proximal half. Apparently, the haft extended to about the midpoint of the biface (Appendix C, Figure C-2).

Specimen #556-11, one of the larger bifaces (Table 6-14), was recovered at 100 cmbs within N106 E104 and was broken into two pieces (Figure 6-53). Based on the width-to-thickness ratio, this is classified as a middle-stage biface (Callahan 1979). A probable cortical platform is present along one lateral edge.

The platform area is surrounded by cortical remnants and has a chalky appearance. The worked right-lateral edge is discontinuous as it is worked on both sides of this platform. The base has been thinned and rounded. A "knot" appears on the obverse face just above the break line (similar in fashion to specimen #630-10). It is likely that the knot contributed to the location of the break. Use-wear analysis documents the presence of plant fiber and raphides with noted hard/high silica polish on the distal end. The proximal half shows evidence of having been hafted. Hardy suggested uses for this tool include cutting plants (Appendix C; Figure C-2).

Table 6-14. Selected Attributes on Terminal Archaic Component 1 Bifaces.

PNUM	Unit	Depth (cmbs)	Max Length (mm)	Max Width (mm)	Max Thickness (mm)	Weight (g)	Stage of Reduction
109-10	TU2	60-70	24.05	30.1	6.28	4.3	Indeterminate
144-10	TU8	80-90	36.31	33.96	9.36	11.6	Middle
466-13	N103 E105	80-90	48.95	44.72	17.04	22.9	Indeterminate
519-11	N105 E104	80-90	30.18	11.68	4.05	1.6	Middle
550-12	N106 E103	80-90	19.88	16.93	3.75	1.3	Early
55610	N106 E104	90-100	23.83	16.36	4.38	1	Middle
556-11	N106 E104	100	61.62	27.4	8.91	12.6	Middle
564-11	N106 E106	70-80	19.18	23.41	3.7	1.6	Late
574-12	N106 E108	90-100	22.12	19.55	4.73	1.5	Middle
577-10	N106 E109	70-80	16.85	7.07	3.17	0.4	Indeterminate
604-12	N107 E105	70-80	27.92	11.39	3.83	1.3	Middle
630-10	N108 E102	92	82.95	52.23	11.27	4.07	Late
651-10	N108 E108	80-90	42.53	16.86	6.26	4.2	Early
659-10	N108 E110	81	49.3	27.2	8.68	10.3	Middle
685-10	N109 E109	70-80	10.64	16.34	4.3	0.7	Indeterminate
690-10	N109 E110	80-90	40.27	22.81	9.13	6	Early
724-10	N111 E107	74	37.16	16.98	4.73	2.4	Middle
731-10	N111 E108	70-80	46.83	43.77	10.76	48.8	Indeterminate
740-10	N111 E110	80-90	24.93	29.9	6.04	5.5	Late
746-10	N112 E106	80-90	48.4	27.46	7.89	9.6	Middle
703-11	N110 E107	70-80	15.75	37.10	9.59	5.6	Early

Figure 6-52. Complete Unwashed Biface #519-11. Scale in cm.

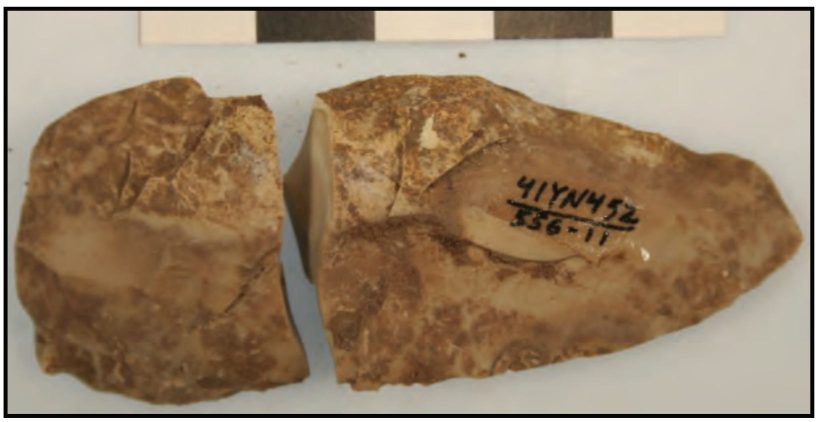

Figure 6-53. Complete Unwashed Biface #556-11. Scale in cm.

Biface #630-10 is a large, asymmetrical distal fragment recovered from 92 cmbs in N108 E102 (Figure 6-54). The dimensions (see Table 6-14) of this fragment are relatively large in comparison to other complete bifaces, discarded cores and flakes recovered from this component. Callahan's (1979) width-to-thickness ratio scales indicate this is a late-stage biface. A knot appears on the obverse face just above the break. An area on the lower right lateral side (straight edge) has been more intensively flaked resulting in a thinner edge angle in that location and a wider flaked edge width. Use-wear analysis documented soft polish on the excurvate edge. Microscopic analysis also indicated hair and wood tissue towards the straight edge. In addition, the striations, mastic, and wood tissue residues indicate this biface was hafted along the straight long axis (see Appendix C, Figure C-9). If this is an accurate interpretation, this hafting technique is unique in this tool assemblage.

Specimen #690-10 was recovered between 80 and 90 cmbs within N109 E110. This is an early stage biface based on the sinuous lateral edges with large flake scars relative to its overall dimensions (Table 6-14, Figure 6-55). The lateral edges are asymmetrical with a straight edge part on the right lateral side. The base has been worked and is excurvate in shape. This biface was manufactured from a cobble rather than a flake, given its thickness and general bulky appearance.

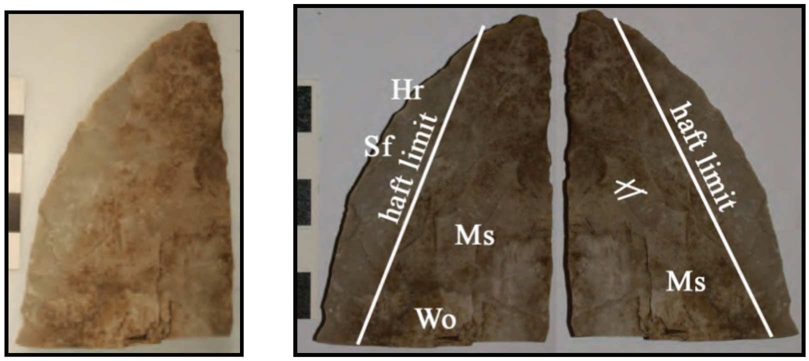

Figure 6-54. Distal Biface #630-10 Depicting one Straight and one Curved edge. Use-Wear Results on Right. Scale in cm.

Use-wear analysis found evidence of hafting and polish that would indicate wood-scraping activities (Appendix C). Specimen #724-10 was recovered at 74 cmbs within N111 E107. This complete biface is relatively small (see Table 6-14) when compared to other bifaces in the assemblage. It appears to have been fashioned from a flake given the flat, partially unworked face is present on the ventral surface (Figure 6-56). This face was only marginally flaked. Both lateral edges appear to have been resharpened, given the presence of pressure-flake scars. Use-wear analysis could not determine the function based on wear, but raphides cover most of the both faces indicating its use on plants (Appendix C, Figure C-5).

Biface #740-10 was recovered from between 80 and 90 cmbs in N111 E110. This is the proximal section of a longer biface (Figure 6-57). The width-to-thickness ratio classifies this fragment as a late-stage biface—but this ratio could reflect biface manufacture from a flake rather than from a bifacially reduced cobble. A remnant of an unmodified ventral face surrounds the cortical edge. The transverse snap indicates breakage during use. Use-wear analysis documented the presence of hard high silica polish and abraded flake scar ridges on both faces (Appendix C).

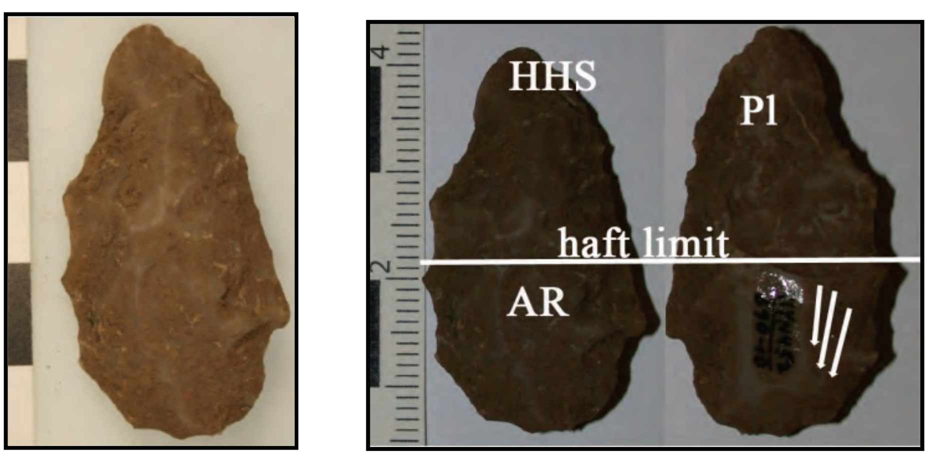

Figure 6-55. Complete Unwashed Biface #690-10. Scale in cm.

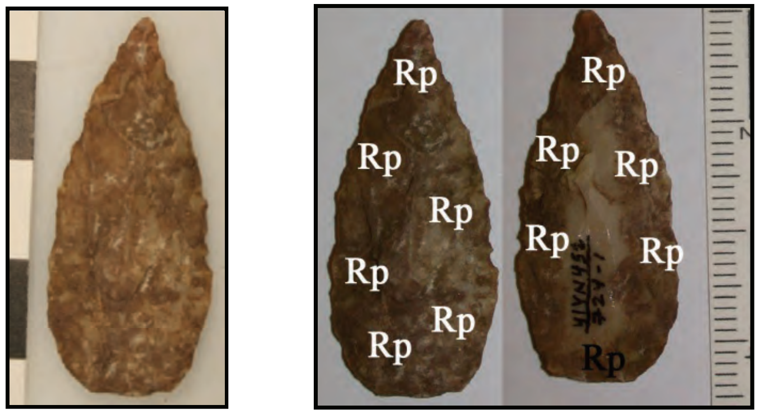

Figure 6-56. Complete Unwashed Biface #724-10. Use-Wear Results on Right. Scale in cm.

Figure 6-57. Unwashed Proximal Fragment of a Biface #740-10. Scale in cm.

Figure 6-58. Unwashed Medial Biface Fragment #746-10.

Tool function was not discernable via use-wear analysis, but evidence of hafting was present from the proximal end to just below the beak. This is the proximal (hafted end) end, even though it actually represents the distal part of a flake. Specimen #746-10 is a medial biface fragment that has been flaked on both faces (Figure 6-58). With the low frequency of flaking and the fact that flake characteristics are easily recognizable, one could argue that this specimen could be classified as an edge-modified flake. The dorsal surface bears several flake scars and has some edge-modification on the right-lateral edge. The left lateral edge, however, shows little if any edge-modification. The ventral face exhibits two large flake scars extending from the left-lateral edge (corresponding to the right lateral edge on the dorsal side). Also present is an erraillure scar originating at the apparent platform. Use-wear analysis observed hard high silica polish just below the break, as well as soft polish along the left lateral edge (Appendix C, Figure C-5).

Both polish locations are on the ventral face. In addition, microscopic examination observed wood tissue and raphides. Based on these observed characteristics the function was interpreted as cutting of starchy plants.

Specimen #604-12 is a complete, small, thin, irregularly shaped biface, whose sides are asymmetrical (Figure 6-59). The overall form/morphology indicates that it was hafted, but overall size is much smaller than most bifaces. Use-wear analysis observed polish and striae in two locations on one face, and raphides and possible starch grains on the obverse face (see Appendix C: Figure C-7). In addition, the use-wear analysis concluded that this tool was hafted and used for scraping plants.

In summary, the mean length of five complete bifaces (#519-11, #604-12, #651-10, #690-10, and #724-10) is 35.61 mm with a mean width of 15.94 mm, and an average thickness of 5.6 mm. Overall mean biface size seems to vary much more than what the standard deviation values of complete specimens (length of 6.33 mm, width of 4.69 mm, and thickness 2.19 mm) indicate. For example, the standard deviation of biface widths, the tool dimension least affected by fragmentation, across all specimens is 11.91 mm. This range in biface size may be indicative of the variation in the size of raw material package size (i.e., cobble size). It is also possible that the biface size variance may have been functionally related, but to determine this would require further examination of micro-wear on a larger sample of bifaces from this component.

As a group, these bifaces reveal random flaking patterns, indicating an expedient or nonstandard reduction sequence. Callahan (1979) provided a classification scheme for bifaces recovered from Paleoindian contexts, in which he used width-to-thickness ratios to determine biface reduction stages. In general, the preparation and reduction scheme for specimens included in Callahan's studies are more complex than what was observed at 41YN452. Almost half (42 percent) the

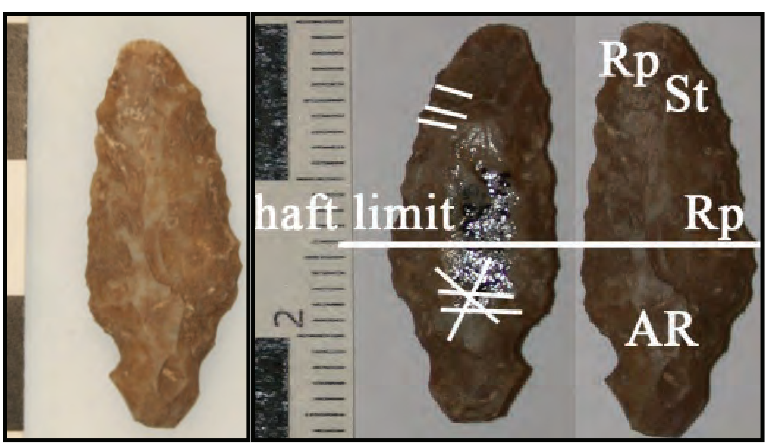

Figure 6-59. Unwashed Biface #604-12. Use-Wear Results on Right. Scale in cm.

bifaces were classified as middle-stage, with almost a quarter of the biface assemblage unclassifiable due to fragmentation. Use-wear analysis on nearly all the bifacial pieces revealed some type of use-wear and/orplant microfossils, despite the fact that the bifaces were not always finished according to Callahan's (1979) definitions.

Breakage of bifaces (76 percent of the assemblage) may have occurred during manufacture, use, or post-depositionally. By examining the break areas on each specimen, it was determined that at least three bifaces were broken during manufacture (#556-10, #630-10, and #703.-11) and at least one (#740-10) was broken during use.

Plant cutting is the most common (37 percent) indicated function of the analyzed bifaces, according to use-wear observations. The second most common function (25 percent) was plant/wood scraping, followed by butchering (12.5 percent). In addition, 75 percent of the bifaces examined show evidence of hafting. It is apparent that these bifacial tools were used for a variety of activities and were functional end products rather than intermediate or preforms for more specialized tools. It is still unclear, however, whether these bifaces were specifically used in food-procurement/processing activities or some other purpose.

Scrapers

The incidence of unifacial tools with steeply formed edges is quite low (3 percent) within the assemblage. Only three examples of this tool class are present. All three specimens are made from Edwards chert, though the similarities between these three scrapers ends there (Table 6-15). None of the scrapers are morphologically similar to the others, or to the teardrop-shaped scrapers often found in Late Prehistoric assemblages across the Southern Plains.

Specimen #711-10 was made from a pinkish-gray chert and has the morphology of a prismatic blade. Such blades, if produced in multiplicity, were detached from carefully prepared cores designed to produce blades of a standardized form. Given its form and material characteristics, it is uncertain whether this tool was made on-site or carried in. If this scraper was made on-site, one would expect to have recovered additional blades from this component. This specimen is steeply flaked (52 degrees) on one of its longer, lateral edges, while the opposing edge is not macroscopically altered. This suggests that this scraper may have served multiple uses. Its overall form is that of a prismatic blade, with one prominent ridge running two-thirds the length of the dorsal surface (Figure 6-60). This specimen has the smallest width of the three scrapers, and bears traces of woody plant residues, raphides, striae, and exhibited hard/high silica polish in use-wear analysis.

It can be, therefore, suggested that this tool was used to scrape woody material. Specimen #728-10 is a grayish, asymmetrically-shaped scraper made on a flake from a stream cobble (Figure 6-61). With cobble cortex covering approximately 40 percent of the dorsal face, it has areas of steep flaking on the lateral and distal edges. What makes this scraper distinct is its incurvate lateral edge, which limits its use in this area to excurvate surfaces (e.g., shafts of bone or wood). The angle of this edge is 60 degrees. Use-wear analysis showed evidence of starch grains and high/hard silica polish.

The third scraper recovered (#628-10) is an ovate specimen made from a flake struck from a stream cobble (Figure 6-62). It is bi-convex in cross-section and is almost completely covered with cobble cortex (including its striking platform) on the dorsal side. It bears a large bulb of percussion, indicating it was detached by hard-hammer percussion. It was found in the western part of the excavation block near Feature 5. This scraper is worked on one of its lateral edges, which has an excurvate shape. The angle of the worked edge measures 80 degrees.

Table 6-15. Selected Scraper Attributes

PNUM	Cat	Unit	Depth (cmbs)	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Origin
628	10	N108 E102	70-80	53.68	36.74	11.06	19.5	Pebble/Cobble
711	10	N110 E108	96	64.15	18.39	7.83	10	Prepared Core
728	10	N111 E107	90-100	41.53	48.82	9.45	22.2	Pebble/Cobble

Figure 6-60. Unwashed Scraper (#711-10). Scale in cm.

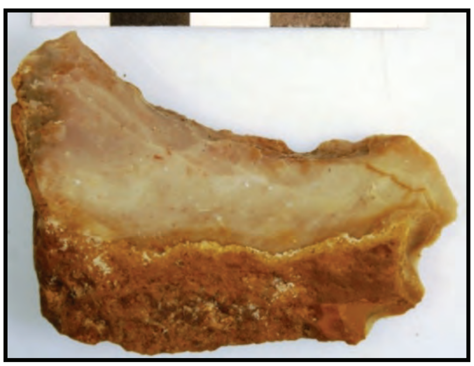

Figure 6-61. Unwashed Complete Scraper #728-10. Scale in cm.

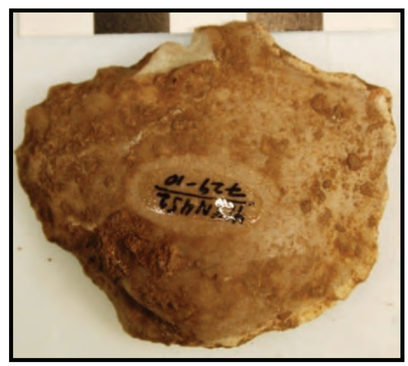

Figure 6-62. Unwashed Complete Scraper #628-10. Scale in cm.

Use-wear analysis on this specimen found plant-tissue residue and high/hard silica polish. Therefore, this tool may have been used on plant matter.

Edge-Modified Flakes

Seventy-one edge-modified flakes were recovered and are considered informal tools that were likely produced, used, and discarded on-site. This group is the largest chipped-stone tool class, composing 46 percent of the of tool assemblage. Specifically, informal tools represent those specimens that have not been altered to a degree that significantly changed the shape/form of the original flake blank. In most instances, these flakes or parts of flakes have minimal but noticeable edge scaring, flaking, or rounding.

These informal tools vary widely in size (Table 6-16). Edge angles measured for each modified-edge were fairly consistent with medians of 49 to 50 degrees and standard deviations of 11 to 12 degrees. These values indicate that most edge-modified flakes were subjected to similar types and intensities of modification.

Table 6-16. Summary of Metric Measurements on Edge-Modified Flakes

Edge-Modified Flake (N=71)	Length (mm)	Width (mm)	Thickness (mm)	Edge Angle A	Edge Angle B
Mean	29.03	22.60	6.11	49.01	52.73
Median	26.82	23.32	5.76	49	50
Standard Deviation	11.31	6.63	3.20	11.97	12.79

This is not surprising since, by definition, informal tools are not modified to any great extent prior to use. Ninety-nine percent of these specimens were fashioned from Edwards chert with only one specimen (#552-10) identified as an untyped chert-chalcedony combination.

These raw materials were most likely gathered from nearby before being reduced on-site. Within this class, 11 percent (*N* = 8) have 26 to 50 percent cortex on the dorsal face, 42 percent (*N* = 30) exhibit 1 to 25 percent cortex on the dorsal face, and 47 percent (*N* = 34) have no cortex on the dorsal face. The high incidence of cortex on the dorsal face in this class is a direct result of flake removal from a cobble core. Many flakes exhibit remnants of the outer cortical surface due to the small cobble sizes.

Thirty-four percent exhibit evidence of thermal alteration in the form of a color changes and potlidding. This is a much larger percentage than in any other tool class. Edwards chert is a high grade material that does not usually require heat treatment prior to flaking as the fracture predictability is already high. This indicates that thermal alteration occurred post-use, as these expedient tools were discarded or otherwise accidentally incorporated, into the fires of heating elements.

Fourteen specimens (ca. 20 percent) were submitted for use-wear analysis (Appendix C). On the whole, there is almost an equal distribution of uses represented, including cutting (*N* = 5), slicing (*N* = 4), scraping (*N* = 4) and unknown (*N* = 1). These diverse uses document the range of tool functions that informal tools can be expected to represent.

Unifacial Tool

Unifaces are defined as those tools that are flaked on one face/side to the degree that the original flake blank form is significantly modified (Figure 6-63). Only one tertiary flake fragment #598-10 fits this definition. This uniface was found at N107 E104 between 60 and 70 cmbs. One-sided flaking was observed on the distal edge as well as both lateral remnants, which differentiates this tool from other edge-modified flakes. This uniface is possibly a distal flake fragment withe dimensions of 25.95 mm long, 25.39 mm wide, 5.67 mm thick, and weighs 3.6 g. No cortex is present and no thermal alteration could be discerned. Use-wear analysis observed hard/high polish and striae on the incurvate lateral edge (Figure 6-63).

In addition, raphides and possible starch grain residues were also noted. The interpreted use is cutting of plant material (Appendix C).

6.3.3.3 Lithic Debitage

As by-products of tool manufacturing, debitage analysis is an extremely informative tool in interpreting human behavior (Andrefsky 1998). Attributes that can be documented from specimens within a debitage assemblage may be used to highlight trends that provide insight into resource procurement, tool production location, material reduction strategy, tool production, and tool maintenance.

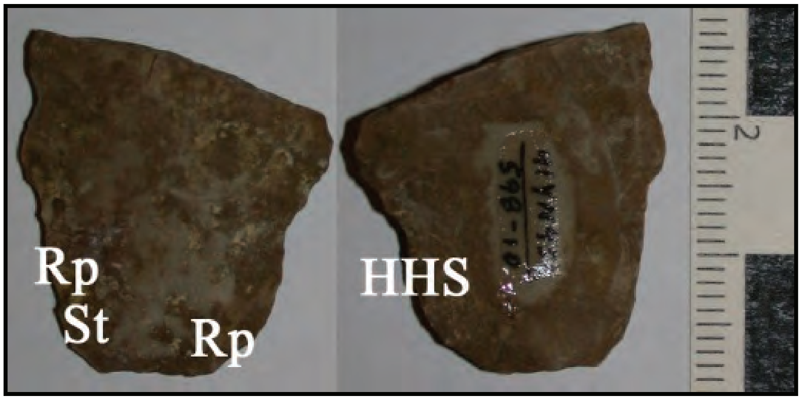

Figure 6-63. Unifacially Worked Flake #598-10. Scale in cm.

The lithic debitage assemblage (*N* = 1,017) consisted of platform bearing flakes, distal flakes/shatter/angular debris, and cores. These primarily occurred within the buried 2Akb horizon between with the majority of material recovered from 70 and 100 cmbs (Figure 6-64).

The raw material diversity throughout the debris assemblage is quite limited. In fact, very few materials other than Edwards chert (***N*** = 973; 97 percent) are present. The second most prominent material is quartzite (*N* = 27; 2.6 percent), with a much smaller frequency in this component. Other materials include silicified limestone (*N* = 7; 0.7 percent), chalcedony (***N*** = 5; 0.5 percent), jasper (*N* = 2; 0.2 percent), fossilized wood (*N* = 1; 0.1 percent); unidentified metamorphic (*N* = 1; 0.1 percent), and unidentified sedimentary (*N* = 1; 0.1 percent). It is probable that most, if not all, of the material was procured from a common location and was highly selective.

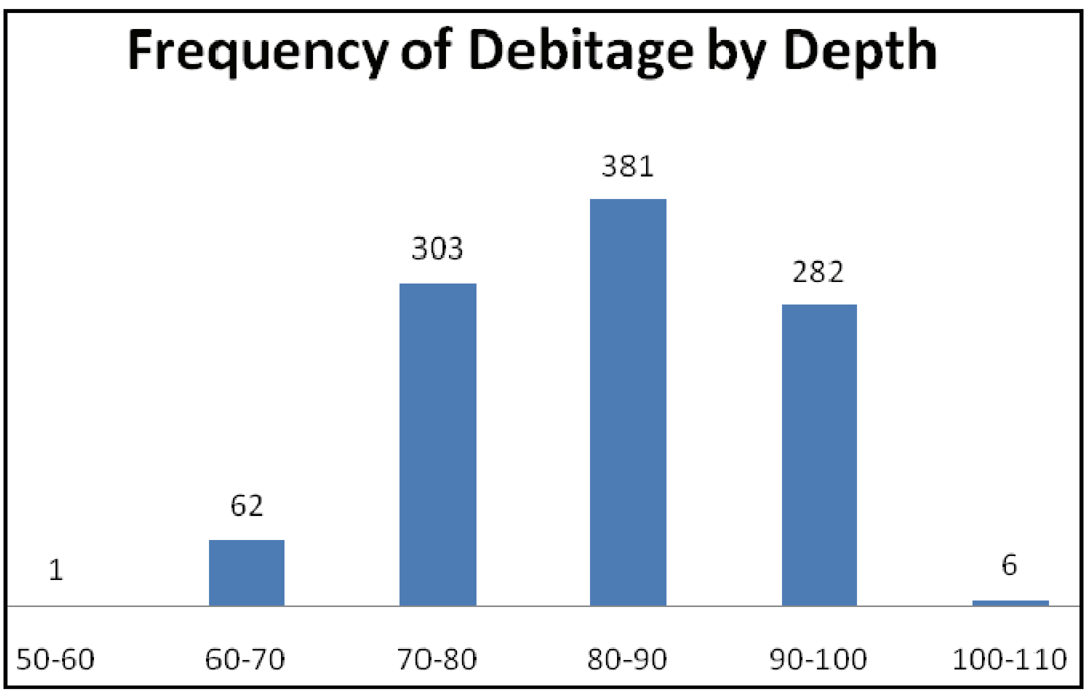

Figure 6-64. Depth Range and Frequency for Lithic Debitage from Terminal Archaic Component 1. Depths are in cmbs.

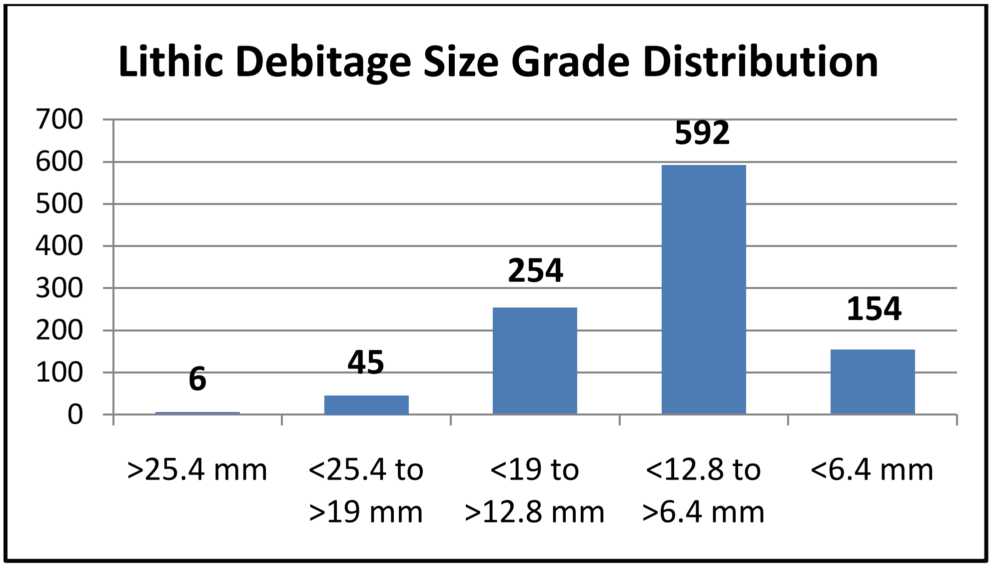

Figure 6-65. Size Grade Distribution of Lithic Debitage in Terminal Archaic Component 1

The majority of the debitage (N = 592; 56 percent) falls within the >6.4 to <12.8 mm size range (Figure 6-65). The second largest group (N = 254; 24 percent) is within the >12.8 to <19 to mm range. This prominence of mid to larger size debris is evident of an emphasis of material reduction and tool production rather than rejuvenation, where tool blanks are produced and used without much refinement (edge-modification producing smaller flakes) are made and resharpening. It could also represent a highly expedient form of tool production as opposed to a curative one that conserves material use.

The frequency of thermal alteration among platform bearing flakes is a low 11 percent (Figure 6-66). It is evident primarily on the Edwards cherts. The most obvious thermal alteration occurs in the form of potlid marks (saucer shaped divots) and thermal breaks. These are signs that heating probably occurred after discard.

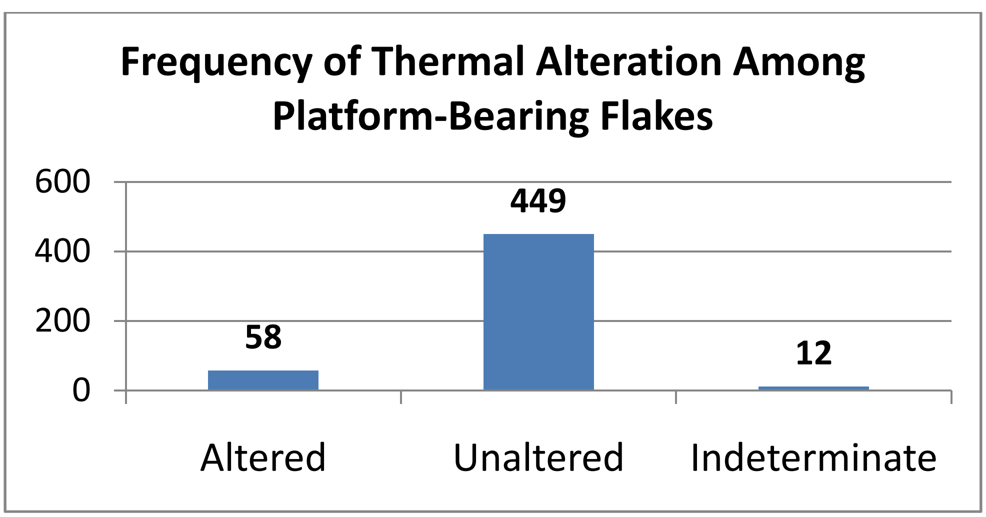

Figure 6-66. Distribution of Platform-Bearing Flakes that Exhibit Thermal Alteration

Purposeful/ intentional heating of new material to improve quality for knapping would be monitored and removed from the heat source before such detrimental alterations occurred. Furthermore, the Edwards chert here is very fine–grained material, quite suitable for knapping without heating and hence, possesses a higher quality than locally available quartzite, chalcedony, or petrified wood.

The breakdown of platform types is depicted in Figure 6-67. There are a total of 519 platform bearing flakes in this debitage assemblage. This constitutes approximately 50 percent of the debitage. Of these, approximately 23 percent exhibit multifaceted platforms (i.e., faceted plus complex groups). These flakes originate from more intensively modified objective pieces (e.g., bifaces or cores with prepared platforms).

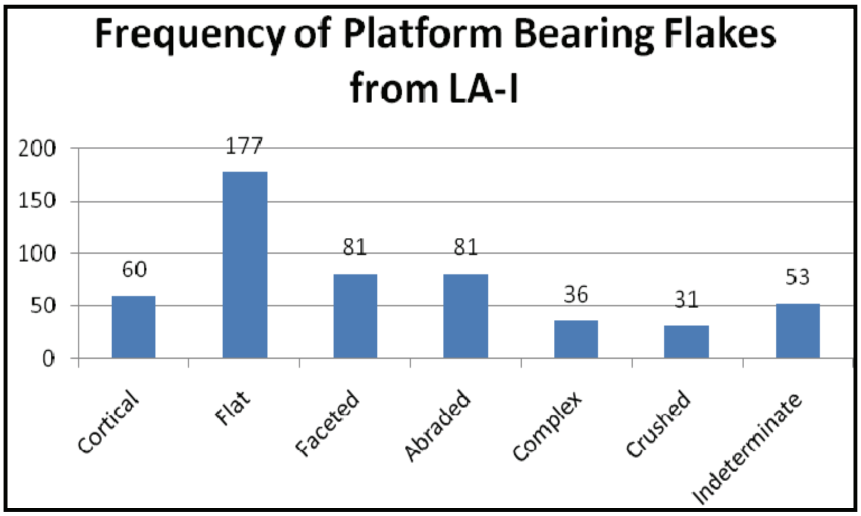

Figure 6-67. Frequency of Platforms Types in Terminal Archaic Component 1 Debitage Assemblage

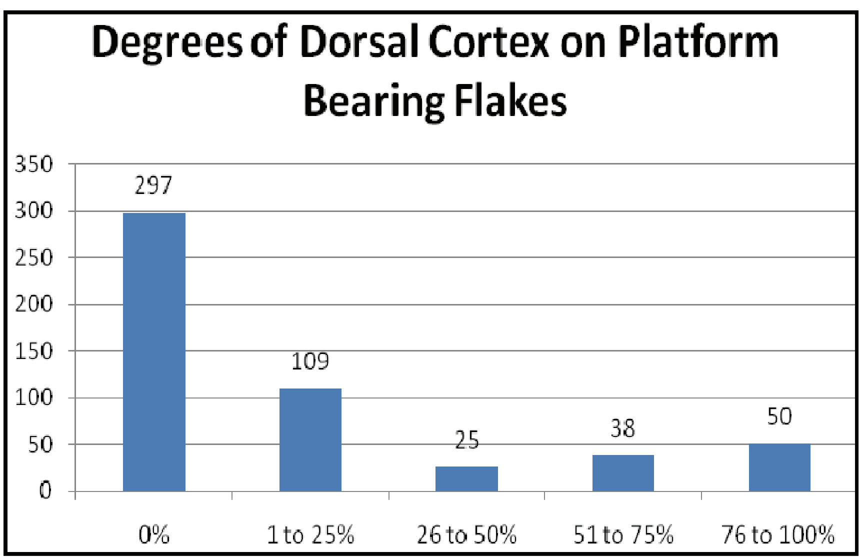

Figure 6-68. Cortex Presence on Lithic Debitage from Terminal Archaic Component 1 Horizontal Distribution of Lithic Debitage

Approximately 12 percent of the platform-bearing flakes are cortical (Figure 6-67). These indicate initial flake detachment from a cortex covered objective piece (e.g., a rounded river cobble). Flat striking platforms are by far the largest group and represent 35 percent of the platform bearing assemblage. Flat platform flakes were detached from nonbifacial tools or planar, unmodified core surfaces (Andrefsky 1998:94; Whittaker and Kaldahl 2001:54). Obviously, both core and biface reduction occurred in this component.

Lithic debitage with evidence of cortex on the dorsal faces signifies early stage reduction of objective pieces (Figure 6-68). Almost half (42 percent) of the platform-bearing flakes exhibited cortex. The reason for this high presence of cortex is the reduction of rounded cobbles as opposed to large nodular pieces from bedrock sources. The relatively high incidence of cortex-bearing specimens documents on-site early reduction of cortex cobbles.

The horizontal distribution of debitage by count and weight across the North Block clearly reveals that many of the higher concentrations were outside of designated cultural features (Figures 6-69 and 6-70). The features consisted largely of concentrations of mussel shells and burned rock secondary dump or discard locales. These waste products stem from the heating/cooking of the shells by the rocks.

The one documented heating element is Feature 1 with very sparse debitage scattered in its vicinity. The fact that lithic debris resided mostly outside the identified discard features indicates three things: 1) that lithic reduction activities primarily took place in areas that were meters from discard features and separate activities, and 2) debitage discard was not the result of heating element cleanouts or directly associated with cooking activities; and 3) there was definite intrasite pattern of various human behaviors.

In summary, the lithic debitage reveals clear patterns of local raw material procurement, cobble reduction, biface and flake tool production, and cobble reduction activity areas in the North Block. The uniform nature of the raw material types indicates a preference for high quality material, in this case Edwards chert, over all other gravel outcrops. Ogallala quartzite is available in the local upland gravel outcrops and in the gravel bars along the river. The minor incidence of Ogallala quartzite here indicates a clear and direct selection of the high quality cherts. Furthermore, the absence of any formal tools composed of quartzite is supporting evidence that quartzite played a very minor role in tool produciton and use (see Chapter 7, for a more detailed examination of this relationship). The high incidence of cortex on platfrom bearing flakes supports the on-site reduction of small rounded, stream rolled cobbles. These could have been gathered locally from nearby sources such as the Clear Fork of the Brazos River or the upland gravel outcrops immediately north of this site.

Furthermore, the relatively restricted incidence of thermal alteration (11 percent of platform bearing flakes) supports that intentional heat treatment of lithic materials was not a necessary precursor to material reduction/use. The small percentage observed most likely represents events that ocurred post use. Overall, it does not appear that occupants employed heat treatment at this camp.

The large portion of platform-bearing flakes with less than two facets (35 percent) indicates core reduction activities were the primary source of the flakes produced on site. This is the more likely mode of production for such flakes in the archeological record (see Carr and Bradbury 2001:134). Bifacial reduction flakes represented more often by multifaceted platforms are also present and account for a significant portion of the flakes present. Therefore, both core an bifacial targets were reduced on site. However, it is unclear by strictly examinating the platform–bearing flakes what proportion of bifacial reduction flakes originate from bifacial cores as opposed to the modification of large flakes.

Figure 6-69. Horizontal Distribution of Terminal Archaic Component 1 Lithic Debitage by Counts across the North Block

For that, one must examine the relationship between debris and chipped stone tools (see Chapter 7.0 for further discussion).

The horizontal distribution of lithic debitage across the North Block indicates discrete knapping locations located away from the delineated feature boundaries (i.e., mussel shell and burned rock concentrations). The apparent lithic concentrations are interpreted as *in situ* reduction locations where individuals sat around and reduced cobbles

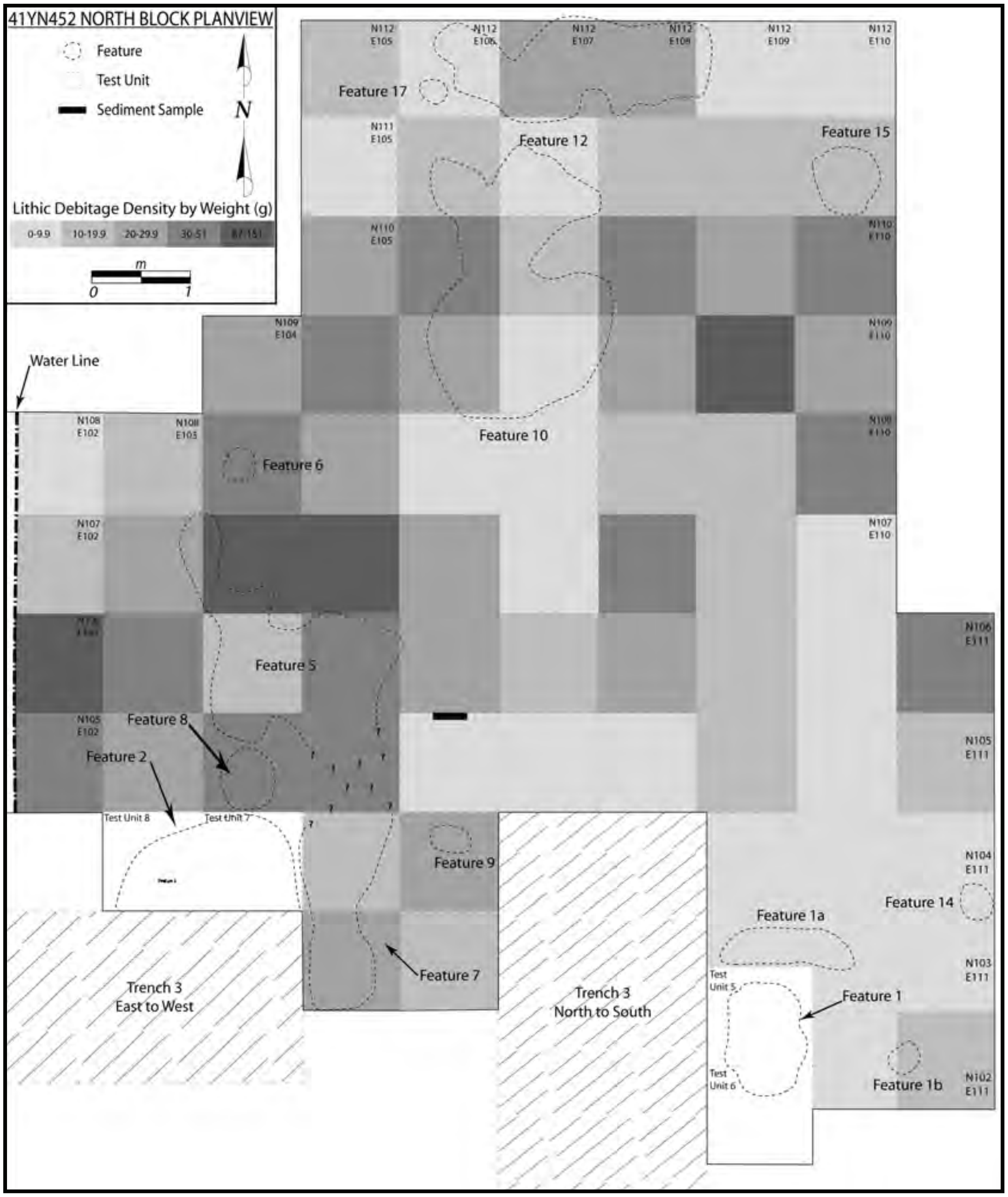

Figure 6-70. Horizontal Distribution of Terminal Archaic Component 1 Lithic Debitage by Weight across the North Block

and created initial and middle stage bifaces and selected individual flakes for use. In Chapter 7.0, these lithic concentrations will be examined more throughly in relation the horizontal distribution of other artifact classes to gain a greater understanding of discrete activity areas and overall site function.

Component Interpretations Based on Lithic Analysis

The chipped stone tool assemblage and associated lithic debitage reflects lithic knapping activties focused primarily on the production of expedient (informal) tools using core reduction techniques. Formalized tools such as bifaces and scrapers were likely produced on site, but less frequent. It is also plausible that the three dart points and many of the bifaces were brought to the site as finished products and discarded after tool failure. The complete projectile points may have been lost in meat packages and not located and retreived. Activities represented based on use-wear analysis and organic residue observations of chipped stone tools denote a wide array of functions such as cutting, scraping and slicing. These functions appeared to primily target plants, woody plants, with limited use directed towards meat or animal products. The edge angles observed across chipped stone tool clases support these assessments.

The limited diversity of chipped stone tool classes combined with the lack of specialization (high range of tool variability) within tool classes, supports the existence of a short-term camp that operated under a broad-based economy. Given this, it is doubtful that site occupants were operating in a specialized task-oriented fashion to procure resources specific to this location. The lithic assemblage instead supports an existence that centered on foraging activities where occupants took advantage of the resources at hand for a brief time before relocating camp to a new location. Further examination of these concepts is presented in the discussion of the research questions (Chapter 7.0) where relationships between the lithic assemblage and other artifact classes are considered in the interpretation of overall component function.

6.3.3.4 Ground Stone Assemblage

Two items (#703-12 and #705-10) were classified as ground stone. The first (#703-12) is a wedge shaped mano fragment from 77 cmbs in N110 E107. This piece-plotted fragment was just outside the northern margin of Feature 10 and near the southern margin of Feature 12. Since both features had ill-defined boundaries, the fragment may have been part of either feature, but it is open to interpretation. This fragment is 90.2 mm in width from one side to the other with an unknown length, as both ends are missing. The fragment is 35.6 mm thick at the thickest (middle) and weighs 220 g. This is a piece of sandstone that may have originally had a blocky rectangular shape that was subsequently fashioned into the current general shape (Figure 6-71).

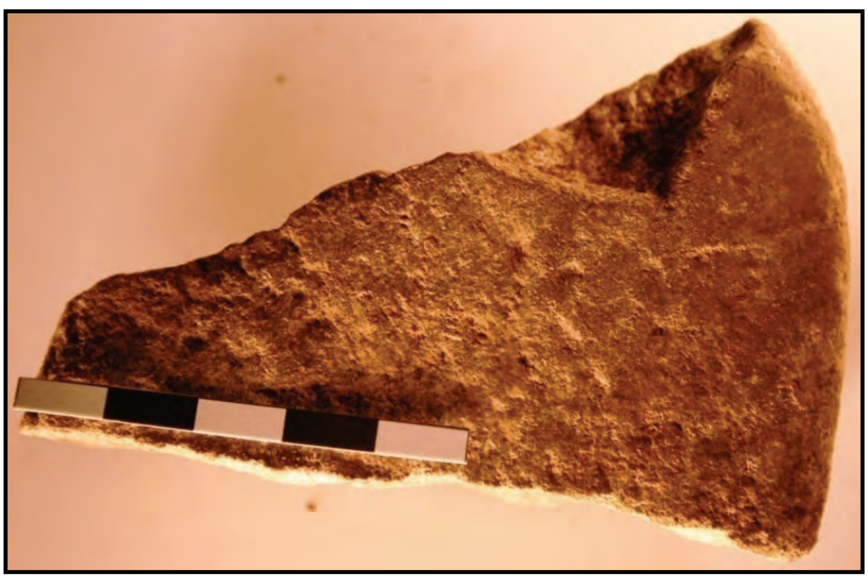

Figure 6-71. One Convex Face of Mano Fragment (#703-12) Showing Pecked Marks in Ground Surface

Both faces are convex and taper slightly from the thicker middle to the thinner margins with thicknesses of 28.1 and 22.0 mm near the broken ends. The convex faces may indicate this mano was used in a well worn metate that had at least a shallow trough as opposed to a flat surface. One face exhibits some 35 to 40 small, shallow pits on the ground surface indicating it had been pecked with a relatively sharp object in a refurbishing strategy to roughen up the smoothed face.

The opposite face has a very slight convex surface with possible pits, which are quite indistinct across the ground surface. The one longer of the two lateral edges is definitely rounded and smoothed with a nearly flat surface along the very edge. This edge is definitely ground and has been used. The very short opposite edge appears to have been ground and used as well. Therefore, both faces and the two lateral edges have been ground and used.

The interior of this rock is a light gray (10YR 6/1), fine grained sandstone. The relatively light color indicates this piece was not likely used as a burned rock, as heating would likely have darkened the interior.

This entire fragment was sent for starch grain analysis. Unfortunately, no starch grains were recovered (Appendix B). Visually, this is the one of only two probable plant processing tools recognized from this block. Its presence is a clue to plants having been processed, although no direct evidence for the plants still remain.

The second piece (#705-10) is another probable mano fragment from 82 to 84 cmbs in N110 E107. Again this fragment was just outside Feature 10. It is 96 mm long, 36 mm wide, 25.7 mm, and weighs 120 g. This is relatively soft sandstone that broke longitudinally with a jagged break indicative of having been used as a burned rock (Figure 6-72). One face is slightly convex with what appears to be peck marks in the surface. The opposite face is smooth, but lacks peck marks. The lateral edge present is rounded with a possible beveled or flat edge. The wear is very difficult to see with the naked eye. This entire fragment was sent for starch grain analysis. No starch grains were recovered (Appendix B). The lack of starch grains and the limited visible wear may reflect limited use or no use from plant processing.

6.3.3.5 Vertebrate Faunal Assemblage

The North Block yielded 147 bone fragments that weigh 59.8 g for an average bone weight of 0.4 g. Ninety-five percent fall in the 0 to 3 cm size category with only one long bone fragment greater than 3 cm. The small size of these fragments hinders positive species identifications. However, these tiny fragments reveal a diverse prey resource with at least one deer, one turtle, four fish, and one rabbit size (*Sylvilagus* sp.) animal.

Figure 6-72. Possible Mano Fragment (#705-10)

The deer was positively identified by one unburned 1st phalange, in two pieces, which was directly associated with this component. These two pieces were butchered and exhibit a green bone spiral fracture. Deer size pieces (*N* = 103) account for 71 percent of the fragments by count. Of those deer size pieces, 85 pieces or 82 percent were burned to one degree or another. Most were burned to a combination of dark gray to black, with some just gray. One group of 26 deer size fragments that represent a single long bone was burned to gray and black, and also exhibits four tiny cut lines on the exterior surface.

Only a single fragment revealed possible rodent gnawing. Apparently, the entire deer carcass was brought to this location as indicated by the phalanges, the tooth fragments, and the partial mandible from the cutbank. These few elements indicate this animal was not field butchered, but brought back as a complete carcass. In addition to acquiring the meat, the bones appear intentionally broken to retrieve the marrow and then smashed, likely to facilitate the extraction of bone grease as reflected by the end result of the small fragments represented. A possible explanation for the burned fragments is that they were discarded into a fire. The majority of the deer size pieces, mostly burned long bones, were in Feature 15. This feature was interpreted as a discard from cleaning activities with burned rocks, burned bones, and a few pieces of charcoal present.

The turtle is represented by five tiny fragments (#824-002, #574-002, and #679-002) that weigh 1.3 g. These include parts of the carapace and one right scapula (#679-002). The four carapace fragments are all shiny black, which indicate they were burned and definitely part of the cultural resources. These pieces were recovered from outside any recognized feature, although two pieces (#824-002) were from next to Feature 1.

Four fish otoliths (8.7 g) were recovered from across the block (Figure 6-73). All four represent freshwater drum (*Aplodinatus grummiens*) and are different sizes and represent four individual fish. No other fish bones were recovered. It is possible that these otoliths were deposited during alluvial events, but their lack of rounding, and apparent vertical and horizontal association with the rest of the cultural items indicates they were part of the cultural occupation. One otolith (#740-11) was recovered from the same unit as Feature 15, which further supports the otoliths were culturally derived. All four otoliths were cut in half to conduct seasonality studies (Appendix J). Once in half, the cut edge was ground and polished to examine the growth rings. This polished half will be curated. The other half was sent for radiocarbon dating. The Georgia laboratory conducted the extraction process, but recovered no collagen. The laboratory did recover sufficient carbonate for dating. It was decided that a carbonate date would not be sufficiently precise to enable the positive association with the cultural assemblage. No dates were obtained on the four fish otoliths.

Minimally four rabbit size long bone fragments are represented. However, none of these pieces retained diagnostic characteristics to permit positive identification. At least two rodent size fragments, possibly rabbit, were burned black. This indicates that some small rabbit size animal was present and used to some extent, and that the bone was then likely discarded into the fire. At least three rabbit size pieces revealed green bone spiral fractures that indicate they were part of this cultural assemblage.

Seasonality

This very limited vertebrate assemblage does not provide much data to interpret what season this site might have been occupied.

Complete large mammal jaws, whole incisors and eruption sequences or fetal animal remains are most often used for defining seasonality of animals at sites. Without adequate samples of these artifact classes, only the fish otoliths provide seasonal indications of use. Three otoliths (#561-11, #628-11, and #642-11) were determined to best reflect a fall season of death (Appendix J).

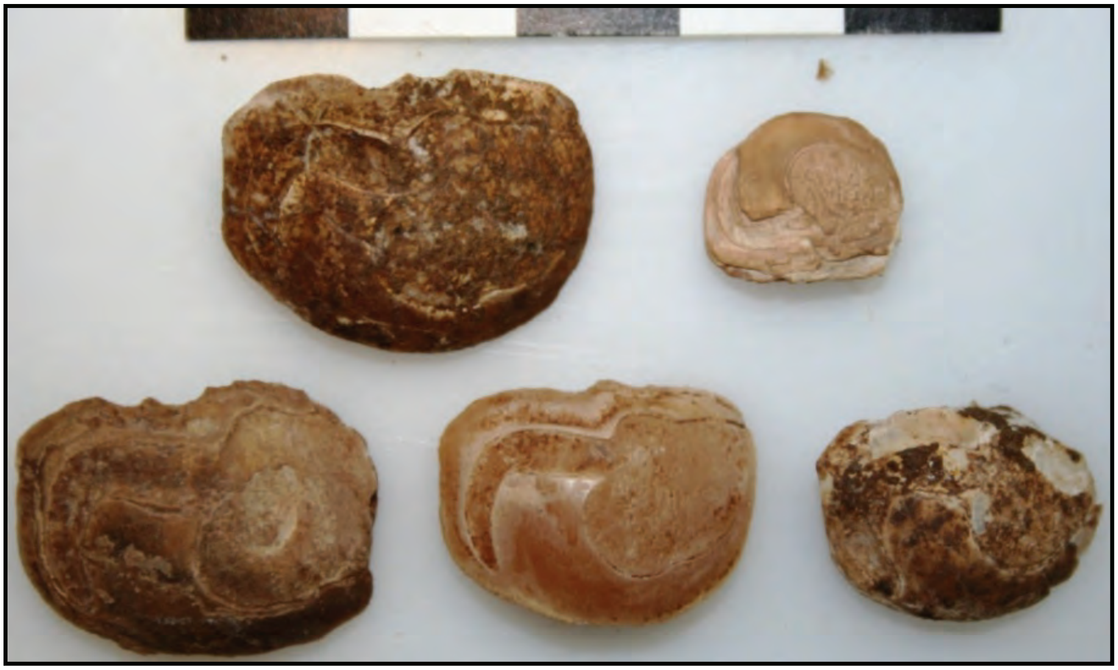

Figure 6-73. Terminal Archaic Fish Otoliths from Freshwater Drum (Aplodinatus grummiens) (scale in cm). (Top #561-11, #740-11, Bottom #628-11, #642-11, and #419-10)

The forth (#740-11) reflects a summer death. This seasonality study indicates this component was likely occupied during the late summer or fall period.

