CULTURAL RESOURCE

TECHNICAL SERIES 2015-2

NMDOT

Adaptations in the Northern Jornada Mogollon

Four Sites on US 54, Carrizozo, New Mexico

Museum of New Mexico

Office of Archaeological Studies

AN 436

2016

NMCRIS activity no.: 118953

NMDOT project no.:
AC-GRIP-BR-(NH)-054-2 (380107);
CN G3a 12

NEW MEXICO DEPARTMENT
OF TRANSPORTATION

NMCRIS Activity No. 118953

NEW MEXICO DEPARTMENT OF TRANSPORTATION
CULTURAL RESOURCE TECHNICAL SERIES 2015-2

ADAPTATIONS IN THE NORTHERN JORNADA MOGOLLON:

FOUR SITES ON US 54, CARRIZOZO, NEW MEXICO

DOROTHY A. ZAMORA AND YVONNE R. OAKES

WITH CONTRIBUTIONS BY

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NMCRIS Activity No. 118953
NMDOT Project No. AC-GRIP-BR-(NH)-054-2 (380107), CN G3a 12
MNM Project No. 41.894 (Carrizozo)
NM Archaeological Excavation Permit No. SE-288
BLM Cultural Resource Use Permit No. 21-8152-10-18

ARCHAEOLOGY NOTES 436
MUSEUM OF NEW MEXICO
OFFICE OF ARCHAEOLOGICAL STUDIES
SANTA FE 2016 NEW MEXICO

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.:	2a. Lead (Sponsoring) Agency:	2b. Other Permitting Agency(ies):	3. Lead Agency Report No.:
118953	US Department of Transportation, Federal Highway Administration	Bureau of Land Management-Roswell Field Office	NMDOT CR Technical Series 2015-2/ Archaeology Notes 436

4. Title of Report: Adaptations in the Northern Jornada Mogollon: Four Sites Along US 54 Near Carrizozo, New Mexico

Author(s) Yvonne R. Oakes, Dorothy A. Zamora

5. Type of Report
☐ **Negative** ☒ **Positive**

6. Investigation Type

☐ Research Design ☐ Survey/Inventory ☐ Test Excavation ☒ Excavation ☐ Collections/Non-Field Study
☐ Overview/Lit Review ☐ Monitoring ☐ Ethnographic study ☐ Site specific visit ☐ Other

7. Description of Undertaking (what does the project entail?): The undertaking was data recovery of three sites along US 54 south of Carrizozo. The data recovery included the Oscura rail station, one Archaic site, and two prehistoric Jornada Mogollon sites.

8. Dates of Investigation: (from: 6/22/2009 **to:** 7-15-2010)

9. Report Date: 4/26/2016

10. Performing Agency/Consultant: Office of Archaeological Studies
Principal Investigator: Robert Dello-Russo
Field Supervisor: Yvonne Oakes
Field Personnel Names: Isaiah Coan, Lynette Etsitty, Veron Foster, Rick Montoya, Don Tatum, Karen Wening, and Dorothy Zamora

11. Performing Agency/Consultant Report No.: Archaeology Notes 436

12. Applicable Cultural Resource Permit No(s): NM Archaeological Excavation Permit No. SE-288

13. Client/Customer (project proponent): New Mexcio Department of Transportation
Contact: Laurel Wallace
Address: 1120 Cerrillos Road, Room 213
Santa Fe, NM 87505
Phone: (505) 827-5240

14. Client/Customer Project No.: NMDOT Project No. AC-GRIP-BR-(NH)-054-2 (380107), CN G3a 12

15. Land Ownership Status ***(Must be indicated on project map):***

Land Owner	Acres Surveyed	Acres in APE
LA 114462 Private	**3.86**	**30m within right-of-way**
LA 130331 BLM-Roswell Field Office	**.36**	**30m within right-of-way**
LA 120972 Private Individual and NM DOT	**NMDOT 5.164 Private 0.716**	**30m within right-of-way**
LA 120973 Private Individual and NM DOT	**NMDOT 1.909 Private 0.851**	**30m within right-of-way**
TOTALS	**12.86**	

16 Records Search(es):

Date(s) of ARMS File Review 6-18-09	**Name of Reviewer(s) D. Zamora**	
Date(s) of NR/SR File Review 6-18-09	**Name of Reviewer(s) D. Zamora**	
Date(s) of Other Agency File Review	**Name of Reviewer(s)**	**Agency**

17. Survey Data:

a. Source Graphics ☐ NAD 27 ☒ NAD 83

☒ USGS 7.5' (1:24,000) topo map ☐ Other topo map, Scale:

☒ GPS Unit Accuracy ☒<1.0m ☐ 1-10m ☐ 10-100m ☐>100m

b. USGS 7.5' Topographic Map Name / USGS Quad Code

USGS 7.5' Topographic Map Name	USGS Quad Code
Oscura	33106-D1
Cub Mountain	33105-E8

c. County(ies): Lincoln

17. Survey Data (continued):

d. Nearest City or Town: Oscura and