6.3.3.6 Mussel Shell Assemblage

The North Block consisted of 78.5 m^2 block that yielded a mussel shell assemblage of 4,848 pieces that weighed 14,149 g for an average of 3.4 g per piece. Seventy-three percent were small fragments and unidentifiable as to species (Figure 6-74). The 27.2 percent (*N* = 1,312) identifiable consisted of seven different species and MNI of 658. Represented are smooth pimpleback (*Quadrula houstonensis*, 71.5 percent), southern mapleleaf (*Quadrula aplicata*, 13 percent), Threeridge (*Amblema plicata*, 8.9 percent), pistolgrip (*Tritogonia verrucosa*, 2.9 percent), yellow sandshell (*Lampsilis teres*, 2.3 percent), less than 1 percent mapleleaf (*Quadrula quadrula*), and 1 percent Tampico pearlymussel (*Cytonaias tampicoensis*).

A 16.5 percent (*N* = 217) sample of the more complete shells were individually measured to gain an understanding of the size range of the shells collected. Measurements were taken for the length and width with the largest measurement considered here. The measured shells were grouped into 1 cm size classes beginning with 1 cm and ending with 9 cm. The smallest shell measured 1.6 cm, whereas the largest measured 8.9 cm. Ninety-six percent of the shells measured less than 6.0 cm. The highest percentage (44 percent) of measured shells was between 3.0 and 3.9 cm. These data document the overall small size of most shells.

General habitats for the recovered and identified mussels have a broad range of conditions. These include streams, rivers, standing and flowing water, mud, sand, and gravel substrates, which are not very useful as indicators of what water conditions were in the immediate vicinity of the site (Howell et al. (1996). All the species identified have been identified in the Brazos River system in historic times.

Figure 6-74. Example of the Shells Recovered from One 10 cm Level

The fragmentary nature of the mussel assemblage (73 percent unidentifiable fragments) was potentially influenced by direct human alterations or a combination of human interference, weathering, and excavation damage. Minimally 595 pieces (12.3 percent of the total) were recognized as the crescent shaped posterior margins that were separated from the main shell (Figure 6-75). This separation apparently occurred along a growth line, a possible weak area in the shell. It is likely that this area was weakened through cultural heating. Consequently, the occurrence of this separated crescent shaped section may indicate human alteration through heating/cooking. Minimally 27 pieces (0.5 percent of the total) exhibit signs of having been burned as evident by their mostly gray (7.5YR 6/0) appearance, although a few pieces exhibit crazed and/or a very light gray (7.5YR 7/0) color (Figure 6-76).

The burned pieces are most often small fragments of the dense beak and/or tooth area. Once burned, the thinner outer margins of the shell became brittle, crumbled, and detached from the beak area. This very low frequency of burned shells indicates that not many shells came in direct contact with open flames or extremely hot coals.

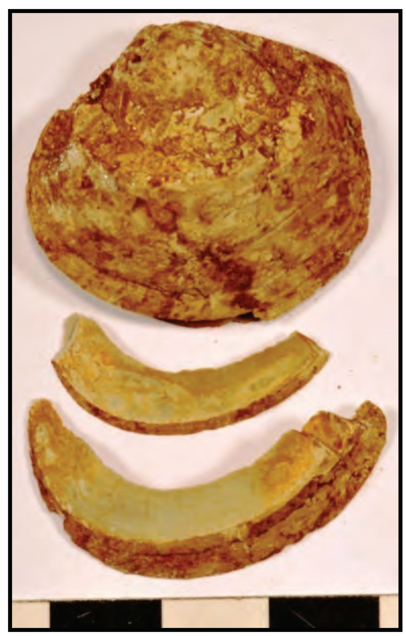

Figure 6-75. Example of Crescent Shaped Posterior Margin After Separation from Main Shell Body. (scale in cm).

Figure 6-76. Examples of Burned Mussel Shell Fragments

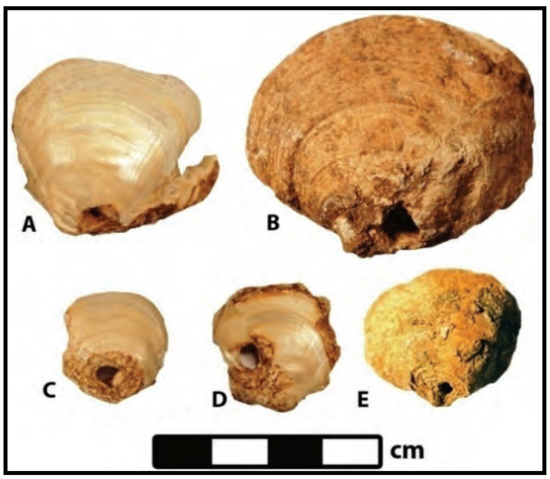

Figure 6-77. Examples of Holes Consistently near Beaks of Mussel Shells that Exhibit Ragged Outer Edges

Experimental work has demonstrated that open flames will scorch the outer shell causing most shells to crumble and disintegrate during meat removal (Dugas and Rollins 2003; Quigg's personal observations 2010). The visibly burned shells are interpreted to not have been an intentional process during the heating/cooking, and likely accidental or potentially an unsystematic discard procedure.

Thirteen shells exhibit small diameter holes (2.5 to 8.6 mm) near or on their beak (Figure 6-77). The origination of the hole is unclear. The exterior of the shell exhibits an irregular, rough and ragged edge, whereas the interior exhibits a smooth margin. Minimally one shell (#456-006-1) exhibits irregular, rough exterior without the hole extending clear through to the interior. This indicates that the hole originated from the exterior. Most holes are oval to ovate and not very smooth.

At least one southern mapleleaf shell (#516-006-4) with a 4.8 mm diameter hole was also completely burned. Two shells have two holes side by side (Figure 6-78). Most shells with a hole are quite small with the largest about 37 mm across and weighing roughly 10 g.

These holes appear noncultural, although it is not clear what caused these holes. If the holes were intentionally created by man, they most likely would have been drilled from both sides to create a smooth hole and margins. None of the holes appear to have been drilled.Dusek (1987) provides some indication that similar holes may be from a carnivorous snail similar to the family Naticidae, which creates similar small round holes in marine shells.

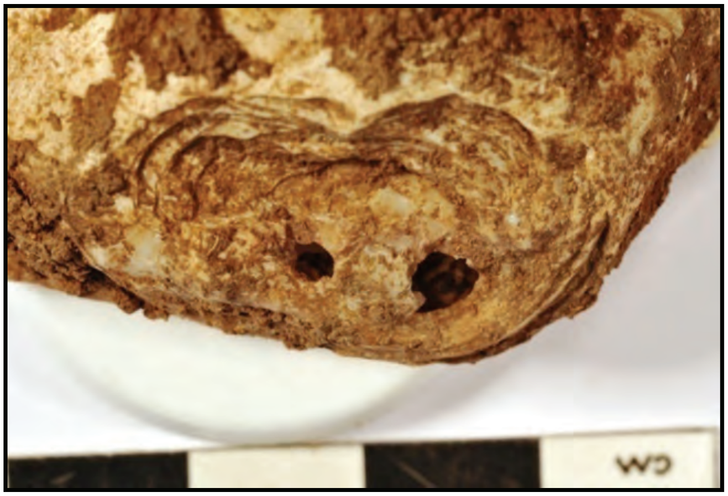

Figure 6-78. Close-Up of Rough Exterior Holes in Shell (#218-006) Near Beak

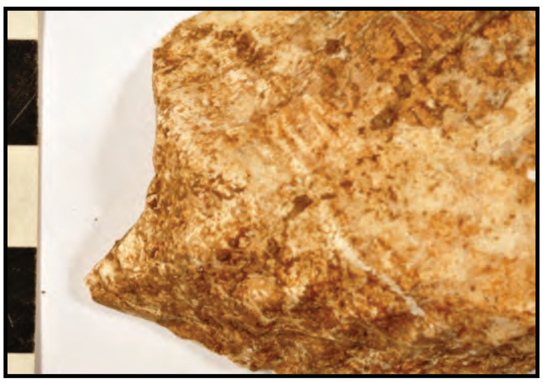

Figure 6-79. Close-Up of Broken and Slightly Worn Margin of a Pistolgrip Shell (#677-006-1). (scale in cm).

Currently, no known species of freshwater gastropod that are carnivorous exists.

Similar irregular and rough holes have been recognized in other freshwater mussel shell assemblages from archeological sites such as McKinney Roughs site (41BP627) in Bastrop County along the lower Colorado River southeast of Austin (Carpenter et al. 2006), site 41DL270 along Denton Creek in north-central Texas (Anthony and Brown 1994), McKenzie site (41HL115) at Aquilla Reservoir in Hill County (Brown 1987), and J. B. White site (41MM341) Features 20 and 24 in Milam County (Gardner 2006).

Although the pistolgrip species is limited in number (*N* = 44 or 3.3 percent of the identifiable pieces), one shell (#677-006-1) that is nearly complete exhibits what may be a worn concave edge at the posterior margin along the edge of the posterior ridge (Figure 6-79). This potential worn section created a dull point along the lateral edge. It is not clear if this was culturally modified or just a break that has been slightly water worn.

The horizontal distribution of all mussel shells across the North Block is depicted by count in Figure 6-80 and by weight in Figure 6-81. This distribution documents the greatest shell densities were generally identified in the field and labeled as features. Although higher densities were labeled as features, defining the precise outer margins of those dense clusters was difficult and very subjective as most features did not have well-defined boundaries. Beyond the feature margins, mussel shells were broadly scattered across the block. Although the densities are presented by unit, two high density concentrations are visible with moderate densities between the two areas.

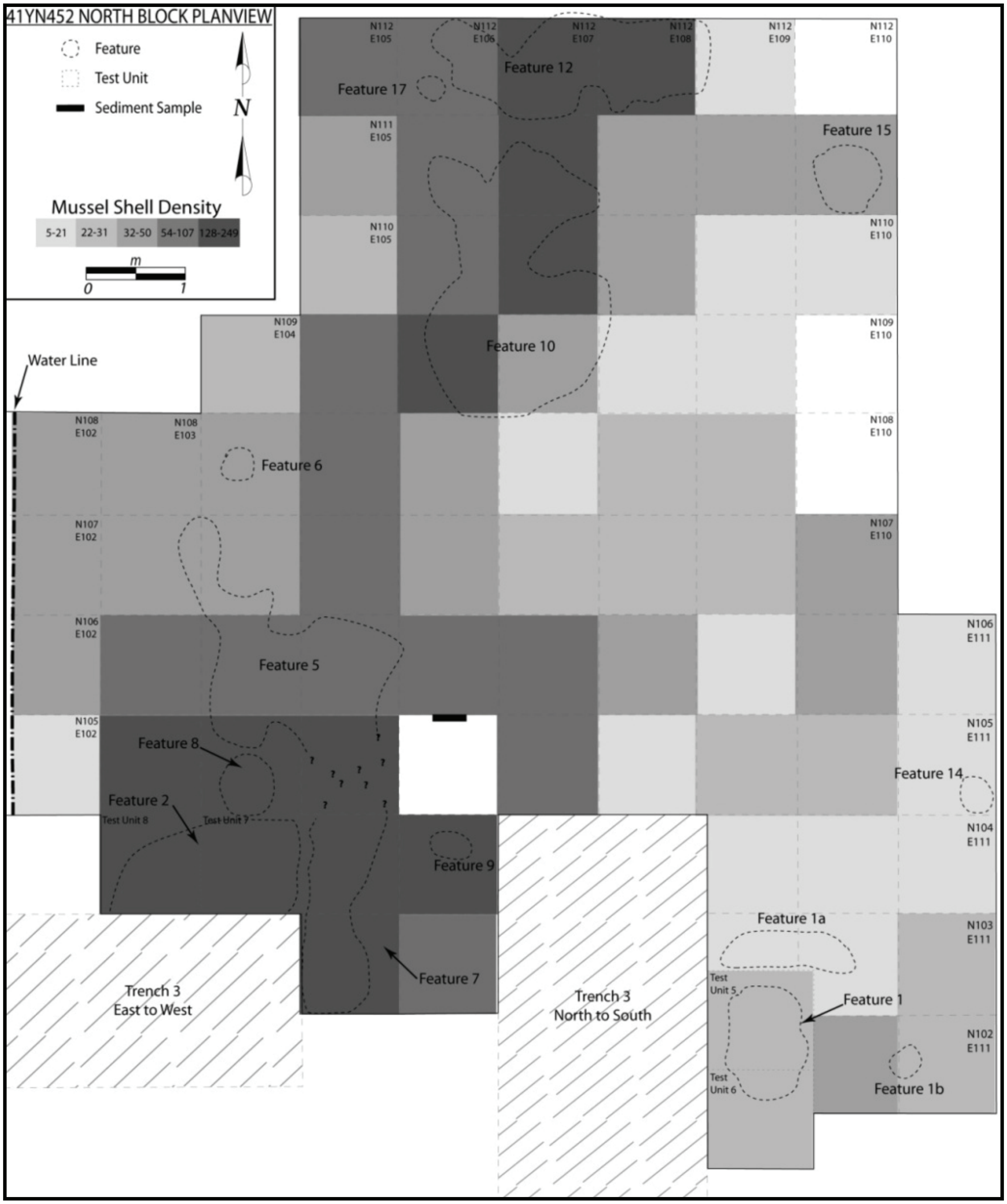

Figure 6-80. The Horizontal Distribution of All Mussel Shells by Count

One high density area was in the southwestern corner centered on Features 2, 7, 8, and 9. This high density corner engulfed eight units. The second high density area was near the middle of the northern end of the block and centered on parts of Features 10 and 12. That area consisted of five units. These two high density areas were linked together by a moderate density of discarded shells forming an irregular and north-south line that included part of Feature 5. Moderate densities generally surround the higher density areas.

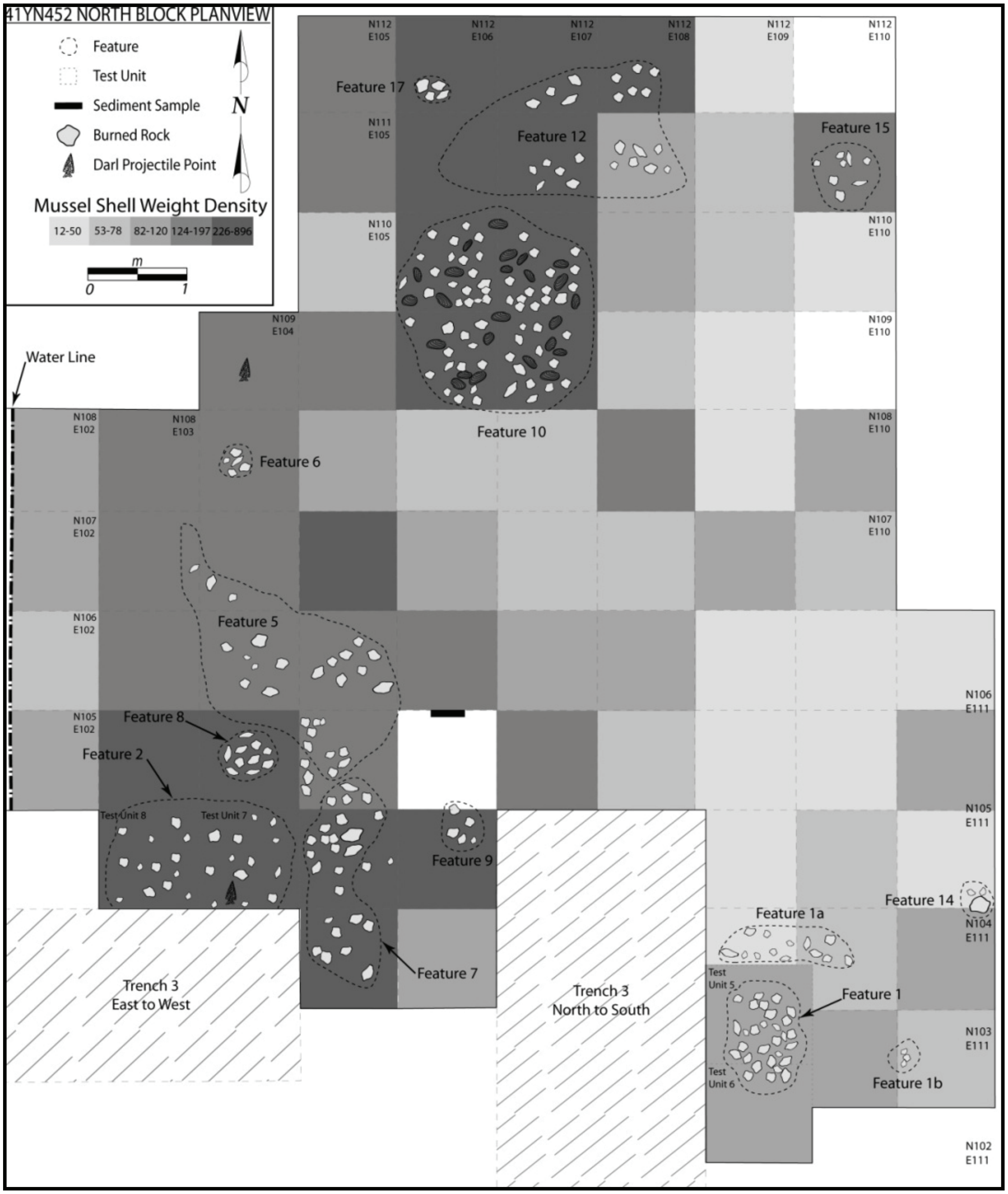

Figure 6-81. The Horizontal Distribution of All Mussel Shells by Weight

These three areas create somewhat of a linear alignment diagonally across the western part of the block. In contrast, most of the eastern side and near the middle of the block relatively low densities of shells occurred. This low density area may represent work areas where people were actively working with the discard zone of shells further west.

Smooth pimpleback shells dominate (71 percent) the identified species, but the less frequent species may provide indications of selective targeting. The horizontal distribution of the minor species is depicted in Figure 6-82. These minor species by count appear to have similar distributions to the overall mussel shell distribution pattern. Again, the minor species were concentrated almost in the same areas where the highest densities occurred. This was in the northern end of Feature 10 and within Feature 2 in the southwestern corner. This distribution indicates that the minor species were probably not selected, but accumulated with the more prominent smooth pimpleback shells.

The horizontal distribution of the weight of all the mussel shells reveals nearly identical distribution patterns by counts, although a few additional units are included in the concentrations (Figure 6-82).

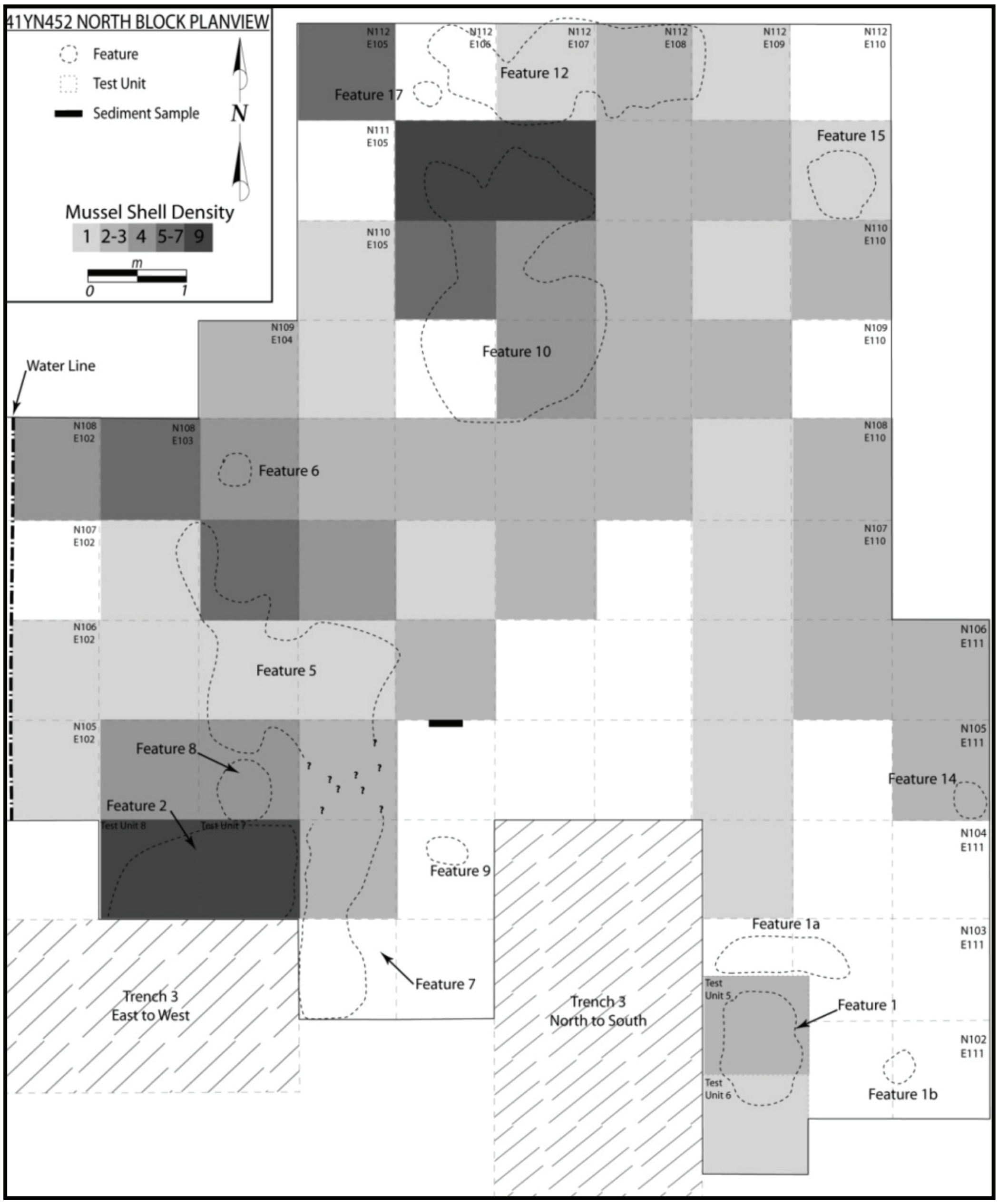

Figure 6-82. The Horizontal Distribution of all the Minor Mussel Shell Species by Count

The heaviest concentration of shells was again in the southwestern corner and in the middle of the northern end. These two areas were again linked by slightly lower weights that also surrounded the heaviest concentrations. Minor variations are apparent, with the weight of those shells within Feature 15 yielding noticeably heavier weights over the counts. Still, it is apparent that the overall pattern of a linear north to south trend shifted slightly towards the western side holds together. The eastern half also still reveals noticeably lower weights in contrast to the western part.

It is also obvious that very few shell, either by count or weight were in the immediate vicinity of the only identified heating element – Feature 1. This potentially indicates that this was not were the shells were heated. Feature 1 yielded some 47 sandstone rocks surrounded by chunks of charcoal that imply that rocks were heated there. It is currently not obvious where the shells were heated/cooked, only where they were most often discarded.

6.3.3.7 Bone and Shell Artifacts

No bone artifacts were recognized. Bone preservation was not good and generally only the burned pieces were recovered. Poor preservation may be the primary factor in its absence. Although considerable quantities of mussel shell were recovered, no formal recognizable ground or shaped shell tools were positively identified. Only a single shell (#677-006-1) exhibits an outer edge with a short concave section that shows minimal rounding that may have been worked or used for a short period and then discarded. This piece was from 80 to 90 cmbs in N109 E107 in Feature 10.

6.3.3.8 Burned Rock Assemblage

This block contained quantities of sandstone burned rocks, both scattered and in features across the 78.5 m^2 excavation area. This block yielded 4,974 burned rocks that weighed 180,127 g for an average weight of 36.2 g per rock. This reveals a density of some 63 burned rocks per m^2. Ninety-eight percent of the rocks were less than 9 cm in length. The 0 to 4 cm size class accounted for 75 percent (*N* = 3,743 or 63,242 g), whereas the 4.1 to 9 cm size rocks accounted for 23 percent (*N* = 1,130 or 78, 195 g). The remaining 3 percent consisted of 95 rocks (32,850 g) in the 9.1 to 15 cm size class at just fewer than 2 percent. Less than 1 percent or six rocks (5.841 g) were greater than 15 cm. Obviously few large rocks were recovered.

All 14 features contained some burned rocks, some more than others, and all were directly associated with mussel shells. The features contained 1,811 rocks or 36 percent of the total rocks. The rocks weighed 75,326 g for an average weight of 42 g. Surprisingly the average feature rock weight was slightly heavier (6 g) than the scattered rocks that weighed an average of 33 g. Feature 1, the *in situ* heating element that yielded 46 large rocks that averaged 310 g, is the primary reason for the higher average in the feature rocks. All 13 other features were discard/dumps and those rocks were considerably smaller that the Feature 1 rocks.

The nonfeature rocks represent 63.6 percent of the total count and 58.2 percent of the total weight. The nonfeature rocks, 3,163 rocks weighed 104,801 g for an average of 33 g,

Although rock types were not consistently recorded in the field, only a couple of nonsandstone rock types were observed. Sandstone bedrock surrounds the site with quartzite, conglomerates, cherts, and other types present in the gravel bar along the river and in the upland gravel outcrops just above the site. Consequently, the occupants had access to multiple types of rocks, but purposely selected for sandstone for their cooking and heating purposes. The angularity observed in the sandstone pieces reflects procurement from the bedrock sources.

Figure 6-83 reveals the horizontal distribution of all the burned rock by counts. The greatest concentration by count was generally centered in recognized features or next to features. The highest frequencies form a general diagonal alignment from the southwestern corner to the northeastern end, with one major exception being the high frequency in Feature 1. Close examination of the distribution indicates two primary concentrations within this linear alignment, one at the southwestern end centered on discard Features 2, 5, 8, 7, and 9, and the other towards the northeastern end in Feature 10. Those two areas document the highest counts, together with Feature 1.

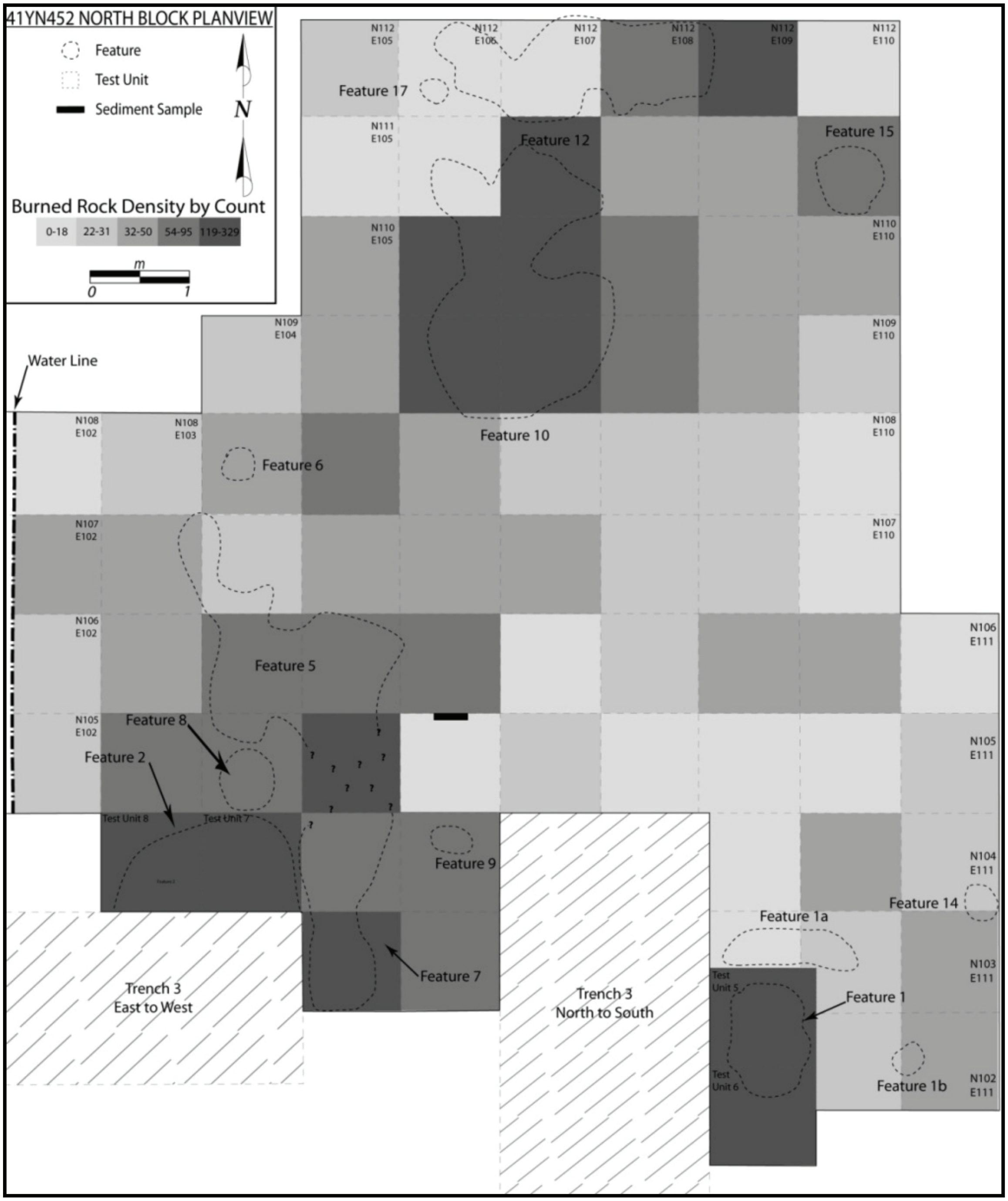

Figure 6-83. Horizontal Distribution of Burned Rocks by Counts in North Block

The lack of any real quantity of burned rocks across the southeastern half of the block and to the northwestern side of the high counts is definitely intriguing. Those areas were obviously not used for discarding burned rocks, which indicates a well-defined pattern to the discard or rocks and specific use areas away from the burned rocks.

The horizontal distribution by weight is similar to that of the counts (Figure 6-84). The same general diagonal trend with the heaviest rocks is still evident from the southwestern corner to the northeastern corner with Feature 1 also representing a heavy concentration. A couple of units in the very southeastern corner, just east of Feature 1 exhibit heavy concentrations, and both of those were recognized as features (Features 1b and 14) in the field. The two areas with limited weights mimic the two areas where counts were also low..

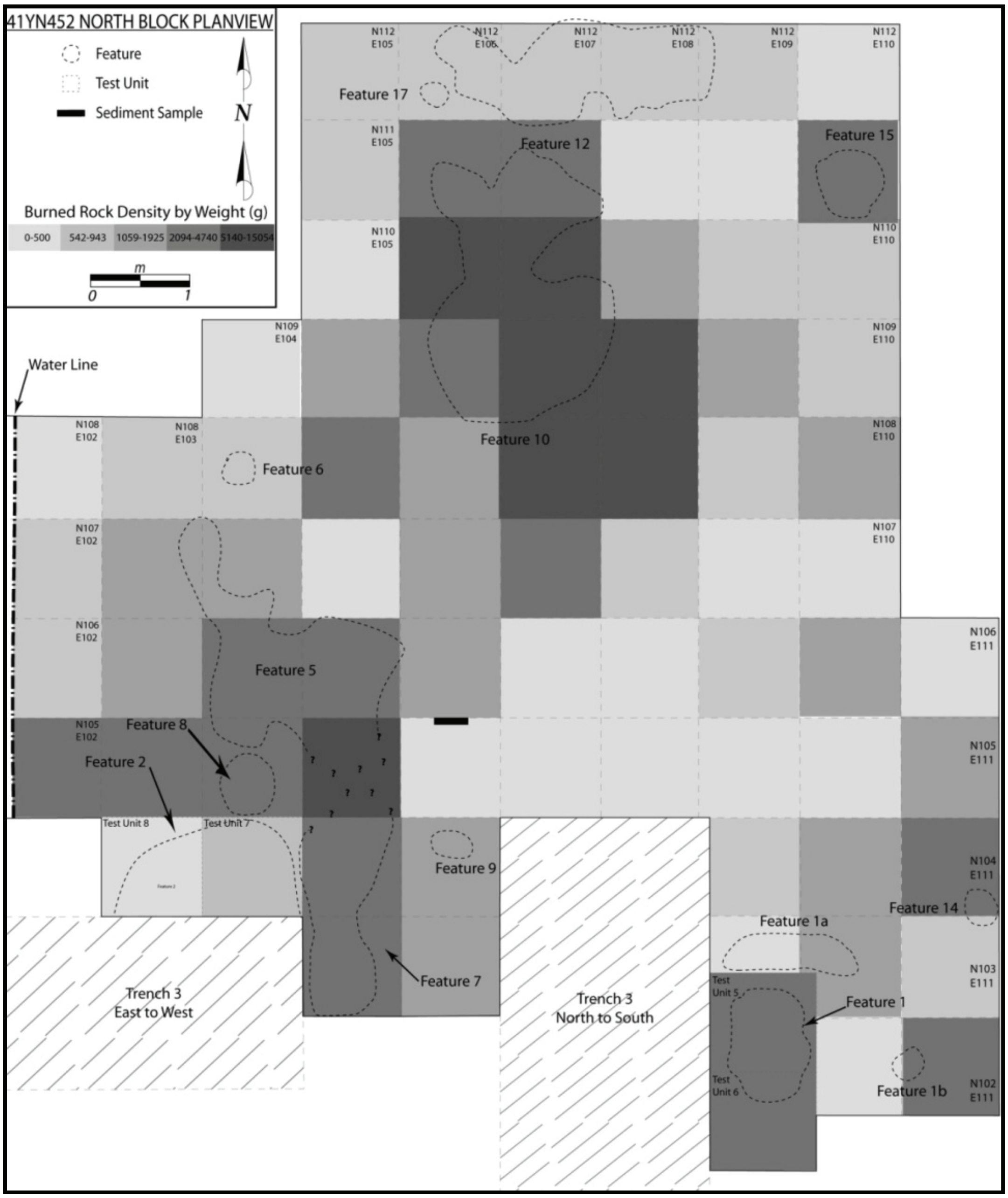

Figure 6-84. Horizontal Distribution of Burned Rocks by Weights in North Block

This recognizable horizontal pattern in the burned rock distribution supports the interpretation that this component represents a single occupation with well-defined areas for specific tasks.

Table 6-17. Summary of Terminal Archaic Component 1 Assemblage

Cultural Material Classes	Terminal Archaic Component 1 (1,100 to 1,300 B.P.)
Features	
Heating Elements	1
Dumps/Discard Areas	13
Post Holes	0
Other	0
Dart Points and Fragments	
Darl and Darl Like	0
Elam-Like	1
Untyped	2
Fragments	3
Arrow Points	
Scallorn	1
Bifaces	21
Scrapers	3
Drills	0
Unifaces	1
Gouges	0
Ground Stone	2
Hammerstones/Choppers	0
Edge-Modified Flakes	71
Lithic Debitage	1016
Cores	1
Shell Tools	0
Bone Tools	0
Bone Fragments*	147/59.8 g
Mussel Shells	4,838/14,198 g
Burned Rocks	4,974/180,127 g
Socialtechnic Objects	0
Carbonized Plant Remains	333/<29 g
Total Materials	**11,095**
Average Thickness (cm)	**20**
Spatial Extent Excavated	**78.5**
Volume Excavated (m^3)	**31.4**

* Bone, mussel shell, and carbonized remain totals are weights in grams; This table does not include materials from float samples

6.3.3.9 Summary

The Terminal Archaic component 1 was identified throughout the North Block. It was stratigraphically restricted to roughly a 20 cm thick sloping zone in the broader 40 cm thick 2Akb paleosol. In general terms, this cultural assemblage is relatively restricted in terms of artifact classes represented (Table 6-17).

This component was dominated by the mussel shells and burned rocks with a restricted formal stone tool assemblage. Fourteen features were identified with all but one considered discard areas of shells and burned rocks.

Organic preservation is poor based on the limited charcoal and lack other charred macrobotanical remains. Although limited in quantity, sufficient wood charcoal was recovered to obtain 11 absolute radiocarbon dates from this North Block. Nine of the 11 wood charcoal dates are accepted and document a 200 year period between 1100 and 1300 B.P. The limited bone assemblage resulted from poor preservation as many of the recovered items were burned, facilitating the preservation of those pieces.

The analyses document a diverse subsistence base that included mussel meat, at least four fish, one deer, one small mammal (rabbit size), one turtle, some wildrye grass seeds (*Elymus* sp.), possible other grasses and mesquite beans. Most, if not all these resources, were cooked with hot rocks, specifically through a stone boiling technique. The limited stone tools were dominated by informal edge-modified flakes with a few dart points and bifaces that at first impressions reflect some hunting and butchering activities. However, use-wear analyses revealed that nearly all tools analyzed had plant remains attached to them. The discovery of plant remains on the tools indicates the tools were not specialized or restricted to one specific task. The limited lithic debitage indicates that minor cobble and biface reduction occurred at this camp. The debitage also reveals the procurement and use of small rounded chert cobbles which reflect the dominance of Edwards chert sources. This Terminal Archaic component reflects a short-term fall camp by a group of mobile hunter-gatherers. Based on the absence of nonlocal chert and exotic goods (e.g., marine shells, bannerstones, etc.) this group was not interacting extensively with neighboring groups. Apparently, this was one of the last groups to employ atlatls and darts, at a time when many adjacent groups had already adopted the bow and arrow technology.

6.3.4 Late Archaic Component 2

The South Block was separated into two components (Late Archaic component 2 and 3) based on the wood charcoal radiocarbon date differences discovered for materials from each end of the block (see 6.2 above for discussion concern age and stratigraphy). The northern two-thirds of the South Block yielded a separate component – labeled Late Archaic component 2. The cultural materials in the northern end were from 48 m^2 continuous hand-excavated units with Trench 6 forming the western margin of the block (Figure 6-85). These materials were concentrated between ca. 45 and 55 cmbs with some scattered to 65 cmbs. The artifacts appeared within the same buried A horizon as Terminal Archaic component 1 in the North Block and the Late Archaic component 3 in the southern end of this block. Late Archaic component 2 was horizontally distinct and separated from the Late Archaic component 3 at the southern end. During eligibility assessment, no other component was recognized above this one cultural zone in this specific location. Therefore, this zone was targeted in the subsequent data recovery with the sediments above mechanically removed to facilitate access to this isolated cultural zone.

Based on eight wood charcoal dates that range from 690 ± 40 B.P. (UGAMS-5179) to 1320 ± 30 B.P. (UGAMS-5183) from this end of the South Block, TxDOT archeologists thought that at least this northern part might be mixed with materials that reflect two different time periods. Consequently, they decided the cultural materials from this northern end of the South Block should not be subjected to detailed analyses, except for the features and formal stone tools. Due to the possibility of mixed cultural events, these materials from the South Block will not be used to address the research questions in Chapter 7.0 below.

6.3.4.1 Cultural Features

Two cultural features (Features 11 and 13) were recognized in this northern area of the South Block (Figure 6-86). Each feature is described to help reveal the nature of the activities represented. Feature 11 was discovered in the southern part of N15 E13. It consisted of a tight cluster of 20 medium to small size sandstone burned rocks with charcoal chunks next to and under some of the rocks (Figure 6-87).

The excavation revealed the burned rocks were in an indistinct shallow basin 6 to 7 cm deep between 47 and 53 cmbs (Figure 6-88). This cluster of rocks extended over an area about 60 by 35 cm. Four rocks along the outer western edge sloped inward and downward toward the middle (Figure 6-88). The sloping rocks combined with a slight vertical difference in their depths and light stained sediment indicated the presence of a shallow basin. Most burned rocks (N = 20) encountered were on the northern side of the basin.

The rocks were blocky and angular indicating they were derived from bedrock sources and not from river gravels. The shallow basin contained slightly darker stained sediment with small charcoal chunks and tiny flecks throughout. The charcoal chunks and dark staining was spotty and not throughout the entire basin. A single, nearly complete mussel shell valve was at 44 cmbs on the northern edge of the burned rocks and was collected for possible dating as it was directly associated with charcoal. Samples of charcoal were collected from specific areas as they became visible. Tiny rootlets and insects holes were the only turbation observed amongst the rocks and in the basin.

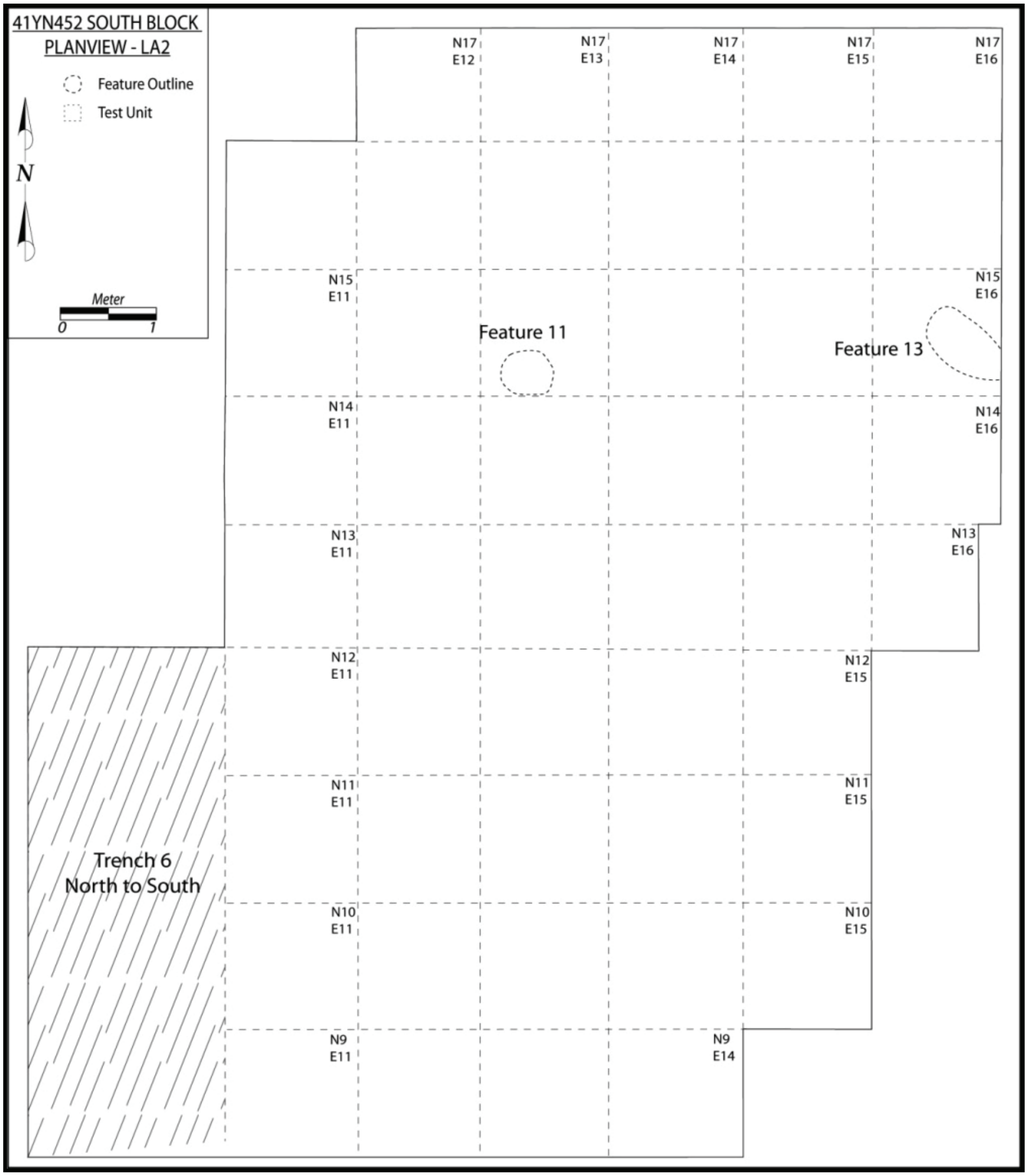

Figure 6-85. The Northern End of the South Block Depicting the Horizontal Positions of Features 11 and 13

The northern part of N15 E13 yielded roughly 20 mussel shell fragments, a couple of chunks of scattered charcoal, and two small burned rocks (46 g). No lithic tools or debitage were recovered in the unit with Feature 11.

Feature 11, and the area immediately surrounding it, were systematically sampled in a tight grid pattern for magnetic susceptibility and chemical analyses (see Figure 5-16). This sampling and subsequent analysis was to investigate the intensity of the fire and address the length of the fire and the occupation.

The sampling occurred through two sets of samples at two levels separated by ca. 5 cm. The sampling used small 1.5 cm plastic squares at 20 cm intervals.

Figure 6-86. Close-up of Small *In Situ* Heating Element Feature 11. Scale is 10 cm.

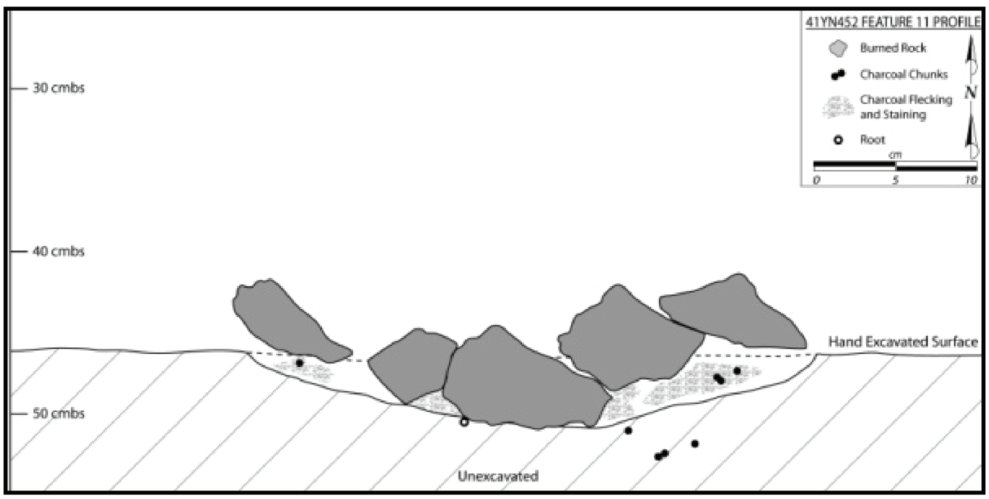

Figure 6-87. East-West Profile Drawing of Feature 11

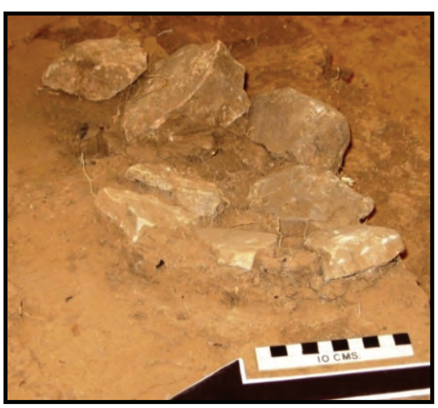

Figure 6-88. Obtuse Angle View of Sloping Burned Rocks on Western Side of Feature 1

The first set of samples (N = 21) was extracted from ca. 45 cmbs, labeled A1 through A21, and collected in five west to east rows starting 10 cm north of the feature rocks and sampled southward through Feature 11 to 10 cm south of the rocks. The second set of samples (N = 18) vertically below the first set at 50 cmbs were labeled C1 through C18. These lower samples were collected in three rows. All samples were collected from the southern half of N15 E13. A single oriented micromorphological block was collected from the upper level grid near the center of the feature.

A nearly seven liter sediment sample from the basin between 44 and 50 cmbs, all the burned rocks, a phytolith sample from under one burned rock, and individual chunks of charcoal, were collected and returned to the laboratory for analyses.

Three piece plotted wood charcoal samples (#400-007-1, #404-007-1, and #404-007-1a) from this feature were radiocarbon dated. A single piece of unidentified charcoal (#404-007-1a) from 51 cmbs yielded a $\delta^{13}C$ adjusted date of 960 ± 40 B.P. (Beta-230768). A second piece (#400-007-1) from 49 cmbs yielded a $\delta^{13}C$ adjusted date of 690 ± 25 B.P. (UGAMS-5179). The third piece (#404-007-1) from 53 cmbs yielded a $\delta^{13}C$ adjusted date of 940 ± 25 B.P. (UGAMS-5180). The three dates combined to average 863 B.P. However, the date of 690 B.P. from slightly higher in the profile is significantly younger than the two older dates by 260 years. If the date of 690 B.P. is considered anomalous and rejected, then the two remaining dates average to 950 B.P. The latter is accepted as the more probable age of Feature 11.

The twenty tightly clustered burned rocks were divided into size classes that consisted of ten pieces less than 4 cm, five in the 4.1 to 9 cm class, and five in the 9.1 to 15 cm size class. The 20 rocks weighted 2,571.1 g for an average rock weight of 128.6 g. All were relatively soft sandstone and mostly brown (7.5YR 5/2) to reddish gray (2.5YR 4/4) color on their exteriors.

Two bulk sediment samples from Feature 11 were floated. The first, a 6.7 liter sediment sample (#400-004-1) from 40 to 50 cmbs, had a dark brown (10YR 4/3) color. The 28 ml, or 5 g, of light fraction yielded over 25 charred woody pieces that weighed only 0.3 g with many tiny hair rootlets and shell fragments (Appendix D). The woody pieces were identified as oak (*Quercus* sp.; Appendix B). The second sample (#404-004-4), 3.8 liters from 50 to 60 cmbs, yielded 52 ml or 4.4 g of light fraction with many tiny unburned rootlets. The 1.9 g of charcoal (*N* = 25) is all mesquite wood (Appendix D). Three individually plotted charcoal samples from Feature 11 were also submitted to Phil Dering for identification. Two of the three pieces were identified as oak with one sample (#404-007-1a) being indeterminate (Appendix D).

Sections of four burned rocks (#400-003-1a, 2a, 3a, and 4a) from Feature 11 were sent to Dr. Perry for starch grain analysis. One brown (7.5YR 5/2) mottled and pinkish gray (7.5YR 7/2) rock (#400-003-3a) yielded a single starch grain from wildrye (*Elymus* sp.). One strong brown (7.5YR 5/6) rock (#400-003-2a) with specks of reddish gray (2.5YR 4/4) yielded a single animal hair. The third rock, (#400-003-4a) with a reddish gray (5YR 5/2) exterior and a dark brown (10YR 4/3) interior yielded an unidentified starch fragment (Appendix B). This latter fragment appears to be from a lenticular grain that has been processed in some unidentifiable fashion. The observed processing damage has not yet been experimentally replicated in the laboratory.

One 37 g section of burned rock (#400-003-1b) from Feature 11 was sent to Dr. Malainey for lipid residue analysis. The rock exterior was a reddish gray (5YR 5/2) with some pink (5YR 8/3). The interior was a light reddish brown (5YR 6/3) mottled with weak red (10YR 5/3). This rock yielded very high C18:1 isomers (47.74 percent) indicating decomposed residues high in fat content such as derived from seeds and nuts (Appendix H). Although plant products were present, so were animal products. Biomarker dehydroabietic acid was also detected, which indicates that conifer products were present. Here, conifer products were most likely from juniper trees. The acid was most likely derived from the fuel wood used in the heating this and other rocks.

Although the macrobotanical analysis did not identify any seeds or nuts from Feature 11 sediment, the chemical residues from the one burned rock analyzed indicate that those types of plants were likely cooked by the rocks in this feature. Decomposed residues from meat products appear as well, and it is likely those meats would have been mussels that were cooked with these rocks. The lipid residue interpretation supports the presence of the wildrye starch grain and an unidentifiable grass starch grain. It is assumed that the grass seeds were at least part of what is reflected in the lipid residue analysis.

The collected grid samples yielded variable results. Magnetic susceptibility, total organic carbon, soil organic matter stable carbon isotopic composition, and total and bray phosphorus were determined for the upper level samples. Only the magnetic susceptibility was determined for the lower level samples (see Section 6.1 above). The combined results support the general expectations, with the feature sediments exhibiting a significant increase in magnetic susceptibility, which was best observed in the lower grid samples and elevated concentrations of total phosphorus. The spatial pattern exhibited by the total phosphorus is perhaps the result of cleaning out this feature from the east, which would scatter phosphorus-rich ash onto the occupation surface. The magnetic susceptibility would be expected to mirror this distribution if more than ash was removed from the feature. The spatial distribution of elevated magnetic susceptibility does show a very small eastward deflection, but the correlation is less than anticipated from such a process. The amount of thermal refuse revealed by petrographic examination of soil from the center of the feature is less than anticipated, but indicative of minor thermal alteration of the rocks and substrate.

Feature 11 is interpreted as an *in situ* heating element where rocks were heated for the purpose to cook foods. This feature was ca. 3.5 m west of the lithic and shell concentration labeled Feature 13 (see below). About 130 cm northeast of Feature 11 was a limited area of charcoal chunks scattered around a few burned rocks. This ill-defined cluster may have been associated with this heating element, a possible discard of charcoal and rocks no long desired or a rake out/clean out. Multiple pieces of wood charcoal in this and the adjacent units were selected from radiocarbon dating to address the question of association. A piece of wood charcoal (#406-007-1) at 49 cmbs in N15 E14 was sent for radiocarbon dating. It yielded a $\delta^{13}C$ adjusted date of 940 ± 25 B.P. (UGAMS-5181). One piece of wood charcoal (#426-007-1) from 55 cmbs in the adjoining unit to the north (N16 E14) yielded a $\delta^{13}C$ adjusted date of 1320 ± 30 B.P. (UGAMS-5183). One wood charcoal sample (#429-007-1) at 54 cmbs from N16 E15 yielded a $\delta^{13}C$ adjusted date of 1220 ± 30 B.P. (UGAMS-5184). The forth piece of wood charcoal (#442-007-1), between 60 and 70 cmbs from N17 E14, yielded a $\delta^{13}C$ adjusted date of 930 ± 30 B.P. (UGAMS-5185). Two of the four dates appear contemporaneous with the two accepted dates from Feature 11. However, two are obviously older by some 280 to 380 years. It is unclear if these two older dates can be interpreted as old wood or just represent some undetected event not associated with Feature 11.

Feature 13 was towards the northeastern corner of the South Block in N15 E16, about 3.5 m east of Feature 11. Feature 13 consisted of a concentration of lithic debitage (approximately 138 pieces from levels 5, 6, and 7) combined with scattered mussel shells (48 pieces weighing 225 g) in an irregular and ill-defined area about 50-by-60 cm in diameter. This apparent flake and shell concentration was encountered during shoveling and as numerous pieces of debitage began to appear, the excavator switched to troweling. Therefore, a number of the items were found *in situ* while troweling, but many more pieces were recovered through shoveling and found in the screen. Figure 6-89 depicts the concentration of the flakes in N15 E16 discovered during troweling and is only a partial representation of the number of items from this and the adjacent units.

Most debitage and mussel shells were lying flat between 54 and 60 cmbs with no obvious stacking and a few pieces scattered between 60 and 65 cmbs. One small mussel shell was next to the clustered flakes, whereas a number of small mussel shells and a few more flakes were some 20 cm southeast. No discolored or dark stained sediment was observed in this area. The sediment surrounding these artifacts was a brown (10YR 4/3) hard pack, silty clay loam. Five small burned rock pieces less than 4 cm in diameter were recovered from 50 to 60 cmbs in N15 E16. A small brown (10YR 5/3) sediment sample (#414-004-1) was collected from between 62 and 65 cmbs and a charcoal sample (#414-007) was collected from 63 cmbs in the southeastern quadrant. Materials in Feature 13 were at the same general elevation as most recovered cultural materials in the adjacent units including Feature 11.

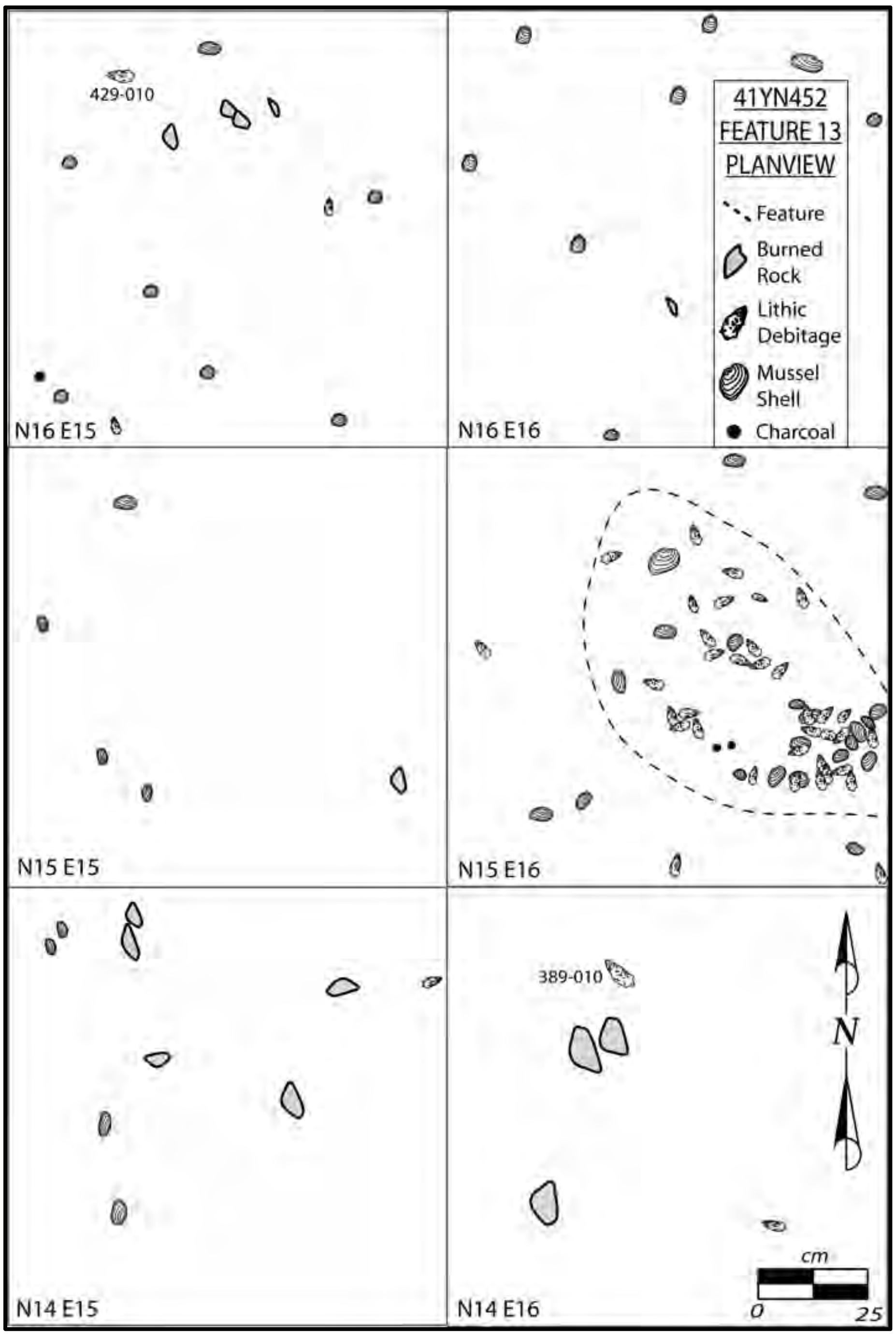

Figure 6-89. Cultural Materials Plotted Around Feature 13 and the Part of the Concentration that Makes up Feature 13

Mussel shell analyses from N15 E16 revealed only two species. This included seven specimens identified as smooth pimpleback (*Quadrula houstonensis*) and one southern mapleleaf (*Quadrula aplicata*). The remaining 40 pieces were too fragmentary for positive identification. Four fragments were crescent shaped outer margins, which may be a weak spot along a growth line and weakened following their heating and/or cooling process. One shell (#410-006) from N15 E16 exhibits a small diameter hole near the beak, but positive human alterations such as incising or burning were not observed on any of the other pieces. It is not assumed that the hole in the shell represents a direct human action. On average, the 48 shell pieces weighed 4.7 g each, indicating the pieces were small valves and small fragments. These pieces were vertically distributed between 43 and 65 cmbs, with the majority between 50 and 60 cmbs together with the highest concentration of lithic debitage.

Two chert pieces (#414-10 and #414-11) from Feature 13 in N15 E16 are edge-modified flakes. Both pieces were 60 to 62 cmbs and amongst the lithic debitage.

6.3.4.2 Chipped Stone Assemblage

The chipped stone tools identified include 4 bifaces, 2 complete (#374-10 and #429-10) and 2 fragments (#342-12 and #354-10); 1 broken chopper (#389-10); 1 complete projectile point (#409-10); and 18 informal edge-modified flakes. Each formal tool is described below. Specimen #342-12 is the distal section of a finished biface that was broken during use. It came from 45 to 50 cmbs in N12 E12. This biface was manufactured from a very light colored Edwards chert. Both lateral edges are extensively worn and the distal tip exhibits an impact fracture testifying to its previous use.

Specimen #354-10 was from 48 cmbs in N13 E11. It is a small section of the lateral edge of a relatively thin biface. Both faces exhibit short, small flake scars along the very margins and combined with the overall thinness, this piece is indicative of a dart point. The lateral edge is extensively worn to the extent of being ground. This lateral edge was found in the unit just north of the previous biface.

Specimen #374-10 was a complete triangular biface shattered in the field. This Edwards chert biface was between 40 and 50 cmbs in N14 E11, about 2 m west of Feature 11. The biface was well-executed and quite thin. The base and lateral edges are straight and the overall outline and workmanship fits the definition of a Friday biface (Turner and Hester 1999). This unwashed biface was sent to Dr. Hardy for high-powered use-wear analysis. The lateral edges appear lightly used. The analysis revealed an impact fracture on the very tip, and abraded flake scar ridges on the proximal half (Figure 6-90). These abraded ridges indicate that this biface was hafted and the haft extended to about the midpoint (Appendix C).

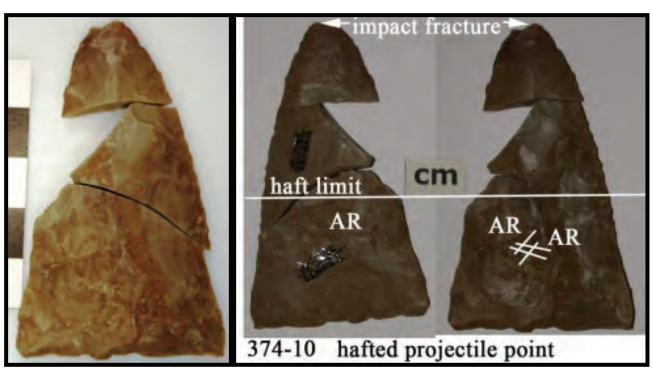

Figure 6-90. Biface #374-10 Showing Use-Wear and Half Limit Locations

A broken chopper (#389-10) was from 42 to 45 cmbs in N14 E16 just south of Feature 13. This is a dense, light reddish brown (2.5YR 6/4) with a pink hue, fine grained quartzite (Figure 6-91). This broken specimen measures 55.7 mm long, 86.9 mm wide, and weighs 238 g. The long axis is broken and possibly the short axis is as well.

The distal worked end is present and reveals multiple short, thick flake scars across both faces, which created a convex distal end. The very distal edge is crushed with numerous small short hinge scars on the edge testifying to its use on stiff or hard materials.

Specimen #429-10 is a complete biface, possibly a perform (Figure 6-92). It came from 57 cmbs in N16 E15 in the unit just north of and at the same vertical elevation as Feature 13. It was manufactured from Edwards chert as indicated by the yellowish florescence under short-wave ultraviolet light. One lateral edge is very well finished with broad soft hammer flake scars, whereas the opposite lateral edge exhibits a lump that could not be removed. The basal edge appears damaged and is not the original finished edge. This unwashed biface was sent to Dr. Hardy for high-powered use-wear analysis. His analysis revealed this biface functioned at least for scraping plants as evident by the presence of raphides, striations, and hard high silica polish (Figure 6-92).

Figure 6-91. Broken Chopper (#389-10) with Worked Distal End at Top Scale in cm.

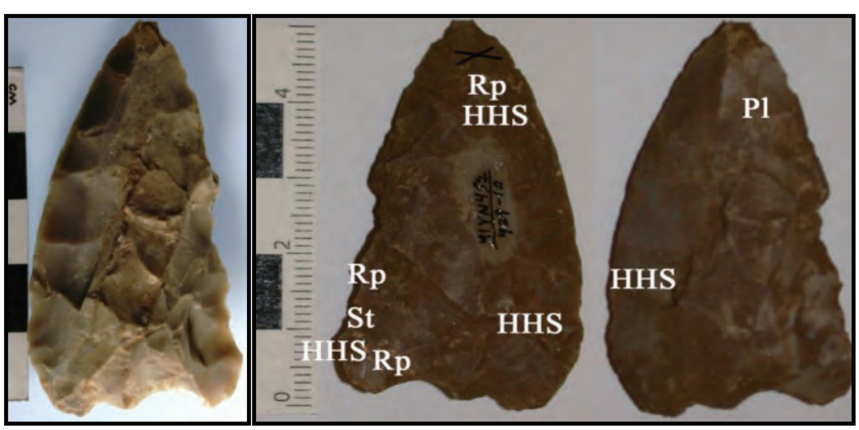

Figure 6-92. Complete Biface #429-10 Showing Location of Raphides, Striations, and Hard/High Silica Polish. Scale in cm.

This biface was apparently hand-held as it lacked abraded flake scar ridges in contrast to many of the other specimens analyzed (Appendix C). The presence of plant fibers indicates this was not a preform, but a functional formal tool that had been used, and used sufficiently long enough to acquire the polish.

Following the use-wear analysis, this same biface was sent for starch grain analysis. Dr. Perrys' analysis yielded no starch grains (Appendix B). It is surprising that no starch grains were detected given that this tool was used to cut plants.

The one complete dart point (#409-10) came from 40 to 50 cmbs in N15 E15. Its horizontal position was roughly 1 m northwest of Feature 13 and roughly 2 m northeast of Feature 11. The vertical position was nearly identical to that of both features. This point is an asymmetrically stemmed projectile with a long blade and pronounced shoulders that extend outward (Figure 6-93). In overall form, this point resembles a Yarbrough point (Johnson 1962; Turner and Hester 1999).

This unwashed biface was also sent for high-powered use-wear analysis. The analysis revealed soft polish striations at the distal tip, which was interpreted to indicate this tool was used in a boring fashion. It also exhibits abraded flake scar ridges on the proximal half (Figure 6-93). These abraded ridges indicate that this biface was hafted and the haft extended to about the midpoint, considerable further along the blade and past the stem, which is often considered the haft area (Appendix C).

The 18 edge-modified flakes are summarized in Table 6-18, which provides basic information concerning these informal tools.

A single unwashed, edge-modified flake (#396-10) from 47 cmbs in N15 E12 was sent for use-wear analysis. This Edwards chert flake came from the unit just west of Feature 11. This is the medial section of a long thin blade with both the proximal and distal ends snapped off. It is a bifacial thinning flake with a strong curve towards the distal end. It exhibits a central ridge with two tapering lateral edges. The left lateral edge exhibits two small prominent flake scars, creating a tiny projection or point that might have served a specific function. The rest of this lateral edge exhibits tiny use scars towards the distal end. The right lateral edge lacks visible scaring. The use-wear analysis reveals that both lateral edges have raphides present with hard high silica polish on the dorsal and ventral surfaces of the right lateral edge (Figure 6-94; Appendix C).

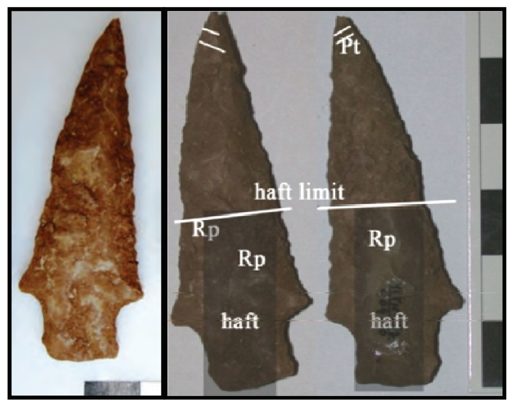

Figure 6-93. Complete Dart Point #409-10 Showing Striations on Tip and Raphides across the Medial Section. Note the horizontal white line indicates the maximum extent of the half wear on scar ridges. Scale in cm.

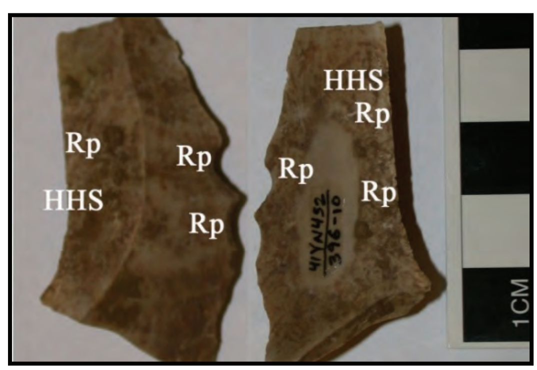

Figure 6-94. Edge-Modified Flake #396-10 Showing Locations of Use-Wear and Raphides

6.3.4.3 Lithic Debitage Assemblage

The lithic debitage assemblage consists of 436 pieces, which include platform bearing flakes, distal flakes/shatter/angular debris, and cores. These pieces were primarily within the buried A horizon from roughly 45 to 60 cmbs. Their horizontal distribution is depicted in Figures 6-95 and 6-96. The distribution reflects a light scatter across much of the excavation with at least more concentrated pieces at least 1 m away from the *in situ* heating element Feature 11.

The most intensive concentration and the heaviest by weight were in and north of Feature 13. The latter was an apparent discard area. Because of the likelihood of mixed cultural events, TxDOT archeological staff directed TRC not to conduct a detailed lithic debitage analysis using materials from the Late Archaic component 2.

A single specimen (#367-11) was classified as a core. This core came from 42 to 45 cmbs in N13 E15. It may or may not be associated with this component, as it was a few centimeters higher in the profile than most other materials. This is part of a small water worn cobble that exhibits a dark polished exterior surface and represents a corner of the original cobble (Figure 6-97).

The original cobble was split diagonally that created a steep edge near what would have been the middle of the rock and opposite the angular corner. That broken edge was primarily worked from one direction with at least 20 short hinge scars that are within 1.5 cm of the newly created edge.

Only two major flake scars were observed on the opposite face. The short axis is 48.6 mm, the long axis is 80.8 mm, and it is 27.7 mm thick, with a weight of 103.8 g. It may be that the edge was used in a chopping motion on a hard substance, which would have created the multiple, short flake scars on the one face. If that interpretation is correct, then this piece functioned as a chopper and not as a core to produce flakes.

Table 6-18. Summary of Late Archaic Component 2 Assemblage

Cultural Material Classes	Late Archaic Component 2 (930 to 1,320 B.P.)
Features	
Heating Elements	1
Dumps/Discard Areas	1
Post Holes	0
Other	0
Dart Points and Fragments	
Darl and Darl Like	1
Elam-Like	0
Untyped	0
Fragments	2
Arrow Points	
Scallorn	0
Bifaces	4
Scrapers	0
Drills	0
Unifaces	0
Gouges	0
Ground Stone	0
Hammerstones/Choppers	1
Edge-Modified Flakes	18
Lithic Debitage	436
Cores	3
Shell tools	0
Bone Tools	0
Bone Fragments*	13/20.8 g
Mussel Shells	1,412/2,975 g
Burned Rocks	542/6,792 g
Socialtechnic Objects	0
Carbonized Plant Remains	116/1.4 g
Total Materials	**2,550**
Average Thickness (cm)	**20**
Spatial Extent Excavated	**48**
Volume Excavated (m^3)	**9.6**

* Bone, mussel shell, and carbonized remain totals are weights in grams;

This table does not include materials from float

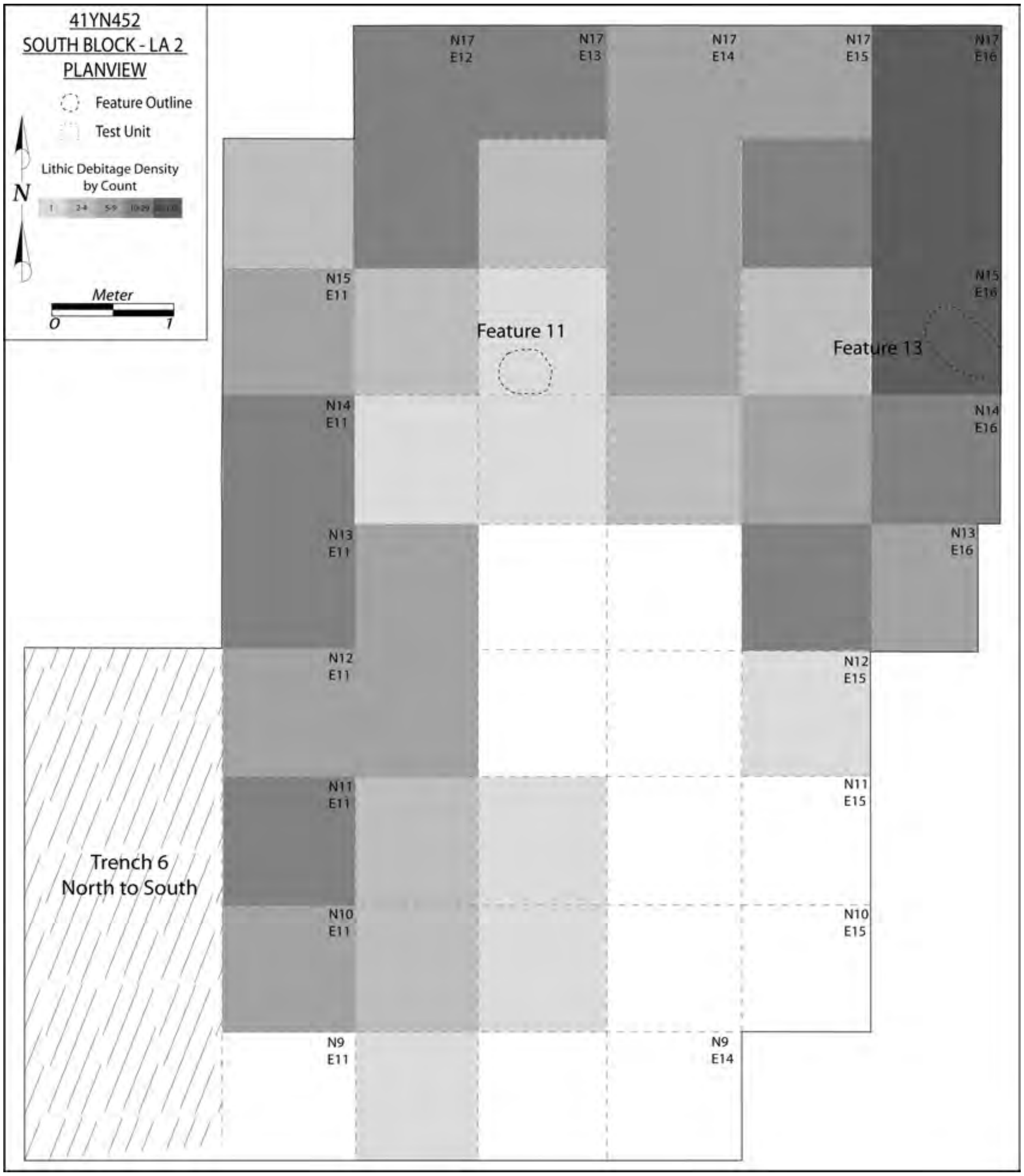

Figure 6-95. Horizontal Distribution of Lithic Debitage by Count across Late Archaic Component 2

6.3.4.4 Ground Stone Assemblage

No ground stone tools were identified in this component. The absence is not hard evidence, but is indicative of the lack of plant processing to any significant degree, often associated with ground stone tools.

6.3.4.5 Vertebrate Faunal Assemblage

This Late Archaic component 2 yielded only 13 bone fragments that weigh 20.8 g, for an average weight of 1.6 g. All but two pieces were too fragmentary to allow positive identification. A single fish otolith (#419-10) was recovered between 40 and 50 cmbs in N16 E12, roughly 1.5 to 2.0 m northwest of Feature 11. This otolith represents a freshwater drum (*Aplodinatus grummiens*) and reflects a fish age of about six years (Figure 6-98).

At that age, the fish is estimated to have weighted about 16 g (Appendix J). The otolith measured 11.9 mm by 10.2 mm, 4.1 mm thick, and weighed 0.6 g. This otolith was sawed in half and one edge was polished to facilitate the counting of the grow rings and determine the approximate age and season of death. Based on the estimated percentage of the final growth ring, this fish apparently died in the fall of the year. The unpolished half was sent for possible radiocarbon dating, but the laboratory did not retrieve any collagen,

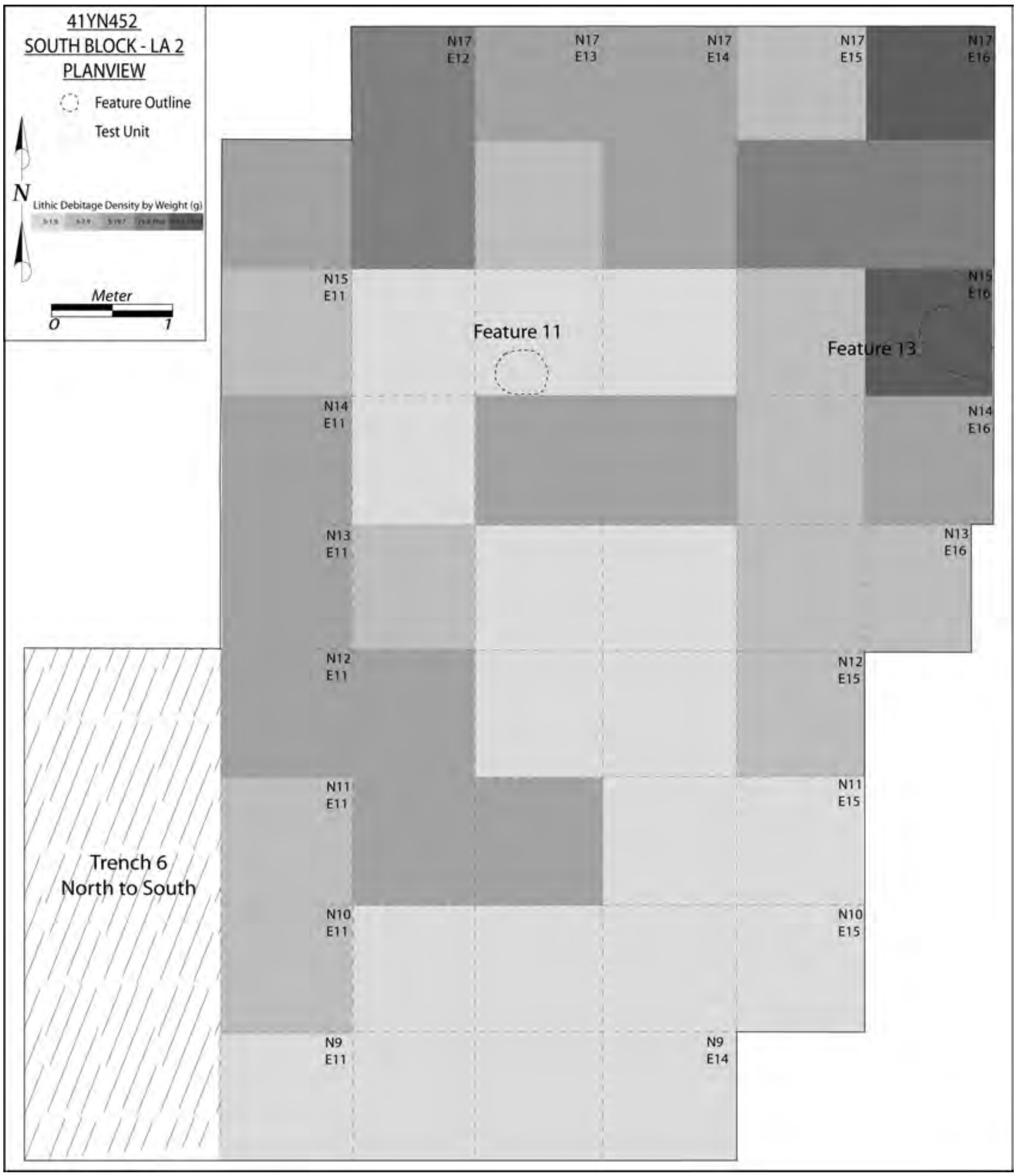

Figure 6-96. Horizontal Distribution of Lithic Debietage by Weight across Late Archaic Component 2

only aragonite. Therefore, it was determined that a precise age could not be derived from this material.

The only other identifiable bone (#378-002) was five fragments of a left deer pelvis (*Odocoileus* sp.). These five chunks have a weight of 17.7 g that account for 81 present of the total weight of all the bones from this component. Small thin lines that may be cut marks are on one piece of this pelvis. The pelvis was 62 cmbs in N14 E12 and less than 100 cm west of heating element Feature 11. One deer size long bone fragment (#358-002) was burned to a brown and black color. This burned piece was roughly 48 to 50 cmbs in N13 E12. This was some 150 to 200 m south of Feature 11. A small tooth fragment (#374-002) in the size range of deer could not be positively identified. This tooth fragment was between 40 and 50 cmbs from N14 E11 and roughly 1.5 m southwest of Feature 11. In general terms, these few bone fragments were west and southwest of the heating element.

At least four rodent size, possible rabbit, fragments (#414-002 and #414-004) were present in and around Feature 13, but lack sufficient characteristics to allow positive identification. Three of the four rodent size bones are burned to a black color. Their burned state indicates these fragments were definitely part of the cultural assemblage and may have been previously discarded into a fire as part of the discard process. All four pieces were between 60 and 65 cmbs in N15 E16 and around or in Feature 13.

Based on the analysis of one fish otolith that exhibits an estimated 70 to 80 percent of the last growth ring, the season of death was in the fall of the year (Appendix J). This is approximately the same season of the year as indicated by the four fish otoliths in the Terminal Archaic component 1 in the North Block. Although the data to interpret the season of occupation is limited to one element, it is all that is available for seasonality interpretations and must be considered reasonable at present.

6.3.4.6 Mussel Shell Assemblage

This Late Archaic component 2 across the northern part of the South Block consisted of 48 units, roughly two-thirds of the block north of N8 row, which extended from the northern edge of Feature 4.

Figure 6-97. Complete Core (#367-11) with Platform or Battered Edge. Scale is in cm.

Figure 6-98. Close-Up of Fish Otolith (#419-10).

The mussel shell assemblage from this component yielded a total of 1,412 mussel shell pieces that weighed 2,975 g for an average of 2.1 g per shell. Only 12 percent (*N* = 171) of the pieces were identifiable to specific species. The five species include smooth pimpleback (*Quadrula houstonensis*), southern mapleleaf (*Quadrula aplicata*), mapleleaf (*Quadrula quadrula*), pistolegrip (*Tritogonia verrucosa*), and Texas pimpleback (*Quadrula petrina*). The smooth pimpleback accounted for the overwhelming majority of the identifiable pieces (*N* = 121 or 71 percent). Low frequencies of southern mapleleaf (*N* = 26 or 15 percent) and mapleleaf (*N* = 17 or 10 percent) were present. Pistolgrip (*N* = 6) and Texas pimpleback (*N* = 1) were presence in very limited numbers.

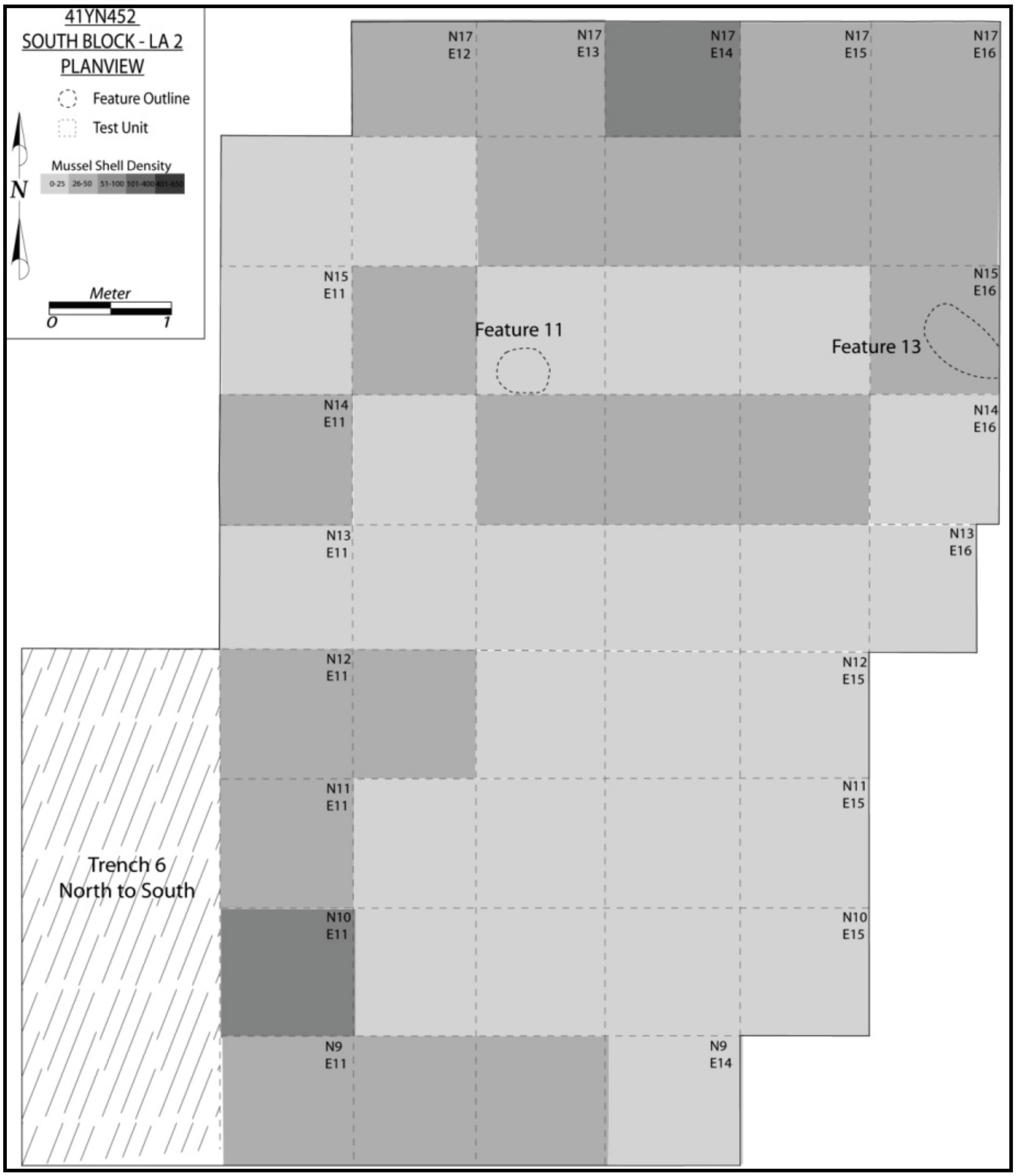

Figure 6-99. Mussel Shell Distribution across the Northern End of the South Block

General habitat descriptions for mussels of Texas are provided by Howell et al. (1996). However, the five species represented can and do occur under many different conditions. So the species represented do not contribute to understanding the specific characteristics of the water conditions in the vicinity of this site.

Only six pieces, or less than 0.5 percent, exhibit possible evidence for direct human alterations. Five pieces were burned as evident by their gray appearance. Most burned pieces were small, mostly the dense beak and tooth area. Once burned, the thinner parts of the shell become brittle and crumble easily. Therefore, the dense beak area is often all that remains once burned. This very low frequency of burning indicates that not many specimens were subjected to direct heat, either in a fire or on extremely hot coals.

One 2.8 g unidentifiable shell (#426-006-1) has a relatively large diameter hole (6.6 mm) just to the side of the beak opposite the teeth. The hole appears to have originated from outside with the rough and irregular edge of the hole on the outer surface and the cleaner edge on the interior.

Nearly 88 percent of mussel shell assemblage was quite fragmentary, with 11 percent (N = 118) of those fragments being the outer growth ring that is a crescent shaped segment. Currently, it is not clear how and why this piece separates from the main shell. The growth line is likely a weak area in the shell and may loosen or become separated from the main body as a result from cooking activity or from normal weathering and splitting along the edge.

The horizontal distribution of the mussel shells is depicted in Figure 6-99. No significant shell concentrations appear in this component.

The greatest density was in one unit at the northern edge of the block, away from either of the two recognized features. The distribution norm appears as a light scatter across the area, unlike the more clustered shells in the North Block. None of the five burned fragments were in the same unit or in the unit that contained the heating element Feature 11. Thirty-one mussel shell pieces (201 g) were in the same unit with Feature 13, which was the cluster of chert flakes and shells. Only eight of those pieces associated with Feature 13 were identifiable to species; seven were identified as smooth pimpleback. One of the many fragments was the crescent shaped outer edge.

The unit that contained the heating element (Feature 11) also yielded six unidentifiable shell fragments that weighed 16 g. Two fragments were the crescent shaped outer margins. Although Feature 11 is considered an *in situ* heating element with burned rocks and charcoal in a shallow basin, none of the shell fragments were visibly burned.

6.3.4.7 Bone and Shell Artifacts

No bone or shell artifacts were identified from this Late Archaic component 2.

6.3.4.8 Burned Rock Assemblage

For the most part, the burned rocks were unevenly scattered across the 48 m^2 area with one obvious burned rock dominated feature (Feature 11) recognized. Including Feature 11, this component yielded 542 rocks that weighed 6,792 g for an average weight of 12.5 g per rock. Nearly 88 percent were in the 0 to 4 cm size class, with only 11 percent in the 4.1 to 9 cm size class, and less than 1 percent greater than 9 cm. Excluding the 20 burned rocks in Feature 11 and their weight (2,571.1 g), the remainder were quite small in comparison, with an overall average weight of only 8.1 g per rock. Apparently, those small pieces outside of Feature 11 had been used to such an extent and reduced in size that they no longer were deemed suitable for retaining heat and further use. Therefore, those small pieces were considered expendable and were discarded.

Their horizontal distribution by counts appears to have been mostly random and scattered (Figure 6-100).

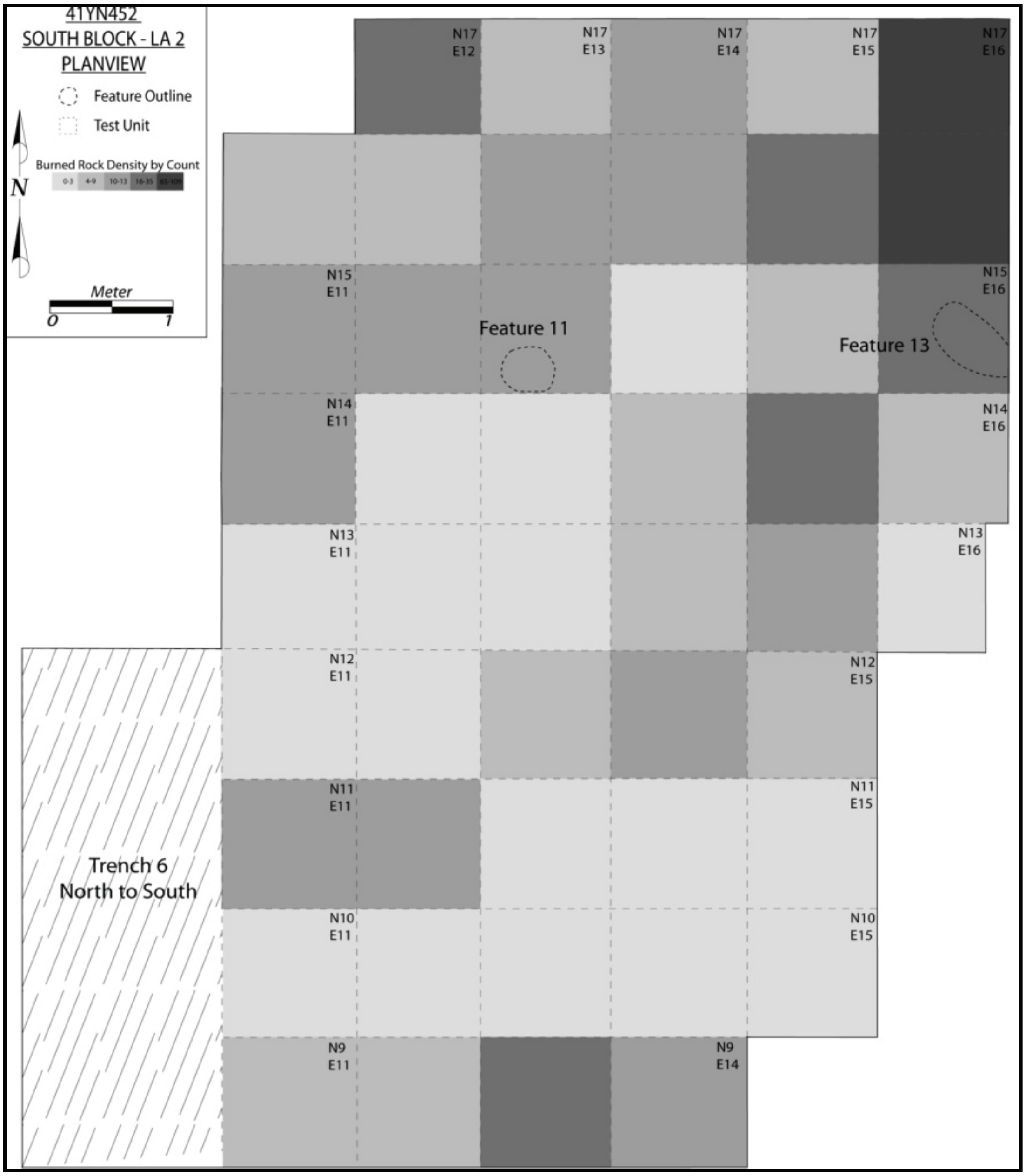

Figure 6-100. Horizontal Distribution of Burned Rocks by Counts

In the very northeastern corner, two units revealed the greatest concentration by count. This is just north of the unit that revealed a high frequency of lithic debris and shells, labeled Feature 13.

Apparently, this northern corner represented the primary area for discarding used rocks. Five other separated units reflect moderate densities, indicating possible dump areas. In contrast, the horizontal density of the burned rocks by weight reveals somewhat of a different pattern (Figure 6-101). The five individual units with the greatest rock weight were not the same as those with the most rocks. This generally reflects the difference of many small rocks in a unit, in contrast to a unit that had only a couple of large rocks. Apparently some larger and heavier rocks surrounded Feature 11. Therefore, they may have been used and/or associated with that *in situ* heating element.

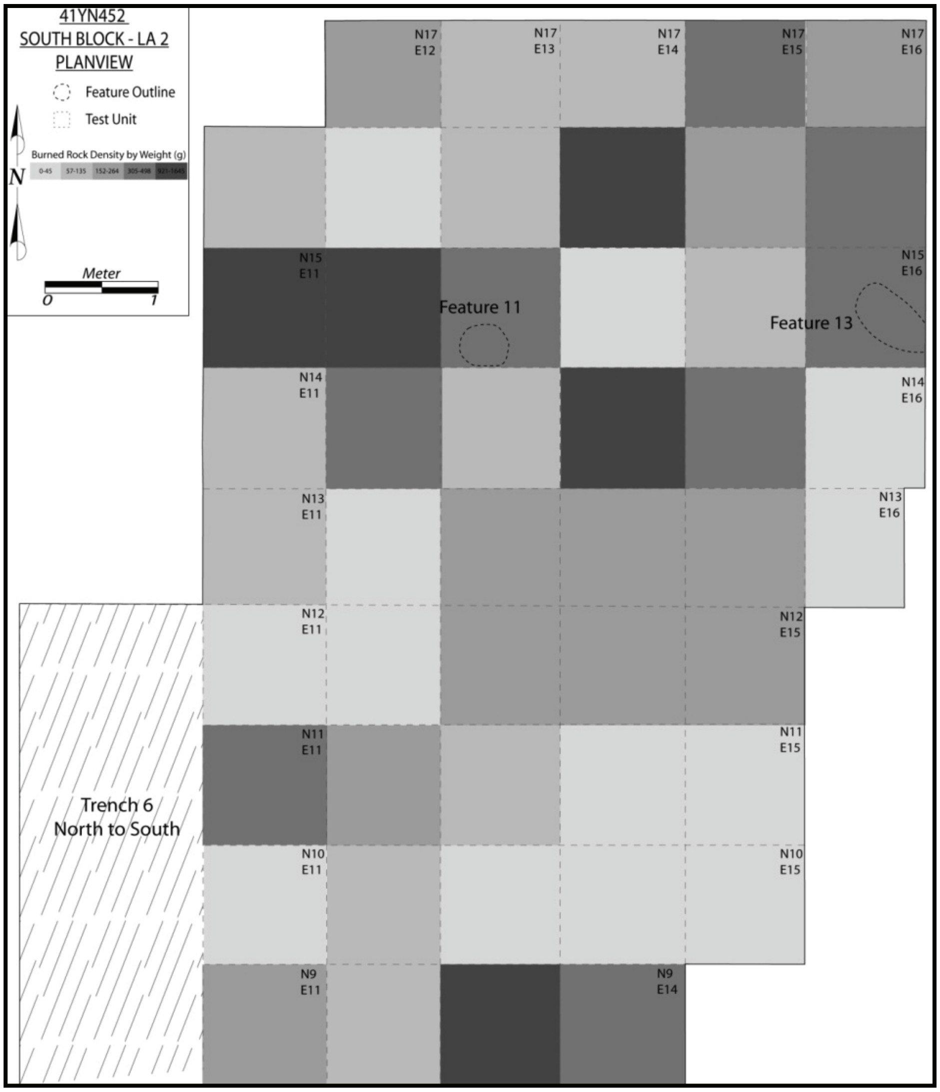

Figure 6-101. Horizontal Distribution of Burned Rocks by Weight

6.3.4.9 Summary

This Late Archaic component 2 was identified across the northern two-thirds of the South Block. It was stratigraphically restricted to the roughly a 20 cm thick zone between ca. 45 and 65 cmbs and within poorly visible 2Akb paleosol. Based on nine absolute wood charcoal dates from this area, of which only six are accepted as reliable indicators of period of occupation, this component dates to between 930 and 1320 B.P. Based on these ages TxDOT archeologists thought the cultural materials may be mixed. Therefore, TxDOT directed TRC to only analyze the two identified cultural features and the formal stone tools. Since they thought the materials mixed, these were not suitable to address the Terminal Archaic research questions.

This component was again dominated by mussel shells and burned rocks (see Table 6-18). The stone tool assemblage was restricted in the classes represented and the number of actual tools present.

The two features identified include one small well-defined heating element and one general discard area dominated by mussel shells and lithic debitage. The discarded materials were about 3.5 m directly west of the heating element. A large and complete

Late Archaic dart point similar to a Darl or Yarborough point was recovered from between the two features.

The limited analyses document the occupants focused on the procurement and cooking mussel meat during a short-term camping episode. The subsistence resources included at least fish, deer, and wildrye (*Elymus* sp.) grass seeds. Microfossil analyses of the burned rocks indicates that the foods were cooked using a stone boiling technique.

The lithic debitage discarded in Feature 13 appears to represent general cobble or core reduction process, with as at three cobbles represented. This component reflects a short-term fall camp by a mixed group of hunter-gatherers.

6.3.5 Late Archaic Component 3

The South Block was separated into two components based on 14 radiocarbon dates that reveal age differences on charcoal from each end of the block (see 6.2 above). The southern end of the South Block yielded a separate Late Archaic component (3), which is dominated by Feature 4. The cultural materials were from 21 m^2 of continuous hand-excavated units with Test Unit 3 just outside this block on the western margin (Figure 6-102). This component appeared in the same buried A horizon as the two previous components.

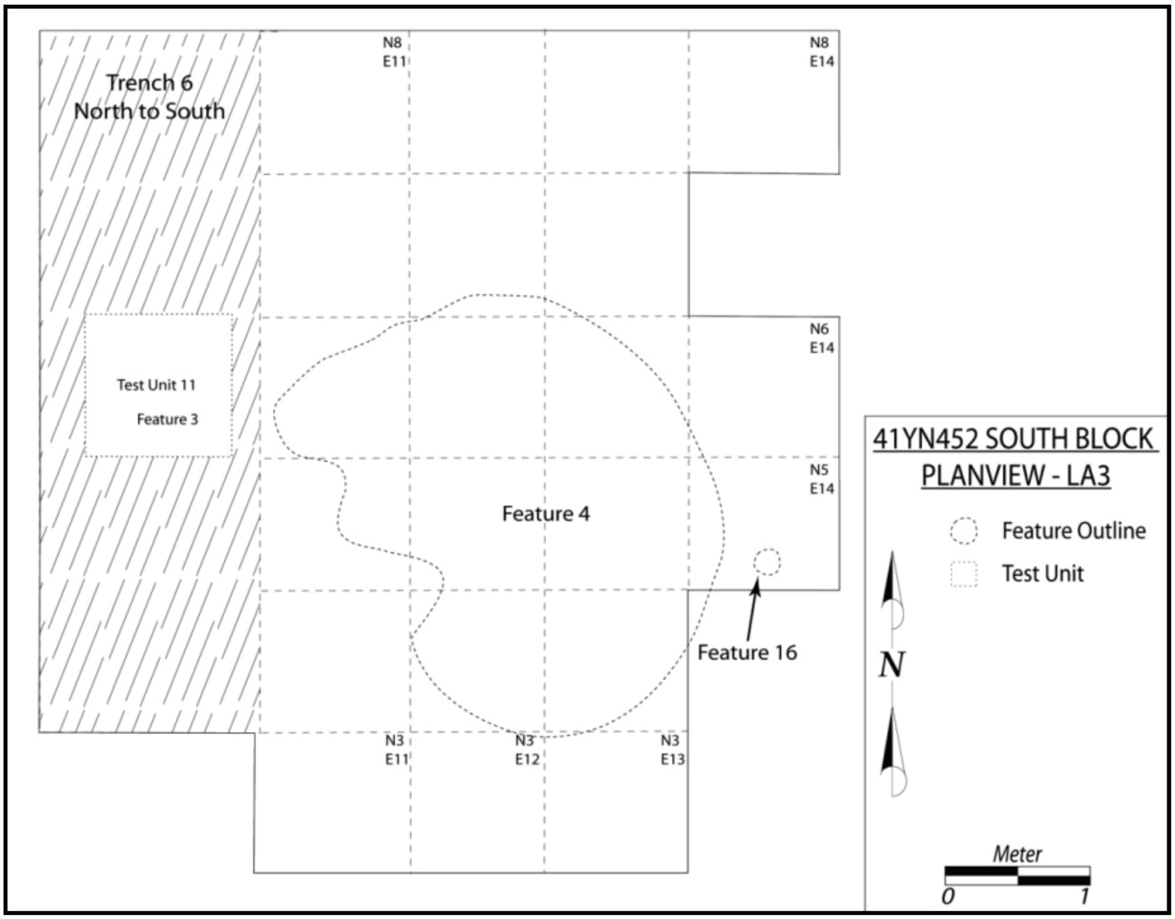

Figure 6-102. Southern End of South Block Depicting Horizontal Position of Feature 4

During the eligibility assessment no cultural component was identified above Feature 4, but a few scattered Late Prehistoric items were recovered. This well-defined component was horizontally separated from the Late Archaic component 2 at north end of this block with no stratification of cultural components recognized in this specific location. These Late Archaic component 3 materials will not be used to address the research questions in Chapter 7.0 below that focus on the Terminal Archaic period.

6.3.5.1 Cultural Features

Feature 4 extended across multiple excavated units (at least 9 m^2) in the southern end of the South Block. This feature was dominated by mussel shells, both complete and fragments (*N* = 3,780 pieces weighing 24,520 g or 6.5 g piece), with the occasional small sandstone burned rock, charcoal fleck, chert flake, and chert tool. The feature was a massive concentration of shells that crossed at least parts of nine units and lacked well-defined boundaries (Figures 6-103 through 6-106).

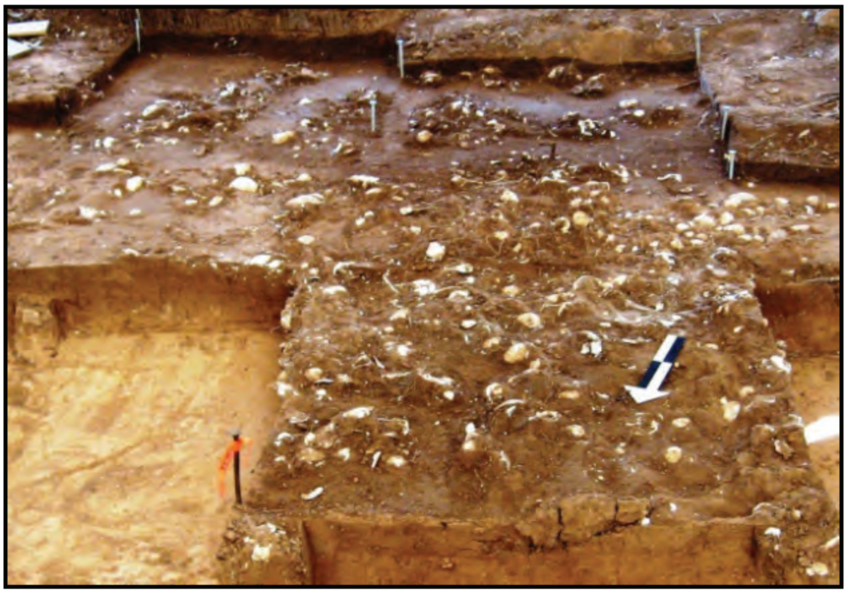

Figure 6-103. A Section of Feature 4 Depicting Dense Mussel Shell Concentrations

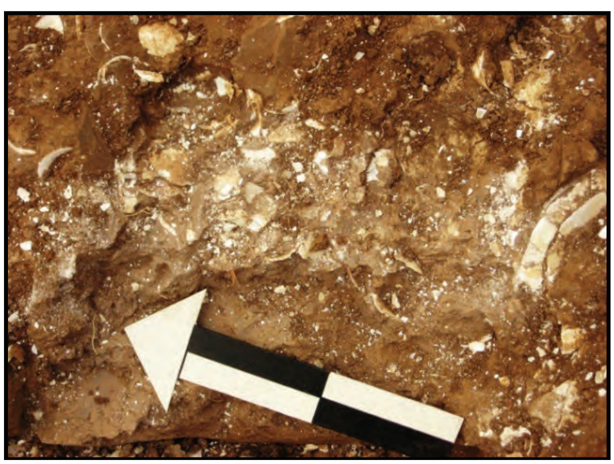

Figure 6-104. Close-Up of Mussel Shell Concentration in Feature 4

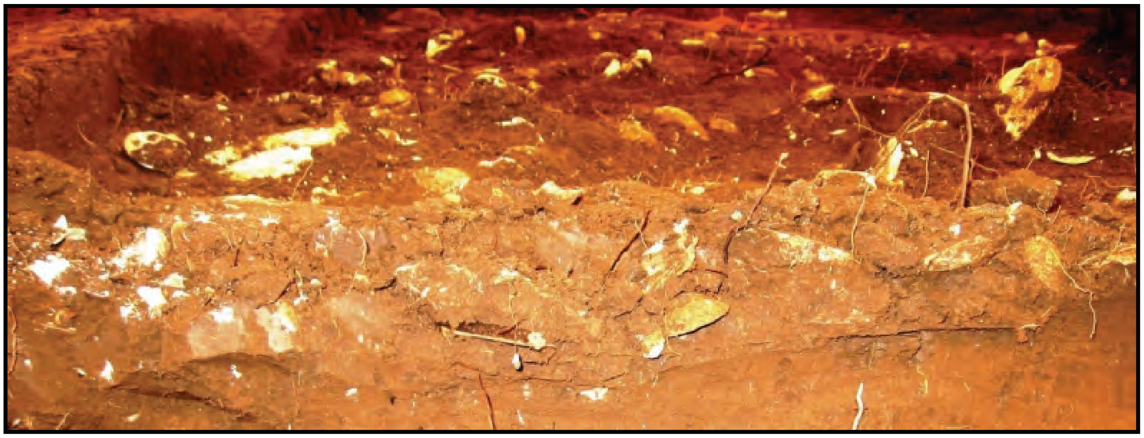

Figure 6-105. Profile Section of Feature 4 Depicting Thin Lens of Discarded Shells

The lack of ill-defined boundaries allows various interpretations of the overall shape and exactly what materials were inside or outside. Depending on one's view of this broad lens/scatter, the concentration of shells assigned to Feature 4 is estimated to cover an oval area about 300 to 350 cm with shells vertically distributed from 38 to 67 cmbs, although the majority of shells were between 45 and 55 cmbs.

Feature 4 may be classified as a shell lens or a thin midden, as numerous places within this feature revealed clusters of shells with some stacked shells, whereas some areas had only one or two shells thick or lacked shells altogether. Shells were lying mostly flat while a few were on edge. Many shells appeared in small clusters with various thicknesses and widths throughout this broad scatter. These apparent clusters may represent individual dumps following the removal of the meat.

In the laboratory, all the piece plotted data was combined into a single horizontal distribution map. Carefully examination of the plotted shells revealed Feature 4 to have a possible defined outer edge that formed a rough arc or circular eastern boundary as shown in Figure 6-106.

It is possible that some type of structure limited the horizontal distribution of the shells to the eastern side. However, no large rocks, post molds, or other cultural artifacts were found along that perceived boundary to support that interpretation. The western side does not reveal the continuation of that arc or a well-defined edge with shells lightly scattered making it difficult to define a specific edge. This ill-defined edge may represent an opening to the possible structure or the place where people sat or worked, while extracting the meat from the shells.

Towards the middle or just north of the center of this half moon pattern was a dense concentration of shells with a few scattered burned rocks. No specific distributional pattern could be positively identified for the dense cluster that measured roughly 150 cm east to west and 50 to 60 cm north to south. The apparent arc shape to the dense cluster with the concave part to the south side may indicate an individual(s) sat on the southern side and discarded shells to the north.

Three charcoal chunks were sent for wood identifications, and one bulk sediment sample (#249-004-1) of 6.4 liters, from 56 to 60 cmbs in N6 E11, was selected for flotation. Two of the charcoal samples (#236-007-1a and #249-007-1) could not be identified to a specific species, whereas the one chunk (#251-007-1a) was identified as granjeño (*Celtis pallida*; Appendix D). The floated sediment yielded <0.1 g of charcoal flecks with many tiny root and shell fragments.

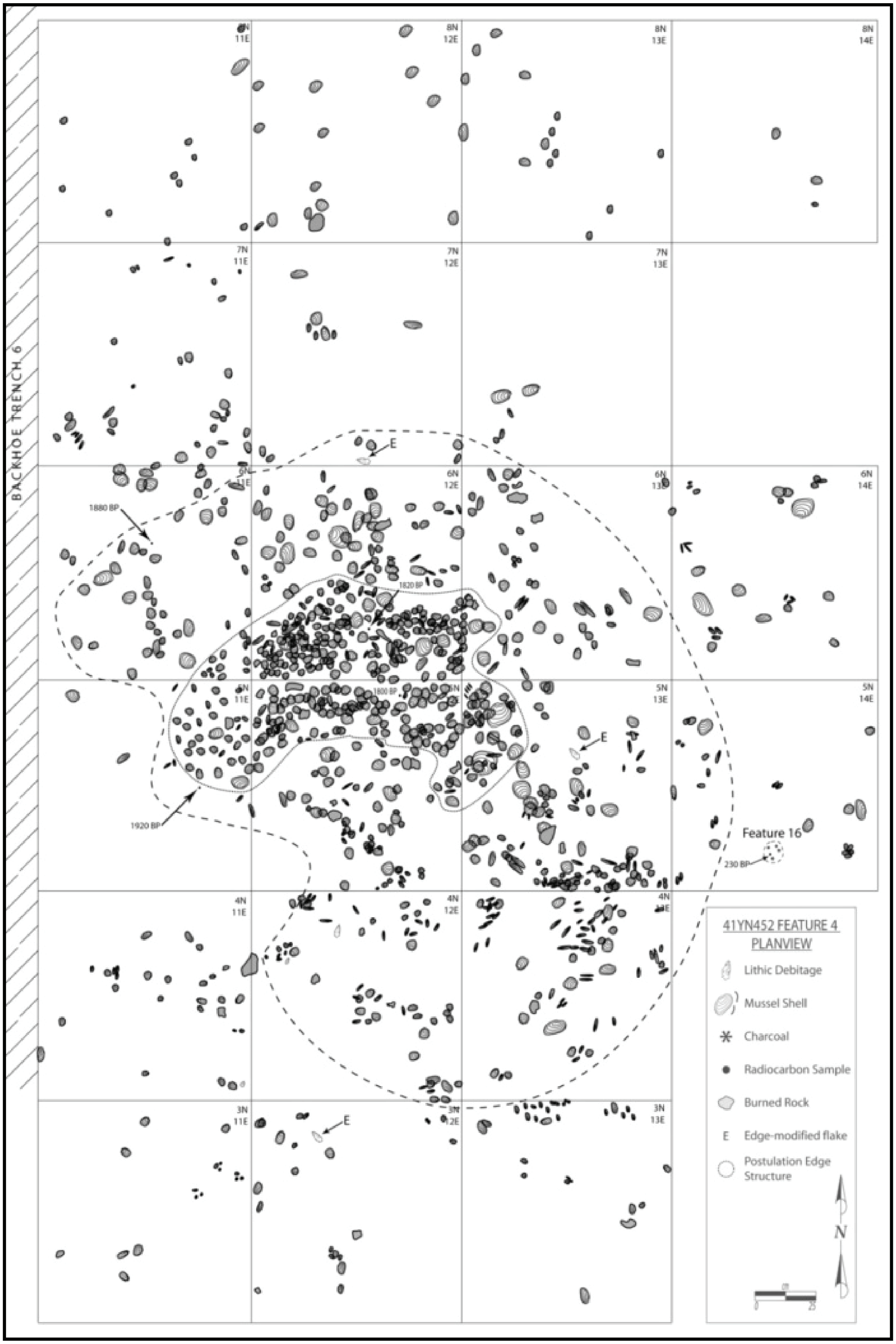

Figure 6-106. Overview of Mussel Shell Feature 4 in South Block

Five wood charcoal chunks from Feature 4 were radiocarbon dated (Table 6-19). One modern date of 120 B.P. is clearly not associated with Feature 4 and is not accepted as reflecting the age of this prehistoric feature. The other four dates fall within a narrow 120 year period from 1800 to 1920 B.P. The oldest of these four dates (1920 B.P.) is possibly on old wood, whereas the remaining three dates are nearly identical and reflect an even narrower time frame of 80 years from 1800 to 1880 B.P. These four dates provide a clear indication of the chronometric age for Feature 4, specifically around 1850 B.P. This accumulation of mussel shells occurred during the Late Archaic period. Feature 4 is definitely earlier than the two Terminal Archaic components represented at 41YN452. A few pieces of lithic debitage and at least one tiny bone fragment were amongst the Feature 4 shells.

Table 6-19. Radiocarbon Data from Feature 4

Catalogue Number	Unit Number	Depth (cmbs)	Material Dated	Weight of Sample (g)	Lab. No.	13C/12C Ratio (‰)	Conventional Age (B.P.)	2 Sigma * Calibration Range
228-7-1	N5 E11	51	Charcoal	0.4	UG-5175	-25.7	1920 ± 30	AD 0-210
236-7-1	N5 E12	67	Charcoal	0.8	UG-5176	-26	1800 ± 30	AD 130-320
249-7-1a	N6 E11	56	Charcoal	0.1	B-230766	-25.7	1880 ± 40	AD 50-230
255-7-1	N6 E12	53	Charcoal	0.1	UG-5177	-25.2	1820 ± 30	AD 90-320
259-7-1	N6 E13	47	Charcoal	0.2	UG-5178	-23.7	120 ± 30	AD 1680-1950

* = Reimer et al. 2009; B = Beta; UG = University of Georgia, AMS

Three informal edge-modified flakes and one biface fragment were mostly near the margins of the dense shell concentrations. The matrix that surrounded the shells was a hard packed, reddish brown to light red brown clay loam. A part of Feature 4 was sampled for magnetic susceptibility prior to the completion of the hand-excavations. It occurred across 7.5 units along the densest part of the shell lens and beyond that to enable comparisons and contrasting the different areas. A total of 45 samples in 1 cm cubes were collected across the 7.5 units in N4 N5 and N6 rows. Along with those samples, two micromorphic columns that extended through the shell lens were collected from N6 E12.

All the mussel shells and most fragments, the burned rocks (*N* = 65), and other cultural materials from this feature and the surrounding units were collected. Other samples obtained from Feature 4 included those for phytolith and macrobotanical analyses. Following the data recovery fieldwork, two burned rocks from 51 and 54 cmbs in N5 E12 were submitted for lipid residue analysis to determine the feasibility of going forward with a more intensive chemical analysis program later in the analysis stage.

A 27 g fragment of burned rock (#236-003-1b) yielded very high levels (59.28) of C18:1 isomers, which is an indication of decomposed residues of very high fat content such as seeds and nuts, although the presence of cholesterol indicates animal products were also present (Appendix H).

A 33 g fragment of #236-003-2b yielded similar results with high levels (42.42) of C18:1 isomers, which is also an indication of decomposed residues of high fat content such as seeds and nuts, again with some animal products (Appendix H).

These chemical results definitely reflect residues of both plant and animal origins on these rocks indicating they were used to process a variety of foods. Unlike most rocks analyzed from the other two Late Archaic components, no conifer products were detected. This would indicate a different fuel source was used to heat these rocks.

Part of the same rock (#236-003-2a) used in the lipid residue analysis was also sent for starch grain analysis. No starch grains were detected on this rock (Appendix B). This may indicate that no starchy plants were processed by this one rock. A larger and more intensive sampling of the rocks from this feature may reveal different results.

One burned rock and several sediment samples from Feature 4 were submitted for diatom analysis. The rock (#236-003-1c) from 51 cmbs yielded only 10 diatoms and phytoliths. The sediment samples (#249-006-1b) from 56 cmbs did not yield any diatoms (Appendix F). The absence of phytoliths in the sediments indicates that the sediment did not contaminate the rocks and that what was on the rocks came from their use in cooking foods. The presence of phytoliths attached to the rock is an indication that the foods cooked with the rock included at least some plants that produce phytoliths. The presence of phytoliths on the rock supports the lipid residue findings that indicate plants were cooked with the rocks. The diatom results are very similar to the results from the other two Late Archaic components recognized here.

A suite of 45 small sediment samples was collected from a grid across part of Feature 4 that were designed to investigate the nature of this shell feature and compare it to other types of features represented here. The sample locations and detailed results are presented in Section 6.1 above. In general, the spatial variation in the magnetic susceptibility analysis shows a poor spatial correlation within Feature 4, which indicates that thermal refuse, is not the defining characteristic. It is also possible that the calcium carbonate from the mussel shells (which is diamagnetic and generally exhibits low magnetic susceptibility values) is reflected in this pattern.

Two separate thin sections from two micromorpholgical orientated samples revealed a tightly intermixed suite of unburned and burned shell refuse. The mussel shells range from large shells almost 5 mm thick, to very thin shells that are less than 0.5 mm. The burned shells are clearly discolored in both plane light and cross-polarized light in the photomicrographs (see section 6.1 above). Although these smaller shell fragments are very close together and look like they are a single discard event, given their obviously different histories, it is probable that they represent different discard events. The fine-grained matrix is a granular microstructure composed of discrete and welded earth worm casts. The amount of thermal debris observed in the thin section appears to be at odds with the results of the magnetic susceptibility analysis and the reason for this is not clear.

Feature 4 is interpreted to reflect at least the direct discard or byproducts from intensive cooking of mussel shells to obtain the inner meat. The limited area excavated around the Feature revealed no specific heating element. Although no intact heating element was detected, the presence of burned rocks, the few burned shells, and the discarded shells, testify to the process of cooking or heating the shells to extract the meat. Once the meat was extracted, the shells and small burned rocks were discarded in this selected location. Although it is speculative, a possible structure of some nature, lean-to, skinned covered poles, or brush wall, may have restricted the horizontal distribution of the discarded shells at this location. The absence of bones or other signs of food resources testify to the focused nature at this place. The overall limited stone tools and lithic debitage indicates that little or no stone tool manufacturing or even tool resharpening occurred at this location. Those activities may have been in the surrounding area outside the excavation block.

Feature 16 was discovered in N5 E14 near the southeastern corner of the South Block and along the southeastern margin of shell lens Feature 4. It consisted of a small 12 cm diameter dark oval stain that was first recognized at 62 cmbs. The dark yellowish brown (7.5YR 4/6) loamy matrix was cross sectioned and revealed a vertical, dark stained area that terminated at 74 cmbs (see Figure 6-106). The distinct base was not pointed, but roughly straight across with a few rootlets and worm-like holes at the bottom that blurred the dark matrix at the bottom. The dark stain included wood charcoal flecks and chunks. No burned rocks, mussel shells, or lithic debitage were recovered from in or immediately around this vertical stain. The stain maintained a constant width of 12 cm wide for the entire 12 cm of depth.

Two pieces of wood charcoal (#245-007-1 and #259-007-1) from Feature 16 were sent for identification. Dr. Dering identified both pieces as mesquite (*Prosopis glandulosa*; Appendix D). Part of the wood charcoal sample #245-007-1 from 64 cmbs was sent for radiocarbon dating. This mesquite charcoal yielded a $\delta^{13}C$ adjusted date of 230 ± 25 B.P. (UGAMS-5182). This date indicates this apparent vertical post was much younger than Feature 4 and definitely not associated with Feature 4. This vertical stain is interpreted as the remains of a historic post and definitely not part of the prehistoric component.

Figure 6-107. Profile of Feature 16 Depicting Small Vertical Post with Charcoal and Recent Roots

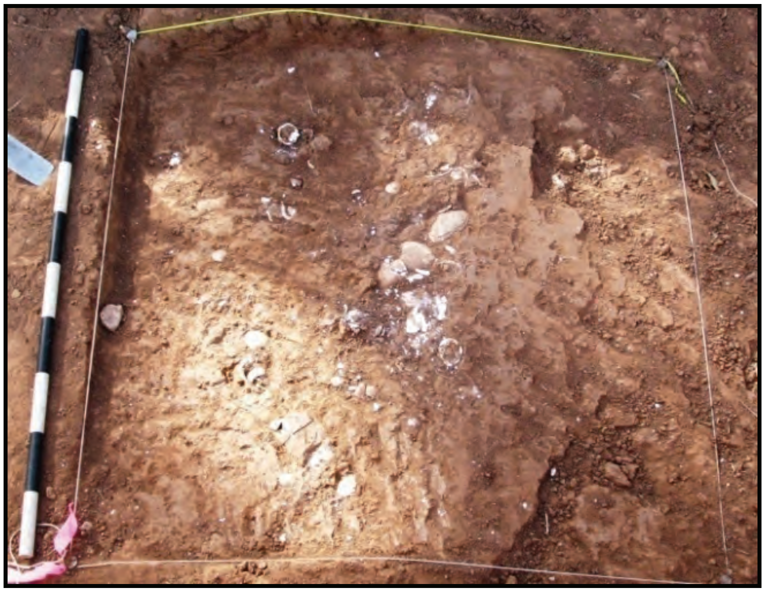

Figure 6-108. Overview of Mussel Shell Concentration Feature 3 as First Exposed within Trench 6 During Site Assessment. Note: Feature 3 will eventually end up on the western edge of the South Block.

Feature 3 was a small mussel shell concentration encountered by the Gradall® during the excavation of Trench 6 while conducting the site assessment (Figure 6-108). Trench 6 was excavated at the southern periphery of the development area excavation and eventually became the western edge of the South Block. The Gradall® excavation ceased upon recognition of the cluster of mussel shells to allow hand-excavation. The shells were detected at a depth of 40 to 45 cmbs with a potential that the very top of this cluster may have been removed during trench excavation before the shells were exposed.

The Gradall® apparently did remove part of the northern one-third of this cluster as the matrix in that area was removed to about 60 cmbs. Unit 11, a 1-by-1 m unit, was hand-excavated over the visible shells remaining in the trench. This unit encompassed all of the exposed mussel shell, but may not have encompassed all the associated shells.

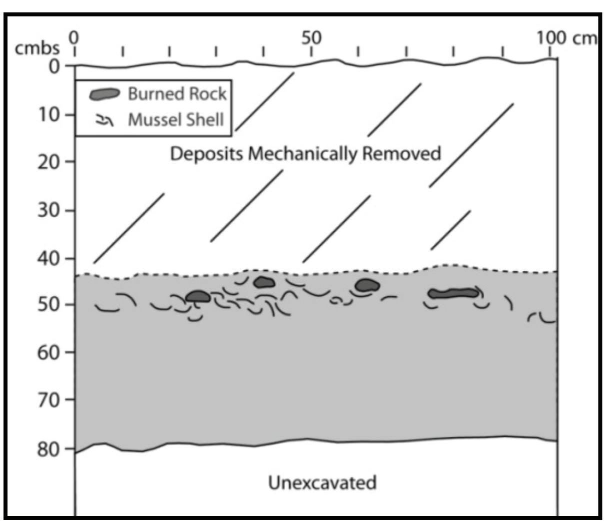

Figure 6-109. Profile of the Plotted Cultural Materials in Feature 3

Hand-excavations exposed part of the concentration, which exhibited a thin, 3 to 4 cm or one two shell thick lens. The mussel shells valves extended to a depth of 3 to 4 cm in the southeastern part of the concentration. This shell cluster measured 91 cm east to west by 50 cm north to south, and was within a buried A horizon between 45 to 54 cmbs.

A profile was excavated and drawn through this thicker section of shells (Figure 6-109). In most instances, shell valves were stacked on top of each other in a top-to-bottom fashion with shell ventral surfaces adjacent to one another. Shell frequency dropped off considerably after 54 cmbs, although a few pieces were encountered below this depth. So the base of Feature 3 was designated at 55 cmbs. At least 96 valves were recovered from the hand-excavation and many more appeared outside this unit in the immediate vicinity.

Very few cultural materials other than the mussel shells were recovered from this concentration in Unit 11. The materials detected included eight small pieces of sandstone burned rocks, one chert flake fragment, and one broken chert cobble. No charcoal or other macrobotanical samples were observed. Even though burned rock was present, no evidence of burning was apparent on the shell specimens.

Based on the fact that three material classes were present, and no clear horizontal pattern was observed, Feature 3 is interpreted as a refuse dump, where primarily mussel shell and burned rocks were discarded following their use in heating/cooking. Feature 3 ended up along the western edge of Feature 4 and was probably associated with Feature 4, as it exhibited the same classes of cultural debris in roughly the same percentages.

6.3.5.2 Chipped Stone Assemblage

A single formal chipped stone tool was from the margin of Feature 4. This is a biface fragment (#202-10) from 50 to 60 cmbs in N3 E11, along the southern side of Feature 4. This fragment represents roughly 20 percent of the entire biface and is the rounded, proximal corner of a projected ovate form. The break appears to have occurred towards the middle of the biface with both lateral edges removed, possibly by a burin blow(s). The pointed tip exhibits tiny scars that might have come from use. The flake scars on both faces appear to have been created by soft hammer percussion blows. This piece was manufactured from Edwards chert based on its dark grayish color and its yellowish-orange response to fluorescent light.

Four edge-modified flakes (#204-10, #208-10, #238-10, and #277-10) were recovered: three just south of Feature 4 with one (#277-10) just on the northern edge of Feature 4. All five pieces appear to be similar in color made from Edwards chert. The near absence of formal tools indicates that chipped stone tools did not play a significant role in the collection, processing, or cooking the mussel shells that composed Feature 4 or for other activities in this immediate vicinity.

6.3.5.3 Lithic Debitage Assemblage

A detailed lithic analysis was not performed on lithic debitage assemblage as directed by TxDOT archeologists. The lithic debitage assemblage consists of 17 pieces, which consisted of platform bearing flakes, distal flakes/shatter/angular debris, and cores. These pieces were scattered primarily within the buried A horizon with the majority of material recovered from 45 and 60 cmbs (Figure 6-110). The horizontal distribution of the sparse lithic debitage is depicted in Figures 6-110 and 6-111. The sparse lithic debitage implies that limited tool resharpening and tool manufacturing occurred in this excavated area. The few pieces may indicate this area functioned as a discard area over an *in situ* work area. However, the original function of this area is not clear at the present time.

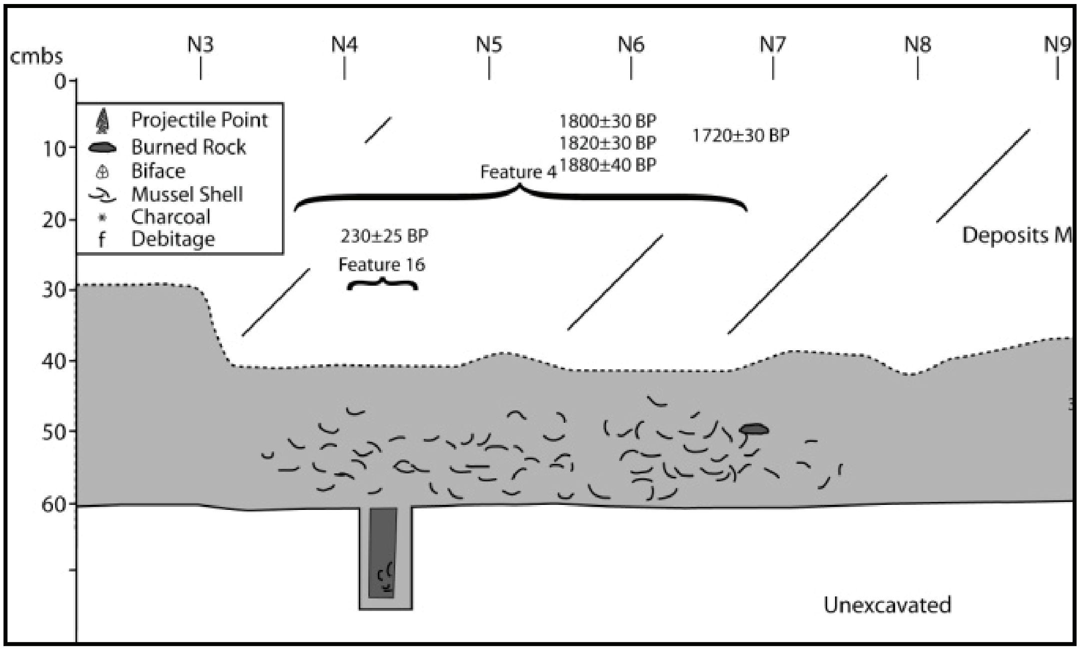

Figure 6-110. Vertical Distribution of Artifacts in Feature 4 Associated with Feature 16

6.3.5.4 Ground Stone Assemblage

No ground stone tools were recovered from this component to indicate that another type of plant processing occurred in or around Feature 4.

6.3.5.5 Vertebrate Faunal Assemblage

Feature 4 yielded only two tiny unidentifiable bone fragments that weigh 0.8 g. One fragment is in the 0 to 3 cm size class. This latter fragment was between 50 and 60 cmbs in N8 E12 on the northern side of Feature 4. Another tiny fragment (0.6 g) was recovered from 47 cmbs in N4 E12 along the southern margin of Feature 4. Obviously, vertebrates were not being processed in this excavated area. It is even possible that these tiny fragments of bone were intrusive to this occupation zone.

6.3.5.6 Mussel Shell Assemblage

The southern end of the South Block contained Feature 4 across 21 m^2, with mussel shell Feature 3 identified in Test Unit 11 on the western margin of the block, most likely an extension of Feature 4 as well. The mussel shell assemblage from Feature 4 yielded a total of 3,766 pieces that weighed 24,520 g for an average weight of 6.5 g per piece (Appendix K). Nearly 54 percent of the count was represented by unidentifiable fragments. The remaining 46 percent (*N* = 1,735) were relatively complete valves identified to species. In gross term this equates to roughly 868 individual mussels.

The ten species represented include smooth pimpleback (*Quadrula houstonensis*) at 66 percent; southern mapleleaf (*Quadrula aplicata*) at 15.2 percent; pistolegrip (*Tritogonia verrucosa*) at 6.5 percent; mapleleaf (*Quadrula quadrula*) at 5.4 percent; tampico pearlymussel (*Cyrtonaias tampicoensis*) at 2.7 percent; and threeridge (*Amblema plicata*), fragile pearlshell (*Leptodea fragilis*), bleufer (*Potamilus purpuratus*), yellow sandshell (*Lampsilis teres*), and Texas pimpleback (*Quadrula petrina*) all at less than 1.0 percent. Smooth pimpleback clearly dominated the assemblage.

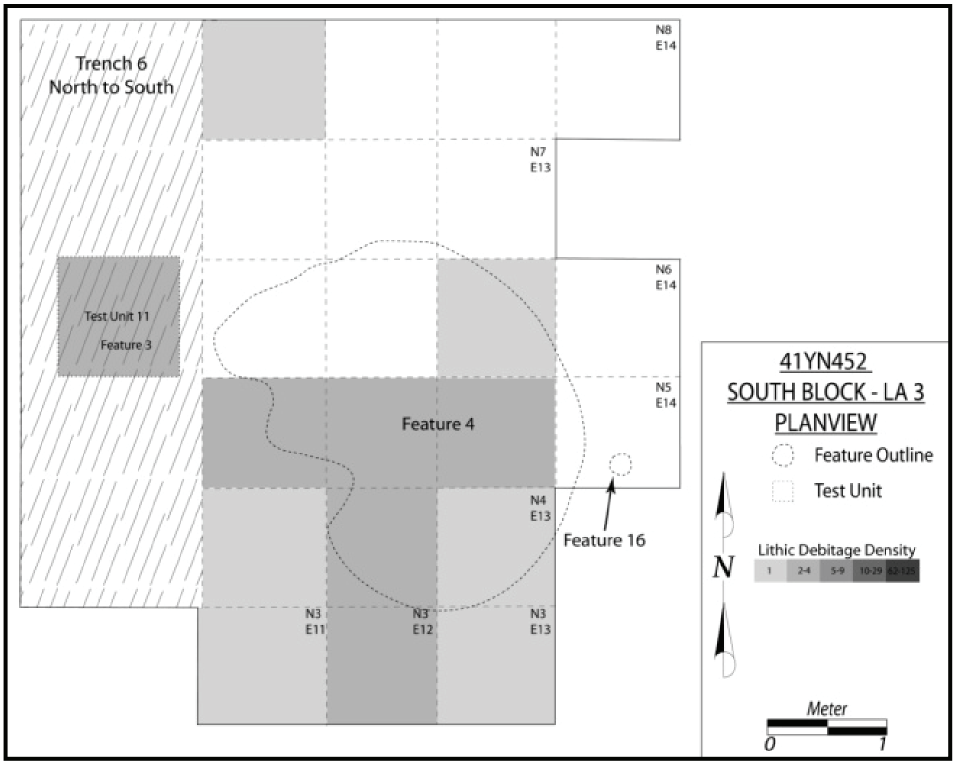

Figure 6-111. Horizontal Distribution of Lithic Debitage by Count across Late Archaic Component 3

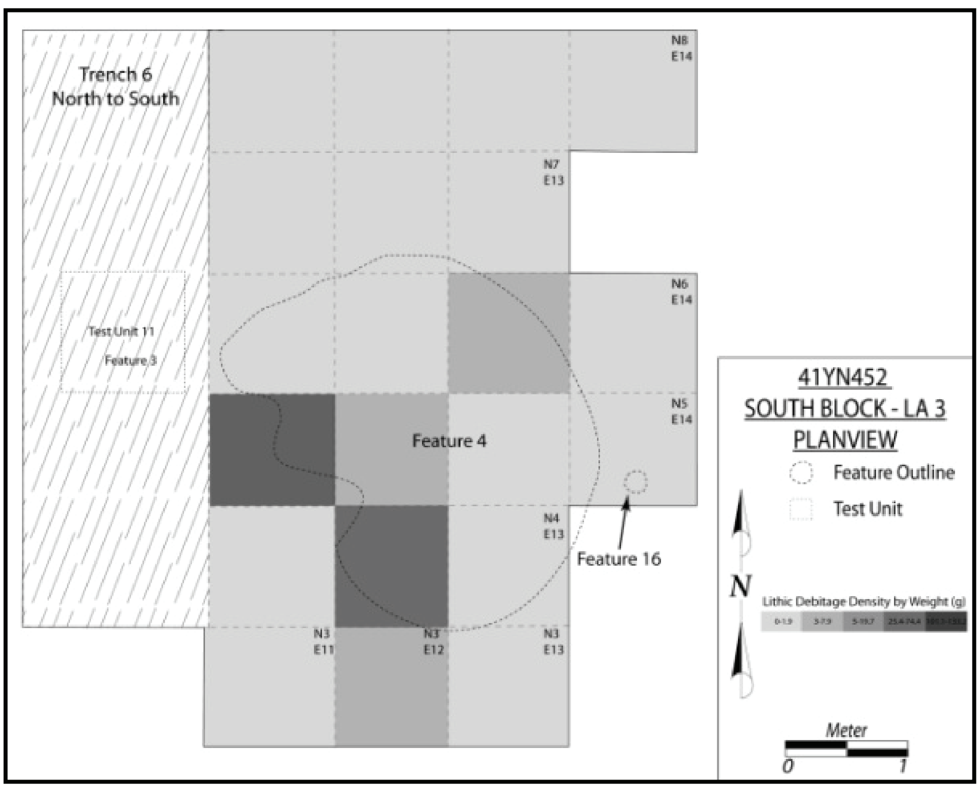

Figure 6-112. Horizontal Distribution of Lithic Debitage by Weight across Late Archaic Component 3

Howell et al. (1996) provides general habitat descriptions for these species, but the diverse conditions represented by these species and their diverse adaptability to various water and substrate conditions provide little specific information to help define the local creek and river conditions. As an example, the dominant Smooth pimpleback occurs in mixed mud, sand, and fine gravel. This species occurs across a broad area of Texas including the Colorado, Brazos, and San Jacinto river drainage basins. The shells can reach a maximum length of 66 mm (Howells et al. 1996:112).

Less than 0.5 percent of the shells (*N* = 17) were a gray color (7.5YR 6/0), which indicates their contact with fire. This is the only observed condition that directly supports a human manipulation of the shells. A consistent breakage pattern was not apparent with a relatively high percentage of the shells more or less complete. Of the 54 percent that were fragments, 37.3 percent (*N* = 757) were the crescent shaped posterior margin that had detached from the main body of the umbo. It is likely that heating the shells to open them to extract the meat contributed to weakening this outer edge at a growth line and permitting its separation from the main body. This is probably a sign of human use.

Another possible human manipulation of the shells is the presence of small diameter holes near the beak on a few shells. About 50 specimens or 1.3 percent of the assemblage exhibited these small oval and irregular holes (Figure 6-113). It is not clear if these holes were caused by man, as, they are not very regular, although the holes appear consistently present near or on the beak. The holes appear to have originated from the outside where the rough edge appears, whereas the interior is relatively smooth and smaller than the outer surface. If the hole was drilled by humansthe smooth edge of the hole would be the starting side with the ragged outer edge being created as the bit pushes through. However, most holes drilled by man would have been done so by drilling from both sides, so as not to leave a ragged edge. It is likely that these ragged holes were not created by humans.

Figure 6-113. Two Mussel Shells from Feature 4 with Holes (#238-006 and #238 - 006).

The horizontal distribution of the mussel shells considered part of Feature 4 is depicted in Figure 6-114. While excavating this area in 1 by 1 m units, it was not possible to detect or see any a real continuous pattern to the distribution of shells. In many instances, shells appeared in small, less than 40 cm diameter clusters with a few shells scattered about. Often the shells in these apparent clusters exhibited vertical separation as in a jumbled pile, although they were not neatly stacked. Most clusters appeared as small dumps or discard piles with irregular and random horizontal and vertical separation of the shells. An attempt was made to consistently piece plot the larger and more complete shells and the clusters of shells. This continuous plotting has enabled the assembling of the broader overall distribution in the laboratory. The mapped cultural materials reveal an intriguing horizontal pattern.

A number of observations can be made from this map. An apparent core or central area of dense mussel shells is obvious. It exhibits no specific form other than it has an irregular outline and was roughly 175 cm east west by roughly 100 cm north south. The shells in this central area were vertically distributed over roughly 15 cm.

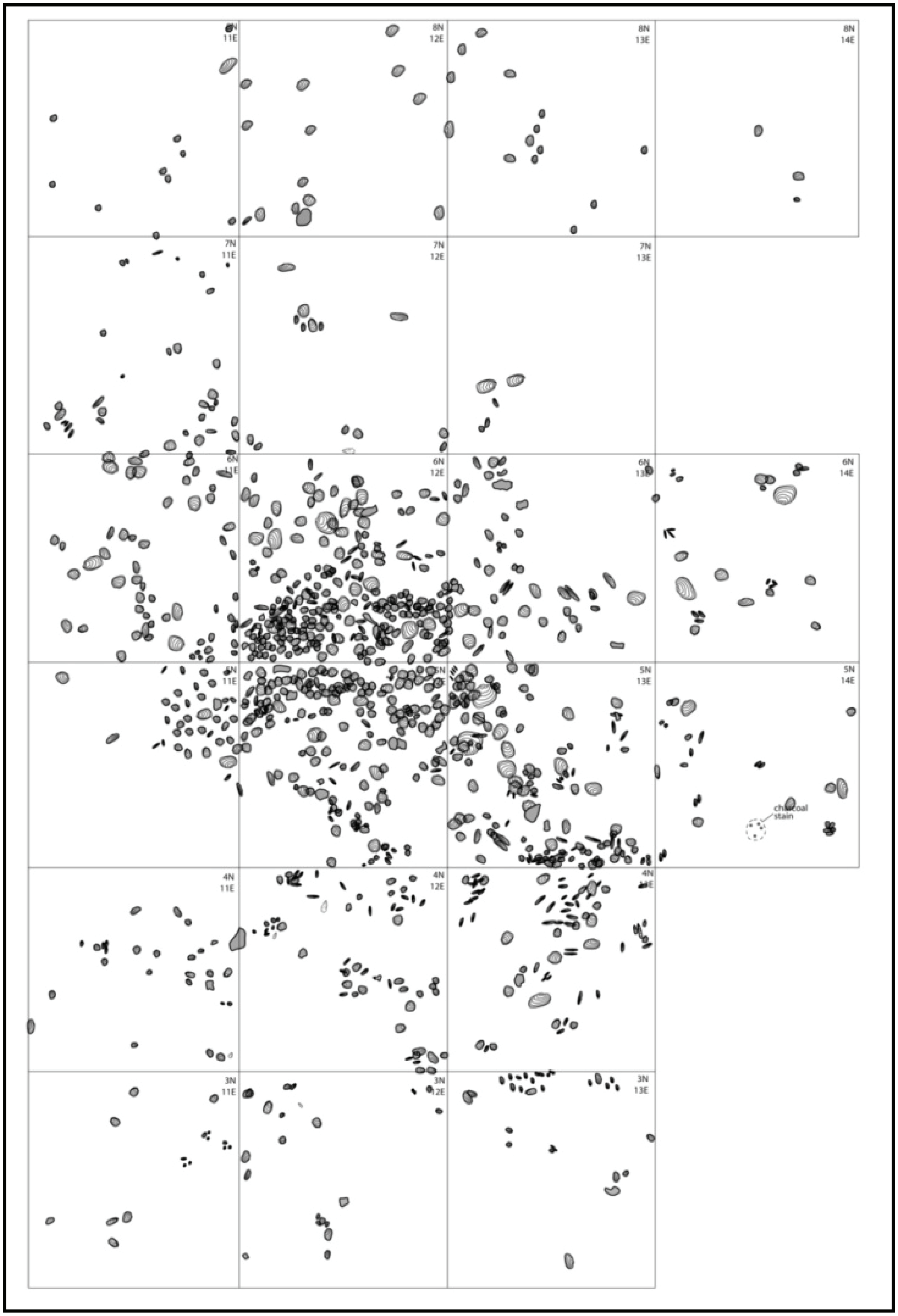

Figure 6-114. Horizontal Distribution of Mussel Shells and Burned Rocks across Feature 4

Within this core area was a number of small, scattered sandstone burned rocks, but no pit or obvious indications of a heating element such as charcoal, oxidation, or placement of the rocks. Beyond this core area, the shells appeared more randomly scattered with few concentrations. Upon close inspection, however, an apparent circular edge was observed along the eastern half of the scatter (Figure 6-115). It appears some type of physical barrier was around at least the eastern half of the core, and it restricted the distribution of the shells on that side. This pattern is suggestive of a structure having been present. The maximum diameter of the roughly circular pattern is a little over 3 m. It is unclear if the shells scattered just outside the central core were the result of the core being scattered, or a discard pattern. Beyond the interpreted eastern edge of the postulated structure, the shells were definitely more limited in number and not as clustered. The western edge of the postulated structure is ill-defined and may reflect a broad opening on that side.

6.3.5.7 Bone and Shell Artifacts

No bone or shell artifacts were identified in the recovered assemblage from in or around Feature 4.

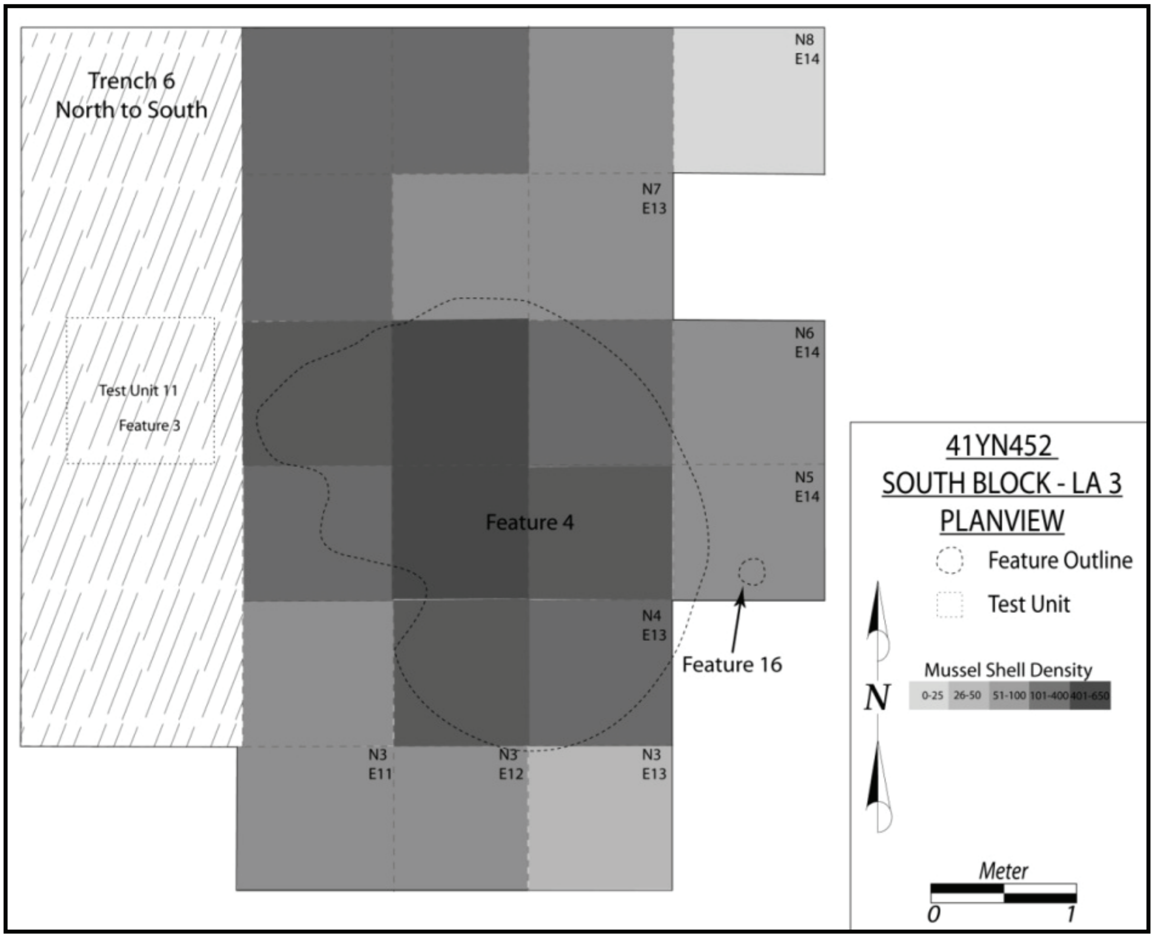

Figure 6-115. Horizontal Distribution of All Species of Mussel Shells by Count across Late Archaic Component 3

6.3.5.8 Burned Rock Assemblage

The frequency of burned rocks was quite limited in comparison to the mussel shells in and around Feature 4. The burned rocks are discussed in two groups. First, the data from entire 21 m^2 area that includes those units through row N8, and both inside and outside the Feature 4 concentration will be presented. These 21 units yielded only 78 rocks that weighed a total of 2,443 g for an average weight of 31.3 g per rock. These relatively small pieces were scattered across the area with no apparent concentration detected either in the field or on paper (Figure 6-116). In general, the rocks were associated with mussel shells.

The second part of this discussion focuses specifically on Feature 4 and the 9 m^2 area that contained the highest concentrations of mussel shells. That specific concentration of mussel shells revealed relatively few burned rocks. Feature 4 yielded 64 rocks that weighed 2,061 g for an average weight of 32 g per rock. The dominant small size (0 to 4 cm size class) accounts for 70 percent. The slightly larger size, 4.1 to 9 cm size class, was represented by another 28 percent. The rocks in Feature 4 were nearly identical in size and type to the few rocks scattered outside what is considered Feature 4. The horizontal distribution of rock weights reveals three individual units that had slightly heavier concentrations than the surrounding units with moderate weights (Figure 6-117). This distribution reflects rocks both inside and outside what is considered Feature 4.

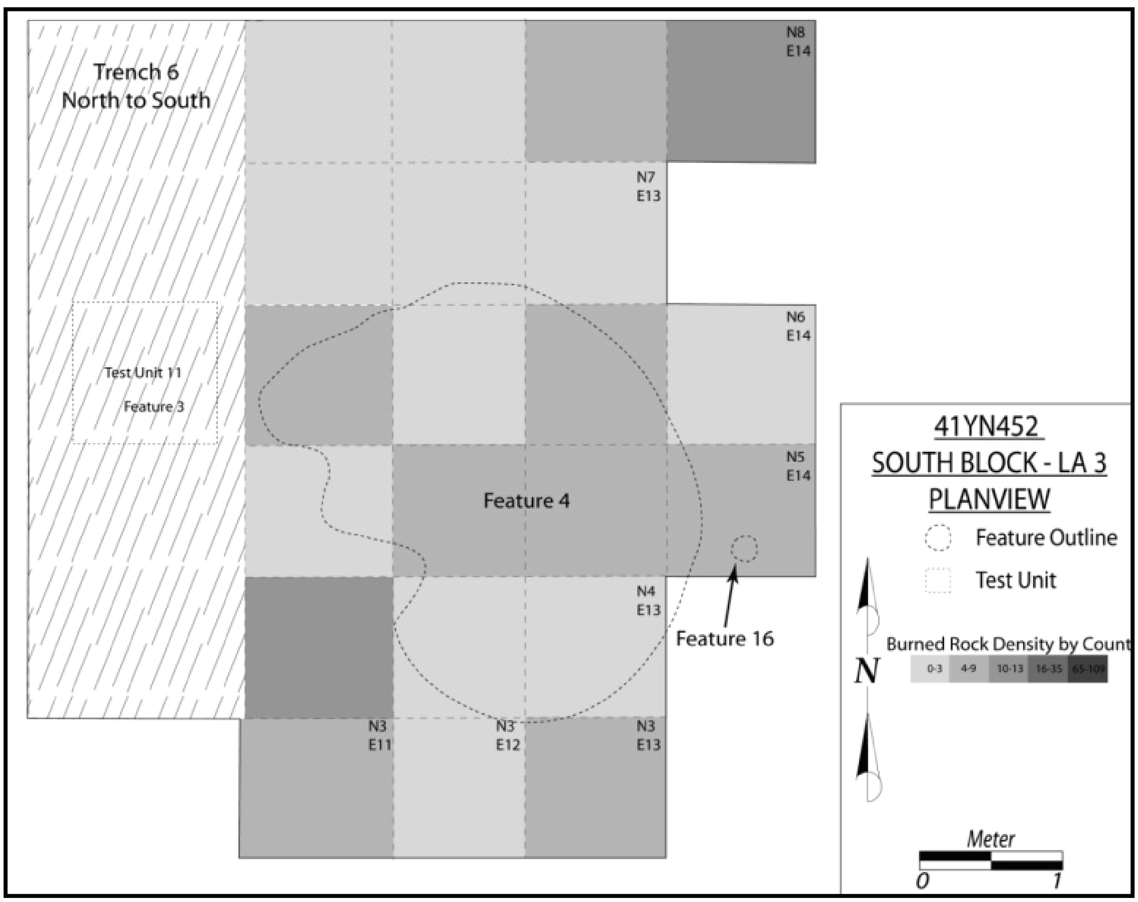

Figure 6-116. Horizontal Distribution of Burned Rocks by Count across Late Archaic Component 3

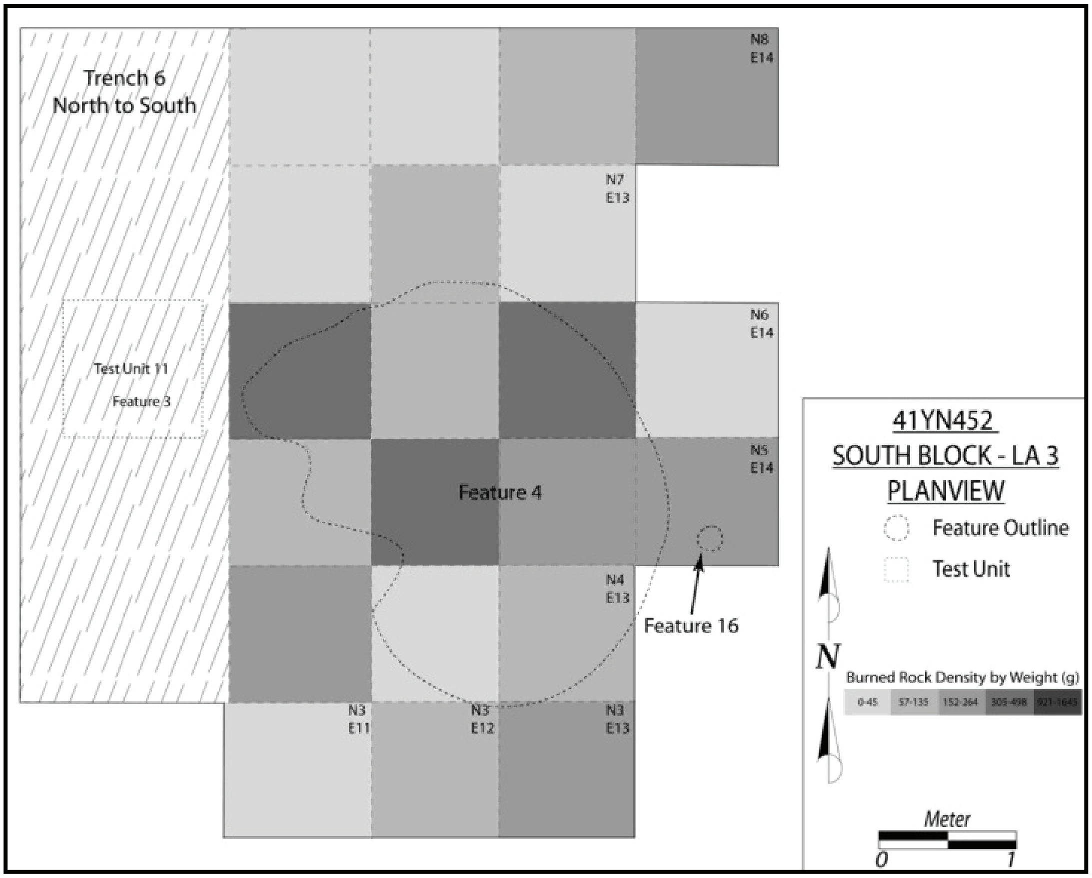

Figure 6-117. Horizontal Distribution of Burned Rocks by Weight across Late Archaic Component 3

6.3.5.9 Summary

This Late Archaic Component 3 was identified only in the southern 21 m^2 of the South Block. The component was dominated by one 3 to 3.5 m diameter cluster/lens of mussel shells labeled Feature 4. Feature 4 was stratigraphically within the same paleosol as the Late Archaic Component 2 in the northern part of this block. The shells were concentrated between 45 and 55 cmbs with some sparse scattering of shells between 38 and 67 cmbs.

Four of the five wood charcoal dates are accepted and range over a narrow 120 years between 1800 and 1920 B.P. Feature 4 is considered to date to a relatively early part of the Late Archaic period. Unfortunately, no diagnostic projectiles were recovered from the 21 m^2 excavation area (Table 6-20). In fact, few tools were recovered. The near absence of stone and bone tools, limited debitage, near absence of mammal bones support an interpretation that this area reflects a short-term event that clearly focused on the collecting and processing mussel meat. Feature 4 shells appear to form a horizontal pattern, with a possible ill-defined and irregular boundary along the western two thirds. However, the eastern half of this cluster of shells appears to be limited and forms an arcuate boundary (see Figure 6-114). No direct evidence is present, other than the restricted distribution, to indicate the possible presence of a structure. A very dense concentration of shells with a few very small burned rocks was just north of the center of Feature 4.

Table 6-20. Summary of the Late Archaic Component 3 Assemblage.

Cultural Material Classes	Late Archaic Component 3 (1800 to 1920 B.P.)
Features	
Heating Elements	0
Dumps/Discard Areas	2
Post Holes	1
Other	0
Dart Points and Fragments	
Darl and Darl-Like	0
Elam-Like	0
Untyped	0
Fragments	1
Arrow Points	
Scallorn	0
Bifaces	1
Scrapers	0
Drills	0
Unifaces	0
Gouges	0
Ground Stone	0
Hammerstones/Choppers	0
Edge-Modified Flakes	4
Lithic Debitage	17
Cores	0
Shell tools	0
Bone Tools	0
Bone Fragments*	4/0.8 g
Mussell Shells, Feature 4	3,766/24,520 g
Burned Rocks	78/2,443 g
Socialtechnic Objects	0
Carbonized Plant Remains	21/0.4 g
Total Materials	**3,895**
Average Thickness (cm)	**20**
Spatial Extent Excavated	**21**
Volume Excavated (m^3)	**6.3**

* Bone, mussel shell, and carbonized remain totals are weights in grams; This table does not include materials from float samples

6.3.6 Unassigned Materials

The 2006 eligibility assessment and 2007 data recovered investigations yielded a few scattered cultural items from proveniences that were not assigned to one of the three identified Late Archaic components. These cultural items were either, from above these Late Archaic components, collected from the surface, or from the eroding cutbank along Gages Creek that was just outside the APE. These items are presented below, but not in detail except for the formal stone tools and features. TxDOT directed that these materials be minimally addressed as they are not relevant to addressing the research questions presented in Chapter 4.0 above.

6.3.7 Chipped Stone Assemblage

As mentioned this is a catch–all group that is comprised of surface finds, material from the Gages Creek cutbank, and any material above ca. 45 cmbs and above the targeted Late Archaic components. A total of 20 artifacts are included as unassigned (Table 6-21). Because this group has no bearing on the analytical units discussed above, TRC has been instructed to provide only the most general information regarding this material. The projectile points are described in detail below.

Table 6-21. List of Unassigned Stone Artifact Classes and Frequency

Component	Artifact Classes	Frequency (*N*)
Unassigned	Debitage	13
Unassigned	Edge-Modified Flakes	1
Unassigned	Bifaces	1
Unassigned	Points	5
Total	--	**20**

Figure 6-118. Complete Scallorn Arrow Point (#309-10)

A complete corner-notched arrow point (#309-10) was recovered from 38 to 48 cmbs in N0 E11, which was a few centimeters above the Late Archaic component 3. This specimen is classified as a Scallorn point (Figure 6-118) and is thought to pertain to the Late Prehistoric period that follows the Late Archaic component 3.

This Scallorn appears in proper stratigraphic context just above the well-defined Late Archaic component 3. It measures 20.1 mm long, 13.6 mm wide, 2.8 mm thick, and weighs 0.9 g. It is well manufactured from a light colored chalcedony and has a yellowish orange response to florescent light, indicating it is Edwards chert. The notches originate at the proximal corners and extend towards the middle of the point. The direction of the notches creates an expanding stem with moderately long barbs. The base is straight. No features or other identifiable materials appeared associated with this point.

An unnotched arrow point or perform (#393-10) was recovered from 45 cmbs in N15 E11 in the northern part of the South Block. This specimen appeared just a few centimeters above the lower Late Archaic component 2 that is radiocarbon dated here to roughly 950 B.P. It is well-made from Edwards chert with one face completely worked, whereas the opposite face was partially worked by small thin pressure flakes (Figure 6-119). The base is straight with well executed pressure scars along the very edge. One corner is missing with a small nick in the right lateral edge. This specimen weighs 1.4 g and measures 25 mm long by 17.0 mm wide and is 4.1 mm thick.

Figure 6-119. Unwashed and Unnotched Arrow Point (#393-10)

A complete arrow point (#788-10) was recovered from the surface, between the North and South Blocks. It is classified as a Basset point (Turner and Hester 1999). The well-executed pressure flaking is in a general chevron design (Figure 6-120). It has a biconvex cross section. The left lateral edge is straight with the right lateral edge slightly concave. A very short contracting stem in the middle of the base creates a recurved base. The base concavities are 3.3 mm deep. The slight pink color hints it has been thermally alerted. The point measures 23.7 mm long, 21.9 mm wide, 2.8 mm thick and weighs 0.9 g. This point was manufactured from Edwards chert with a yellowish orange response to florescent light.

Figure 6-120. Complete Bassett Arrow Point (#788-10)

A distal tip (#805-010-17) was recovered from 63 cmbs on the exposed cutbank. This tip is thin and probably represents an arrow point. It was manufactured from a thin flake with one face partially worked, whereas the opposite face is worked only along the margins. This piece was manufactured from Edwards chert.

A second distal tip (#792-10) was also recovered from the cutbank at 65 cmbs. This thin biface fragment represents a middle stage reduction with less than 25 percent cortex remaining. It exhibits random flaking pattern. Both edges are nearly at 65 degree angles. This fragment measures 20.9 mm long, 22.8 mm wide, 5.5 mm thick, and weighs 2.3 g. This piece was manufactured from Edward chert. It appears to have been slightly thermally altered.

Specimen #153-10 was from 54 cmbs in Unit 10 at Trench 5. This well-worked biface may represent the proximal half of an unnotched projectile point perform (Figure 6-121). It is triangular in outline with pressure flaking across both faces. This specimen measures 23.1 mm long, 20.0 mm wide, 4.7 mm thick, and weighs 2.0 g. Both lateral edges are straight, whereas the base is slightly irregular. The lateral edge angles are 66 and 74 degrees. This was manufactured from Edwards chert.

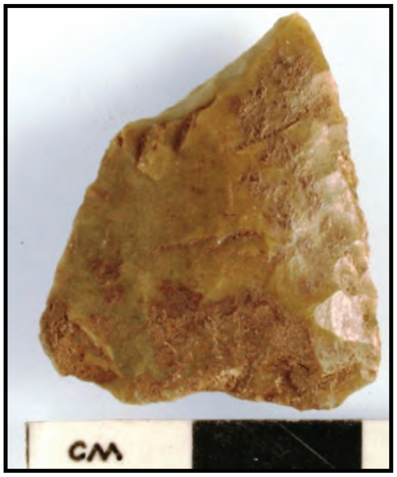

Figure 6-121. Unnotched Arrow Point Fragment (#153-10)

Figure 6-122. Complete Darl Point (#8-11 - 10) from Surface (scale in cm)

A complete dart point was recovered from the surface near the northwestern end of the North Block. It was on the backdirt of the water pipeline ditch that runs along the western edge of the North Block. It is classified as a Darl point with both lateral edges beveled from alternate resharpening (Figure 6-122). The resharpening is restricted to the very margin and created lateral edges that are at 57º and 63º angles. The body has a bi-convex asymmetrical cross section. One ear is well-defined while the other is minimally present. Both ears are about 80º. The stem is straight with a spot of cortex towards the right lateral edge. The stem measures 14.7 mm long, 15.4 mm wide, and is 4.6 mm thick. The base is straight with no obvious basal grinding, but light grinding is present along the sides of the stem. Overall, the specimen is 51.1mm long, 19.4 mm wide, 5.6 mm thick, and weighs 5.4 g. The specimen was manufacture from a light colored of Edwards chert.

6.3.7.1 Feature 18

This mussel shell lens was not excavated, but observed in the cutbank of Gages Creek about 30 m to the west of the APE. Horizontally it was positioned roughly between the North and South excavation blocks. Texas A&M survey archeologists observed this or a similar mussel shell lens during the 1988 and 1989 fieldwork (Sanders et al. 1992). In 2007, the shell lens appeared as a thin disarticulated lens of one to three mussel shells thick near the bottom or just below the buried A horizon. In the same vertical horizon as this shell lens were small scattered burned rocks and other mussel shells (Figure 6-123). This lens represents only one cultural event from a number of cultural events stratigraphically observed in this same profile. At least two other very sparse cultural lenses were stratigraphically above the more prominent shell lens. A few individual charcoal pieces and a couple bone fragments of medium size ungulates were systematically collected from the top and lower cultural events for potential dating.

Bone fragments that included a deer mandible, a few pieces of lithic debitage, a biface tip, many scattered mussel shells and burned rocks, and one arrow point were scattered across the eroded slope below this cutback and shell lens. The small pores visible in the cutbank are the result of small insects, whereas root disturbance is also present but limited.

Since this area was not excavated or intensively collected, no specific information from this area of the site is available beyond the three radiocarbon dates

Figure 6-123. Mussel Shell Lens – Feature 18 Exposed in Cutbank at the Base of the Buried A Horizon (lower right) of Gages Creek West of the APE

obtained (see 6.2 above for more discussion on dates). A piece of charcoal (#800-7-1a) from 64 cmbs δ^{13}C corrected date of 720 ± 40 B.P. (Beta-230765). A mussel shell (#800-6-1) from immediately next to the collected charcoal also at 64 cmbs yielded a δ^{13}C corrected date of 1530 ± 40 B.P. (Beta-730774). A deer bone (789-2-a) from 62 cmbs in the exposed cutbank yielded a δ^{13}C corrected date of 750 ± 40 B.P. (Beta-230773). The charcoal and deer bone dates confirm the presence of a Late Prehistoric event at his location. The shell date is 810 radiocarbon years older than the charcoal date.

6.3.7.2 Vertebrate Faunal Assemblage

Only three bone fragments were recovered from the cutbank. Two pieces, a right distal femur (#799-002) and a left mandible section (#810-002) with M_2 and M_3 present, were identified as deer (*Odocoileus* sp.). The mandible fragment came from the eroding slope below the vertical cutbank. The femur was extracted from the cutbank at 62 cmbs and associated with a few scattered mussel shells. About 8.0 g of the femur were sent for radiocarbon dating and yielded a δ^{13}C corrected age of 670 ± 40 B.P. (Beta-230773). The δ^{13}C value of -20.3‰ obtained during the AMS dating process supports the identification of a deer element. This obtained age indicates the deer femur was during the Late Prehistoric. No bones were detected in the lower Late Archaic component.

Two fragments of a long bone (#104-2) are in the size range of a deer and were recovered from Unit 1 on the side of Trench 5 some 15 m north of the South block. These fragments were from 80 cmbs and in the buried A horizon. They were burned to a gray and black state, which indicates they were cultural and part of one of the Late Archaic components. Three tiny fragments (#121-002) were recovered from Test Unit 4 on the northern end of Trench 6, along the western side of the South Block. One bone was a fragment of tooth enamel, probably from an ungulate. The other two pieces were unidentifiable.

Two bones were collected from Trench 4, about 16 m south of the North Block. One bone (#809-002) was a complete left calcanium of a canid (coyote) size mammal. This 4 cm long calcanium exhibits three tiny cut lines, which indicate it was altered by man. The other bone (#807-002) was three fragments of a rib head, in the size range of a deer. It was recovered from 68 cmbs and its association was unclear, but it was in the buried paleosol. Test Unit 9, on the western side of the north-south Trench 4 yielded a single bone fragment (#147-002) from 30 to 40 cmbs. This tiny fragment was not identifiable, but was burned to a light gray color.

7.0 RESEARCH QUESTIONS ADDRESSED

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7.1 INTRODUCTION

In Chapter 4.0 above, a research design was presented that formulated the strategies for the analyses of materials recovered from 41YN452. The research design was developed following the data recovery phase of fieldwork, and was approved by TxDOT archeologists prior to the initiation of analyses.

The research design was formulated with the idea that the entire excavation (both North and South Blocks) had targeted and exposed a single, discrete, Terminal Archaic component. Based on the initial nine wood charcoal radiocarbon dates, it appeared that the human occupation that left behind this component may have overlapped in time with populations that employed the bow and arrow (and therefore, by traditional definitions in Texas archeology, pertained, at least partially, to the Late Prehistoric period). The initial radiocarbon dating also included assays run on samples of mussel shell paired with wood charcoal, with the goal of ascertaining how closely dates on mussel shell would correspond to results obtained on samples of wood charcoal. Organic residues extracted from burned rocks were also radiocarbon dated to determine their reliability based on direct comparisons to wood charcoal dates obtained from contemporaneous contexts. After reviewing the results from these three different materials, we chose not to rely upon dates obtained on shells and burned rocks due to significant discrepancies with ages obtained from wood charcoal. Only the wood charcoal results are considered useful and reliable for identifying the date of the Terminal Archaic occupation at the Root-Be-Gone site, and it is on those dates that our chronological interpretations rely.

Following the approval of the research design by TxDOT, the initial step prior to conducting the analyses was to clearly establish the age of the cultural materials recovered from both excavation blocks as the chronological basis for going forward with site analysis. The age determinations were bolstered by an additional series of 18 wood charcoal assays from the Terminal Archaic component in response to Research Question 1. The following section recapitulates each of the six research questions as listed in Chapter 4.0 above, and summarizes our thoughts on, and approach to addressing, each question.

7.2 RESEARCH QUESTION 1. IS A DISCRETE AND ISOLABLE TERMINAL ARCHAIC COMPONENT IDENTIFIABLE AT THE SITE?

To address this question, a more intensive and broader absolute dating program was conducted that focused on dating wood charcoal in order to more clearly document the precise age of the cultural features and associated activities exposed across the excavated area. To accomplish this, 26 wood charcoal samples and two animal bones were selected for radiocarbon dating. With the broader radiocarbon program completed and the wood charcoal results in hand, the site's physical stratigraphy was addressed. The stratigraphy and the cultural sequence that it appears to represent have been thoroughly documented and discussed in Section 6.2 above using the wood charcoal dating results. The results and interpretations of the cultural stratigraphy presented in Section 6.2 will not be repeated in detail here, but it is very briefly summarized below.

Based on the wood charcoal results, the excavated materials are divided into three temporal groupings, as revealed by slightly different ages derived from across the excavated areas. The three documented age clusters are horizontally dispersed across three different areas of the two excavation blocks. The three clustered age groups are briefly discussed below by the excavation blocks.

7.2.1 The North Block: A Discrete Terminal Archaic Component Dating from 1100 to 1330 B.P

Of the total 11 radiocarbon dates on wood charcoal from the North Block, two are rejected as unreliable. A date of 360 B.P. (Beta-214362) from the top of the 2Akb soil horizon is rejected as too recent to be associated with the cultural component in the buried 2Akb soil. A date of 940 B.P. (UGAMS-5171) is also rejected as too recent, as it clearly falls outside the range of the other nine dates, being 160 years younger than the next youngest date. The nine accepted dates range over a relatively narrow time span of 230 years, from 1100 to 1330 B.P. The entire North Block is considered to represent a discrete Terminal Archaic component based on the recovery of three complete dart points that represent variations on a theme of slender-bladed, stemmed points in direct association with the dated features. A single arrow point was recovered and it arguably was in a secondary context due to vertical position indicative of translocation (i.e., a stemmed arrow point found vertically oriented at a depth of 84 cmbs). The Terminal Archaic component appears to reflect a single occupational episode, as the features were intact, relatively thin, nonoverlapping, were all more or less at the same vertical elevation, and exhibited a general pattern of horizontal distribution that can be associated with the distributions of other classes of cultural material.

The horizontal arrangement of the features is also highly indicative of a single, discrete occupation. They all conform, in their spatial arrangement, to a broadly circular pattern that circumscribes a central area devoid of features and largely devoid of burned rocks and mussel shells. Such a basic pattern has been repeatedly documented ethnoarcheologically as a common spatial arrangement of activities within hunter-gatherer encampments (e.g., see Binford 1983).

7.2.2 The South Block: A Mix of at Least Two Late Archaic Components

In contrast, the South Block contained components of two distinctly different ages, based on 11 radiocarbon dates. Three of the 14 dates from the South Block fall within the last 300 years and are, therefore, deemed too recent to represent the prehistoric components identified in the excavations. Four of the five results on wood charcoal from Feature 4, dispersed across the southern third of the South Block, indicate that Feature 4 was some 500 years older than the Terminal Archaic component in the North Block. The one rejected date falls within the last 300 years and is much too recent for this prehistoric event. The four accepted wood charcoal dates for Feature 4 range over a narrow 120 year range, with an average age of 1855 B.P., an age that, while pertaining to the a general Late Archaic time frame, is distinctly older than the Terminal Archaic materials from the North Block. Feature 4 and the materials surrounding it represent a separate and distinct occupational component from that revealed in the North Block. Therefore, the cultural materials in the southern third of the South Block that encompass Feature 4 are referred to as Late Archaic component 3 in the above text. Since these materials are 500 years older than the Terminal Archaic component in the North Block and do not reflect the Terminal Archaic to Late Prehistoric transitional period, they are not relevant for addressing Research Questions 2 though 6.

The northern two-thirds of the South Block are chronologically definable on the basis of seven wood charcoal assays. Three charcoal samples were extracted from Feature 11 and four others were on chunks of charcoal scattered just east and outside Feature 11 at approximately the same elevation. Six of the seven wood charcoal dates are accepted, with a date of 690 B.P. rejected as it is 240 years younger and not comparable to any of the other wood charcoal results. The six accepted dates range over nearly 400 years, from 930 to 1320 B.P., with an average age of 1052 B.P. These wood charcoal dates may or may not represent a different temporal interval than documented for the North Block, and are significantly more recent than the four dates that document the age of Feature 4 in the southern part of the South Block. Consequently, the range of dates obtained here may indicate a mixing of materials that represent different events. A complete Terminal Archaic, Darl-like dart point was recovered from between Features 11 and 13. A couple of small arrow point preforms were recovered, but from slightly higher in the profile than the dart point and the two features. It is assumed that the dart point was associated with Features 11 and 13 and therefore, the majority of materials recovered reflect a Terminal Archaic occupation at roughly 1052 B.P. Because of the possible mixing of events in the northern two-thirds of the South Block and the difference in derived charcoal ages compared to the North Block, this area is not considered to be definitively part of the same Terminal Archaic I component evidenced in the North Block.

In accord with the agreements reached in a meeting between TRC staff and TxDOT archeologists held on January 12, 2010, detailed analysis was to focus on materials and data from the North Block because of the potentially compromised integrity of the materials in the South Block. Since the research questions presented in Chapter 4.0 were formulated towards understanding of the Terminal Archaic component, and subsequently at the direction of TxDOT archeologists, only the North Block data that are believed to represent a discrete, well-defined component of the Terminal Archaic will form the bases for addressing Research Questions 2 through 6.

7.3 Research Question 2: What was the Nature of the Terminal Archaic Occupation at 41YN452?

7.3.1 Introduction

All classes of cultural materials encountered in the North Block that represent the Terminal Archaic component 1 were collected and analyzed. These materials include the vertebrate faunal assemblage (animal bones, *N* = 147 pieces), invertebrate faunal assemblage (mussel shells, *N* = 4,838 pieces), burned rocks (*N* = 4,974 pieces), lithic debitage (*N* = 1,017) and stone tools (*N* = 103), and the macrobotanical remains (ca. 9.1 g). Although the features themselves (*N* = 14) were not collected as a unit, various components of those features such as sediment, mussel shells, burned rocks, and charcoal, were collected together with detailed observations, drawings, and photographs to contribute, through further analyses, to a greater understanding of the function of each feature.

To help identify the function of individual features and the broader component of which they are a part, samples of various artifact classes were subjected to different technical analyses. The analytical techniques applied included, but were not limited to, 1) classification of the features represented, 2) classification of the formal stone tools to elucidate the range of onsite activities, 3) debitage analysis to contribute to the identification of kinds of stone knapping activities, 4) identification of the macrobotanical remains to assess the role of the plants in the site-specific subsistence economy, 5) use-wear studies on lithic tools to help determine the range of site activities and tool functions, 6) starch grain analysis to determine what, if any starchy plants were used on site, 7) diatom analysis directed at burned rocks to help determine if the rocks were used in conjunction with water for cooking foods, 8) magnetic susceptibility and phosphorus analyses on sediment samples from different feature types to address intensity of use and functional variability, and 9) examination of the spatial patterning of classes of cultural materials to help interpret the overall feature and site function.

7.3.2 Feature Function

A total of 14 features were identified. Only Feature 1 is considered to have been an *in situ* heating element where a fire was maintained for a short period. All 13 other features are classified as dumps or discard areas for waste products. Most discarded waste consisted of small fragments of burned rock (ca. 5,000 pieces) and mussel shells (ca. 5,000 pieces or 658 individuals). The latter were a significant food resource, and once the meat was removed, the shells no longer served any purpose and were discarded. The burned rock pieces were a result of the cooking and/or heating processes, likely directed towards heating/cooking mussels and various other food resources. As the rocks broke down during the heating and cooling sequences, they eventually became too small to adequately contain and transfer heat; therefore, they were no longer useful and discarded.

Some variability was evident in the 13 discard features. Six were dominated by burned rocks, while seven were comprised of a mix of mussel shell fragments and burned rocks. The limited diversity detected in the identified features is somewhat surprising, and is interpreted to reflect a significant focus on a particular food resource, namely, the mussels. No dumps of ash or charcoal were found, and no features were identified that would reflect tool production or resharpening. Also, no potential structures, storage pits, or animal processing areas were identified. Within the excavation block, a significant focus was on heating/cooking mussels, followed by the basic campsite maintenance activity of discarding the unwanted shells and functionally exhausted cooking rocks. Only limited evidence was found of minor tool maintenance or tool production.

7.3.3 Subsistence

Research Question 3 (see below) goes into detail concerning the subsistence activities documented at this campsite. Briefly, the faunal remains are dominated, quantitatively, by small mussel shells (N = 4,838 pieces, 1,316 identifiable values that equal a minimum of 658 individuals). However, the 658 individual mussels account for far less useable meat weight than a single white-tailed deer (Table 7-1). Although mussels were present in nearly every unit with some in defined features and many scattered, some animal bones were also recovered. Actual counts of bones are limited (N = 147 pieces), but they represent diverse food resources.

Table 7-1. Estimated Usable Meat Resources from the Different Species Represented

Food Resource	Minimum Number of Individuals	Estimated Meat Weight (g)
Deer Meat	1	45,500 [1]
Rabbit Meat	1	974 [2]
Turtle Meat	1	454 [3]
Mussel Meat	658	3,290 [4]
Fish Meat	4	2,602 [5]

1 = Based on Brown 1987:43-20
2 = Based on Brown 1987(43-20)
3 = Based on an estimate
4 = Based on Lintz 1996
5 = Based on Appendix J

Deer, turtle, fish, and small game such as rabbit are all represented. The deer and turtle bones are burned to definitely indicate they were part of the prehistoric occupation. However, if preservation accounts for the limited number of bones recovered, then the ratio of species represented is quite biased. It is apparent that a range of animal resources was exploited, including freshwater mussels and fish from the nearby stream, plus terrestrial mammalian and reptilian species.

7.3.4 Cooking Technology

The following discussion deals with questions associated with food-cooking technology. In general, it is assumed that the recovered sandstone burned rocks were heated in at least the one recognized heating element, Feature 1, and then used to heat/cook mussels, causing the shells to open and allowing for extraction of the meat. Specifics of how that process was accomplished are not directly discernible in the archeological record. All that is visible are the end products, such as the discarded shells, used burned rocks, and various features used in the process. The inference that mussels were heated is based on the fact that the cultural debris, both inside and outside the recognized cultural features, was dominated by mussel shell fragments and small chunks of heated sandstone, inferentially linking these two classes of materials together.

The primary function of rocks here, as at most hunter-gatherer camps, was to transfer heat from a fire/heating element to foods that required cooking. Most burned rocks exhibit a slight color change, from the natural brown of the sandstone to a reddish hue, once heated. This color change, combined in some instances with fracture patterns, is the basis for the interpretation that the rocks were heated and used for cooking. To obtain greater insight into the cooking process and the potential foods cooked, four different technical analyses (lipid residues, starch grain, diatoms, and phytoliths) were directed towards the microfossils found on or in these rocks.

One result of the lipid residue analyses was the discovery of the presence of a specific biomarker, dehydroabietic acid. This indicates that conifer products were present on/in the rocks (Appendix H). In the environmental setting of this site, the conifer most likely to be represented is juniper. Interestingly, no juniper wood was identified in the macrobotanical analysis of the 47 individual wood charcoal samples or 13 analyzed flotation samples (Appendix D). The two principal woods identified include oak and mesquite. Both are hard woods, whose density most likely accounts for their preservation. Juniper is a softer, less-dense wood, the charcoal of which would be less likely to be preserved. Also, the lighter juniper wood may have been more susceptible to complete combustion, thereby being completely converted to ash. Therefore, the chemical analysis of the rocks reveals the probable use of a third wood for fuel, despite its absence as preserved charcoal. In short, at least three wood species were prominently used as fuel woods in the heating of cooking rocks.

The assumption that the rocks were used in the cooking process is further supported by the fact that organic lipid residues were recovered from 11 (73 percent) of 15 analyzed rocks (see Appendix H). The high to very high levels of C18:1 isomers, in combination with various other isomers, indicates decomposed residues high in fat content such as would be generated from seeds or nuts, as well as from animal residues. Animal products are indicated by the chemical presence of the sterol cholesterol in 11 of the 15 rocks. The decomposed residues are definitely linked to plants and animals, just not large herbivore meat or fats such as deer or bison (Appendix H). Further support for the rocks having been used in cooking is the fact that at least six (21 percent) of the 28 rocks analyzed yielded wildrye (*Elymus* sp.) starch grains (Appendix B). Wildrye grass is a C_3 species that occurs within environments otherwise dominated by C_4 grasses (Appendix E). Since wildrye starch grain was generally not associated with the sediment samples analyzed, it is apparent that wildrye was most likely selected as a food resource, rather than a naturally occurring plant growing on the site. The presence of wildrye starch grain supports the interpretation that lipid residues found on/in the burned rocks represent the cooking of seeds or nuts.

The diatom analysis of nine selected burned rocks paired with the analyzed sediment samples from the same 10 features also provides relevant information. Aquatic diatoms, grass phytoliths and plant fibers were all detected in the organic coatings on all nine analyzed burned rocks (Appendix F). The presence of whole and intact aquatic diatoms undoubtedly represents exposure of the rocks to stream/creek water. The aquatic diatoms indicate that once the rocks were heated, they were placed in water where they accumulated the intact aquatic diatoms. This placement of hot rocks in water specifically indicates stone boiling, a process often referred to in the ethnographic literature as a means of cooking foods (Wandsnider 1997). The grass phytoliths present in the rock rinds support and document the presence of various grasses, whereas other plant fibers indicate that those microfossils were part of the plants being cooked. The presence of wildrye grass starch grains indicates that at least this specific plant was cooked. Therefore, not only were mussels cooked/heated by hot rocks, but some grass seeds were also cooked through stone boiling. The starch grains recovered from the burned rocks were not gelatinized (a response to heat and water), which would directly indicate that seed grains had come in contact with heat and water. Different starches gelatinize at different rates, some at very low temperatures, whereas boiling gelatinizes all starches (Reichert's 1913). However, since mussels require very low heat to cause them to open, it may be that sufficient heat was not present to gelatinize these starch grains.

It is not clear if both animal and plants were cooked at the same time or separately. It is possible and likely that the rocks were used in multiple heating episodes. If so, the residues that accumulated on those rocks could, obviously, reflect more than one cooking episode.

The burned rocks in the discard features were significantly smaller than the rocks recovered in the one recognized heating element, Feature 1. Feature 1 rocks averaged about 310 g in weight, whereas most all rocks in the 13 discard features averaged less than 100 g, and most were less than 50 g. This significant decrease in rock size between the heating element and the rocks in the discard features supports the assumptions and the experimentally documented fact that rocks fractured and broken during the heating and cooling process (Duncan and Doleman 1991; Leach et al. 1998, 2001). Once the rocks reached a certain size, documented here at less than 100 g, they were no longer considered suitable to hold the heat needed for continued use in cooking and were discarded.

The visible and most obvious foods heated or cooked with the hot rocks were the mussels. However, direct evidence for heating the mussels, or for actually cooking the meat, is limited, but is partially indicated by the dark gray discoloration of some 27 shell pieces. To open and extract the targeted mussel meat inside the shell requires limited heat for a relatively short-time, either through direct or indirect heating that would cause the shells to open. Once the shell relaxed and partially opened, the meat could be easily extracted without leaving any visible signs of alteration on the shell. If the mussels were heated, no tool was required to open the shells. If lightly heated, it was not necessary to smash the shells, which might cause fragments of the shells to get into the meat, or to physically pry open the closed shell, which would damage the outer edge of the shells and take more time and effort than heating the shells. The outer margins of the shells revealed no consistent damage pattern that could be related to prying open the shells. In contrast, the outer growth ring was often found detached from the main body of the shell, which may reflect the boiling process that weakened the joint at that location, which caused it to become detached.

7.3.5 Stone Tool Manufacture and Use

The stone tools (*N* = 102) described in Chapter 6.0 are separable into five classes: projectile points, bifaces, scrapers, edge-modified flakes, and unifacial tools (Figure 7-1). These account for only 9 percent of the entire lithic assemblage (*N* = 1,119). What can be discerned from these data? More specifically, what do these frequencies convey about human activities and raw-material use in this Terminal Archaic component?

On the basis of artifact class frequencies, raw-material replacement rates can be examined for the Terminal Archaic component 1. By comparing the frequency of tools and tool fragments with the relative amounts of debitage for each raw material type, it is possible to can gauge material discard and replacement in the occupational episode that is represented (Magne 1989:22).

Figure 7-2 shows the tool-to-debitage comparisons (complete and fragmented specimens), using raw material as a common factor. It is abundantly clear that Edwards chert was the predominant material used at this location. The strong reliance on chert in this component may reflect its local abundance, preference at this location, or both. The ratio of debitage-to-tools is low (on average, 10:1). This frequency of debitage-to-tool is too low to denote any strong emphasis on formal tool production. This proportion most likely reflects a focus on expedient tool production (flake tools), which compose between 70 and 80 percent of the chipped stone tool inventory at this location.

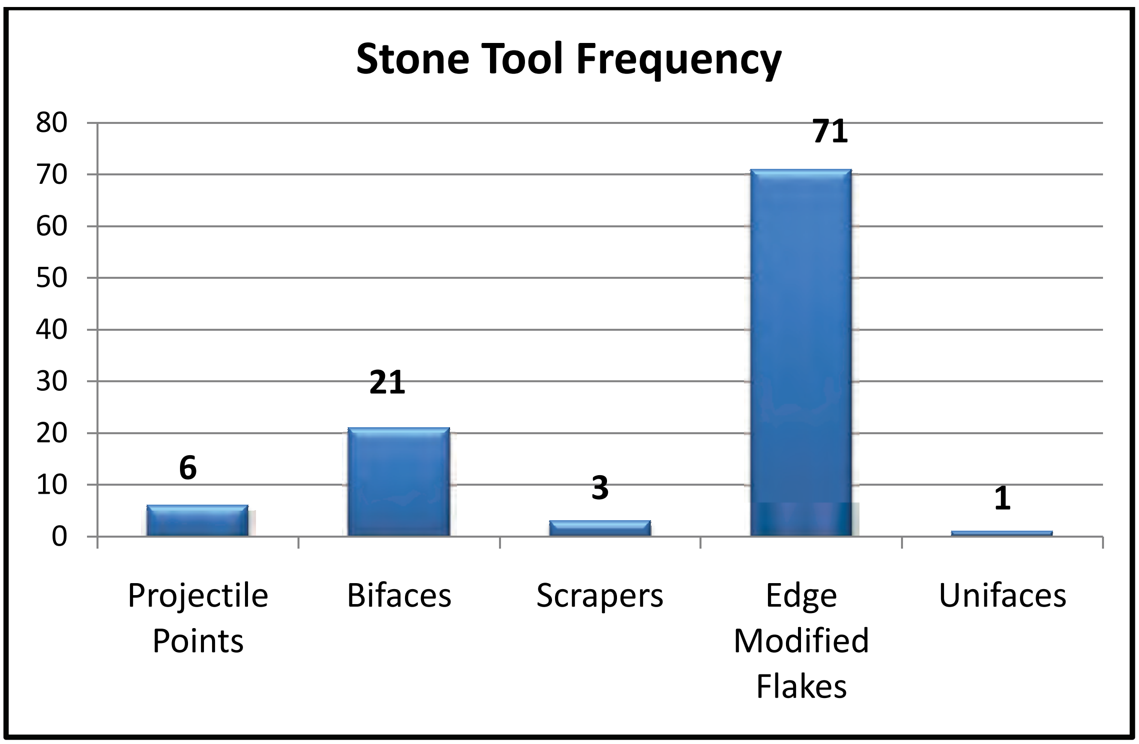

Figure 7-1. Stone Tool Frequency at Terminal Archaic Component 1

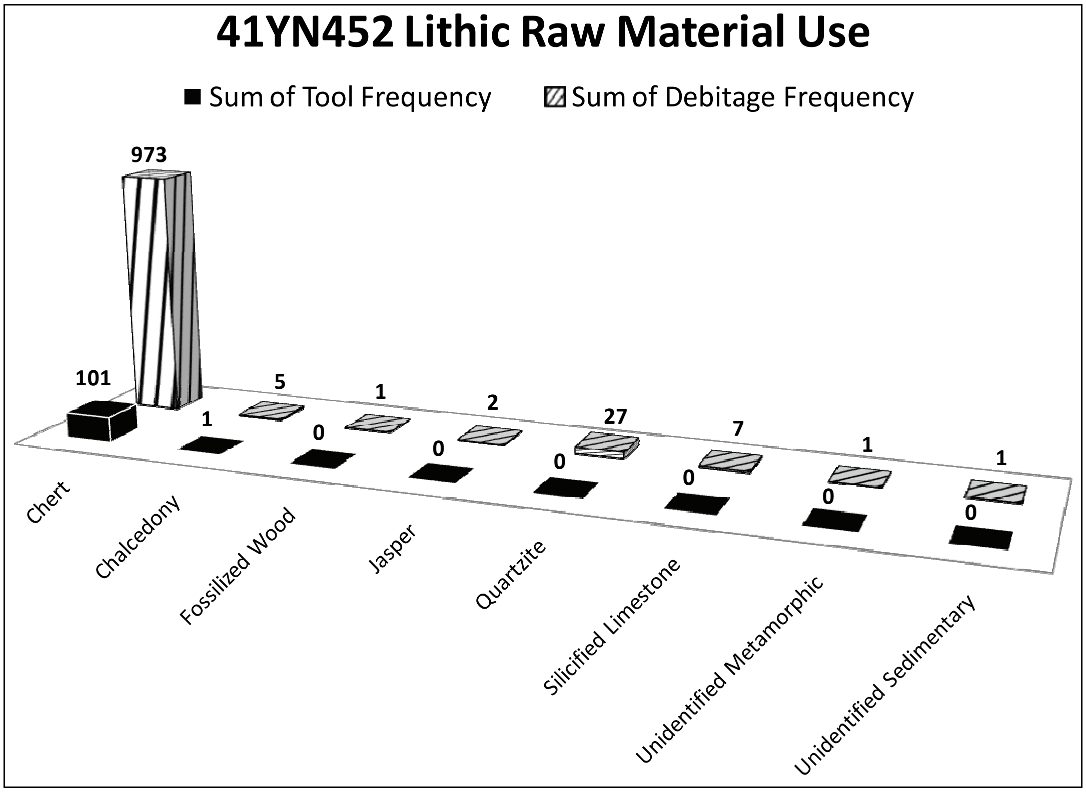

Figure 7-2. Raw Material Use within Terminal Archaic Component 1

Magne (1989) makes the case that by examining the relationship between debitage and tool frequency and late-stage debitage one can highlight differences in technological strategies (Figure 7-3). According to Magne's assemblage formation model, sites with assemblages that exhibit a high debitage-to-tool ratio versus a low percentage of late-stage debitage can be seen as having relatively limited completion of tools on site, and that perhaps blanks/unfinished pieces were taken away for finishing elsewhere. Furthermore, those sites that exhibit a low debitage-to-tool ratio and low late-stage debitage percentage are thought have a high discard rate of manufactured t tools and/or blanks, perhaps due to the implementation of expedient tool manufacturing. Likewise, those sites with high debitage-to-tool ratios and high late-stage debitage percentage reflect sites that likely represented in a tool maintenance strategy that was highly conservative and involved low degrees of discard. Sites exhibiting low debitage-to-tool ratios and high percentage of late-stage debitage are also in a tool maintenance regime, but follow a high tool discard pattern. Other scenarios that take into account situational tool repair activities and site reoccupation are also delineated in smaller niches of the model. To further understand the activities within this Terminal Archaic component 1, this debitage-to-tool ratio and the percentage of late-stage debitage relationship are examined. In this case, late-stage debitage equates to those pieces devoid of dorsal cortex. In order to derive any meaning from these data, it is necessary to compare the values at this location with those of other Terminal Archaic assemblages. For the sake of brevity, the comparison is limited to two other assemblages: the Darl component at the McKinney Roughs site (41BP627) in Bastrop County, Texas (Carpenter et al. 2006) and Terminal Archaic deposits at the Shepherd Site (41WM1010) in Williamson County, Texas (Dixon and Rogers 2006)

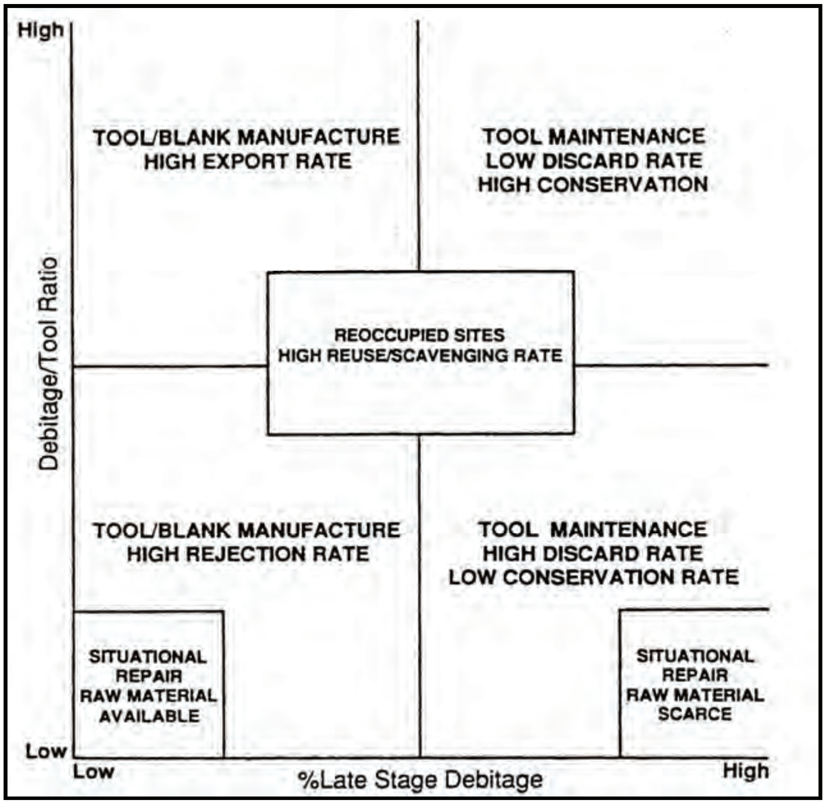

Figure 7-3. Magne's Assemblage Formation Model (1989)

Other site assemblages were sought for this comparison but were not assessed due to inconsistencies in data presentation which make comparison problematic. Figure 7-4 shows that the relationship in the Terminal Archaic component 1 between debitage (complete flakes) -to-tool ratio and percentage of late-stage debitage (complete flakes) falls within the tool maintenance and high discard quadrant of Magne's model (see Figure 7-3). It also shows a marked similarity of this assemblage with the Darl component at the McKinney Roughs site (41BP627), a short-term camp that exhibited generally expedient behavior (Carpenter et al. 2006:193).

The Shepherd site (41WM1010), on the other hand, exhibits a somewhat higher debitage-to-tool ratio but maintains a similar percentage of late-stage debitage (Dixon and Rogers 2006). Without a larger sample of sites with which to compare, it is difficult to say what the significance of this debitage increase is in terms of the formation model. However, one can assume that a larger ratio of debitage-to-tools at 41WM1010 represents a higher incidence material reduction at that location.

The relatively low ratio of debitage-to-tool demonstrated in Figure 7-4 can be further emphasized when these data are compared against ratios of other prehistoric components from sites in central Texas (see Table 7-1). It is largely apparent at sites such as 41HY202-A, a lithic tool manufacturing site of the Toyah interval, and 41HY202-T, a short-term encampment of the Austin Interval (Ricklis 1994a, 1994b), that lithic reduction via tool production activities occurred at a much higher rates. Ratios for components 41HY209-T (Toyah) and 41BP627 (Late Archaic), on the other hand, are more comparable to the Late Archaic components presented in Figure 7-4. In general, components with low debitage-to-tool ratios are locations where very little formal tool production occurred. The production of flakes at these components was most likely the result of expedient tool production.

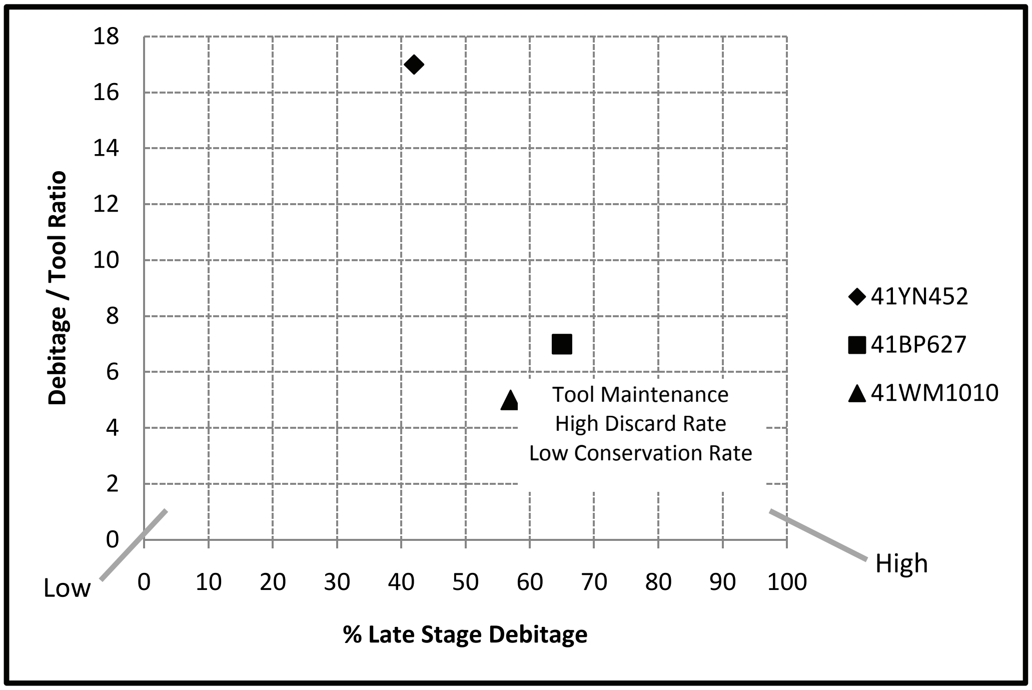

Figure 7-4. Index of Tool Technology Strategy at Multiple Sites with Terminal Archaic Components.

Table 7-2. Debitage-to-Tool Ratios from Selected Prehistoric Sites.

Site Trinomial	Debitage-to-tool Ratio	Reference Citation
41YN452 (Terminal Archaic 1)	5:1	This citation
41BP627 (Darl)	7:1	Carpenter et al. 2006:108-134
41WM1010 (Terminal Archaic)	17:1	Dixon and Rogers 2006: Appendix A
41HY209-T (Toyah)	17:1	Collins 1994:101-189
41HY202-A (Toyah)	62:1	Ricklis 1994b:207-316
41BP627 (Ensor II)	15:1	Carpenter et al. 2006:108-134
41HY209-T (Austin Interval)*	105:1	Ricklis 1994a:196-203
41WM230 (Driftwood)*	61:1	Prewitt 1981:166-167

*complete and fragmented flakes

Overall, the Terminal Archaic component 1 was where expedient tool production occurred in conjunction with the procurement and processing of a variety of resources. The lithic tool assemblage shows little evidence in the way of formal tool production or "gearing up" activity (Binford 1977). This analysis indicates that the recovered artifacts were left by a relatively small group who occupied this location for a short-time.

7.3.6 Data Trends in Lithic Debitage

The lithic debitage reveals clear patterns of local raw material procurement, cobble reduction and tool production, and specific activity areas in this component. Raw material diversity is low, indicating the predominant use of available material for procurement and a preference for high quality material over all other potentially available materials**.** The low incidence of quartzite (though available in the local upland gravel outcrops and stream gravel bars) indicates a clear preferential selection of the high quality cherts. Furthermore, the absence of any formal tools composed of quartzite, as discussed above, is supporting evidence that quartzite played a very minor role in tool production and use. The high incidence of cortex observed on lithic debris supports on-site reduction of small rounded, stream-rolled cobbles. These could have been gathered locally from nearby sources such as gravel bars in the Clear Fork of the Brazos River or the upland gravel outcrops immediately north of the site. Furthermore, the relatively restricted incidence of thermal alteration observed on debris supports the notion that the heat treatment of lithic materials was not a necessary precursor to material reduction/use.

The preponderance of less than two facets observed on flake platforms indicates core reduction activities were the primary source of the flakes produced on site; flakes for use as expedient tools were removed from cores. Multifaceted platforms are also significnt in the debitage assemblage and based on debitage-to-tool comparisons likely represent the reduction of multidirectional cores during the production of expedient tools.

Discrete knapping areas are evident within the Terminal Archaic component 1 occupation area. One such lithic debris concentration, located in N106 E108, N106 E109, N107 E108, contained 94 pieces of debitage with 43 (46 percent) bearing platforms. Of the specimens bearing platforms, 23 (49 percent) have flat or cortical striking platforms. As mentioned, the preponderance of unmodified platforms is an indicator of core reduction that involved production of useable flakes, as opposed to biface production. Less frequent mutlifaceted (*N* = 6; 14 percent) and complex platforms (*N* = 3; 7 percent) are also present. This is typical of the concentrations that were evident outside of the burned rock concentrations and delineated features mapped in this component. These concentrations are interpreted as *in situ* reduction locations where individuals reduced cobbles, flakes for use as tools were created, and early-stage and middle-stage bifaces for use as tools were produced.

7.3.7 Projectile Point Technology

Most researchers would not have a problem in labeling three of the four projectile points found in the Terminal Archaic component as darts points. The metric measurements taken on the projectile points, specifically the neck widths, overall thickness, and weights of each support the idea that three of the four points were used on dart shafts, with the single exception being one obvious arrow point. The latter was definitely within the Terminal Archaic component 1 at 84 cmbs, but it is considered to be an intrusive item. Each of the three dart points directly recovered from the Terminal Archaic component 1, plus the one Darl point from the surface has morphology different from the other specimens. The social and/or technological explanations for the variations in style are not known at this time. All four points are more-or-less narrow bladed and stemmed, with unbarbed shoulders, and all have counterparts in illustrated samples of

Darl points (e.g., see Suhm and Jelks 1962). So, while the sample shows morphological variability, all five specimens are tentatively assigned to a generic, "Darl-like" category. In fact, other researchers (e.g., Carpenter et al. 2006 discussing McKinney Roughs and Gadus et al. 2006 discussing J. B. White) also lump a fairly wide range of forms into what they call Darl, meaning that Terminal Archaic, more-or-less slender, stemmed points do, in fact, present a typological challenge at the present time. However, we are not equipped to tackle this typological problem with the small sample.

7.3.8 Hafting Technology

The high-powered use-wear analyses contributed to a greater understanding related to tool-hafting technology. A diverse suite of 29 tools from this component was analyzed and included points, bifaces, scrapers, a uniface, and edge-modified flakes. Based on the presence of rounded and abraded flake scar ridges, 8 of 29 tools examined (28 percent) were determined to have been hafted (Table 7-3). This included 4 of 8 bifaces, 3 of 3 points, and 1 of the 16 edge-modified flakes. One significant fact is that the haft wear extended to about the midpoint of the long axis of the artifact haft. The observed wear extends nearly half the distance along the tool regardless of the total length of the tool or the tool type. Even two tiny bifaces (#519-11 and #604-12) that are less than 3.0 cm long were hafted. Haft wear also occurred on at least one biface (#374-10) that exhibits no notches or other hafting alterations to the proximal end.

This hafting technology that extends the wooden haft past the notched area to near the midpoint of the tools has also been detected in two Late Archaic hunter-gatherer components dated to ca. 2300 and 1600 B.P. at the Pipeline site (41PT185) in the Texas panhandle (Quigg et al. 2010; Hardy 2010). This same strategy was detected on analyzed tools from the Varga site (41ED28) in southwestern Texas (Quigg et al. 2008; Hardy 2008). Apparently, this hafting technology/strategy is widespread across a broad region of Texas, and possibly over a broad time span as well. An undated, wooden cigar-shaped foreshaft from Val Verde County, Texas, reveals a squared distal end that is split or bifurcated (Lintz n.d.). The gap in the distal end is for seating a dart point and the gap is 2 mm wide by 3.4 cm long. This open gap would accommodate a projectile point up to 2 mm thick with the wooden shaft that would definitely extend past the notches a considerable distance.

On the distal half of one large, asymmetrical biface (#630-10), the haft wear extends the entire length of the tool and nearly three-quarters of the width, with the one straight lateral edge in the haft, whereas about one-quarter of the convex lateral edge would have been exposed for cutting (Appendix C, Figure C-4).

Table 7-3. Summary of Use-Wear on Chipped Stone Tools

Tools Count & Type	Hard High Silica Polish	Striations	Raphides	Hafted	Cutting Actions	Scraping Actions	Whittling	Butchering
16 Edge-Modified Flakes	13	6	13	1	9	4	1	_
8 Bifaces	3	4	5	4	3	2	_	1
3 Projectiles Points	3	2	3	3	1	_	_	_
3 Scrapers	3	1	3	_	_	3	_	_
1 Uniface	1	1	1	_	1	_	_	_

This biface also revealed mastic, wood fibers, and plant cells towards the distal end at the break. This example indicates this large biface was mounted along one side instead of at the usual proximal end. This deviation from the norm may indicate this tool had a special function. The use-wear analysts interpreted this tool as used in butchering, based on the presence of a hair and soft polish on the curved lateral edge (Appendix E), but this type of hafted biface could have also served to chop a plant such as agave.

Tool function is not always what we think based on observed morphological characteristics. All 29 tools analyzed for use-wear from this Terminal Archaic component 1 in the North Block revealed the presence of abundant plant fibers. At least 86 percent of the analyzed specimens revealed raphides on their surfaces, indicating contact with plants (Appendix C). That includes projectile points (#663-10), bifaces (#724-10), edge-modified flakes (#707-10), and scrapers (#728-10). Each tool may have been used for multiple purposes, but the specific form of the tool apparently did not limit its use to one type of material. The projectile points and bifaces often assumed to have been killing and butchering tools, were also used, in some way, on plants. The extensive presence of raphides on these diverse tools strongly supports the use of plants by the occupants of this camp and accords with the findings from technical analyses.

7.3.9 The Technology of Collecting Mussels

No direct evidence is available to document exactly how mussels were collected from their watery habitat. The overall small size of the complete shells recovered (most less than 4 cm) and the occurrence of quite small shells (some as small as 15 mm), combined with diverse species represented (*N* = 7), may indicate that some form of mass collection was conducted. That is, these mussels may have been collected using some type of collection device, such as woven baskets. If mass collection was the strategy employed, then collection would not have singled out specific sizes or species of mussel, yielding an assemblage similar to what was recovered and identified here. This mussel resource could be pursued by all individuals including men, women, and children, young and old, with women and children suggested as the principal collectors by various authors (e.g., Meehan 1982; Claasen 1998; Moss 1993). Although no direct evidence is available as to who did the collecting, or how it was carried out, it seems quite probable that men would have focused on hunting game animals while women and children collected mussels and plants. This division of labor among hunter-gatherers is supported by numerous ethnographic accounts (e.g., Klein and Ackerman 1995; Claasen 1998:175; Moss 1993:632; Meehan 1982).

It is also possible that during the pursuit of mussels in their aquatic habitat, fish were encountered and collected at the same time, in chance encounters. The presence of four fish otoliths from the North Block, which represent four individual fish, indicates they were procured. Again, no direct evidence is present for how or by whom this procurement was accomplished (i.e., no fish hooks or net weights were found in this component). Given that fish were procured by the site's residents, the use of baskets may have been one means of procurement as hooking fish is a time consuming and challenging activity. If the waters were shallow and the collectors numerous, fish may have been captured by hand. Three of the four fish weighed at least 0.45 kg (1 pound) and were of sufficient size.

7.3.10 Bone and Shell Technology

Animal bone recovery was quite limited (*N* = 147 pieces) and it is not clear if that reflects poor preservation or just the limited amount of animals processed here. Many of the animal bones recovered were at least partially burned, which hardens the bone and helps preserve it. No bone tools of any type were recognized in the artifact assemblage.

Shell was not limited and in fact was quite plentiful. In prehistoric times, shells were often used to manufacture decorative items such as beads or pendants (e.g., Hall 1981; Prewitt 1982; Taylor and Highley 1995). Less than 1 percent (*N* = 13) of the freshwater mussel shells recovered exhibit small (mostly less than 3 mm in diameter) holes near their beaks. Contrary to most culturally created shell pendants and beads, the holes were not drilled from both sides. One side, most often the exterior, has a very irregular and ragged edge. The opposite side of the ragged end is sharp and lacks a concave or tapered edge. This ragged nature of one end combined with the fact that the holes were not biconcave, and the recovery of shells with holes came from a number of different mussel shell discard features, creates considerable doubt that the holes were man-made. If these holes are thought to be created by humans, no evidence exists in the recovered tool assemblage as drills were not recovered.

Although it is not known how the holes were created, humans probably did not drill them. Dusek (1987) points out that similar irregular holes have a striking similarity to the small-diameter holes in similar positions on marine shells that were caused by a carnivorous snail. Dusek could not find any mention in the literature that indicates a carnivorous gastropod that preys on freshwater mussels. A similar creature may be the explanation of these holes as well. If these holes were created by carnivorous gastropods, then their occurrence in archeological sites implies a nonselective collection strategy was in use by the collectors. Otherwise these shells would not have been harvested. Shells with holes in them would have been collected when employing a bulk collection strategy, as discussed above.

7.3.11 Fuel Wood Selection

The wood species associated with the different features is significant as at least five different species were identified during the macrobotanical analysis of the charcoal and float samples. In general, preservation of plant materials was poor, as is evident by the presence of tiny flecks and soot instead of charcoal chunks (Appendix D). Oak wood charcoal was present in only two features, Features 5 and 10. Hackberry charcoal and ash were present in only Feature 1. Mesquite charcoal was the most frequent and was identified in at least four features, Feature 1, 7, 14, and 17 and possibly Feature 5. The macrobotanical analysis detected a diverse array of plant taxa with no obvious preferential selection pattern (Appendix D). The presence of mesquite is interesting in this locality along the edge of the Western Cross Timbers, and specifically during this 200 year span between 1100 to 1300 B.P. The chemical detection of conifer products in 73 percent of the burned rocks analyzed during lipid analyses through the detection of dehydroabietic acids supports the presence of one invisible wood species, most likely juniper. The multiple woods from Feature 1 may further support the interpretation of this feature as a heating element, which required considerable wood to fuel the fire and heat the rocks. It is likely that the hardwoods such as oak and mesquite preserved longer than the soft woods (i.e., juniper) in the fires and over time. Although mesquite and oak are often considered optimal woods for creating hot fires, obviously multiple wood species were available in the vicinity, and were used to provide fuel for the fires associated with these features.

7.3.12 Camp Duration

A relatively high density of cultural features (*N* = 14) was identified within the ca. 78.5 m^2 excavation block. The fact that discard features covered roughly 26 percent of the area indicates considerable camp maintenance activities. Activities centered on collecting and then cooking food resources, including an abundance of mussels, followed by discarding the unwanted remains. The length of time required to collect the minimally estimated 658 mussels is not clear. If the mussels were collected in mass, as inferred, then the collection time must have been relatively short, though the actual duration would depend on the number of people involved in the effort. During the occupation of this component, at least one deer, a rabbit size animal, a turtle, and four fish were also procured. The procurement of the mussels, fish, and terrestrial animals may have been conducted at the same time by different task groups within the population. It is possible that there was a division of labor, with males hunting game animals at the same time as the females, and children collecting mussels. This type of division of labor is supported by ethnographic records and allows all parties to contribute to sustaining the group.

The procurement of all the identified food resources would not have required many days. Aside from a relatively short-time to collect, the preparation and cooking of mussels would have been a process of short duration, as mussels require no preparation other than limited application of heat. The heat is required to cause the shells to open, after which the meats may have been consumed raw or lightly boiled. Based on these considerations, the occupation of this locus may have lasted only a few days.

The presence of only one heating element (Feature 1) probably also points to a short-term occupation. If a longer occupation had occurred, it would seem reasonable that multiple heating elements would have been present, and that greater quantities of tools and animal bone would have been left behind. The lack of any sign of oxidation around the margins of Feature 1 also indicates that fire was not in use over many hours or days. In an experimental hearth, constructed on top of natural levee deposits of the San Gabriel River, four hours of continuous burning in a 41 cm deep pit produced a 2.5 cm thick oxidation rim on the walls of the pit (Bond 1978:117). Based on that experimental hearth, Feature 1 was not apparently in use that long or was not as intensively fired. The lack of diversity in the recognized features also indicates a relatively short stay that involved only a very limited range of activities. No indications of structures, intensive processing of multiple large game animals, or long-term cooking features (e.g., earth ovens), as required for some geophytes or tubers, were found.

Further support for a very short-term occupation is the low frequency of formal tools recovered. The degree of intensive tool use and maintenance is proportional to the occupation length. Therefore, as more tools are exhausted, broken, and discarded, additional tools are fashioned as replacements. Here, very limited evidence was detected for tool manufacturing or resharpening, and few tools were discarded.

7.3.13 Seasonality

As usual, at most open-air hunter-gatherer campsites, only limited evidence is available to identify the season of occupation. In this instance, the Terminal Archaic component yielded minimal, but diverse lines of evidence to indicate the season of use. Five fish otoliths were recovered (four from the North Block) and all were determined to represent death in the summer-fall part of the year (Appendix J). The presence of wildrye grass seeds, as revealed by the starch grains, generally supports a fall occupation as these seeds are ripe and most often collected in the fall. Similarly, the recovered charred mesquite seeds and pods in Feature 1 are most often ripe and collected in the fall. Therefore, the evidence, though limited, combines to indicate that the season of use represented by this component was the fall.

7.3.14 Trade and Exchange

All stone, bone, and shell items recovered are thought to be of local origin. The chipped stone tools are all believed to represent cherts that originated as rounded gravels from the Callahan Divide and are considered to be varieties of Edwards chert. None of the lithic materials could be identified as coming from outside sources (e.g., obsidian from New Mexico, Alibates from the Texas panhandle, Frisco or Ozarks cherts from Oklahoma, Manning fussed glass from eastern Texas, or Pisgah Ridge chert from just to the south, in north-central Texas [McGregor 1993]). The burned rocks and ground stone items recovered were of local sandstones that occur within 100 m of this site. Interestingly, rounded quartzite cobbles are not represented in this assemblage, although they are immediately available in exposed gravel deposits in the surrounding uplands.

No exotic goods such as marine shell pendants or beads, or pipestone or soapstone objects, were recognized. The lack of imported objects negates any indication of past movements or trade connections with populations in other areas. The total absence of imported goods indicates that this population was essentially a self-reliant group of local foragers who had a limited territorial range and minimal contact with distant peoples. This limited home range and contact with other groups may be a partial explanation for the continued use of the atlatl dart at this late time. However, it seems contrary to suggestions that populations were increasing at this time (Skinner 1981; Story 1981; Prewitt 1981, 1985; Prikryl 1990). If this were the case, more contact and interactions would have occurred. It is possible that the small group that resided at this component was part of a larger population that periodically aggregated at base camps, where interactions with people from other groups and/or areas may have been more likely.

7.3.15 Component Activities

Overall, the recovered cultural remains combined with the multiple technical analyses that targeted microfossils represent a population that focused on collecting and cooking freshwater mussels during a short-term occupation that took place in the fall season. The presence of a few animal bones indicates only limited hunting, animal processing, and cooking and consumption of limited meat products. The detection of mesquite seeds and pods, wildrye grass seeds, as well as plant fibers/residues on the stone tools and burned rocks, all testify that plant collecting, processing, and consumption were also a significant part of the subsistence activities undertaken at this camp. The subsistence base was not narrowly focused or restricted to any one, predominant resource, but rather was diversified to include hunted mammals, aquatic resources such as mussels and fish, and plant foods that were available during the fall season.

Chipped stone tool production was not a significant onsite task, and minimal tool maintenance occurred. Apparently, one of the primary tasks was the procurement and cooking of mussels, an activity that did not require intensive investment of labor, and would not have required stone tools, related tool manufacturing, or tool maintenance activities. The occupants were a small foraging group that resided here only a short-time (perhaps a week or less) and then moved on, in what was likely a relatively highly mobile settlement-subsistence strategy. Significantly, this group possessed the atlatl and dart weapon system at a very late date (ca. 1100 to 1300 B.P.) at the same time that other groups in the adjacent regions had already adopted the bow and arrow as their primary hunting implements.

7.3.16 Intrasite Pattern

The Terminal Archaic component 1 in the North Block at Root-Be-Gone encompassed only 78.5 m^2 in a continuous block. This excavated area revealed only a small part of a much larger campsite assumed to include multiple and diverse activities. The activities represented within this North Block are interpreted to help shed insight into that part of the camp that was excavated.

Fourteen cultural features were identified and those appear to reflect specific human behaviors. Only a single *in situ* heating element, Feature 1, was identified and that was in the southeastern corner. The remaining 13 features were interpreted as discard or dump areas that contained primarily different frequencies of mussel shells and burned rocks from cooking activities. These 14 features document a focused cooking process that included the heating of rocks in the heating element and the discard of the by-products of cooking/heating of mussels.

The recovered formal stone tool assemblage is quite limited in number (*N* = 34) and in classes represented (*N* = 5) with a relatively low number of lithic debitage (*N* = 1,017). This data also indicates that the activities within the excavated area were quite limited and not intense. Poor or limited preservation potentially accounts for the limited animal bones (*N* = 147) and the sparse macrobotanical remains (*N* = 29 g) uncovered.

The horizontal distribution of these cultural materials is interpreted here. The heating element, Feature 1, in the very southeastern corner exhibited three small burned rock dominated discard piles (Features 1a, 1b, and 14) within 2 to 3 m immediately east. Roughly 3 m to the west of this heating element and extending at least 10 m to the north and slightly northeast were 10 more identified discard features. Those 10 discard features were dominated by mussel shells and small burned rocks. Those same discard features were within 1 to 2 m of each other and some were next to each other, with two that covered nearly 4 m^2 in area (Features 5 and 10) and three others in small tight concentrations (Features 6, 9, and 17). These 10 discard features formed an irregular line or partial arc across the western half of the block that extended from the southwestern corner to the northeastern corner. East of that line of discard features was an area of low artifact density that also lacked features. The relatively low counts of burned rocks and mussel shell in that area were countered with relatively high frequencies of lithic debitage, a few broken formal tools and many informal tools. That area apparently was the focus of *in situ* knapping activities directed primarily towards cobble reduction, early biface production, and informal tools.

This observed horizontal distribution pattern of the discarding of waste by-products from cooking along the western side of the block, the *in situ* knapping towards the eastern side, and an *in situ* heating element to the southeast definitely reveals specific human behavior patterns across this excavation. Broader excavations would undoubtedly provide more specific human behaviors and potentially bring into focus and shed more light on individual camp activities.

7.4 Research Questions 3 and 6: Was the Subsistence Economy Represented in the Terminal Archaic I Component Focused or Diverse? Was their Economic Pattern Based on a Broad – Based Resource Collection Strategy?

These research questions seek to shed light on a key human ecological issue: Was the subsistence economy represented at this component based on the focused use of one or a very few key resources, or did it involve a more broad-based, relatively diversified, exploitation of available food resources? To address this question, the ecofactual materials collected from the North Block were identified according to species. Materials examined included the faunal remains and the macrobotanical assemblages, as well as the data generated by technical analyses that included starch grain, phytolith, diatom, and use-wear conducted on various artifact classes. These latter studies were performed in anticipation that they would reveal a broader range of resources utilized. These technical analyses focused on microfossils, because the macrobatanical samples available for study were limited as is often the case.

The recovered vertebrate faunal sample from the North Block is meager (*N* = 147 pieces or 59.8 g), although a moderate diversity of species is represented. Fish (freshwater drum, *Aplodinatus grummiens*), were represented in the North Block by four otoliths, each from a separate individual. Medium-size mammals such as deer are represented by the burned long bone fragments in Feature 15, and by one positively identified deer phalange. These sparse medium sized mammal bones represent at least one individual deer. Small rodent size mammals such as rabbit are represented by a few long bone fragments that represent at least one individual. Turtle is represented by four tiny fragments of burned carapace and one unburned scapula. A canid (probable coyote) is represented by a single calcanium from Trench 4, which may or may not be part of this component. All species, with the exception of the fish, represent single individuals. The four freshwater drum fish otoliths are of four different sizes and, as determined by microscopic analysis, reflect four different ages. The medium size mammal and turtle fragments were burned, indicating human modification and use as subsistence resources. The meat weight provided by these vertebrate remains is shown in Table 7-1.

Use-wear analysis on one large biface tip revealed evidence of butchering a mammal, in the form of adhering animal hair (Appendix C). It is most likely that the animal processed by this tool was then consumed as part of the food resources, thereby adding to the evidence for the exploitation of vertebrate animals. The lipid residue**s** found on 75 percent of the burned rocks analyzed indicate that animal products were part of the decomposed residues recovered from the rocks (Appendix H).

In contrast to the few vertebrate remains, the invertebrate mussel shells were quite visible and abundant by count (*N* = 4,838 or 14,198 g). Although 73 percent of the shell fragments are unidentifiable as to species, the remaining 27 percent have been identified and represent at least seven different species, which include, smooth pimpleback, *Quadrula houstonensis* (71.5 percent), southern mapleleaf, *Quadrula aplicata* (13 percent), threeridge, *Amblema plicata* (8.9 percent), pistolgrip, *Tritogonia verrucosa* (2.9 percent), yellow sandshell, *Lampsilis teres* (2.3 percent), mapleleaf, Q*uadrula quadrula (<1 percent*), and Tampico pearlymussel, *Cytonaias tampicoensis (1 percent*). Obviously, one species, smooth pimpleback, clearly dominates this assemblage. Based on counts of umbo fragments, a minimum number of 658 individual mussels is represented.

These shells were both scattered across the block and concentrated in irregularly shaped clusters, designated as specific features. The clustering combined with the association of shells with other cultural remains such as burned rocks, lithic debitage, and stone tools, combined with the fact that a few (0.5 percent) shells were burned, all testify to these shells being culturally relevant. Mussel meat is assumed to have been a fairly significant food resource.

Use-wear analysis on 35 chipped stone tools revealed evidence that plants were also targeted by the Terminal Archaic occupants at this site. Eight-three percent of the analyzed tools revealed direct linkage with plant processing through wear and/or adhering microfossils (Appendix C). Adhering residues include raphides (calcium oxalate crystals), plant tissue fragments, and possible starch grains. Additionally, hard/high silica polish, resulting from use on plant materials, was identified. These various indicators are consistent with the processing of succulents such as agave, yucca, or sotol. Although this locality is beyond the known range of sotol, other agave species were likely present. It cannot be determined if all plant species processed with these chipped stone tools were consumed as food resources, since plants in general have many uses other than as food.

Edible plant parts in general were poorly preserved, as is evident from the extremely limited macrobotanical remains other than wood charcoal (*N* = 3 types). Mesquite seed and pod parts (*N* = 3) were recovered from Feature 1, indicating that the seeds were potentially processed (Appendix D). However, no other microfossil evidence (e.g., starch grains) from mesquite seeds was detected to support this inference. However, the lipid residue analysis on nine burned rocks (75 percent of those analyzed) indicates the cooking of seeds and/or nuts

(Appendix H), which may reflect the processing of mesquite seeds.

The starch grain analysis revealed at least two different grass seed species (*N* = 29), with one specifically identifiable as wildrye grass (93 percent of the total, Appendix B). No starch grains were gelatinized or damaged through grinding. Only their presence on burned rocks indicate that these grass seeds were part of the repertoire of cooked foods. Currently, it is unclear how grass seeds were collected or consumed.

In sum, wildrye (*Elymus* sp.) grass starch grains and other unidentifiable grass seeds (*N* = 2), mesquite seeds (*N* = 2), and possibly agave, are plants represented in this Terminal Archaic component. All three species are limited in quantity, but that may only reflect poor preservation and low visibility. These species are nearly impossible to detect macroscopically, and were only identified through technical analyses. In support of the cooking of plant foods, the microfossils recovered from 81 percent of the samples analyzed for diatoms reveal plant products (i.e., phytoliths) that are most likely representative of cooked food resources (Appendix F). It is significant that through these technical studies the plant gathering aspect of hunter-gatherers is finally starting to appear in sites.

The very limited faunal remains that represent a minimum of five animal species and seven species of mussel, combined with the recognition of wildrye (*Elymus* sp.) grass starch grains, and various other grass seed starch grains, and as evident by the microfossils of rods and/or raphides in rinds of the burned rocks and attached to the stone tools, reveal considerable diversity in utilized resources. The above list reveals a diversified pattern of resource exploitation, as opposed to a concerted focus on one or two resources.

Technical analyses employed here focused on microfossils, which brings to light otherwise indiscernible evidence for plant use. Although diverse plant products are clearly represented, it is impossible to specify how significant a role plant species played in the overall subsistence economy at this Terminal Archaic campsite.

Although diverse resources were exploited, the availability of mussels may have been the principal factor in the choice of this locale for a camp**.** This is despite the fact that mussels would not have provided as much meat or food value (e.g., protein or calories) as the single deer that is represented in the bone sample. In other words, the localized availability of, and ready access to, shellfish may have been the decisive factor that led to establishment of an encampment at this particular location. Shellfish were clearly used over a very long time in Texas (e.g., Watt 1978; Prewitt 1982; Quigg et al. 1996), across the Plains (e.g., Warren 2000**;** Lippincott and Davis 2000), and indeed, throughout the world (e.g., Parmalee and Klippel 1974; Jochim 1976; Meehan 1982; Glassow and Wilcoxon 1988; Peacock 2002; and Lindsay 2003). Mussels have often been thought of as a "starvation food" with very low return rates in terms of nutritional value (Parmalee and Klippel 1974; Teit 1990). However, reevaluation of the nutritional values has shown that mussels may have served as a useful and viable alternative to terrestrial protein (e.g., Perlman 1980; Yesner 1980; Erlandson 1988; Glassow and Wilcoxon 1988; and Classen 1998).

Erlandson (1988:105) elaborates on the low technological investment required to collect shellfish and describes them as a predictable and readily available meat resource, easily gathered by all of a society's members including men, women, children and old people. So, although the nutritional benefits derived from mussels may be relatively limited in a few categories, the cost of their procurement was minimal, they would have offered an attractive cost benefit ratio as a subsistence resource.

According to Ugan (2005), accumulating evidence shows that prey body size is not a critical factor in the usefulness (thus the ranking) of a food resource. He points out that the relatively low return rates of some species, such as mussels, is mitigated if these types of resources are collected in mass, and by techniques that are relatively low cost in terms of time, energy, and risk. Additionally, the exploitation of mussels would have involved very low processing costs, given that they were easy to open (with heat), and could be cooked rapidly. Ugan (2005) further points out that the ease of collection meant that mussels could be procured by women, children, and old individuals, those members of a hunter-gatherer group who were probably the least fit to perform more arduous tasks that may have provided a higher rate of return in terms of their nutritional value (e.g., meat procured through hunting). A number of authors (e.g., Meehan 1982; Klein and Ackerman 1995; Claasen 1998; and Moss 1993) note ethnographic evidence to the effect that women and children gathered shellfish. At Root-Be-Gone, the proximity of the camp to the stream from which the mussels would have been procured would allow women, children, and/or old individuals to collect these bivalves without necessarily disrupting the scheduling of other in-camp activities, all of which could be carried out while fit adult males were engaged in offsite activities such as hunting.

It is assumed that a mass collection technique was practiced, judging by the small sizes of most shells recovered archeologically **(**average 30 to 39 mm), the range of species represented (N = 7), and the abundance of specimens (MNI = 658) present within the Terminal Archaic component 1 at Root-Be-Gone. The fact that the Terminal Archaic component 1 yielded a considerable quantity of mussel shells is not interpreted to reflect a population experiencing dietary stress, but rather, a group that had a diverse food resource base, and that incorporated mussel gathering into their resource procurement strategy as a means to significantly supplement the acquisition of meat foods with minimal additional investment of time and energy. Where diets were broad, readily available, lower-ranked resources generally comprise relatively greater portions of the diet (Ugan 2005).

As discussed above, the Terminal Archaic component 1 at Root-Be-Gone, other food resources such as a deer, a rabbit size mammal, turtle, and fish were also utilized. The individual physical size of the food resources (tiny grass seeds, turtle, rabbit and deer size mammals), or the processing time for a given resource (skinning, disarticulating, defleshing and extracting marrow from a deer verses heating mussels or grinding grass seeds), do not appear to have played a significant factor contributing to an emphasis on any particular food resource. From an ecological perspective, both r-selected and K-selected species were procured and consumed by the population at this Terminal Archaic component. This stands in possible contrast to human adaptations during other periods of Texas prehistory. For example, the Late Prehistoric Toyah interval, during which there was considerably more (though not exclusive) emphasis on the procurement of large-bodied K-selected species such as deer and bison (e.g., Prewitt 1985; Black 1986; Johnson 1994; Ricklis 1994b; Quigg and Peck 1995; Quigg 1997b). However, a review and synthesis of Toyah interval subsistence data from mostly across the Edwards Plateau concluded that the Toyah interval diet-breadth was much broader than many currently believe. The wide diet-breadth documented was based on the extreme variation in plant and animal resources represented at 12 analyzed Toyah sites (Quigg and Dering 2007; Dering 2008b).

Though a single deer is represented at the Terminal Archaic component 1 at Root-Be-Gone, we suggest that this is in striking contrast to the numbers of deer/antelope/bison that are frequently represented at even short-term occupation Toyah sites (e.g., the Mustang Branch Site, 41HY209-T; Ricklis 1994b), a comparison that simply serves to highlight the diversified subsistence strategy that is represented here. Probably the presence of the large bodied bison during the Toyah interval reflects bison availability, which was generally not the case during the Terminal Archaic, at least not in north-central Texas**.**

This same scenario is represented at other components/sites that have been intensively excavated, reported, and dated to the Terminal Archaic period (see Section 7.4 below for more detailed comparisons). At most Late Archaic and Terminal Archaic components and sites discussed below, a similar diversity of food resources (excluding the foods identified by microfossil analyses reported herein) reflect similarly diversified subsistence strategies that relied upon procurement of multiple food resources (Table 7-5). In sum, the currently available comparative data indicates that the Terminal Archaic in central and north-central Texas was characterized by small, highly mobile hunter-gatherer groups who practiced a diversified, essentially "satisfying" adaptive strategy, as opposed to one based on optimal returns obtained through an emphasis on one or two highly ranked resources.

Table 7-5. Selected Late Archaic and Terminal Archaic Components/Sites and Their Subsistence Data

Name and Number (Analytical Zone)	Subsistence Resources								
	Mussel Shells	Large Mammal	Small Mammal	Fish	Turtle	Nuts	Seeds	Bulbs/ Tubers	Reference
Root-Be-Gone, 41YN452 (TA 1)	abundant	1 deer	? rabbit	4 otoliths	1	-	grass	-	this report
Millican Bench, 41TV163, (zone III-B)	present	-	-	-	-	-	-	1 onion	Mauldin et al. 2004
Barton, 41HY202-T	-	bison, deer	-	-	-	-	-	-	Collins 1994
Barton, 41HY202-B (Features 17, 21, 23)	-	bison, deer	-	-	-	-	-	-	Collins 1994
Mustang Branch, 41HY209-M (BRM)	-	2 deer, antelope	-	-	-	-	-	-	Ricklis & Collins 1994
Loeve-Fox, 41WM230, (lower part Stratum 2)	cache	1 deer	-	-	-	-	-	-	McDonald 1982, Prewitt 1982
Evoe Terrace (41BL104) Area C, Zone 2, Level 2	-	deer	-	-	-	-	-	-	Sorrow et al. 1967
McDonald, 41HI105	abundant	-	-	-	-	-	-	-	Brown et al. 1987
McKenzie, 41HI115	abundant	deer	-	-	present	-	-	-	Brown et al. 1987
McKinney Roughs, 41BP627, Darl Component	1473	-	-	otoliths	present		grass	present	Carpenter et al. 2006
Smith Rockshelter, 41TV42, Layer I	-	deer, bison	2 beaver	-	present	-	-	-	Suhm 1957

Table 7-5, continued

Name and Number (Analytical Zone)	Subsistence Resources								
	Mussel Shells	**Large Mammal**	**Small Mammal**	**Fish**	**Turtle**	**Nuts**	**Seeds**	**Bulbs/ Tubers**	**Reference**
41MM340 (AU-2)	abundant	bison, deer	beaver, rabbits, Canis	-	present	hickory	-	-	Mahoney et al. 2003
J. B. White, 41MM341 (AU-3)	abundant	deer	-	-	present	present	hickory	-	Gadus et al. 2006
41WM53 (Features 4 & 6)	-	-	-	-	-	acorns	aster, hedge hog	-	Peter et al. 1982:8-16
Hoxie Bridge, 41WM130, testing (Feature 16)	present	1 deer	-	-	1	-	-	-	Bond 1978
41WM328, (Features 15, 16, 17)	-	-	-	-	-	acorns, pecans	-	-	Peter et al. 1982
41CV988, Feature 2A, Au 1	-	-	-	-	-	-	-	Crom	Kleinbach et al. 1999
Baylor, 41ML35 (AU-2), mixed	abundant	deer	-	-	-	-	-	-	Mehalchick & Kibler 2008
Britton, 41ML37 (AU-1)	abundant	deer	-	-	-	-	-	-	Mehalchick & Kibler 2008
McMillion, 41ML162 (AU-2)	abundant	present	-	-	-	-	-	-	Mehalchick & Kibler 2008
Bear Creek Shelter, 41HI17 (Occupation II)	abundant	10 deer	7 rabbits	present	present	-	-	-	Lynott 1978
41CO141, testing 10 m2	present	deer	rabbits	present	present	-	-	-	Prikryl and Yates 1987
41TR170 (Late Archaic site)	2,254	deer	rabbits	present	present	-	-	-	Lintz et al. 2008
41TR174, testing, Analytical Zone II	present	deer	rabbits, beaver	1	present	-	-	-	Lintz et al. 2004
41DL184	-	deer	opossum, rodents	-	present	-	-	-	Martin 1995; Peter et al. 1988
41DL189	present	deer			present			1	Martin 1995; Peter et al. 1988
41DL199	present	deer, pronghorn	cottontail, beaver, badger, gopher	present	box, others				Martin 1995; Peter et al. 1988
41DL270, testing, (Features 1, 29, and 36)	present	deer		catfish	present				Anthony & Brown 1994
AU = Analytical Unit, LA = Late Archaic,									

7.5 Question 4: How does the Terminal Archaic Component 1 at Root-Be-Gone compare to other known Terminal, Transitional, or Late Archaic sites?

7.5.1 Introduction

In order to address this question, a broad literature search was conducted. Although broad in scope, this search was not meant to be all-inclusive or totally exhaustive, and was geographically restricted to central and north-central Texas. The focus was to target components or sites that have yielded a preponderance of Darl type dart points, or assemblages that have been assigned to the Terminal or Transitional Late Archaic, for one or more reasons, across the north-central half of Texas.

7.5.2 Comparative Issues

Many problems exist in trying to compare assemblages from different sites/components. Previous investigations have been conducted by many individuals and institutions with different backgrounds, approaches, and understandings of the archeological record, and using differing approaches to stratigraphic contexts, and different terminologies. Some of the biggest difficulties are due to the lack of adequate excavations, lack of rigorous observations, and limited reporting, especially when it comes to presentation of geoarcheological and/or stratigraphic information. Some problems in trying to conduct direct comparisons stem from the use of different terminology, not only regarding how projectile points are classified (i.e., by type, form, in unnamed groups, etc.), but the descriptive nomenclatures applied to the formal and informal tools as well as features. For example, bifaces may be listed by overall shape, while in other instances, they may be given names or assigned to stages of reduction, but references to biface subdivisions in the literature are not consistent. Sometimes features are lumped into general categories such as a "hearth" without explicit indications of how a hearth is defined. In other reports, features are split into numerous divisions based on slight differences in their artifact content. Therefore, consistency (or lack thereof) is a problem. Often features are not interpreted as to function, but just referred to by feature number. Many times in the earlier literature, features were not described in detail and associations of those features with other materials are not clear, or as in the case of many north-central Texas sites, features are just briefly mentioned, or not discussed at all (i.e., Lynott 1977; Skinner et al. 1978; Prikryl 1990). As Lintz et al. (2008) point out from their literature review of thermal features across the Trinity River Basin, this may stem from the fact that few features have been recognized in the north-central region. This lack of thermal features in the Trinity River Basin contrasts to the documentation of many features in the middle Brazos River region.

Terminology is even a problem in discussing the Late Archaic, as researchers sometimes use it for a discussion of a component that represents ca. 1,000 years of time, but the time period for the Late Archaic in central Texas is nearly 3,000 years (Prewitt 1985; Johnston and Good 1994; Collins 2005). In north-central Texas, the beginning and ending dates for the Late Archaic have not been established (Prikryl 1990). In central Texas, the diagnostic projectile points presently assigned to the Late Archaic period have changed drastically (see Johnston and Good 1994; Collins 2005) from what many researchers have used and accepted since the mid to late 1970s (Prewitt 1985). The key index markers for the Late Archaic previously included some 8 to 10 types, but since the Johnson and Goode (1994) article, the number of key markers has expanded by 5 or more types. As examples, dart point types once placed in the Middle Archaic, such as Bulverde and Pedernales (e.g., Weir 1976; Prewitt 1981, 1985), have more recently been assigned to the Late Archaic (e.g., Johnson and Goode

1994; Collins 1995, 2004), a shift reflecting a redefinition of the earliest temporal range of the Late Archaic rather than a revision of the age of such types. Consequently, using the generic term "Late Archaic" has new or possibly clear meaning and timing, depending on when that term was used in the literature, for what area of the state is being discussed, and by which researcher (e.g., see Perttula 2004, Table 1.1).

Another problem is the lack of standard excavation procedures that have drastically changed over the years. That includes whether screens were used or not, the size of mesh used when screening, the thickness of the arbitrary level, and so on. Today's standard for data collection is far different than those used 30 or more years ago. Another example is the use of flotation to collect macrobotanical remains, which has only been around for 30 or 40 years, but has not been evenly applied from site to site or over time. The flotation of feature fill and the identification of the recovered macrobotanical remains has a great deal to do with the quantity and quality of subsistence data obtained from a feature, a component, or a site, and how much we know concerning subsistence economies. Few excavated sites have had systematically or randomly selected samples floated, but even the amount of sediment collected, the selection procedures, and the analyses of those samples has not been consistent for all sites investigated.

Radiocarbon dating has only been in use since the mid-1950s, but even when this dating technique has been available, when funds have been limited, many features and/or components have not been directly dated. In many instances, of course, dateable charcoal simply was not available. Consequently, only guess or extrapolated dates have been applied to many sites and components. Often, the guess dates are based on projectile points present and their presumed age, although we are still in the process of documenting the precise age of many of the known projectile types. When charcoal was not available (e.g., 41TR174, Lintz et al. 2004), a variety of other organic substances have been used (e.g., mussel shell at 41TR174) to obtain a clue to the general age of the deposits, but those other materials may or may not be comparable to wood charcoal results.

Despite these various problems, we have attempted to scan the literature and arrive at some general comparisons to establish the range of past human behavioral, stylistic, and technological traits with the goal of making direct and specific comparisons between Terminal Archaic sites in central and north-central Texas.

Many sites and components across central Texas and those areas immediately adjacent to central Texas, including north-central Texas, have been identified as Late Archaic or Terminal Archaic in age. Most have been identified and assigned to this time period based on the recovered projectile points and the estimated ages of specific point types. In fact, many authors (e.g., Weir 1976; Story 1981, 1990; Skinner 1981; Prewitt 1985; Prikryl 1990; Johnson and Goode 1994) see the Late Archaic as a time of increased population density across broad regions of Texas, based primarily on the relatively high frequency of Late Archaic sites and projectile points. Prikryl (1990:74) found that the Late Archaic sites in the Lower Elm Fork region of north-central Texas were 3.5 times more frequent than those that represent the Middle Archaic period. For central Texas, Dixon and Rogers (2006) conducted a review of sites along Brushy Creek in Williamson County and found that the Late Archaic sites outnumber sites of all other time periods by a considerable margin. However, simply because there are more sites potentially representing larger regional populations does not mean there is greater understanding of this period. In fact, the "Terminal" or "Transitional" Late Archaic period most often identified and associated with the Darl dart point type in central Texas is one of the least understood time intervals (see Carpenter et al. 2006). Darl projectile points are the last dart point type recognized in the central Texas Late Archaic sequence prior to the introduction of arrow points. However, few sites or components in which

Darl points are the predominant type have been intensively excavated and fewer still have been in a good context within well-defined, isolable components with multiple radiocarbon dates for precise age determinations or clearly associated nonpoint tools forms or ecofactual materials.

The presence of one or more Darl points at a particular site does not automatically mean that a Terminal Archaic component/assemblage was identifiable. Many sites have yielded Late Archaic or Terminal Archaic point types, but in most sites a coherent Terminal Archaic assemblage cannot be identified and described. Many of the better known sites in the region (e.g., High Bluff [Flinn and Flinn 1968]; Kyle site - 41HI1 [Jelks 1962]; and Harrell site - 41YN1 [Krieger 1947]) have yielded many Darl points, but these sites have no associated radiocarbon dates to support the precise age of the Darl points or associated deposits, and the context of those points was poor. Although 33 Darl points were recovered from the High Bluff site, at least 57 other nonDarl dart points and 34 arrow points were recovered in the top 16 cm of the sites' deposits (Flinn and Flinn 1968). The context of those Darl points is considered poor and unsuitable for discussions beyond the simple fact that they were present, or a description of their metric and/or morphological characteristics. Like High Bluff, the Acton site (41HD13) was on a sandy knoll above the Brazos River, and lacked obvious and well-defined stratigraphy. Although this site yielded at least 12 Darl points, it also produced other types falling into the long-lived Late Archaic period such as 5 Yarbrough, and various other types, as well as some 34 Early Archaic points (Blaine et al. 1968). Again, only the projectile points could be assigned to general time periods as there is no current way to separate the other material classes into specific time periods with any degree of confidence.

The nearby Harrell site (41YN1) has similar contextual problems with materials recorded in thick arbitrary zones without clear separation of age-specific features or components (Hughes 1942; Krieger 1947). Only two natural strata were recognized in the roughly 3 m deep deposits in Excavation 3, with a lower red clay stratum likely predating the Holocene. The upper stratum, often referred to as "the midden," contained nearly all the cultural debris, and varied in thickness from 75 to 180 cm (Krieger 1947). Excavation and recording standards during those early years were not what they are today and the stratigraphic information provided concerning the deposits and positions of the artifacts is imprecise by today's standards. Associations of the cultural materials presented are not obvious, other than they were present within the "midden." This thick cultural deposit is considered mixed and yielded information of limited usefulness for direct comparisons with materials from well-defined, discrete components.

Southeast of Young County along the Brazos River, the well known Kyle site (41HI1) in Hill County also yielded a Darl dart point (*N* = 1) and other presumably Late Archaic point types such as the Trinity (*N* = 1) and Godley (*N* = 2) from Stratum 1, the lowest of six recognized strata. Stratum 1 also yielded some 45 arrow points. Stratum 1 varied from ca. 35 to 180 cm thick and consisted of numerous localized lenses of gray midden soil in thin alternating layers of cultural and noncultural deposits (Jelks 1962). Jelks (1962:9) stated that "Possibly some of the lenses and layers would have been useful for fine stratigraphic control, but since only a few squares were taken down into Stratum 6 [1] (because of its depth), the details of its structure could not be worked out sufficiently for isolation of substratums." The materials from Stratum 1 were presented in the published table. The reporting centered on the Late Prehistoric Austin and Toyah materials found in Strata 2 through 6.

The Bear Creek Shelter (41HI17) also in Hill County revealed 4 m of stratified deposits, but these were poorly differentiated natural and cultural deposits with no clear separations between six rather arbitrarily defined cultural zones (Lynott

1978). The stratigraphy was relatively complex with wedge-shaped Holocene deposits that sloped across the shelter floor, intermixed with various amounts of roof fall throughout the nearly 4 m of deposits. The natural layers varied from 10 to 150 cm thick. The recovered assemblage contained materials associated with the Middle Archaic, Late Archaic, Transitional Archaic, and Late Prehistoric Austin and Toyah phases. The postulated Transitional Late Archaic zone was roughly 30 to 50 cm thick and contained some Scallorn arrow points together with Darl, Ensor, and Kent dart points. Lynott (1978:85) stated this transitional zone could not be separated from the Transitional III zone or the Austin phase above. The 12 radiocarbon dates document the general age of the deposits with the oldest date of 2200 ± 120 B.P. (Tx-2958) from 250 cm in Unit 11. The youngest date is 630 B.P. or ca. A.D. 1320 ± 50 (Tx-2939) from 80 cmbs in Unit 11 (Lynott 1978:30). Inconsistencies exist within the sequence of 12 radiocarbon dates, with some dates in reverse order. This indicates vertical displacement of charcoal and potentially other cultural materials from bioturbation caused by rodent burrowing. Consequently, the associations of individual artifacts are not clear and the associations with assayed charcoal are open to interpretation. The interpreted divisions between the cultural zones can be questioned and the artifact associations are not clear. Discrepancies exist in depths of strata between the two excavation blocks, which indicate the cultural stratigraphy was not uniform across the shelter.

In fact, most known Terminal or Late Archaic sites have one or more serious problems stemming from a variety of circumstances. The problems include, but are not limited to, a lack of recognizable stratigraphy, few or no radiocarbon dates, dates based on humates or mussel shells that provide only approximate ages of cultural events, dates from scattered charcoal not directly associated with diagnostic tools, the mixing of cultural materials from various time periods, or dated events that lack associated tool assemblages. For Example, the J. B. White (41MM341) in Milam County yielded two features (Features 20 and 24) directly radiocarbon dated to the Late Archaic period. But Features 20 and 24 were assigned to Analytical Unit 3 that contains multiple point types (4 Darl, 4 Scallorn, and 1 Ensor) that indicate probable mixing (Gadus et al. 2006). Although these two features date to the Transitional Late Archaic, the broader component has a mixed assemblage.

The excavated materials assigned to Analytical Units (AU) for the Baylor (41ML35), Britton (41ML37), and McMillan (41ML162) sites at Waco Lake represent individually defined components, but the components were sometimes as much as 1 m thick and contained multiple cultural occupations with overlapping cultural features that cannot be separated into temporally discrete individual occupations (Mehalchick and Kibler 2008). Therefore, one can discuss a general time period, the Late Archaic, for example, which may in fact represent centuries or even millennia of recurrent occupations. However, it is not clear which artifacts and features were associated with a single occupation, so usefulness in making intersite comparisons for a discrete time period is extremely limited, at best.

Many other Terminal or Late Archaic components exist, but the limited testing conducted at many has yielded few Darl or other diagnostic points (with these few examples being often in poor context; e.g., the Terri and Lightfoot sites at Proctor Reservoir in Comanche County [Prewitt 1964]), limited associated stone tool assemblages, a radiocarbon date of this period without diagnostic artifacts, and Darl points mixed with other point types. These diverse and unclear conditions do not often permit a clear understanding of the human activities during a specific occupational episode or allow confident assignment of recovered materials to this specific cultural phase/time period. These few examples highlight some of the known problems with many sites with designated Late Archaic components, specifically that they lack well-defined stratigraphy and poor contexts for isolating Terminal Archaic assemblages.

7.5.3 Sites with Good Contexts and Isolable Assemblages

The Terminal Archaic component 1 at Root-Be-Gone was isolable within a 40 cm thick paleosol (2Akb) that sloped across the 13 m long excavation block. This 15 to 20 cm thick cultural zone across the ca. 78.5 m^2 continuous excavation block yielded 14 identified features, three Late Archaic dart points, one arrow point, and nine accepted wood charcoal radiocarbon dates. Eligibility assessment revealed no identifiable component above or below this paleosol. However, sparse cultural items were occasionally encountered above the main identified occupation. This is one of the better isolated components so far identified and reported upon for this time period in north-central and central Texas.

A few other sites with good contexts have been previously identified. The Darl component in Stratum 2 at Loeve-Fox (41WM230, Prewitt 1974, 1982), Layer I at the Smith Shelter (41TV42, Suhm 1957), AU 1b at the Shepherd site (41WM1010) in Williamson County (Dixon and Rogers 2006), and the Darl component at the McKinney Roughs site (41BP627, Carpenter et al. 2006) in Bastrop County also had good contexts. Each of these sites is briefly discussed below to provide an overview of what artifact assemblages are available for intersite comparisons for this specific time period.

At Loeve-Fox in Williamson County, Stratum 2 of this well-stratified site was assigned to the Driftwood Phase dominated by Mahomet/Darl points. This 60 to 90 cm thick stratum was clearly separable into two parts with the lower part sterile. It was composed of gray sandy clay with cultural debris restricted to the upper part. Only a single radiocarbon date was obtained from one feature (Feature 44) in this stratum. A charcoal sample from basin hearth Feature 44 in excavation unit 3 yielded a $\delta^{13}C$ corrected age of 1630 ± 145 B.P. (Tx-3404). Prewitt thought this date was too old to be associated with the Darl points recovered. Six dates were obtained from Stratum 1 above and document a range between 850 and 1230 B.P. Another eight dates were obtained from Stratum 3 below to bracket Stratum 2 and fall between 1280 and 2140 B.P. (Prewitt 1982:29). Stratum 2 yielded at least 8,419 pieces of cultural debris from three excavation blocks. Those artifacts include 12 Mahomet/Darl and two Ensor dart points, and various classes of stone tools, cores, and lithic debitage. Seventeen cultural features were also found in Stratum 2, and included basin-shaped hearths of various sizes, six burned clay and charcoal pits, and one burned clay and charcoal lens. One bone awl, one bone bead, and six freshwater shell pendants were recovered. No exotic items were identified (Prewitt 1981). A high ratio of chipping debris compared to other artifacts was documented. Cores were quite sparse in comparison to the chipping debris. The projectile points accounted for 14 percent of the total tool assemblage. Cutting tools were more frequent than crushing and grinding tools. However, scraping tools were more prevalent than cutting tools. The horizontal distribution of the material indicates possible knapping areas around hearths with low density areas that contained burned mud dauber nests possibly indicative of the locations of undocumented structures (Prewitt 1982).

At Smith Shelter in Travis County the lowest stratum, Layer I at ca. 167 to 260 cmbs, contained cultural materials that included ashy matrix, lithic debitage, bone scraps, hearth stones, and chipped stone tools. Roughly 21, 1.5 m squares (ca. 47 m^2) were excavated through Layer I. Excavation into Layer I yielded a relatively limited tool assemblage assigned to the late phase of the “Edwards Plateau Aspect” at that time (Suhm 1957). Of the 1,104 artifacts recovered from this shelter, at least 50 dart points were represented, of which 17 were identified as Darl. Sixteen Darl points occurred in Layer I with two Ensor and two

Abasolo points. These 20 dart points were generally below the 3 Scallorn arrow points in this same layer. Layer I included at least 5 "knives," 1 large drill, 3 scrapers, 16 utilized flakes, 3 gravers, and 1 large white limestone boatstone. The boatstone is a rare discovery; it is covered in numerous striations, and is plano-convex in cross-section with a shallow concavity on the flat surface. One end tapers slightly. It measures 25.5 cm long, 4.8 cm wide, and is 2.1 cm thick. Layer I also yielded at least bison, turtle, and beaver bones, plus land snails and fresh water mussel shells. The overlying layers revealed 345 arrow points that included 33 Scallorn, 202 Perdiz, 14 Young, 16 Fresno, 13 Cliffton, 4 Eddy, 2 Cuney, and 1 Alba. The Scallorn (Austin Zone II) and Perdiz (Toyah Zone III) were in general stratigraphic order (Suhm 1957). Prewitt (1985) reports 18 radiocarbon dates from this site. He assigned four dates that range between 240 ± 70 B.P. (Tx-509) and 520 ± 90 B.P. (Tx-508) to the Toyah Phase. He assigned 11 dates that range between 565 ± 145 B.P. (Tx-25) and 830 ± 75 B.P. (Tx-518) to the Austin phase, and three dates that range between 1100 ± 95 B.P. (Tx-515) and 1160 215 B.P. (Tx-27) to the Driftwood phase. Unfortunately, the proveniences of these dates from Smith Shelter are not included by Prewitt (1985) in the collection of dates he assigns to the Driftwood phase. Significantly, the three latter dates indicate a relatively young Driftwood phase component in the ca. 1100 to 1200 B.P. range dominated by 16 Darl points.

The Shepherd site (41WM1010) in Williamson County appeared to have excellent context within three spatially distinct areas (Areas A, B and D, Dixon and Rogers 2006). The cultural materials were contained in vertically accreted overbank deposits that covered limestone bedrock. At least two thin paleosols were recognized within the thick, gravelly deposits. The cultural materials were divided into three analytical units (AU) based on 39 wood charcoal dates and diagnostic Darl and Scallorn projectile points. Of interest is AU 1b that contained cultural materials assigned to the Driftwood phase (Prewitt's 1981, 1985 terminology) of the Late Archaic period. Below AU 1b were materials assigned to AU 1a associated with the Twin Sisters phase of the Late Archaic that lacked diagnostic dart points, but produced Erath and San Gabriel bifaces. Above AU 1b were materials assigned to the Austin phase and dominated by Scallorn arrow points. In AU 1b, 30 burned rock features were targeted and excavated. Fourteen features in AU 1b were directly radiocarbon dated to this component with Darl points in five of the dated features. The absolute dates for AU 1b range over a narrow 200 year period from 1150 to 1350 B.P. (ca. A.D. 600 to 800). At least 5 of the 11 Darl points were in direct association with those dated features. Unfortunately, the vertebrate faunal assemblage and macrobotanical remains, other than sparse wood charcoal, were very limited. Mussel shells were present in most features, but in relatively low frequencies. Few formal tools and only limited lithic debitage were recovered in direct association with the excavated Darl features. The Driftwood phase features were mostly surface hearths; other features included four basin hearths and one earth oven. Dixon and Rogers (2006) interpret the multiple features and the entire component to reflect a focus on mussel shell meat processing activities by many foraging groups during short-term encampments.

The excavated (ca. 98 m^2) Darl component at McKinney Roughs site was isolable and represented a single living surface radiocarbon dated by two wood charcoal samples to 850 ± 110 B.P. (Beta-169225) and 940 ± 70 B.P. (Beta-195847). Stratigraphically this component was above two lower Ensor components, which were radiocarbon dated to earlier times. The roughly 10 cm thick sloping occupational zone yielded intact activity areas centered on five recognized cultural features (Features 1, 3, 5, 7, and 11). Features 3 and 7 were directly dated through wood charcoal, and a Darl point was recovered in Feature 3. The assemblage includes three Darl points, mussel shells, burned rocks, lithic debitage, cores, edge-modified flakes, a mano, and sparse, well-preserved charcoal. A distinctive core reduction area was also identified. The ground stone tools were minimally used and were not formally shaped. Mussel shells dominated the faunal remains. Limited faunal bone was present, although fish otoliths and deer teeth were recovered. No pollen, phytoliths, or other floral remains were recovered. The authors interpret these remains to indicate a broad-based subsistence strategy focused on small-scale resource extraction. They infer the exploitation of various plants, though direct evidence was absent (Carpenter et al. 2006:191). The Darl occupants utilized locally available materials (e.g., wood and rocks) for food procurement and processing tools. Based on the feature types and the thermal breakage patterns of heated rocks, Carpenter et al. (2006:191) speculated that two types of cooking technology were carried out, namely, oven cooking and stone boiling. However, limited evidence is presented to support the postulated stone boiling process. Discard patterns and *in situ* features were recognized, as were core reduction areas. The raw lithic materials used for stone tools were said to be from the local area, with no exotic materials identified. The available information was interpreted to represent a small, short-term foraging camp (Carpenter et al. 2006).

Stratum 2 at Loeve-Fox, AU 1b at the Shepherd site, the Darl component at McKinney Roughs, and the Terminal Archaic component 1 at Root-Be-Gone provide rare glimpses into short-term occupations with isolable components, which specifically relate to the Darl period of the Terminal Archaic. These four components currently provide the greatest potential for meaningful interpretations relevant to understanding human behavior during this period. Larger block excavations directed at isolable components from across the region will be required to clearly understand the lifeways of these specific populations and to gain a greater understanding of their interactions within the environment and with neighboring groups.

Various data sets from many different Late Archaic sites and components that date roughly between 2000 and 1000 B.P. are used to help elucidate the human behaviors throughout the Terminal Archaic period. The following will examine the topics of subsistence, tool assemblage, lithic technology, cultural features, trade networks, seasonality of site use, and treatment of the dead.

7.5.4 Subsistence

In terms of subsistence strategies, Table 7-5 reveals some selected Late Archaic sites that date roughly between 1000 and 2000 B.P. These sites have yielded identifiable faunal and/or floral resources that directly relate to the Late Archaic and/or Darl/Terminal Archaic. Late Archaic sites in north-central Texas such as 41DL184, 41DL189, and 41DL199 in Dallas County were reviewed, but very few carbonized plant remains were recovered from flotation samples (Martin 1995:222). Only the faunal resources were preserved to provide data that represents subsistence resources at those sites. It should also be noted that those sites represent Late Archaic debris that accumulated from numerous, recurrent, short-term occupations and not single, occupational episodes.

In broad and general terms, this period has demonstrated considerable diversity in food resources exploited by populations. Considering that macrobotanical resources were poorly preserved in most open sites (i.e., sites 41DL184, 41DL189, and 41DL199 [Martin 1995]; 41DL270 [Anthony and Brown 1994]), and microfossils (such as phytoliths and starch grains) and chemical analysis (i.e., lipid residues) have rarely been examined, the recovered faunal resources generally provide the primary evidence for the diversity of exploited food resources. Often, animal bones were also poorly preserved in central and north-central Texas. When present, deer appears most consistently among large mammals encountered as it was represented in nearly every component identified to this period, regardless of where the site is located (e.g., central or north-central Texas), or season of occupation (i.e., Kibler and Mehalchick 2010). Brown (1989:211) pointed out that deer provide more than ten times the meat per individual than any other animal that was regularly available in the Aquilla Lake region of Hill County along the margin of the Cross Timbers and Blackland Prairie.

Bison remains were quite sparse in the reviewed sites from across north-central Texas. Bison were minimally represented in only a few sites in the Austin area (e.g., Layer I at Smith Rockshelter, [Suhm 1957]; Barton [41HY202-B, Collins 1994]; 41MM340, Analytical Unit 2 [Mahoney et al. 2003]) during this period. This period falls during Dillehay's (1974) Absence Period III period (in central Texas bison remains may be more prevalent around ca. 2000 B.P. [e.g., Feature 17 at the Barton site]) as nearly all the post-2000 B.P. components and sites lack bison remains, especially in north-central Texas (Lintz et al. 2004). If bison were present during parts of this period, they do not appear to have been relied upon heavily; perhaps they were relatively scarce. In general terms, bison are thought to have been decreasing in frequency across the Southern Plains around ca.1500 B.P.

One mammal that resides in the rivers, the beaver, is represented at three components: Layer I at the Smith Shelter in Travis County (Suhm 1957), 41TR174 in Tarrant County (Lintz et al. 2004), and 41DL199 in Dallas County (Martin 1995; Peter et al. 1988). Also, other riverine resources such as aquatic turtles are well represented. Although very sparse, fish remains have been recovered from a few sites (see Table 7-5). Fish remains may not have been recovered from sites even though they might have been present, as the tiny bones easily pass through 6. 4 mm mesh screens such as those used at most sites; so, potentially, they may simply have gone unrecognized. Additionally, tiny and fragmented fish bones may not be preserved at many sites. Fish and other riverine food resources are not restricted to a specific season in the streams and rivers and were accessible year round. However, their sparse recovery from any one component opens the door to speculation that these few remains may be deposited during the same overbank flooding events that deposited sedimentary matrices for the cultural materials.

Other small mammals such as rabbits are represented in at least six assemblages. Many unidentified small mammal bones may represent rabbit-size individuals. Often, rodent bones have been identified in faunal assemblages with little discussion concerning their association and value. Many very small bones can occur naturally in deposits and researchers must be careful in assigning all recovered bones to the cultural component in question. Various types of turbation can, and likely did, move many small bones from the primary depositional contexts.

Nuts from various trees have been recovered infrequently and in very limited numbers from a few sites, mostly in the central Texas region (see Table 7-5). A significant contributing factor to the reported results is poor preservation at many sites and/or the lack of recovery techniques such as flotation of feature fill. The more recent investigations into sites of this age have yielded the remains of this food resource. Nuts most often ripen in the fall and could provide a sizable, seasonal food resource for the human populations in areas with oak, hickory, and/or pecan trees. Additionally, if nut-producing trees were present in any quantity at a particular site, the seasonality of occupation would likely be, or include, the fall. If the nuts were not used by humans on a regular basis, a sizeable animal population that includes deer consumes these same nuts and were likely attracted to those areas where nuts were abundant. The attraction of various game resources to those nut producing areas would most likely have attracted human populations to these same localities.

Only limited direct evidence exists for the use of geophytes (e.g., roots, tubers, and bulbs) from a couple of components, but it is unclear if limited recovery reflects the care in which these plants were processed, poor preservation, lack of flotation of matrices, the lack of use of these plants, or a combination of these factors. In support of the use of underground storage plants, an onion bulb (*Allium* sp.) was recovered from zone III-B at a Late Archaic component at the Millican Bench site (41TV163; Mauldin et al. 2004). Feature D56, an earth oven directly dated by wood charcoal to 1190 ± 40 (Beta-175164) and assigned to AU 1b at the Shepherd site (41WM1010), yielded unidentifiable bulb fragments (Dixon and Rogers 2006). Indirectly, the processing of geophytes may be inferred from the presence of burned rock middens with central slab-lined hearths in Late Archaic sites such as Mustang Branch (Collins 1994), and Area 3 midden at 41CV595 (Abbott and Trierweiler 1995), burned rock midden #1 at 41BL155 (Mehalchick et al. 1999), and midden 3 at Paluxy site 41CV988 at Fort Hood (Kleinbach et al. 1999). At least 11 Darl points have been recovered from burned rock middens at Fort Hood (Abbott and Trierweiler 1995). However, what is processed in most large middens is still being debated, and the direct evidence has been very limited. At Feature 2A, a 175 cm diameter basin-shaped hearth at 41CV988 in Fort Hood, yielded an indeterminate carbonized crom (storage organ) fragment (Kleinbach et al. 1999; Dering 1999). As Dering (1999) rightly points out, the recovery of soft-tissue food storage organs is a rare occurrence. The processing of geophytes was likely a seasonal activity, as many of those food resources are edible or available at limited times of the year (see Brown 1989; Kibler and Mehalchick 2010 for resource-availability studies) and should not be expected in all components of these mobile hunters-gatherers. Many below ground food resources are generally available in the spring.

Mussel shells were by far the most abundant faunal material recovered at most of these time related components. However, the actual significance of mussels as a subsistence resource is often unclear, because in many instances the actual counts of shells recovered or the minimum numbers of individuals represented are not reported. Often, the entire assemblage of shells was not even collected. In components north of Austin, mussels appear to represent the greatest number and were probably a prominently targeted food resource (see Table 7-5). The Terminal Archaic component 1 at the Root-Be-Gone site is similar to the norm for this period. Shells dominated actual counts and were present in large quantities, together with a few animal bones that represent various species.

The microfossil remains (e.g., diatoms, organic residues observed on tools during use-wear analysis, starch grains, and phytoliths) detected in the Terminal Archaic component 1 at the Root-Be-Gone site have contributed to a greater understanding of the plants used by the occupants during this specific time period. The presence of starch grains from wildrye (*Elymus* sp) grass seeds on 25 percent of the burned rocks analyzed (Appendix B), the consistent presence of plant fibers and phytoliths on the discarded burned rocks used to cook foods (Appendix F), and the presence of plant residues in 100 percent of the burned rocks analyzed for lipid residues (Appendix H), combined with the plant fibers on 83 percent of the analyzed stone tools, (Appendix C) testify to a intensive use of plants not documented at most other components. It is envisioned that continued analyses that target microfossils from various artifacts, in combination with chemical residue analysis, will provide a wealth of new data concerning the use of plants at other site components. These microfossil analyses will enhance our understanding of plant gathering and use by the prehistoric populations, especially in components with poor macrofloral preservation.

7.5.5 Tool Assemblage

The relatively small areas hand-excavated in most sites or components of this age, combined with the limited recovery of stone tool assemblages and the lack of multiple wood charcoal radiocarbon dates has greatly limited the number of sites/components to compare with this Terminal Archaic component 1 at Root-Be-Gone. Table 7-6 lists a number of selected Terminal or Late Archaic components/sites with their reported tool assemblages.

Many sites and components referred to as Late Archaic in the literature have mixed assemblages with not only multiple Late Archaic points present in one zone, but often mixed with arrow points (e.g., Transitional I zone at Bear Creek Shelter [41HI17], Lynott 1978; AUs 1 and 2 at Baylor [41ML35] and AU 1 at the McMillan site [41ML162], Mehalchick and Kibler 2008; AU 3 at J. B. White [41MM341], Gadus et al. 2006; Area B, Zone 2 at Evoe Terrace [41BL104], Sorrow et al. 1967; Area B at 41WM53, Peter et al. 1982). In these cases, the mixed assemblages from poor contexts cannot be separated and are not listed in the table. Unfortunately, not many components/sites have yielded extensive tool assemblages that were truly isolated in time and not mixed. Therefore, few sites can be directly related to the Terminal Archaic component 1 at Root-Be-Gone. Because of various limitations listed above, it is not clear if the low frequency of chipped and ground stone tools provides a clear and true picture of the activities pursued at those camps. If so, these limited assemblages reflect primarily short-term camps of highly mobile populations who discarded relatively few tools at any given campsite, and perhaps also carefully curated their tool kits.

Limited suites of stone tools have been recovered from the selected components. Not only are the numbers limited, but the tool classes are also limited. It is striking that so few formal tools have been recovered from components. Basic formal stone tools such as end and side scrapers, drills, and choppers all appear in very low frequencies. These tools are absent from even the larger excavations like those at Terminal Archaic component 1 at Root-Be-Gone, the Darl component at McKinney Roughs, and Stratum 2 at Loeve-Fox.

Most assemblages are dominated by informal edge-modified flake tools, which generally do not represent one particular function or associated specific task. Edge-modified flakes are often considered multipurpose tools that were used in diverse functions such as cutting, scraping, whittling, etc. The next most common chipped stone tools are projectile points and bifaces. The latter two classes are most often associated with killing and processing game animals. Most projectile points are classified into types and then described accordingly. Actual documentation of specific tool function(s) through high-powered microscopic use-wear studies has not been employed for the most part.

Often more than one point type is represented, even where contexts and associations appear to be secure. In other sites, the Ensor point is most frequently in the same context as the Darl points, indicating a degree of overlap in the use of these types, which are generally thought to have been chronologically sequential. The Terminal Archaic component 1 at Root-Be-Gone yielded three points with somewhat different outlines that may represent a range of variation within the Darl type. This variability could also reflect stylistic linkages with point forms more reminiscence with north-central Texas types than the central Texas types. These may have stylistic similarities to Yarbrough, Elam, or even Trinity points.

Prewitt (1981) linked Hare bifaces with his Driftwood phase. Hare bifaces are long and narrow, with convex lateral edges, well-defined basal corners, and straight to gently convex bases (Turner and Hester 1999). Although bifaces are relatively frequent at many sites and components, most have been too fragmentary for classification into particular named types.

Table 7-6. Comparisons of Selected Late Archaic Sites with Tool Type Data

Site Name and Number (Analytical Zone)	Recovered Tool Types									
	Darl Points	Other Points	Bifaces	Scrapers	Drills	Edge-Modified	Ground Stone	Choppers	Hammers	Reference
Root-Be-Gone, 41YN452 (LA-I)	1 surface	3, 3 tips	21	3	0	72	1	0	0	this report
Loeve-Fox, 41WM230, (total Driftwood phase in Stratum 2)	12	2 Ensor, 9 frags	28	3	0	78	2 manos 2 slabs	9	3	Prewitt 1982a:183
McKenzie, 41HI115	0	0	0	0	0	0	0	0	0	Brown et al. 1987
McKinney Roughs, 41BP627, Darl Component	3	1	7	0	0	46	mano	0	2	Carpenter et al. 2006
Shepherd (41WM1010) AU1b	5	2 Fairland 1 Ensor	13+	13+	0	>17	0	0	0	Dixon & Rogers 2006
Smith Rockshelter, 41TV42, Layer I	16	2 Ensor, 2 Abasolo	5	3	1	16 + 3 gravers	boatstone	0	0	Suhm 1957
J. B. White, 41MM341 (AU-3, F20 & 24)	1	0	0	0	0	0	0	2	1	Gadus et al. 2006
41WM53 (Austin/Twin Sisters, L3&4)	14	1 Ensor, 2 Scallorn, 6 frags	56	3	0	~79	0	0	1	Peter et al. 1982
41WM328, (Features 15, 16, 17)	1		3	3		8				Peter et al. 1982:8-175
Britton, 41ML37 (AU-1)	3	28	49	11	0	48	3 manos	0	1	Mehalchick & Kibler 2008
McMillion, 41ML162 (AU-2)	15	50								Mehalchick & Kibler 2008
41CO141, testing (10 m2)		3	10			4	1			Prikryl & Yates 1987
41TR170, testing	0	4	1	0	0	9	2 manos	0	0	Lintz et al. 2008
41DL270	0	0	0	0	0	0	0	0	0	Anthony & Brown
41TR174, Analytical Zone II	0	0	0	0	0	0	0	0	1	Lintz et al. 2004

LA = Late Archaic, AU = Analytical Unit, L = level, F = Feature, frag = fragment

Five Hare bifaces, along with one Erath and five San Gabriel bifaces, are listed from Stratum 2 at Loeve-Fox (Prewitt 1982:266). No bifaces from the Terminal Archaic component 1 at Root-Be-Gone are classified into these shape categories, presumably because the site lies beyond the northern margins of the distributions of these types (see Turner and Hester 1999). None of the bifaces from the Darl component at McKinney Roughs are complete enough to assign to these categories. Layer I at Smith Rockshelter (41TV42) yielded at least four bifaces with oval, triangular, and lanceolate shaped pieces, and parallel blade edges are represented (Suhm 1957:39-40). Corner-tang knives, which are considered part of the Late Archaic in general (Patterson 1937; Hall 1981; Quigg et al. 2010; Quigg 2011), have not been recovered in any of the Terminal Archaic campsites.

End scrapers, a very common tool class at many hunter-gatherer sites, are very infrequent at most reviewed sites, the exception being Analytical Unit (AU) 1 at the Britton site. A possible explanation for the high frequency there may be that AU is nearly 100 cm thick and represents many individual events. Formal end and side scrapers are generally thought to reflect the scraping of hides. It may be that the low frequency of formal end scrapers can be attributed to the low frequency of hide processing, or potentially that task was performed using perishable bone or wooden tools, instead of stone scrapers. Bison bones are also very infrequent in nearly all the assemblages. It may be that the lack of end scrapers reflects the lack of processing of bison hides.

Only one drill is represented in all the selected components (see Table 7-6). The near absence of drills may support the lack of drilled artifacts that would include shell, bone and wooden objects. The latter objects are also absent from most assemblages.

Large chopping tools are nearly absent as well. Their absence cannot be attributed to the lack of cobbles as these were general available in both upland settings and in alluvial gravels in stream channels. It could be the lack of large, thick bison bones, which would have required choppers or chopper-like tools for breakage and marrow extraction, accounts for the paucity of such tools.

Formal and extensively used ground stone tools are also limited in number. These tools, in the forms of manos and metates, are most often linked to the processing of plants such as seeds and nuts, and little or no direct evidence for these plants exist at any of the components. Manos and metates/grinding slabs appear to be a consistent artifact at most components reviewed, although they are relatively scarce. Their presence indirectly supports plant processing, but it is impossible to judge plant contributions to the overall subsistence base. The general absence of manos, grinding slabs, and nutting stones has lead some researches to think that plants were not an important part of their subsistence base. It may be that the limited frequency of the stone tool assemblage reflects a greater emphasis towards gathering plants. A more thorough and accurate understanding of the importance of plant gathering and the range of plants used will probably be more evident through various microfossil analyses. The use-wear analysis on a suite of stone tools combined with the observations of the organic residues on those tools at Root-Be-Gone has documented that various classes of chipped stone tools, generally assumed to have been primarily for killing and processing game (i.e., projectile points and bifaces), were used to process plants. Therefore, tools identified as projectile points from the Terminal Archaic component 1 actually represent a more diverse range of tasks and this could, in part, account for the dearth of specialized tools used in processing plant materials.

Although four otoliths were recovered from the Terminal Archaic component 1 at Root-Be-Gone, and fish are represented in the Darl component at McKinney Roughs (Carpenter et al. 2006), no formal artifacts such as stone or shell net weights or bone or wood fish hooks, were identified at either site. So it is apparent that the lack of obvious fishing gear in this and other assemblages does not necessarily mean fishing was not conducted. Perishable artifacts (e.g., wooden weirs, baskets, or nets) may have been used in procurement of fish. Also, fish remains might be easily overlooked or missed during the recovery process, especially during the earlier decades of archeological investigations (e.g., at sites like Harrell) when recovery techniques were relatively unsophisticated. Moreover, where bone preservation is generally poor, fish bones may be absent, even though they were originally a part of the debris left at camp sites. These factors, in combination, may partly explain the absence of evidence for fishing at some investigated Terminal Archaic components.

Bone tools are not well represented at any of the excavated sites/components thus far. The Darl/Mahomet component at Loeve-Fox yielded a couple of bone items, namely, a bone awl and a bone bead (Prewitt 1982). The Terminal Archaic component 1 at Root-Be-Gone did not yield any bone tools. This absence is similar to the norm for most Terminal or Transitional Late Archaic components so far recognized. Raw bone resources were definitely available with various animals procured and used for food and other purposes. Consequently, bone technology should be expected and represented in the recovered assemblages. Poor bone preservation has likely skewed our ability to see this technology and our understanding of how prevalent it was. In other cases, it may be that artifact sample sizes are simply too small to include bone tools, which may have comprised a relatively limited part of the total Terminal Archaic assemblage.

The shell tool/ornament industry was also very limited, with few shell tools or ornaments recovered from site components of this time period. Even though plenty of raw, freshwater shell was present at many components and sites over a wide area of Texas, no recognized beads, pendants, or other ornaments of shell have been recovered from good contexts. Only the Darl component at Loeve-Fox has yielded freshwater shell artifacts (Prewitt 1982:158-161). These shells were fashioned into small square pendants or beads (less than 2 cm in length) with two holes drilled in each, allowing them to be worn as jewelry or sewn on clothing. The absence of shell tools and ornaments does not mean they may not have used shell for various purposes. As with bone artifacts, artifact samples may simply be too small to include these relatively scarce items.

The small diameter and irregularly shaped holes in 13 freshwater shells recovered from the Terminal Archaic component 1 at Root-Be-Gone are not believed to have been created by human activity. Therefore, these are not considered to be either tools or ornaments. Currently, it is not known how these holes were made. Similar holes in freshwater shells have been recognized in assemblages from numerous archeological sites such as 41DL270 in Denton County (Anthony and Brown 1994), the McKenzie site (41HL115) at Aquilla Reservoir in Hill County (Brown 1987), J. B. White site (41MM341) Features 20 and 24 in Milam County (Gardner 2006), McKinney Roughs site (41BP627) in Bastrop County (Carpenter et al. 2006), and one from the Analytic Zone II at 41TR174 (Lintz et al. 2004).

Only a single shell (#677-006-1) from the Terminal Archaic component 1 at Root-Be-Gone has what might be edge modification that may reflect use as a tool. It was not a prepared edge that was altered to a specific shape. Rather, the edge bears a slight, short concave area that is rounded smooth. If this shell was used, it reflects expedient use and subsequent discard. No other shell amongst the thousands encountered shows any evidence of utilization. The Evoe Terrace site (41BL104) in Bell County, Area C, zone 2, in level 2 yielded a multihole gorget of marine shell (Sorrow et al. 1967). This is the only instance that can be found that is comparable in age to the Terminal and Late Archaic components at Root-Be-Gone and yielded a marine shell. The near absence of shell tools or ornaments from Root-Be-Gone is similar to most components and sites of this age.

The overall low frequency of stone and bone tools at most Terminal and Late Archaic components may be more related to the length of time and the size of the groups that occupied those particular camps. Short-term camps by small foraging groups, whose occupations were too short a duration to leave behind abundant artifactual debris, appear to be the norm. Long-term sites have yet to be identified, with the possible exception of the Darl component at Loeve-Fox. The formal and informal tools recovered reflect very basic and nonspecialized artifacts needed for the procurement and/or processing of resources.

The application of high-powered use-wear analysis on a suite of chipped stone tools from the Terminal Archaic component 1 at Root-Be-Gone has not been conducted at other sites of this age in this region. Consequently, the information obtained from these studies is not comparable to other Darl phase components. Significantly, the perceived belief that projectile points and bifaces reflect only animal killing and processing tasks is not entirely supported by the use-wear analysis. As already noted, the projectile points and other tool classes analyzed revealed a very high frequency of plant fibers adhering to the tools, strongly implying their use in processing tasks, in addition to their function as projectile points.

7.5.6 Lithic Technology

Very limited research has been directed towards understanding the lithic tool technology of the Terminal or Late Archaic period. The analysis of the lithic assemblages from the San Gabriel Reservoir District sites (i.e., 41WM53, 41WM230) in Williamson County provides some information on the ratios of tools-to-debitage, densities, and classification of the debitage into general flake types (Hays 1982; Peter 1982; Prewitt 1982a). Most reports do not discuss the types of bifacial reduction, although bifaces have been recovered. Lack of detailed analyses of the lithic debitage, and reporting of the broader process of crafting stone tools, typifies the extant archeological literature.

For the Darl component at McKinney Roughs, Carpenter et al. (2006) provide basic classification of complete flakes into primary, secondary, and tertiary types, with fragments classified into proximal and shatter. These are presented by unit and level. They do not provide a reduction sequence or strategy, although they do discuss discarded and produced items, and the use of local raw materials. They interpret the overall strategy as one of expedient behavior at this residential camp. This same pattern of local material use was detected at AU 1b at the Shepherd site (41WM1010) where the occupants used a high quality local black Edwards chert found along Brushy Creek for the manufacture of their chipped stone tools (Dixon and Rogers 2006). The site occupants also used local sandstone clasts for cooking and heating tasks.

Interestingly, comparisons of the Terminal Archaic component 1 at 41YN452 to the Darl component of the McKinney Roughs site were quite similar (see Section 7.2). Both assemblages exhibit small debitage-to-tool ratios and represent short-term occupations where largely expedient tools were produced. Other comparable components such as the Terminal Archaic assemblage from the Shepherd site, and the Late Archaic component of 41HY209-T exhibit slightly higher debitage-to-tool ratios but still relatively low when compared to components such as Loeve-Fox (41WM230) (Dixon and Rogers 2006; Collins 1994; Prewitt 1982a).

The Terminal Archaic component 1 at Root-Be-Gone yielded a local, high-quality Edwards chert, both in the debitage sample and among the chipped-stone tools. Also, local sandstone was selected and employed for cooking, as well as for the production of ground stone tools. In contrast to the use of cherts from the Brazos River southwards, site 41CO14, located to the east in Cooke County, yielded mostly local quartzite debitage and artifacts (Prikryl and Yates 1987). The selection of the raw material, either quartzites or cherts by various hunter-gatherer groups, is undoubtedly due to the local availability of those resources. A significant difference exists in the regional availability of cherts. High quality cherts dominate central Texas, whereas the outwash gravels that contain quantities of quartzites are more common across north-central Texas. The Terminal Archaic component 1 at Root-Be-Gone is similar insofar as it conforms to this pattern of using locally available lithic resources, with

Table 7-7. Comparisons of Selected Late Archaic Sites with Feature Types

	Feature Types									
Site/Component	Feature Count	Basin Hearth	Surface Hearth	Burned Rock Dump	Mussel Shell and Burned Rock Dump	Earth Oven	Organic Stain Griddle	Mussel Shell	Other	Reference
Root-Be-Gone (41YN452), TA 1	14	1		6	7					this report
41CO141, testing 10 m2	5	1	2						2	Prikryl and Yates 1987
41TR170, testing	19	5			8	1	1	1	3	Lintz et al. 2008
41DL270, testing, Cultural Zone II	3			1	2					Anthony and Brown 1994
41TR174,testing, AZ II	6	1	1	1				3		Lintz et al. 2004
41CV1329, AU2	1	1								Mehalchick et al. 2000
41CV1049, AU1	2	2								Kleinbach et al. 1999
41CV988, AU1, Features 2A & 4	2	2								Kleinbach et al. 1999
41MM340	12	3	1	2	1		1		4	Mahoney et al. 2003
J. B. White (41MM341), AU3	2								2	Gadus et al. 2006
41WM328, Area B, Stratum 5	3		1	1			1			Peter et al. 1982
Hoxie Bridge (41WM130),	1	1								Bond 1978
41WM53, Areas A & B level 4	6	2	4							Peter et al. 1982:8-13
Loeve-Fox (41WM230) Stratum 2, Darl	15	6	1	2					6	Prewitt 1974, 1982
Shepherd (41WM1010) AU1b	24	1	11	9		1	2			Dixon and Rogers 2006
McKinney Roughs (41BP627) Darl	4	4								Carpenter et al. 2006
Millican Bench (41TV163), zone III-B	3	1				?	?			Mauldin et al. 2004
Mustang Branch (41HY209-M), midden	1								1	Collins 1994
LA = Late Archaic, AU = Analytical Unit, AZ = Analytical Zone,										

minimal if any use of imported lithic materials.

7.5.7 Cultural Features

Features identified in Transitional or Terminal Archaic components and sites reveal a variety of hearth types that included shallow basins, deep basins, surface stains with charcoal, mussel shell dumps and scatters, burned rock discard or dumps, a few rock ovens, and at least one rock griddle (Table 7-7).

The diversity of features represents a diversity of tasks, potentially variable approaches to cooking different foods, and no apparent dominance of one specific hearth type. Currently, too few sites with good context are known to provide a clear and meaningful understanding of this diversity. No doubt, as more excavations are conducted, the types of features will increase and an increased sample may allow for identification of one or more kinds of features as predominant. The lack of detailed studies into features in general and the near absence of technical studies directed towards microfossils from features currently limits interpretation of the range of use for various feature types.

Only two rock ovens have been identified so far (Table 7-7). Often lacking direct evidence of what was cooked in ovens, a number of authors have suggested that ovens or basin hearths were used for cooking geophytes in central Texas (e.g., Black et al. 1997; Mehalchick 2004; Mehalchick and Kibler 2008). The direct association of bulb fragments in Feature D56, considered an oven in AU 1b at the Shepherd site (Dixon and Rogers 2006), definitely links this food with this specific feature type. However, animal bones were also present in Feature D56. Because many geophytes are most abundant during a specific season, the presence of ovens that contain bulbs may be a proxy seasonal indicator for those specific occupations. If true ovens were used to cook geophytes, then it would seem that this kind of plant was not commonly processed. Alternatively, the limited excavations at Terminal Archaic sites may simply not have yet included components that represent the season in which geophytes were collected.

Carbonized macrobotanical remains are often recovered and identified from features. The identifications of the carbonized fuel resources provide indications of human behaviors in the selection of the fuels. The fuel types represented also contribute to our understanding of past local environments around camp sites. A few investigations have provided identifications of the fuels used in features (Table 7-8).

Not surprisingly, oak species are the most common woods identified in most features. Oak is certainly one of the most common species in central and north-central Texas and would be readily available in most locations across this region. This hardwood species is considered one of the best fuels for long-lasting high heat. In contrast, juniper, a soft wood, is poorly represented and may not have been preferred as a fuel wood because it burned too quickly and at a relatively low heat. However, the representation of this soft wood may be limited because of complete combustion and due to subsequent deterioration of charcoal in unfavorable settings. As an example, in the Terminal and Late Archaic components at Root-Be-Gone, the lipid residue analyses directed towards burned rocks were able to identify diterpenoid dehydroabietic acid that is diagnostic of conifer products, most likely represent juniper in this particular setting. The fact that juniper wood was not one of the wood types identified in the macrobotanical analyses implies that this soft wood did not yield charcoal available for archeological recovery that could survive.

Therefore, preservational factors have significantly reduced the number of features that yield carbonized plant remains and this has undoubtedly skewed the overall picture of which wood species were selected for use as fuel. The second-most-frequent wood identified is the *Carya* family with a potential variety of species (e.g., pecan, hickory) represented.

Feature 1 in the Terminal Archaic component 1 at Root-Be-Gone yielded at least three types of wood indicating no obvious selection pattern. Presently, too few features from across the region have yielded identifiable carbonized wood or have been consistently subjected to wood identification analyses to provide clear patterns of wood selection and use. Also, local environmental conditions are reflected in the species available in the immediate vicinity of sites. The presence of mesquite from the Terminal Archaic component 1 at Root-Be-Gone is unusual, not only for this north Texas region, but for the time period as well.

7.5.8 Trade and Exchange Networks

So far, evidence of the Eastern religious cults or ideas that Johnson and Good (1994:37) discuss as influencing the Late Archaic period is extremely limited to nonexistent in the components/sites investigated north of Austin. Very few Terminal or Late Archaic assemblages have yielded any artifactual evidence to allow one to address this subject, which was true back in 1982 (Prewitt 1982). The evidence to support trading or other interactions across regions would be in the movement of raw materials such as nonlocal resources (e.g., raw tool stone or marine shells) from outside the region of the excavated component. In fact, the recovered assemblages reveal almost no evidence of trading networks or exchange relations with nonlocal groups, as the artifacts recovered from components appear to be made of local materials.

The Shepherd site (41WM1010) in Williamson County is a good example, where the Transitional Late Archaic component (AU 1b) is dominated by local black Edwards chert found nearby along Brushy Creek (Dixon and Rogers 2006). The chert recovered from the Terminal Archaic component 1 at Root-Be-Gone also appears to be from local gravels containing Edwards chert that had worked its way eastward from the Callahan Divide. Material goods such as foreign copper, elaborate bone ornaments, Gulf whelk shells, and boatstones (possible atlatl weights) are not present or are extremely rare, in components north of Austin, and are in any case, exceedingly scarce in site components pertaining to the Terminal Archaic. Limited evidence for possible eastern influence is in the form of a single, rather plain and unspectacular boatstone manufactured from local limestone.

Table 7-8. Comparisons of Selected Late Archaic Sites with Fuel Woods Identifications

Site Name and Number (Zone)	Wood Types											
	Oak (*Quercus*)	Mesquite (*Prosopis*)	Juniper (*Junipers*)	Hickory (*Carya*)	Pecan (*Carya*)	Hackberry (*Celtis*)	Elm (*Ulmus*)	Ash (*Fraxinus*)	Willow (*Salix*)	Unknown	Other	Reference
Root-Be-Gone, 41YN452 (LA-I)	X	X	-	-	-	X	-	X	-	X	-	this report
41TR170, testing	X	-	-	-	X	X	-	-	-	-	-	Lintz et al. 2008; Dering 2008
41DL270, Feature 1	X	-	-	-	-	-	-	-	-	-	-	Anthony & Brown 1994, Dering 1994
41TR174, testing, Analytical Zone II		-	-	-	-	-	-	-	-	-	-	Lintz et al. 2004
41MM340, AU2	X	-	-	X	-	-	-	-	X	X	X	Mahoney et al. 2003; Dering 2003c
J. B. White, 41MM341 (AU-3, F20 & 24)		-	-	X	-	-	-	-	-	X	-	Gadus et al. 2006; Bush 2006a
41WM53 (Austin/Twin Sisters, L3&4)	X	-	-	-	-	-	-	-	-	-	-	Peter et al. 1982
Britton, 41ML37 (AU-1)		-	-	-	-	-	-	-	-	-	-	Mehalchick & Kibler 2008
McKinney Roughs, 41BP627, Darl Component	X	-	-	X	-	-	X	-	-	X	X	Carpenter et al. 2006; Bush 2006b
Shepherd (41WM1010), AU1b	X	-	X	X	X	-	-	-	X	X	X	Dixon & Rogers 2006

LA = Late Archaic, AU = Analytical Unit, L = level, F = Feature

This specimen comes from the Terminal Archaic component, Layer I, at the Smith Rockshelter in Travis County. This boatstone may indicate contact or trade, but one unspectacular piece is not strong evidence. The boatstone was burned, but it is not clear if this was intentional. Boatstones are uncommon in central and northern Texas (Patterson 1937b). These objects are more common to the east and northeast, and may reflect contact with more eastern populations. If boatstones functioned as atlatl weights, then it seems likely that more should be present in the region within the numerous Archaic components. A second piece of evidence for exchange evidence is the gorget fragment from Area C, Zone 2 and level 2 at the Evoe Terrace (41BL104, Sorrow et al. 1967). That gorget was not directly dated and therefore its precise age can be debated, although it was associated with Late Archaic materials.

Grant Hall (1981:291-309) has discussed an import-and-export sphere during the Late Archaic period in Texas that involved relationships with groups to the east. Artifactual evidence includes boatstones manufactured from lithic sources in the

Ouachita Mountains in eastern Oklahoma and western Arkansas in conjunction with marine shells from coastal regions. He suggests that the presence of these artifacts indicates that Late Archaic populations participated in an Eastern Import-Export trading sphere. This sphere reached into at least the eastern half of Texas, particularly on the coastal plain in the area of the lower Brazos and Colorado Rivers, but a lack of data from excavated components and sites in central and northern Texas leaves considerable doubt as to its extension into those regions. Generally, prestigious items of high importance and/or high value such as boatstones, marine-shell ornaments, and corner-tang knives, are most often recovered from burial contexts rather than open camps. Consequently, their absence from this and other Terminal Archaic components is not unexpected. Even if this group was participating in an extensive trading sphere, those high-value objects would be curated and carefully cared for. A few scattered boatstones and marine shell artifacts dating to the Late Archaic period have been recovered from burials further west (see Boyd 1997).

Hall (1981) also suggests that the development of the Caddoan cultural pattern in northeastern Texas after the time of Christ virtually halted most import export transactions with central and southern populations in Texas by ca. 1450 B.P. Consequently, if he is correct in that statement, then one should not expect these Terminal Archaic sites/components at 400 to 1300 B.P. in the northern part of Texas to yield eastern derived artifacts in these late contexts.

Johnston and Goode (1994:37-39) also address the spreading from eastern North America of religious ideas into eastern Texas, the Gulf Coastal Plains, and the eastern edge of the Edwards Plateau. They see major goods such as exotic native copper implements, elaborately decorated bone ornaments, Gulf whelk-shells pendants, and atlatl weights (i.e., boatstones) as typical of exotic materials. Similarly recognized items have come, albeit very rarely, from primarily surface contexts and lack tight time controls. However, they do not see these goods at this late time of ca. 1300 B.P. Therefore, the Terminal Archaic component 1 at Root-Be-Gone site is similar to other components in respect to the absence of exotic goods and imported lithic materials.

Relevant in this regard is the suggestion by Ricklis (in press), to the effect that the hunter-gatherer Archaic peoples of the Texas coastal plain were sharing in fundamental belief systems held by peoples in the Eastern U.S., beginning by at least 7,000 B.P. and continuing intermittently over the next several thousand years. Based on findings at the Early Archaic cemetery at the Buckeye Knoll site (41VT98) on the lower Guadalupe River, AMS dated to ca. 7500 and 6200 cal B.P., Ricklis points to a distinct period of early interrelationship, based on the occurrence of Eastern artifact forms (e.g., bannerstones, ground stone perforated plummets, and a large over-sized biface) in burials at Buckeye Knoll. He further notes that the available evidence suggests a waning of Eastern influences during the subsequent Middle Archaic on the Texas coastal plain, and then a rather robust reemergence of a similar interconnection after 3000 B.P. (ca. 1000 B.C.), when certain Late Archaic cemeteries in Texas once again contain mortuary goods of a distinctively Eastern cast, though of forms/styles quite different from those of the earlier period of interconnection (e.g., boatstones, two-hole stone gorgets, large marine shell pendants, and rare implements of native copper). After about 1550 B.P. (ca. A.D. 400), these traits disappear from Texas coastal plain cemeteries (Hall 1981:299-302; see also, Ricklis in press, Figure 36). A dramatic decline in the quantities and kinds of grave goods at this time indicate, according to Ricklis, a waning of concern with mortuary ritual that parallels the decline of contemporaneous eastern Middle Woodland mortuary traditions, as are most markedly manifested in Hopewell and related contemporaneous cultural patterns of the eastern U.S. Judging from the fact that the overwhelming bulk of the evidence for these linkages is found only in mortuary contexts and is not apparent in archeological data from domestic camp sites, Ricklis concurs with Johnson's suggestion, mentioned above, that the appearance of the "eastern" traits reflects a broad dissemination of influences at the level of cultural-ideological patterns, or belief systems and attendant ritual behavior. From this perspective, the overall provincial isolation expressed at Root-Be-Gone and contemporaneous Terminal Archaic sites in central and north-central Texas may reflect fundamental cultural developments that were taking place on a very broad, interregional scale.

7.5.9 Season of Occupation

The season of use at most occupations or sites dating to the Terminal Archaic is not known. The combination of lack of specific animal bone elements (e.g., fetal bison or deer bones, shed antlers, bison mandibles with intact tooth rows, and/or fish otoliths), lack of plant remains (e.g., seeds, nuts, tubers), either through poor preservation or lack of flotation of feature sediments, and repeated palimpsest occupations that could not be stratigraphically separated, has negatively impacted the ability of researchers to document the seasonality of site use.

The Terminal Archaic component 1 at Root-Be-Gone indicates a fall (August through October) event through multiple lines of evidence, including the presence of wildrye grass starch grains, the growth rings identified on four fish otoliths, and the presence of burned mesquite seeds and pods in Feature 1, all of which imply fall, or perhaps late summer-fall, occupation. Fetal or new born deer elements associated with Feature 29 at the 41DL270 in Denton County indicate a spring (May/June) event (Anthony and Brown 1994). Based on the presence of mussel shells at both 41DL270 and Root-Be-Gone components, it is apparent that mussel procurement was not restricted to one particular season.

If direct evidence of bulbs and/or tubers can be proxy evidence as indicators of spring occupations, then Zone III-B at the Millican Bench (41TV163) in Travis County (Mauldin et al. 2004) can be assigned to at least a spring season of use. A spring occupation is also indicated by the presence of a bulb from a rock oven (D56) in AU 1b at the Shepherd site in Travis County (Dixon and Rogers 2006). If the presence of carbonized nut shells are used as proxy evidence for fall (August through October) events when most nut crops are available, then at least six other components can be assigned to fall occupations (Table 7-5). Most components that yielded nuts are further south than Root-Be-Gone, and if all those represent fall occupations, then central Texas may have been a preferred area for fall occupations.

So far, seasonality evidence at individual occupations is too sparse to speculate on seasonal rounds or movements by Late/Terminal Archaic populations. Continually striving to identify plant and animal resources from individual isolated components will undoubtedly provide further evidence for specific seasonal use of sites. With poor preservation at many components across Texas, the use of technical analyses directed towards microfossils may prove the most advantageous means of identifying the presence of seasonally sensitive plants from which to identify seasonality patterns. A few resource availability studies in northern Texas have been presented to help identify when in the annual cycle specific food resources were available (Martin et al. 1988; Brown 1989; Martin 1995; Kibler and Mehalchick 2010). However, in Texas, moisture in the form of rain can significantly influence when certain plant resources (e.g., mesquite beans) become available. Consequently, some plants may not be as seasonally sensitive as many researchers might tend to assume.

7.5.10 Treatment of the Dead

As with nearly all Terminal or Transitional Late Archaic sites in central Texas, the information concerning the burial practices is nearly nonexistent. A review of the literature reveals a few instances where human bodies were associated with Darl points. Prewitt (1982:47) references the Mather Farm (41WM7) in Williamson County that contained a single tightly flexed burial with a metate inverted over the skull. A Darl point was imbedded in the skull, and an Ensor point was between the 2nd and 3rd ribs. In addition to this one reference, few other burials have been recovered that were directly associated with Darl points in the central Texas region. It is significant that two different Late Archaic point types, Darl and Ensor, were found in the same body at Mather Farm. The context of the unquestionable association between these two point types could not be better and reflects that these two point types were in use at the same time and that the their temporal ranges overlapped. Prewitt (1982b:49) also mentions Aycock Shelter (Watt 1936), which contained human burials associated with both Darl and Ensor points. These few examples with Darl points as killing instruments indicate violent interactions with others.

At 41CO141 in Cooke County to the east, a nearly complete, but poorly preserved female was buried in a shallow pit. She was in a tight, knee to chest flexed position with arms bent, the left hand in front of the face, and right hand under her head (Gill-King 1987). She was 40+ years old with a calculated height of ca. 160.1 cm. She had normal perinatal nutrition with a possible metabolic stress between 8 and 10 years old. It was determined she had an omnivorous diet that emphasized plant over animal foods (Gill-King 1987). Although not directly radiocarbon dated, this female had a very similar diet to that suggested by subsistence remains obtained from numerous Late Archaic components and sites to the south.

Given the overlapping dates for the Terminal Archaic dart points and Austin phase Scallorn arrow points, combined with the postulated increase in populations throughout this period, it seems probable that various groups were in contact with each other, at least locally or intra-regionally, and some degree of intergroup conflict was likely. The apparent absence of trading with adjacent groups for raw materials (e.g., cherts for stone tool manufacturing or exotic goods) indicates that these small foraging groups were largely self-sufficient and did not always interact peacefully with their neighbors. At the nearby Harrell site (41YN1) cemetery, at least one multiple burial with three adults contained four arrow points in positions that indicate possible cause of death (Hughes 1942:42; Owsley 1989:128). Also at the Loeve-Fox cemetery, seven individual human burials exhibited Scallorn points in such as a manner as to indicate the penetration of points caused their death (Prewitt 1982a; 1982b). Therefore, it is possible that those burials with Scallorn points in them may represent different groups, possibly Terminal Archaic (i.e., dart-using) groups who had conflict with people using bows and arrows.

The Terminal Archaic component 1 at Root-Be-Gone is similar to most excavated open camps of this period in central and north-central Texas in that it lacks any sign of human burials or a cemetery. Given that most individual sites lack human interments, it is likely the dead were interred in discrete cemeteries during this period. This is certainly the case for sites south of Waco (see Prewitt 1974, 1982b; Huebner and Comuzzie 1992; Taylor and Highley 1995; Broehm and Lovata 2004) and the multiple bodies in adjacent Shackelford County, a probable cemetery for this region (Forrester 1951).

7.5.11 Intrasite Horizontal Patterning

Only three component/site excavations have been of sufficient horizontal extent, and had a stratigraphically isolable component for obtaining spatial data for useful comparisons with Root-Be-Gone. These three sites are briefly discussed to provide a glimpse of possible human behavioral patterns within campsites of the Terminal Archaic period. The 115 m^2 Darl component at the McKinney Roughs site revealed primary and secondary discard patterns, *in situ* hearth features, and lithic-core reduction areas (Carpenter et al. 2006). The findings were interpreted to represent the remains of a small foraging camp. The authors employed Binford's (1978, 1983) drop-zone model, developed using ethnographic data, to conduct their analyses of the horizontal patterning of the cultural debris. They observed five foci of organized activity within the Darl occupation, providing centroids for drop zones that were roughly 1 m in diameter. Four were centered on hearths and one was around a mano and metate, which were inferred to be associated and *in situ* (Carpenter et al. 2006:167-181). These five areas were depicted on distribution maps with mostly piece plotted artifacts shown. These authors interpreted their spatial data to demarcate spatially segregated activities primarily centered on hearths by contemporaneous and probably interrelated individuals within a group, during a discrete, short-term occupational episode. They did not identify areas of potential huts or structures. Examination of the published maps by this author did not reveal clear or obvious evidence for the discussed drop zones or patterns to the plotted materials.

Part of the Darl component at Loeve-Fox was depicted in a single figure that shows the horizontal distribution of features and specific artifact types across the XU3 S2 floor plan (Prewitt 1982:186, Figure 50). Prewitt discusses this distribution map as depicting the "bare inklings of patterning to the distribution (Prewitt 1982:181)." He saw a general tendency towards knapping areas around *in situ* hearths with low density areas combined with burned mud dauber nests to potentially indicate the locations of structures. More detailed analyses of the artifact patterning may bring more to light. He interpreted the data to represent groups that focused on hunting and gathering, with an emphasis on gathering.

The Terminal Archaic component 1 at Root-Be-Gone was revealed across 78.5 m^2 of the North Block. A relatively low density of cultural materials and 14 identified cultural features were from this block. The only *in situ* heating element, Feature 1, was in the southeastern corner with a relatively thin scatter of small clusters of discarded burned rocks (Features 1a, 1b, and 14) within 2 to 3 m immediately east. Roughly 3 m to the west of that heating element, and extending at least 10 m to the north and slightly northeast, were 10 discard features. The discard features were dominated by mussel shells and small burned rock pieces and were often side-by-side or within 1 to 2 m of each other. Features 5 and 10 each covered nearly 4 m^2 in area and Features 6, 9, and 17 were in smaller, tight concentrations. These 10 discard features formed an irregular line or partial arc that extended from the southwestern corner to the northeastern corner of the excavation block. East of that line of discard features was an area of low burned-rock and shell density, which also lacked features. The relatively low counts of burned rocks and mussel shell in that area were countered with relatively high frequencies of lithic debitage, a few broken formal tools, and most of the informal tools. That area apparently was the focus of *in situ* knapping activities directed primarily towards cobble reduction, early stage biface production, and informal tools. This horizontal pattern of distribution definitely reveals specific human behaviors across this block. These three specific examples provide a restricted view of the possible intracamp patterns that may exist in single isolatable occupations, but the limited size of the excavation block has prevented a more complete and thorough understanding of overall spatial patterning within the camp.

7.5.12 Comparative Ages and Assemblages

The Darl component at McKinney Roughs site and AU 1b at the Shepherd site are similar in most respects to the Terminal Archaic component 1 at Root-Be-Gone. First and foremost, the absolute radiocarbon dates determined for each of these isolated components are similar, and younger than some researchers perhaps would believe. The absolute dates from McKinney Roughs are the youngest thus far for the use of dart points. For the Darl component at McKinney Roughs, two wood charcoal dates were derived from excellent contexts in two separate rock basin hearth features definitely within the component. One wood charcoal sample from 50 to 60 cmbs in a small basin-shaped hearth/oven (Feature 3) yielded a $\delta^{13}C$ corrected and conventional date of 850 ± 110 B.P. (Beta-169225). A second wood charcoal sample also from 50 to 60 cmbs from a similar small basin-shaped hearth/oven (Feature 7) yielded a $\delta^{13}C$ corrected and conventional date of 940 ± 70 B.P. (Beta-195847). These are two of the latest wood charcoal dates that can be directly associated with Darl dart points. Although not as recent as those two dates, are the nine accepted wood charcoal dates from the Terminal Archaic component 1 at Root-Be-Gone. The nine absolute dates provide a range of 230 years from 1100 to 1330 B.P. for an average age of 1207 B.P. Although older by at least 370 years than the two Darl dates from McKinney Roughs, these nine dates contribute to refining the age range for use Terminal Archaic dart points across the region.

The age ranges documented at these two components provide an opportunity to directly compare the two cultural assemblages associated with Terminal Archaic populations. Table 7-9 provides direct comparisons of the frequencies and types of material remains from these two well-defined and isolable Terminal Archaic components. The different classes of materials are nearly identical. The frequencies of items in those classes are similar as well.

From the perspective subsistence economy, processing mussel meat was one of the primary activities at both sites. This was evident by the high frequency of discarded mussel shells that dominated the encountered assemblages. The shells were likely heated or cooked with the use of hot rocks as both components yielded quantities of heated rocks. However, the burned rocks from the Darl component at McKinney Roughs were not analyzed. The discard of the shells was different; those at the later Darl component were generally scattered about the occupation surface, whereas those at the Terminal Archaic component 1 at Root-Be-Gone were primarily distinguishable as discard piles in designated areas. This difference in the discard pattern may be linked to differences in individual human behavior, the differences in the length of the occupations, the seasonality of the two components, the specific location of the excavation area within the broader component, or some other unidentified factor. The cleaning of work space and dumping of unwanted shell debris indicate that the Terminal Archaic component 1 at Root-Be-Gone indicate that this component may have been occupied for a longer time than the Darl component at McKinney Roughs, thus necessitating a better-controlled pattern of debris discard.

The seasonality of the latter site was not identified, so any effect of seasonality on discard patterns cannot be assessed.

Aside from the meat of mussels, deer and fish meat were also part of the subsistence base at both components. The presence of multiple types of meat resources from at least two distinct habitats (water and land) indicates broad exploitation of environments and diversity in resources that were acquired for foods.

The macrobotanical remains at both components are limited (4.7 g and 6.5 g) with most remains attributed to various fuel-wood species. Two types of nut shells and grass seeds were identified at the Darl component at McKinney Roughs, whereas the Terminal Archaic component 1 at Root-Be-Gone yielded mesquite seeds and pods, grass starch grains from at least two types of grasses. The limited macrobotanical remains are attributed to poor preservation more than cultural food preferences. If preservation is the key factor, then discussions concerning what plant resources might have been used at these two components in not appropriate.

Table 7-9. Direct Comparisons of Data from Darl Component at McKinney Roughs and Terminal Archaic Component 1 at Root-Be-Gone Sites

Artifact Class	McKinney Roughs (41BP627), Darl Component	Root-Be-Gone (41YN452), Terminal Archaic Component 1
	Counts/Weights	Counts/Weights
Darl Dart Points	3	1 from surface
Other Dart Points and Fragments	1	3 points, 2 distal tips
Wood Charcoal Dates (B.P.) from features	940, 840	1100, 1110, 1120, 1160, 1200, 1270, 1280, 1300, 1330
Bifaces	7	19
Scrapers	0	3
Drills	0	0
Edge-Modified Flakes	46	72
Lithic Debitage	962	1017
Cores	21	0
Hammerstones	2	0
Choppers	0	0
Bone and Shell Tools	0	0
Uniface	0	1
Metates	1	0
Manos	1	1 fragment
Exotic Lithics	0	0
Bone Fragments*	106 (deer, fish, turtle)	147/60 g (deer, fish, turtle)
Mussel Shell*	1,473 (11 species)	4,838/14,198 g (7 species)
Burned Rock	scattered & in features	4,974/180,127 g, scattered, in features
Features	5	14
Basin Hearths	4 (F1, 3, 7, 11)	1 (F1)
Surface Hearths	0	0
Ovens	1 (F5)	0
Burned Rock Dumps	0	0
Mussel Shell Dumps	0	0
Mussel Shell & Burned Rock Dumps	0	13
Activity Areas	present, *in situ* & discard	present, *in situ* & discard
Activities present	cooking mussels, biface reduction,	cooking mussels, core reduction, camp maintenance
Carbonized Plant Remains	4.7 g (wood, grass seeds, nutshells)	6.5 g (woods)
Starch Grain Analysis and Results	None	yes, positive, 29 grains
Diatom Analysis and Results	None	yes, positive
Use-Wear Analysis and Results	None	yes, positive
Phytolith Analysis and Results	None	yes, positive
Total Materials	-	-
Average Thickness (cm)	10 cm	30 to 40 cm
Spatial Extent Excavated	115 m^2	78.5 m^2
Volume Excavated (m^3)	11.5 m^3	314.0 m^3

* Bone, mussel shell, and carbonized remain totals are weights in grams;
** Mussel shell from testing not weighed, F = feature. This table does not include materials from float samples

At the Terminal Archaic component 1 at Root-Be-Gone, the plant utilization was more apparent, as diverse microfossils from various classes of artifacts were identified (see previous discussion, above). Targeting microfossil remains during analyses has revealed plant gathering was definitely a major part of the subsistence activity of this group.

Although limited in numbers, manos at the Terminal Archaic component 1 at Root-Be-Gone may have been used for plant processing, and manos were recovered from both components. This artifact class may fit with the presence of macrobotanical and microfossil remains at both sites. Given the overall limited numbers of plant processing artifacts in most component/sites of this age, it may be that perishable artifacts (i.e., baskets, wood, and bone) were primarily used for plant collecting and processing activities.

The occupants focused primarily on food procurement and processing, as is evident from the cooking features and burned rocks, during a short-term encampment by a relatively small group. Consequently, the types of features, burned rock hearths (heating elements) and discard features, both mussel shells and burned rocks, dominate both assemblages. The raw materials, chert for tool production and sandstone for transferring heat, were procured from local sources. Neither group appears to have participated in trade or exchange networks with neighboring groups (e.g., no nonlocal goods were recovered).

The overall settlement conditions at both sites were very similar. Both sites were in stream-side settings along or near major water ways. Both were in alluvial settings with accumulating deposits. In general, the populations that camped at those two localities appear to belong to hunter-gatherer groups that operated as foragers (Binford 1980) for much of the year. Both components appear to represent short-term camps of highly mobile groups. Both populations successfully operated across the landscape, exploiting various and diverse resource patches, likely on a seasonal basis. Group size is not clear from these relative small excavated areas and understanding is poor of how far each component extended horizontally. Apparently, similar types of human behaviors occurred at each component as the preserved material remains are similar. Therefore, although some 150 to 350 years and roughly 360 km separate these two well-defined and isolatable cultural components, commonalities existed over space and through the represented centuries, despite the likelihood that changes in both climate and hunting technologies were taking place.

7.6 Question 5. Was the Bow and Arrow Adopted Simultaneously by All Groups in the General North-Central Texas Region?

7.6.1 Introduction

To address this question, we have gathered together two groups of selected radiocarbon dates from previously dated components and sites, ranging geographically from Austin northward, through the north-central part of Texas. These dates encompass the Terminal or Transitional Archaic, and the subsequent Austin phase of the Late Prehistoric period. Dates are ascribed to the Terminal Archaic on the basis of their associations with Darl dart points or other diagnostic dart points linked to the period such as Elam, Godley, and Dallas or to the Austin phase based on associated Scallorn arrow points. The working assumption in this is the notion, entrenched as tradition in Texas archeology, that Archaic populations employed atlatl dart weapon technology, that that Late Prehistoric peoples used the bow and arrow. As noted earlier, the replacement of dart points by arrow points is, in fact, the defining criterion for the shift from the Archaic to the Late Prehistoric in much of Texas, where other post Archaic traits such as ceramics or horticultural subsistence appeared later, or did not appear at all.

Thus, in much of Texas, the shift from the Archaic to the subsequent Late Prehistoric cultural pattern hinges on the sole factor of the replacement of one technology (atlatl dart weaponry) by another technology (the bow and arrow). The myriad other changes that are often understood to accompany the transition between Archaic cultures and postArchaic cultures (however they are defined in a given region), such as the introduction of pottery, agriculture, and/or sedentary settlement patterns, become irrelevant in our present area of interest. As we note elsewhere, there are little data to indicate any major shifts in lifeways at the end of the Archaic in north-central Texas (and southward through central Texas and beyond). The end of the "Archaic" and the beginning of the "Late Prehistoric" are marked only by this single technological change (e.g., see Hester 1980; Prewitt 1981, 1985; Collins 1995, 2004) which, while readily recognizable in the archeological record, appears, on the basis of presently available information, to have had little effect on fundamental patterns of economic subsistence or settlement patterns.

Lists of sites with radiocarbon dates, pertinent to the relevant time interval, are provided in Tables 7-10 and 7-11, and a graphic plotting of those dates is depicted in Figure 7-5.

As reflected in the table and the figure, the two sets of radiocarbon dates associated with the two different weaponry systems clearly overlap in time. When presented with this evidence, one of the first questions one might ask is: Is there a direct association between the absolute dates and the diagnostic projectile points? The answer is "yes", as we include only what appear to be direct associations between the radiocarbon dates and the diagnostic points, meaning dates from features or components with demonstrably intact contexts and associations.

Another question may be, are the projectile point identifications correct? While the assignment of a projectile point to one or another type may be questioned in any given case, in nearly every instance there was not a problem between identifying arrow points designated Scallorn and specimens classified as dart points; none of the dart points could be mistaken for Scallorn arrow points. Moreover, the dart points generally belong to a generic category of narrow-bladed, stemmed forms that can reasonably be assigned to the Darl type, or at least to morphological variability within or related to that type (as is, in fact, the case with the five dart points from the Root-Be-Gone site).

Various mathematical means of determining the difference between dart and arrow points have been presented in the literature (e.g., Finnegan 1953; Corliss 1972; Thomas 1978, 1981; Knight and Keyser 1983; Shot 1997; Massine and Pyle 1999; Hettinger and Hearkens 1999). Corliss (1972) employed metric measures and determined that neck widths were useful as an index of continuity and change. Later, Thomas (1978, 1981) examined differences and concluded that points can be correctly identified at least 86 percent of the time into arrow and dart points on the basis of combination of length, width, thickness, and neck widths. Knight and Keyser (1983) also developed a mathematical technique for determining the difference of projectile points from the Northwestern Plains. A broad generalization can be made in that projectile points with neck widths greater than 11.0 mm can be classified as dart points and those under 11.0 mm are most often classified as arrow points, with a few exceptions. As Bettinger and Eerkens (1999) clearly state, arrow points are metrically distinct entities.

The neck widths of the projectile points recovered from the Terminal Archaic component at Root-Be-Gone are 10.8, 21.8, 13.7, 15.4, and 17.1 mm. These measurements generally fit within the range of measurement from suites of other Darl point measurements (see Appendix D in Trierweiler 1996; Appendix G in Kleinbach et al. 1999).

Table 7-10. Late Archaic Sites and Components with Solid Radiocarbon Dates Associated with Diagnostic Dart Points in Good Context

Site Name/No.	Uncorrected Radiocarbon Date (B.P.)	Radiocarbon Laboratory Number	A.D. Date	Associated Point Types	Feature	Provenience	Reference
McKinney Roughs 41BP627	850 ± 110	Beta-169225	-	1 Darl, 1 Darl-like, 1 untyped	F3, small basin hearth/oven	TU 3A, 3B, 50-60 cmbs	Carpenter et al. 2006
McKinney Roughs 41BP627	940 ± 70	Beta-195847	-	1 Darl, 1 Darl-like, 1 untyped	F7, small basin hearth/oven	N112 E116, 50-60 cmbs	Carpenter et al. 2006
41CV1482	1060 ± 60	Beta-87649	-	1 Zephyr	F1-BR hearth	AU 2, 102 cmbs	Mehalchick et al. 1999
Root-Be-Gone 41YN452	1100 ± 40	Beta-214363	-	3 Darl-like	F1, large basin rock filled hearth	85-95 cmbs units 5 & 6	Matchen et al. 2006
Smith Shelter 41TV42	1100 ± 95	Tx-515	-	16 Darl, 1 Scallorn, 2 Young, 2 Ensor, 2 Abasolo,	none	Stratum 1	Tamers et al. 1964:138-159
41WM53	1136 ± 108 or 1155 ± 95	UGa-2471	-	6 Darl, 1 Scallorn	F4, burned rock hearth	Area B, level 4, 70-80 cmbs, on acorns	Peter & Hays 1982:7-7
Smith Shelter 41TV42	1145 ± 130	Tx-28	-	16 Darl, 1 Scallorn, 2 Young, 2 Ensor, 2 Abasolo,	none	Stratum 1	Tamers et al. 1964:138-159
41CV1329	1140 ± 50	Beta-119141	-	1 Zephyr	F2-shallow basin BR hearth	165 cmbs in TP 4	Mehalchick et al. 2000
Smith Shelter 41TV42	1160 ± 215	TX-2731	-	16 Darl, 1 Scallorn, 2 Young, 2 Ensor, 2 Abasolo,	none	Stratum 1	Tamers et al. 1964:138-159
Shepherd site 41WM1010	1190 ± 40 con	Beta-175164	Cal 720-960	1 Darl	D56, oval stone lined earth oven, bulb frags.	Area D2, AU 1b	Dixon & Rogers 2006
41CV988	1230 ± 40	Beta-102095	770-875	2 Darl, 1 Edgewood	F4	AU 1, TP8, 27 cmbs	Kleinbach et al. 1999
Shepherd site 41WM1010	1240 ± 40 con	Beta-169081	Cal 680-890	2 Darl, 1 Scallorn, 3 frags	D2, basin hearth ?oven	Area D, AU 1b	Dixon & Rogers 2006
41CV380	1250 ± 50	Beta-83348	-	1 Darl	midden , F1	TP 1, L 3	Trierweiler et al. 1996
Shepherd site 41WM1010"	1260 ± 40 con	Beta-175169	Cal 670-880	1 Darl @ 74, 1 Fairland @ 79,	D30, basin cobble hearth	Area D, AU 1b, next to Feat D55	Dixon & Rogers 2006
41WM53	1260 ± 150	UGa-2484	-	6 Darl, 1 Scallorn, Fairland, Ensor	F 3, burned rock hearth	Area B, Level 4, 70-80 cmbs,	Peter & Hays 1982:7-7
41CV184	1280 ± 60	Beta-83525	-	3 Darl points	BR midden F1,	TP1, L2	Trierweiler et al. 1996
41CV988	1280 ± 40	Beta-102094	785	1 Darl	2A-basin hearth	AU 1, 37 cmbs	Kleinbach et al. 1999
Loeve-Fox 41WM230	1300 ± 60	TX-1926	650	Darl & Ensor points in Stratum 2	Ash pit 2, charcoal, BR adjacent pit	XU 2, Twin Sisters phase	Valastro & Davis 1977:302; Prewitt 1974:23; 1982b:18,

Site Name/No.	Uncorrected Radiocarbon Date (B.P.)	Radiocarbon Laboratory Number	A.D. Date	Associated Point Types	Feature	Provenience	Reference
Shepherd site 41WM1010	1370 ± 40 con	Beta -176582	Cal 620-700	1 Darl	D39, basin cobble hearth	Area D3 AU 1b, in 3rd paleosol @ 320 cmbs	Dixon & Rogers 2006
41MM341, J. B. White	1390 ± 40	UGa-12496	900-1040	1 Darl	F 24, shell lens	AU 3, EU 151, L 10	Gadus et al. 2006
41CV95	1410 ± 60	Beta-75149	-	1 Darl, 1 Ensor, next to Feat.	F 3	AU1, TP 5, Level 7, 70 cmbs	Abbott & Trierweiler 1995
41WM328	1460 ± 80 unc or 1439 ± 83 cor	UGa-2481	-	Darl	F 17, hearth	Area B, stratum 5 45-60 cm thick	Peter & Hays 1982:7-7
41BL755	1580 ± 90	Beta-75168	370	6 Darl	F 1, BR midden	TP 2, L 5, AU 1, F 1 = 20-53 cmbs	Trierweiler et al. 1996
41CV1098	1590 ± 50	Beta-102096	420-550	1 Darl	F7,	Darl 10-20 cmbs, AU 1, 45-51 cmbs	Kleinbach et al. 1999
41WM328	1595 ± 167 Cor or 1610 ± 165 Uncor	UGa-2483	-	Darl	F 15, hearth	Area B, stratum 5	Peter and Hays 1982:7-7
41CV1098	1600 ± 100	Beta-102097	380-590	1 Darl	F 1A	AU 1, TP3, 28-32 cmbs	Kleinbach et al. 1999
41WM53	1620 ± 70	TX-2539	-	none	none	Level 5 in Unit D	Peter & Hays 1982:7-7
41CV389	1620 ± 60	Beta-83424	-	1 Darl	F 5	Darl 1 Level above date, TP 1 L 18	Trierweiler et al. 1996
41WM328	1620 ± 70 unc or 1605 ± 142 cor	Tx-2539	-	Fairland/Ensor	-	Test Pit E	Peter & Hays 1982:7-7
41CV1191	1630 ± 40	Beta-102104	-	1 Darl, 1 Ensor	F 2, rock hearth	Au 1, 31-38 cmbs	Kleinbach et al. 1999
Loeve-Fox 41WM230	1640 ± 140	TX-3404	310	9 Darl in Stratum 2	F44, small basin hearth	XU 3, Stratum 2, Prewitt says is to old	Prewitt 1982:29
Hoxie Bridge 41WM130	1740 ± 100	TX-2731	-	1 Darl *in situ* inside hearth	F 16, hearth stain, BR, burned soil, ash	unit M, 90 cmbs	Bond 1978:91
41CV382	1840 ± 60	Beta-119137	-	1 Zephyr	F 5	112-116 cm	Mehalchick et al. 2000
41CV382	1920 ± 120	Beta-119135	-	1 Zephyr	F 2, occupation zone	AU 2, 100-102 cm	Mehalchick et al. 2000
41CV1329	1950 ± 60	Beta-11942	-	1 Ensor @ 130-140 cmbs	-	AU3, date @111-130 cmbs,	Mehalchick et al. 2000
41CV957	3160 ± 40	Beta-102108	-	1 Zephyr on surface	F 3	AU 1, 32-36 cmbs	Kleinbach et al. 1999
Shepherd site 41WM1010	-	-	-	-	1 Darl next to D55, D2 dated	Area D, AU 1b, next to dated Feat D30 with Darl	Dixon and Rogers 2006

TX = Texas, UGa = University of Georgia, BR = burned rock, AU = Analytical Unit, con = age converted, F = feature, TP = test pit, cmbs = centimeters below surface, XU = excavation unit, Cal = calibrated

The narrowest value of 10.8 mm is from specimen #138-001, a tapering-stem dart point from 80 to 90 cmbs in Feature 2 of Unit 7. The context of this point is clear and good, and the overall morphology fits within the range of a dart point. The tapered stem, unlike the other projectiles recovered here, may have facilitated the use of a narrow

Table 7-11. Austin Phase Sites and Components with Solid Radiocarbon Dates Associated with Diagnostic Arrow Points in Good Context

Site Name/ No.	Uncorrected Radiocarbon Date (B.P.)	Laboratory Number	A.D. Date	Associated Point Types	Feature No.	Provenience	Reference	Comments
Kyle site (41HI1)	980 ± 170	S-MC C-4	AD 561 ± 150	Scallorn	?	C-2 1.2-1.4 ft below zone 2	Jelks 1962	1-3 ft. thick
Kyle site (41HI1)	1150 ± 150	S-MC C-6	AD 971 ± 170	Scallorn	?	C-4, Zone 1	Jelks 1962	lowest zone 1.4-6.0 ft. thick
Kyle site (41HI1)	1390 ± 150	S-MC C-2	AD 801 ± 150	Scallorn	?	C-6, Zone 1	Jelks 1962	-
Blum site (41HI8)	1410 ± 120	TX-10	AD 551 ± 120	Scallorn	-	-	Stipp et al. 1962; Prewitt 1985	-
Smith (41TV42)	930 ± 60	TX-512	AD 930 ± 90	Scallorn	-	-	Suhm 1957; Valastro & Davis 1970; Prewitt 1985	-
Smith (41TV42)	800 ± 50	TX-507	AD 800 ± 90	Scallorn	-	-	Suhm 1957; Valastro & Davis 1970; Prewitt 1985	-
Bigon-Kubala 41WM258	990 ± 290 uncorrected	RI-1088	-	None	hearth 3	BT	Peter & Hays 1982:7-7	-
41WM328	1290 ± 100 uncor	UGa-2470	-	1 Scallorn	#2, hearth	Area B, stratum 4, a thin cultural zone in buried A,	Peter & Hays 1982:7-7	-
Shepherd site 41WM1010	1160 ± 40 con	Beta-168245	Cal 780-980	Scallorn	B1 BR scatter	Area B, TU 1	Dixon & Rodgers 2006	-
Shepherd site 41WM1010	960 ± 40 con	Beta-169079	Cal 000-1180	Scallorn	B4 coble hearth	Area B, TU 1	Dixon & Rodgers 2006	-
Shepherd site 41WM1010	1130 ± 40 con	Beta-175172	Cal 790-1000	Scallorn	B10, cobble hearth	Area B, TU 1	Dixon & Rodgers 2006	-
41CV935	780 ± 70	Beta-83426	-	2 Scallorn, Bonham, frags,	-	TP 2, L 2, 10-25 cmbs	Trierweiler et al. 1996	Rock shelter, charcoal,
41CV1080	1250 ± 60	Tx-8429	-	4 Scallorn	-	TP 2, L 3 ??	Trierweiler et al. 1996	charcoal
41CV1250	590 ± 50	Beta-102137	1310-1415	1 Scallorn, 1 Cliffton	Feature 4, occupatio n zone	AU 1, TP 1, L 8	Kleinbach et al. 1999	50-80 cmbs
41CV382	830 ± 50	Beta-119136	-	1 Scallorn	3 rock filled hearth	AU 1, TP 1, L 8	Melhalchic k et al. 2000	-
41CV1310	910 ± 50	Beta-119140	-	1 Scallorn, 1 Bonham, untyped dart	F5-BR midden	AU 2, 10-30 cmbs	Melhalchic k et al. 2000	-
41BL504, 41BL567	450 ± 80	Beta-75265	1500	5 Scallorn, I arrow, 1 dart	F 1 = BR midden	TP 1, L 4, AU 1	Abbott & Trierweiler 1995	20-40 cmbs for points, date 40 cmbs

Site Name/ No.	Uncorrected Radiocarbon Date (B.P.)	Laboratory Number	A.D. Date	Associated Point Types	Feature No.	Provenience	Reference	Comments
41BL433	1130 ± 170	Beta-75167	820	1 Scallorn,	NA	TP 1, L 3, AU 1	Abbott & Trierweiler 1995	-
41BL567	790 ± 50	Beta-74069	1160	1 Darl, 3 Scallorn, + arrow frags	-	TP 2, L 2	Abbott & Trierweiler 1995	-
41BL504	1267 ± 70	Beta-8424	-	3 Scallorn,1 Fresno, 1 dart frag	-	TP 1, L4,	Abbott & Trierweiler 1995	40 cm thick A horizon
41CV935	780 ± 70	Beta-83426	-	1 Scallorn, 1 Bonham, 1 Young	NA, charcoal	TP 2, L2,	Abbott & Trierweiler 1995	Rock shelter
41CV115	820 ± 40	Tx-8418	-	1 Scallorn	F1, BR hearth	TP 3, L4, 30-50 cmbs	Abbott & Trierweiler 1995	Rock shelter
41BL567	790 ± 50	Beta-74069	1160	1 Darl, 3 Scallorn, + arrow frags	-	TP 2, L 2	Abbott & Trierweiler 1995	-
Leaday Crossing 41CN19	890 ± 130	Tx-6760	1060	1 Scallorn	F 11 = mussel shell	N102/E201, L 20	Treece et al. 1993	charcoal around F 11
41ML35, Baylor	1170 ± 40	Beta-182827	-	1 Perdiz, 1 Ellis in AU1	Feat 9 basin hearth	AU-1, 10-15 cm below peak artifacts	Mehalchick & Kibler 2008	? Mixed
41ML35, Baylor	1150 ± 50	Beta-182828	-	1 Perdiz, 1 Ellis in AU1	Feat 11 basin hearth	AU-1, 10-15 cm below peak artifacts	Mehalchick & Kibler 2008	? Mixed
Mustang Branch 41HY209-T	660 ± 50	Beta-37286	1279-1389	5 Scallorn, 1 Darl, 1 Ensor, 1 Castroville, 1 Nolan	-	level 7, 60-70 cmbs N204 W202	Ricklis 1994a	Essentially a discrete component 20 thick, Dart points curated
Mustang Branch 41HY209-T	650 ± 50	Beta-37276	1276-1393	5 Scallorn, 1 Darl, 1 Ensor, 1 Castroville, 1 Nolan	Feature 11	level 8, 70-80 cmbs, N201 W201	Ricklis 1994a	Essentially a discrete component 20 thick, Dart points curated items.
Mustang Branch 41HY209-T	790 ± 50	Beta-37280	1210-1277	5 Scallorn, 1 Darl, 1 Ensor, 1 Castroville, 1 Nolan	-	level 7 60-70 cmbs, N200 W204	Ricklis 1994a	Essentially a discrete component 20 thick, Dart points curated
Mustang Branch 41HY209-T	640 ± 80	Beta-37281	1278-1405	5 Scallorn, 1 Darl, 1 Ensor, 1 Castroville, 1 Nolan	-	level 8 70-80 cmbs, N202 W200	Ricklis 1994a	Essentially a discrete component 20 thick, Dart points curated
Mustang Branch 41HY209-T	630 ± 70	Beta-37285	1280-1405	5 Scallorn, 1 Darl, 1 Ensor, 1 Castroville, 1 Nolan	-	level 10 90-100 cmbs, N201 W201	Ricklis 1994a	Essentially a discrete component 20 thick, Dart points curated
J. B. White 41MM341	740 - 1190 (17 dates)	Multiple	900-1240	12 Scallorn, 3 Alba, 1 Perdiz, 1 Darl	F 9, 10, 12, 16, 17, 21b, 25, 22/26, 35, 36, 40, 47,	Analysis Unit 2, Levels 8 & 9 in Main Block	Gadus et al. 2006	1190 B.P. date appears anomalous, next youngest is 1070 B.P.

TX = Texas, UGa = University of Georgia, BR = burned rock, AU = Analytical Unit, con = age converted, F = feature, TP = test pit, cmbs = centimeters below surface, L = level, BT = backhoe trench

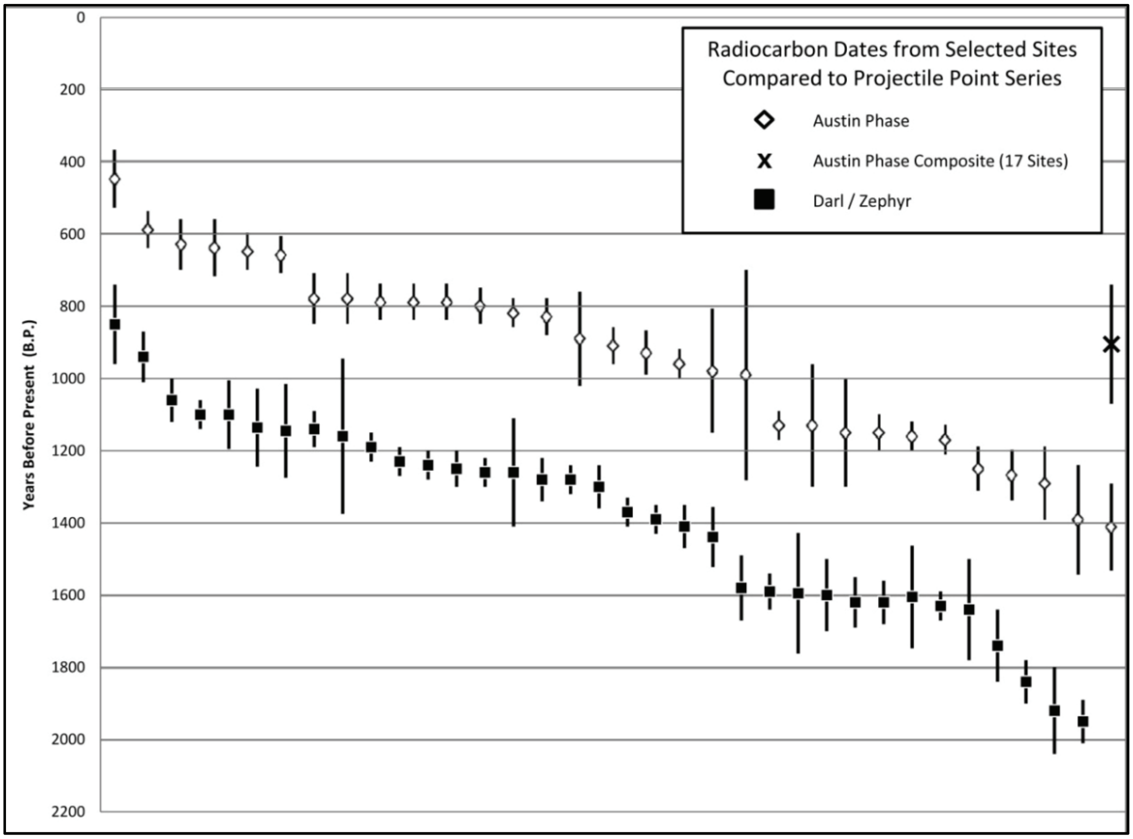

Figure 7-5. Illustration of Radiocarbon Dates from Selected Sites Showing Overlap in Radiocarbon Dates Associated with the Late Archaic and Scallorn Projectile Points

shaft, but this cannot be clearly demonstrated. However, the hafting technique revealed for this specimen is the same as the other dart points and bifaces in this 1100 to 1300 year old assemblage (Appendix C, Figure C-1).

Based on the radiocarbon dates presented here, it is obvious that the atlatl system that employed darts was still in use after some groups, at least the groups using the Scallorn points in the regions of central and north-central Texas, had already adopted the bow and arrow. As a parallel example, Boyd (1995, 1997, 2004) has redefined the Palo Duro complex in western Texas and states that it dates to between 750 and 1450 B.P. (A.D. 500 and 1100/1200), with semisedentary populations using small stemmed and corner-notched arrow points, brownware pottery. At least in parts of west Texas the bow and arrow was in use during a time when populations in at least some parts of central Texas still employed the atlatl-dart weapon system. Blitz (1988) concluded that a large-scale pattern of continent wide diffusion from the from the dart and atlatl system to the bow and arrow bow and arrow involved a broad, clinal, north to south shift over time.

Groups employing dart points with the atlatl, and practicing a basic Archaic lifeway (in the sense of mobile populations, subsisting by means of a diverse hunting and gathering economy), were still in existence as other groups such as those using the Scallorn points had already adapted the bow and arrow. The basic Archaic lifeway documented for the Late Archaic continued into the Austin phase. Therefore, the adoption of the bow and arrow technology apparently did not disrupt or alter the Archaic patterns of adaptation. This continuity in basic lifeways was, in fact, was recognized some three decades ago by

Prewitt (1981) who suggested the term "Neo-Archaic" for the period of early bow and arrow use (e.g., his Austin phase in central Texas) in order to highlight the continuity in fundamental adaptive behavior. This term has not, however, received general acceptance.

Following the excavations and analysis of the data from the Shepherd site (41WM1010) Dixon and Rogers (2006) see the only visible and detectable difference between the Darl dominated Driftwood phase of the Terminal Archaic and the Austin phase of the Late Prehistoric as being the replacement of dart points by Scallorn arrow points (Dixon and Rogers 2006). Based on the 38 radiocarbon dates from the Shepherd site, those authors suggested the change in weaponry occurred around 1150 B.P. (A.D. 800). From the Shepherd site data, these authors saw some limited, though questionable, indications that both weapon systems were in use contemporaneously. That limited evidence consisted of the distal end of a dart point that had been reworked into an arrow point, associated with Feature D30 dated to 1070 to 1280 B.P. (A.D. 670-880; Dixon and Rogers 2006:49). However, that original dart point tip could have been collected from an older campsite by later groups. A similar situation has been documented at other sites such as 41CV935 where an Austin phase component, radiocarbon dated to 780 ± 70 B.P., yielded two complete Scallorn points and a recycled and reused dart point (Trierweiler 1994:429). Another example of curation of dart points was discovered at the Mustang Branch terrace (41HY209-T) where the context was unquestionable, with a well-defined Toyah event that yielded at least 23 Perdiz arrow points and six Archaic dart points of five different types (Ricklis 1994b). However, the dart points were interpreted to most likely represent reuse of older artifacts by Toyah phase people.

Numerous excavated sites have yielded dart and arrow points from apparently the same context (i.e., Mustang Branch terrace [41HY209-T]; Ricklis 1994b; Area D North at the Shepherd site, 41WM1010, [(Dixon and Rogers 2006], Area C at the Millican Bench, 41TV163 [Mauldin et al. 2004; 2006], level 2 in Area B of Evoe Terrace, 41BL104 [Sorrow et al. 1967], AU 3 at the J. B. White site, 41MM341 [Gadus et al. 2006], AU 2 at the Baylor site, 41ML35 [Mehalchick and Kibler 2008], Strata I and 2 at the Kyle site, 41HI1 [Jelks 1962], the Aiken site, 41HD24 [Skinner 1971], the Acton site, 41HD13 [Blain et al. 1968], the Terri site, 41CJ2, and the Lightfoot site, 41CJ23, [Prewitt 1964], and the High Bluff [Flinn and Flinn 1968). In nearly all those instances the stratigraphy was poor, compressed, or nonexistent, resulting in too ambiguous a context for confident assertions that the two point forms were truly associated in one discrete cultural event. A few exceptions are instances with good context where the authors have interpreted the early dart points as having been picked up and reused by later populations (Ricklis 1994a, 1994b). Although fewer in number, some components or sites have been reported that also contain good contexts in which Darl dart points were found stratigraphically underlying Scallorn arrow points (e.g., the Kyle site, 41HI1 [Jelks 1962], Loeve-Fox ,41WM230 [Prewitt 1982a, 1982b]; Mustang Branch Terrace, 41HY209-T [Ricklis 1994b], Smith Rockshelter, 41TV42 [Suhm 1957], and the Shepherd site, 41WM1010 [Dixon and Rogers, 2006]).

There may still be sites or components found that will have the tightly definable contexts and associations in which Darl dart points and Scallorn arrow points can be demonstrated as occurring in clear, direct, and contemporaneous association with one another. Until such a site is found and carefully excavated, definitive evidence for simultaneous use of the dart-atlatl and the bow and arrow by individuals within a single group will remain speculative. Intuitively, it is highly unlikely that all of the hunters within a given group simply stopped using the dart and atlatl one day and took up use of the bow and arrow the next. However, the question that remains, for the time being, is whether the technological shift within a single group was more or less rapid or extended over a longer period, measurable, perhaps, in generations. The extant data from the Root-Be-Gone site and other locales in central and north-central Texas (as evidenced by the chronological data summarized in Figure 7.5 above) do, however, strongly suggest that some groups were already using the new technology while others continued to use the dart and atlatl, and that the complete change-over in technologies may have taken, at the regional scale, several hundred years.

In southwest Texas, Turpin (1994, 2004) states "The terminal Late Archaic blended into the Late Prehistoric period with little evidence of severe disjunctions in the cultural trajectory. Dart and arrow points coexist in strata that were radiocarbon dated to the Transitional centuries" sometime between 1050 and 1350 B.P. (ca. A.D. 600 to 900). Three fragments of an atlatl shaft were recovered from the Fiber Layer, a ca. 10 cm thick lens near the top of Bonfire shelter in far southwestern Texas (Dibble 1967:61). This layer was radiocarbon dated by charcoal to 1400 ± 130 B.P. (Tx-151) and 1690 ± 80 B.P. (Tx-194). This dated layer and associated atlatl were also in association with at least two Castroville dart points and three side-notched points that mostly resemble Ensor points (Dibble 1967). The younger of the two dates falls close to the time of the Terminal Archaic component 1 at Root-Be-Gone (1100 to 1300 B.P.).

Radiocarbon dates obtained from wood from two possible dart shaft frozen artifacts in glaciers in Wrangell and St. Elias National Park and Preserve in Alaska yielded $\delta^{13}C$ corrected ages of 1200 ± 30 B.P. (NSRL-13391) and 680 ± 30 B.P. (NSRL-13394; Dixon et al. 2005). These two examples indicate a relatively recent time frame for some atlatl darts and suggest continued use of the after the introduction of the bow and arrow.

In certain parts of the world, such as Australia (Gason 1879), central Mexico (Nuttall 1891; Kroeber 1946), the northwest coast of the United States, and Alaska (Nelson 1899), the atlatl was still in use in Early Historic times. Krieger (1956) discusses a quartzite Gary point embedded in the top of a complete skull of a European hog found in Lamar County, in northeastern Texas. On that basis, he suggested that atlatl dart usage survived in Lamar County into historic times since the hog could not be any older than roughly 400 years. He also cites documents from the De Soto expedition in which the atlatl and darts were used against the Spanish in historic times, near the mouth of the Mississippi River. This example indicates that the atlatl and its use were not totally replaced when the bow and arrow came into those areas. Apparently, then, there were sometimes perceived benefits from the continued use of this ancient weaponry system, even after the bow and arrow were introduced.

The timing of when the initial use of the bow and arrow in different areas of North America has received considerable attention (e.g., Webster 1980; Blitz 1988; Shott 1993; Nassaney and Pyle 1999; Bettinger and Eerkens 1999). Shott (1993) suggests that there was significant geographical variation in the eastern U.S. as to the timing and rapidity of the adoption of the bow and arrow. He questions what he believes are overly simplistic, unilinear diffusionist models that posit an even spread of the new technology, and its wholesale adoption in any given area. Nassaney and Pyle (1999) point out that the bow and arrow were significantly earlier in some areas than some researchers have postulated, and suggest they may have been independently invented in some instances, and received via diffusion in others. Therefore, it is reasonable to expect that different groups within a particular region used one or the other technology simultaneously. The presently available data strongly suggest that was the case in and north-central Texas. Some groups, as for example the one that occupied the Terminal Archaic component 1 at Root-Be-Gone, were still employing the old dart and atlatl weapon system, while others had shifted to bows and arrows tipped with Scallorn points.

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9.0 GLOSSARY OF TECHNICAL TERMS

A Horizon: The near surface horizon of a natural soil. This is a carbon rich soil horizon characterized by an accumulation of partially decomposed to decomposed organic matter and eluvial loss of constituents such as clays and carbonates, which tend to accumulate in the deeper B horizon. The A horizon represents the upper solum of a soil. Lower case letters with the upper case letter A indicate specific characteristics of that A horizon. An Ab designation indicates the A horizon is buried. An Ap designation indicates a disturbed or anthropically modified soil such as in a plow zone.

Accelerated Mass Spectrometry (AMS): Laboratory technique that separates and identifies ions based on their mass to charge ratios. This technique is used in radiocarbon dating tiny particles of carbon in organic remains and residues.

A.D.: Anno domini in Latin. "In the year of our Lord." For example, A.D. 1000 is 1,000 years after Christ.

Aerophilous Habitats: An environment that has free oxygen or air. These can include damp soils, wet plants and rocks, marshes, wetlands and mud lands. This term is used in the discussion of phytoliths and diatoms. Aerophilic diatoms live exposed to air and are adapted to damp or dry habitates.

Agavaceae: A plant family name that refers to fiber, vascular bundle, or the central stem sections that cannot be specifically identified as agave (*Agave*), yucca (*Yucca*) or sotol (*Dasylirion*).

Allostratigraphic Unit: Depositional unit made up of sediments dating to a similar period of deposition.

Alluvium: Clastic sediments, such as sand, silt, or clay deposited by a flowing stream, either in the channel or material deposited outside the channel during overbank flooding.

Anisotropic: The action of cross-polarization of light under a microscope as it passes through material. If the material causes any deviation in the transmission of light then the material will have illumination in the microscope in a pattern characteristic of the material and its properties. This term is used in the petrographic analysis of ceramic sherds.

Argillic Horizon: A soil horizon (Bt horizon) that exhibits significant enrichment in illuvial clay minerals or clay-sized particles. Such clays typically form grain coats, grain bridges, and ped-face coats of oriented clay that are visible in thin sections, and usually can be identified with a hand lens.

Argilliturbation: Mixing of soil or sediment, and materials contained therein, due to expansion and contraction of clay minerals with wetting and drying.

Atlatl: This is a stick, roughly 40 to 60 cm long, with a handle on one end and a groove or peg at the other end, used for throwing a dart shaft or light spear. This stick adds length to the arm to provide much greater leverage and force to the throw the dart shaft. This is the primary instrument used to propel projectiles before the bow and arrow.

Autecology: The older term, autecology refers to the study of individual species in relation to the environment or, essentially, species ecology.

Azelaic acid: A chemical biomarker found in burned rock residue, which indicates the presence of seed oils.

B.C.: The abbreviation for Before Christ, as in contrast to A.D.

Benthic Diatoms: Those species of diatoms that live in sediment, microbial mats and vegetation at or near the floor of a stream or lake.

Biface or Bifacial: A stone tool that has two distinct sides or faces, both of which have been worked and flaked. This may take the form of many shapes and sizes.

B Horizon: The lower solum of a natural soil. A B horizon is a mineral soil horizon characterized by an accumulation of constituents such as clays, carbonates or salts, or organic complexes that have been translocated from the A horizon. Common subordinates include lowercase letters such as *t* as Bt, which indicates accumulation of illuvial clays. The lowercase k (Bk) indicates accumulation of carbonate. The lower case w indicates structural or color changes with no significant accumulations of alluvial material.

Biosilicates: This is a general term to include various tiny hard bodies that contain silicon and are developed in plants such as phytoliths, diatoms, algal statospores, and sponge spicules.

Bioturbation: The churning and mixing of sediments by living organisms, including burrowing rodents, insects, worms, and plant roots.

B.P.: An abbreviation for before pres-ent, which in radiocarbon dating is referenced to the standard year A.D. 1950, which is considered “present”.

β-sitosterol and Stigmasterol: These are associated with plant products.

Burned Rock Dump: A loose cluster of previously heated rocks that exhibits no horizontal patterning to the positions of the rocks and lacks indications of *in situ* heating/burning, such as a prepared basin, lenses of charcoal or ash, and/or the absence of an oxidation rim. Scattered charcoal or other cultural items may be present between or around the burned rocks.

C Horizon: Weathered, but relatively unaltered parent material at the base of a soil profile. This term is roughly synonymous with subsoil, although the latter term is often used to encompass the lower B horizon.

Calcareous: Rocks, minerals, or sediment containing calcium carbonates.

Calcium: A chemical element with the symbol Ca and atomic number 20. Calcium is a soft gray alkaline earth metal, and is the fifth most abundant element by mass in the Earth's crust. Calcium is also the fifth most abundant dissolved ion in seawater by both molarity and mass, after sodium, chloride, magnesium, and sulfate.

CAM Plants: A photosynthetic pathway for assimilating carbon dioxide into plants that can change from C_3-like to C_4-like plants depending on the diurnal (day or night) cycle. Most succulents such as cactus are crassulacean acid metabolism (CAM) plants. The carbon isotope values of most CAM plants in Texas such as *Agave lechuguilla* and *Opuntia englmannii*, are similar to the values in C_4 plants (see Eickmeier and Bender 1976).

C_3 Plants: A photosynthetic pathway that most trees and flowering bushes use to assimilate carbon dioxide into their systems. The average carbon isotope of C_3 matter is -26.5‰ with a range from about -24.0‰ to -34.0‰.

C_4 Plants: A photosynthetic pathway used by most arid (xeric) grasses and corn to assimilate carbon dioxide into their systems. The average carbon isotope of C_4 matter is -12.5‰ with a range of -6‰ to -19‰. These plants are more resistant to stress due to lack of water, but more susceptible to cold temperatures.

Carbonates: These are rock or mineral classes that include limestone, calcite, ooids, and bioclasts, and used in the petrographic analysis of the pottery sherds. The calcite staining in the thin-section preparation marked all these bodies with a carmine red color.

Cheno-am: A term used in botanical classification that includes the plant family of Chenopodiaceae (goosefoot) and the genus *Amaranthus* (pigweed), with charred seeds that are indistinguishable from each other.

Clast: Any detrital particle of sediment created by the weathering and disintegration of a larger rock mass and transported by water, wind, or ice. Clasts also include discrete particulates created and deposited by volcanic action.

Clay: This is the mineral sediment particles less than 0.002 millimeters in diameter. As a soil textural class, soil mineral that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Colluvium: Soil material, rock fragments, or both, moved by creep, slide, or local wash that is deposited at the base of steep slopes.

Columella Shell: This is the middle part of a conch shell. Often this inner section was made into jewelry by the natives.

Complex: A group of sites dating from the same time period and that contain similar artifacts. This term expresses a relationship of common cultural or technological traits in assemblages within widespread geographic area.

Component: A site or portion of a site that is spatially and chronologically discrete from other accumulations of artifacts. These can be horizontally or vertically differentiated.

Conifers: Any member of the order Pinales, woody plants that bear their seeds and pollen on separate, cone-shaped structures. They constitute the largest division of gymnosperms, with more than 550 species. Most are evergreen, upright trees and shrubs. They grow throughout North American and prefer temperate climate zones. Conifers include the pines (*Pinus*), junipers (*Juniperus*), spruces (*Picea*), hemlocks (*Tsuga*), firs (*Abies*), larches (*Larix*), yews (*Taxus*), cypresses (*Cupressus*), bald cypresses (*Taxodium*), Douglas firs (*Pseudotsuga*), and related groups. The trees are the source of resins, volatile oils, turpentine, tars, and pharmaceuticals.

Context: The association and position of artifacts, materials, and cultural features that are used by archeologists to interpret space, time, and culture.

Cumulic Soil: A soil formed in a setting experiencing relatively slow deposition, so that freshly introduced sediment is incorporated into the A horizon, leading to overthickening of the surface horizon. Cumulic soils are common in alluvial overbank and colluvial settings.

Curie Temperature: The temperature at which the magnetic properties of a substance change from ferromagnetic to paramagnetic. Magnetite has a Curie point of 580 degrees Celsius.

Dehydroabietic Acid: A chemical biomarker, here found in the residues of burned rocks, which indicates that conifer products (likely juniper here) are present. This resin would be from the firewood used to heat the rocks.

Deposition: The accumulation of sediments or gravels laid down by natural agencies such as moving water, or artificial agencies such as dumping.

Detrital: Loose rock fragments or grains that have been worn away from the parent rock.

Diatoms: These are single-celled algae whose cellular contents are enclosed between two valves of silica that are preserved when the organism dies. Often diatoms are preserved in ponds and streams and important to stream ecology. Different taxa have different tolerances for extremes of temperature, salinity, water depth, water clarity, and nutrient concentrations and respond rapidly to changes in the environment. These are useful in reconstructing aquatic paleoenvironments.

Effluent: This is the outflowing of water from a natural body of water, or from a man-made structure. Effluent is generally considered to be water pollution, such as the outflow from a sewage treatment facility or the wastewater discharge from industrial facilities.

Eluvial: The movement of materials such as clay or organic matter from a soil horizon by percolating water.

Eocene Epoch: The period of time between 37 and 58 million years ago, and a subdivision of the Tertiary Period of the Cenozoic era.

Eolian: Earthly particles moved by wind action and include sandy dunes, sand sheets, or loess deposits.

Eraillure Scar: An enigmatic flake formed between the bulb of force and the bulbar scar.

Erosional Uncomformity: A significant break or gap in the geological or depositional record, indicative of erosion of the older unit prior to renewed deposition.

Eutrophic: Having waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the extinction of other organisms. This is used in the discussion of diatoms.

Facies: A definable subdivision of a formal or informal stratigraphic unit.

Fatty Acids: The major constituents of fats and oils (lipids) that occur in nature in plants and animals. They are insoluble in water and relatively abundant compared to other classes of lipids. Fatty acids may be absorbed into porous archeological materials during cooking, including heated rocks and ceramics, or ground into manos, metates, or mortar holes.

Floodplain: A nearly level alluvial plain that borders a stream or river and is subject to periodic flooding.

Gas Chromatograph (GC): A highly technical measuring instrument that separates and measures the amount of elemental components of a specific sample by the measurement of light passed through gas at regulated temperatures, which allows the detection of fatty acids at the nonogram (1×10^{-9} g) level.

Gelatinization: In regards to starch grains this is a morphological change (distortion of the original) in the grain caused by the exposure to heat and water when starches are cooked.

Geomorphology: That part of geography concerned with the form and development of the landscape.

Geophytes: These are plants with underground storage organ such as bulbs (i.e., onions, camas, false garlic), tubers, roots, and rhizomes that are a reserve of carbohydrates, nutrients, and water. These storage organs can be collected, cooked, and eaten as part of the human diet. The study of these geophytes from an archaeological site aids in determining the diet of the past occupants.

Gorget: These are usually a polished stone, sometimes of shell or limestone, with holes drilled in it. These are presumably worn as jewelry.

Graticule: A device used in the microscope to measure the size of items under magnification.

Hard/High Silica Polish: This is a residue that comes from the material the tool comes in contact with. This type of polish is produced when processing soft plants with high silica content in the plant tissues such as grasses, wood, reeds, and potentially soil. This polish was detected during high-powered use-wear studies conducted on stone tools analyzed.

HCL: Hydrochloric acid, which is the solution of hydrogen chloride (HCl) in water. It is a highly corrosive, strong mineral acid and has major industrial uses.

Heating Element: This is an intentional, intact and localized spot were a human created a fire in an archeological site or component. This is generally evidenced by quantities of wood charcoal, prepared basin, lenses of charcoal or ash, and possibly an oxidation rim often accompanied by intentionally placed rocks, either lining the margins or directly amongst the charcoal. The function of this fire may reflect many different things, such as for heat to warm a person, to cook on, or to heat rocks for other uses. The specific contents may provide clues as to a more specific function or length of use.

Holocene: Geological time period spanning roughly the last 10,000-years before present. The Holocene is roughly equivalent to the Post-glacial period, and often referred to as the "Recent" period in geology. Many investigations consider the Holocene to be an *interstadial* in the ongoing Pleistocene epoch.

Horizon: A discrete, relatively uniform layer in a soil profile that is typically parallel with the surface and formed as the result of pedogenic process.

Humates: These are substances formed from the biological and chemical breakdown of animal and plant life over time. Humates are made up of compounds and materials that plant life on earth absolutely needs for growth. The humates contain a mixture of organic acids, including humic acids, fulvic acids, macromolecules of amino acids, amino sugars, and peptides. The chemistry of humate is so complex it can't really be broken down.

Humus: A dark, organic-rich substance consisting of decomposed organic material (animal or vegetable) and is found in the soil.

Illuvium: Material in a sediment profile that has moved downward into another soil horizon by water.

***In Situ*:** Something, generally referring to an artifact, in its original position that was placed or deposited within the landscape.

Integrity: This refers to the degree of intactness of archeological deposits, components, features, or artifacts.

Inulin: This is a carbohydrate, a fructan, that is not digestible via acid hydrolysis, the typical way we digest carbohydrates such as starch.

Isotope: One of two or more forms of a chemical element, differentiated by the number of neutrons contained in the nucleus.

Isotropic: The behavior of cross-polarization of light as it passes through material, especially crystalline material. Having physical properties, as conductivity, elasticity, etc., that are the same regardless of the direction of measurement

Knapping: A term used to describe the manufacturing of prehistoric chipped stone tools using different techniques, such as pressure and/or percussion methods, to chip/flake a target mass of material to form a useful tool.

Krotovina: A discrete, anomalous area visible in plan or profile in a soil resulting from the infilling of a void (e.g. a burrow or root) with dissimilar sediment. Some investigators prefer to limit the term to animal burrows, preferring the term "root trace" for filling related to decayed roots. Some krotovina are obvious, whereas others are tiny and may only be identified in thin sections.

Legume: A plant that produces a bean or seedpod in various forms consisting of one cell and/or two valves. Common legume plants across Texas include; mesquite, Texas ebony, various acacia, retama, *Dalea* sp., mimosa, and rattlebush.

Lipids: These are hydrophobic constituents of living tissues including fatty acids, alcohols, triacylglycerols, sterols, bile acids, and waxes. Lipids are present in tissues of all living organisms in varying proportions. They are insoluble in water, relatively easily extractable, and are readily amenable to separation and characterization.

Lipid Biomarkes: These are chemicals that distinguish the presence of plant residues, animal residues, and plant and animal combinations. These are detected through high temperature gas chromatography and high temperature gas chromatography with mass spectrometry.

Lithic: Means "of stone". This term is used by archeologists to refer to stone artifacts and the debris that result from the manufacture of stone artifacts.

Lithology: The scientific study and description of rocks, especially at the macroscopic level, in terms of their color, texture, and composition. The gross physical character of a rock or rock formation.

Lunate Stones: A relatively small ground stone in the shape of a half moon, with one straight side and one curved side. These occasionally occur in with burials and are most prevalent in Late Archaic burials in Texas.

Lycopodium Spores: These are marker grains used in pollen analyses. Two tablets of 13,500 ± 500 spores are added to each sub-sample to permit calculation of pollen concentration values and provide an indicator for accidental destruction of pollen during the laboratory procedures.

Macrobotanical: These are remains of plant tissues, such as wood, charcoal, and seeds that one can see with the naked eye.

Magnetic Susceptibility: The degree of magnetization of a material in response to a magnetic field. Often this is used in identifying buried soils or humanly altered soils.

M.A.S.C.A.: Museum of Applied Science Center for Archaeology, University Museum, University of Pennsylvania. One institution that has studied tree-ring calibrations of radiocarbon dates.

Manuport: An object, usually a rock, that was transported by humans to the place it was recovered, but its macroscopic appearance does not indicate it had been artificially altered to form a specific tool or other kind of artifact.

Mastic: This is a resin obtained from a plant, often a tree. It is a gum like substance that is often used to bind/glue a chipped stone tool to the haft. Mastic was observed on some stone tools during high-power use-wear analysis.

Matrix: Refers to the sediments in which the artifacts at an archeological site are encased, or surrounds.

Mesic Condition: A relatively moist interval generally used in the context of climatic conditions.

Microdebitage: Any stone or lithic material from the manufacture of stone tools that is less than 4.0 mm in diameter.

Microfossils: These include a variety of very tiny residues including such things starch grains, diatoms, phytoliths, pollen, and organic remains that are only detectable and visible under high-powered microscopes.

Micromorphology: The fine-level structures or shapes of an organism, mineral, or soil component visible through a microscope.

Middens: This is somewhat of a catch-all term. It generally refers to an accumulation of cultural material such as a lens or zone of burned rocks, but it is often used to refer to all types of cultural material in a vertical zone.

MNI: The minimum number of individuals represented in a given faunal or human osteological collection. This is determined by the largest number of any particular bone element representing a given species in a sample of bones.

Molar Solutions: A Molar (M) is a solution that contains one mole of solute in each liter of solution. A mole is the molecular weight expressed as grams. Therefore, 1 M = 1 g of molecular weight of solution per liter of solution.

Mollusks: These include bivalve clams, mussels (Pelecypoda), and univalve snails whelks and conches (Gastropoda). They are soft-bodied and unsegmented with a muscular foot, a head region, a visceral mass, and a fleshy mantle. The shell is comprised of proteins and crystalline calcium carbonate. Marine and freshwater species exist. The associations of mollusks in the sediments reflect the water quality, salinity, and streamflow.

Mussel Shells: This is the hard part of the mussel, which is composed of inorganic and organic components. Three major layers combine to make up the shell and include the thin outermost layer that is called the periostracum or epidermis. Underlying the epidermis is the prismatic layer made of calcium carbonate (calcite). The third layer is the innermost and is the nacre or mother-of-pearl layer, which is also composed of calcium carbonate in the form of calcite, aragonite, or both in alternating layers. These shells protect the soft animal itself or the meat.

Otoliths: This is the hard ear-stone of a fish. Fish have two in their skull. They float in a liquid that fills the inner ear in a chamber behind the cranium. This bone functions to enhance the fish's equilibrium and hearing. They are composed principally of aragonite and conchiolin and forms of calcium carbonate. The otolith has an inner and outer face with the outer face being concave or flat and consists of a series of bumps and ridges. The edges of the outer surface may be crenulated. The inner face exhibits distinctive characteristics that allow for identification.

Overbank Deposits: The deposition of fine silts and clay particles that are left on terrace tops and banks when water in a stream exceeds the capacity of the channel and drops the suspended sediments load in the lower energy environment. Overbank depositional processes usually cause minimal movement to large objects on the terrace surface.

Oxidation: A chemical process wherein oxygen is added to minerals or other compounds; weathering oxidizes minerals; burning wood and rusting metal are types of oxidation.

Paleoenvironment: Ancient or past environments.

Paleogeography: The physical nature of the past landforms.

Paleomagnetic: The past magnetic properties used here in the properties in and around fires.

Paleosol: Generally refers to a soil that developed an A horizon and was subsequently buried.

Palimpsest: Archeologically, refers to the inability to distinguish and separate material remains from repeated occupations by a succession of cultural events of different ages due to their deposition and intermixing over time on relatively stable surfaces. Some palimpsest assemblages are buried following a long period of exposure.

Palynology: The study of fossil palynomorphs (pollens and spores) that are produced by plants. Commonly used to reconstruct the floral communities in paleoenvironments.

Parenchyma Residues: The functional parts of an organ or the thin-walled cells of the ground plant.

Pedogenesis: The dynamic process of soil formation and development, which typically leads to the formation of a darkened, organic-rich A-horizon at or near the surface, and the downward movement of fine clays into, and/or the formation of carbonate nodules within, the underlying B horizons.

Pedoturbation: A general term used to describe soil that has been mixed.

Permian: The seventh and last period of the Paleozoic Era in geologic time and before the Triassic period. A period of rock formation, specifically Alibates of the Quartermaster Formation.

Petrographic: The detailed descriptions and analyses of rocks at the microscopic level. Generally a thin section is prepared from a lump of soil and that thin section is mounted on a glass slide and viewed under a microscope to see and identify the properties present.

pH: The standard numerical designation of acidity and alkalinity commonly used in reference to soils. A neutral pH value (as in distilled water) is 7.0. Lower and higher values are acidic and base, respectively.

Phase: A group of related archeological traits (e.g., artifacts, features) that contain similar cultural material and date to one relatively narrow time period within a limited region.

Phosphorus: A chemical element that has the symbol P and atomic number 15. A multivalent nonmetal of the nitrogen group, phosphorus is commonly found in inorganic phosphate rocks.

Phytoliths: Tiny microscopic silica particles (plant stones) that develop within the cells of most plants. Dissolved silica is transported into growing plants through water intake and then deposited along cell walls as silica particles. Different kinds of plants and different parts of a plant develop phytoliths of distinctive shapes. After the plants die, the silica bodies become part of the mineral component of soils left in the ground. The study of the phytoliths

Planktonic Diatoms: Those species that live suspended in the water column.

Pleistocene: The first epoch, which along with the Holocene Epoch constitutes the Quaternary period, spanning the time between roughly 2.0 or 1.65 million years ago and 10,000-years ago. Characterized by repeated continental glaciations, the Pleistocene witnessed the evolution of modern humans.

Polyunsaturated Fatty Acids: Pertaining to long-chain carbon compounds (e.g., C18:2) like fats with multiple double bonds. These fats are very unstable and degrade very rapidly.

Pressure Flaking: A method used to shape stone tools through the application of force applied by pushing rather than striking.

Profile: A cross-sectional exposure of the sequence of horizons that make up a soil or a sequence of sedimentary deposits. It can be the result of either natural erosional downcutting or an artificial excavation.

Provenience: The specific vertical and horizontal location where an object is found.

Provenance Postulate: This states that chemical analysis can successfully trace artifacts to their source if the differences in chemical composition between different natural sources exceed, in some recognizable way, the differences observed within a given source.

Quaternary: The second period, which along with the Tertiary Period, make up the Cenozoic Era, encompassing the Pleistocene and Holocene epochs; roughly the last 2.0 or 1.65 million years.

Raphides: Needle-shaped crystals in a plant cell, typically of calcium oxalate. These are small (30 to 500 µm) crystals, generally points on the ends and of similar lengths. They are often found in plants of the Agavaceae family such as sotol, yucca, agave, and lechuguilla. They are not diagnostic of any particular plant. Bohrer (1987) and Kwiatkowski (1992) believe that only agave contain these crystals. In contrast, Dering (2003) believes raphides occur in a variety of Agavaceae including sotol, yucca, agave, and beargrass.

Retouch: A technique of chipped stone artifact manufacture in which pressure flaking is used to detach small flakes to sharpen or otherwise modify the edge of a tool.

Riparian Zone: The generally well-watered area along a stream course with trees, bushes, and grasses in contrast to the open prairies.

Root Etching: Thin, shallow lines or pits that are etched into the surfaces of bones by acids associated with plant roots that grow against the bone after the bone is deposited in the ground.

Saprobity: This refers to the presence of biodegradable organic matter and low oxygen concentrations.

Saturated Fatty Acids: Each carbon in the chain is connected to its neighboring carbon by a single bond, which makes them relatively stable. The most abundant saturated fatty acids have chain-lengths of 14, 16, or 18 carbons. Mammal fats primarily consist of saturated fatty acids and are solid at room temperature.

Seasonality: The season of death of the animals killed at a campsite. This is often determined by the presence of fetal or neonatal bones of bison and deer, linked to a specific birthing period or the age of the animal determined by tooth eruption and wear patters. The growth rings detected in the cross-section of fish otoliths provide clues as to the season of death as well.

Silt: A particle size that has a range from 0.06 mm to 0.002 mm. These are smaller than sand grains and larger than clay particles.

Siliceous: Pertaining to silica, as in silicon dioxide, the most common chemical constituent on earth, and the dominant component of chert and quartz.

Site Structure: The spatial distribution of features, artifacts, and debris across a single occupation (or within a component) of an archeological site that is used to reconstruct manufacturing, maintenance, processing, production, and disposal activities at specific loci, and the spatial ways prehistoric groups organized their space at a site.

Slickensides: A term used by geoarcheologist in reference to soils, more specifically the grooved and polished faces between peds in an expansive clay soil. These polished faces are formed by friction as the peds swell and press together during wetting cycles.

Sodium Hydroxide (NaOH): Also known as lye and caustic soda, sodium hydroxide forms a strong alkaline solution when dissolved in a solvent such as water. However, only the hydroxide ion is basic. It is used in many industries, mostly as a strong chemical base. Pure sodium hydroxide is white.

Soil Horizon: A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons an upper case letter (i.e., A, B, C, R, and O) represents the major horizon. Lower case letters that follow the upper case letters represent subdivisions of the major horizons.

Soluble Inorganic Residues: These are silica gel residues that build up with moisture availability on the utilized edges of stone tools, and that form discrete microplates as tool use progresses. Impervious to most acids and strong bases, they were are quite commonly found during use-wear analysis of stone tools and are valuable indicators of tool use due to their long term stability, and affects on the microgemometry of a tool edge that indicate kinds of motion during use. They exhibit flow characteristics of a viscous liquid and desiccation cracks as they harden.

Stable Isotope: An isotope not subjected to radioactive decay, such as carbon (C^{13}), oxygen O^{18}, or nitrogen (N^{15}) isotopes. This contrasts with radioactive isotopes that decay over time.

Starch: Starch is produced by all green plants for energy storage and is a major food source for humans. Pure starch is a white, tasteless and odorless powder that is insoluble in cold water or alcohol. Starch can be used as a thickening, stiffening or gluing agent when dissolved in warm water, giving, for example, wheat paste. In photosynthesis, plants use light energy to produce glucose from carbon dioxide. The glucose is stored mainly in the form of starch granules. Toward the end of the growing season, starch accumulates in twigs of trees near the buds. Fruit, seeds, rhizomes, and tubers store starch to prepare for the next growing season.

Sterol Cholesterol: This chemical is associated with animal products. This chemical was detected in the lipid residue analysis that targeted burned rocks.

Stratigraphy: The study of layering in rocks and/or sediments, and how the layers correlate to each other.

Striae: These are tiny, thin, narrow grooves, channels, or lines, often called striations. Here, they were observed during high-powered use-wear analysis and are an indication of the direction of the movement of the tools during their use. They were observed under high magnification in the residues left on the tools.

Terrace: In geologic terms this is an old alluvial plain that is generally flat and borders a river, stream, lake, or sea.

Trophic State Index: This refers to the presence of inorganic nutrients such as nitrogen, phosphorus, silica and carbon or in organic forms. This is a measure of the ecological potential of the aquatic environment to sustain species at different levels in the food chain.

Turbation: Disturbance to the natural matrix deposits generally caused by biological agents (burrowing rodents, insects, worms, and plant roots) and natural (soil creep, desiccation crack displacement, frost heaving, landslides, etc.) processes.

Ultraviolet Light: The wave length of light above that usually detected by the human eye that fluoresces various kinds of minerals and emits distinctive colors. Here, a multiband light source (UV light 254/366 nm Model UVGI-58) was used to investigate the visual fluorescence of culturally modified stones to help in identifying their source.

µm: This is the short-hand for a micron that is one millionth of a meter, or equivalently one thousandth of a millimeter. It can be written in scientific notation as 1×10^{-6} m, meaning $^{1}/_{1000000}$ m.

Unconformity: Stratigraphic term for a boundary or break created by a depositional hiatus. This boundary separates younger strata from older strata. An unconformity is usually caused by erosion and therefore deposits are missing.

Unsaturated Fatty Acids: These types of fatty acids contain at least one carbon-carbon double bond or point of unsaturation. That point of unsaturation is susceptible to additional reactions. Unsaturated fatty acids are the primary constituents of plant and fish oils and tend to be in liquid-state at room temperature. Their chain-lengths vary with a minimum of 12 carbons, but most common ones contain at least 18 carbons.

Use-wear: The high-powered microscopic evidence on a stone tool that was created from sustained use. The wear may appear as striations, tiny nicks, abrasive particles, polish, rounding, soluble inorganic residues, etc. The accompanying use-wear study used magnification between 100x and 500x to observe wear and edge-modification on selected artifacts. This type of analysis contributes to our understanding of the function of the tools and potentially the substances that tool were used on.

Uvalde Gravel: A gravel deposit throughout much of south and east Texas attributed to the late Miocene to early Pleistocene. The deposits are composed of pebbles, cobbles, and boulders of vein quartz, quartzite, chert, jasper, silicified wood, and limestone. The ultimate source of the lithology indicates the Llano Uplift, likely the Ogallala Formation (see Byrd 1971 for more details).

Vesiculate: Pollen grains that are full of air such as pine or spruce and easily dispersed by wind.

Wildrye (*Elymus* sp.): A common grass throughout the Plains of the United States, from Mexico to Canada and is all across Texas. The seeds of this genus are large and it possesses a large starch grain as well.

Xeric Condition: A dry or relatively arid condition often in reference to climatic conditions.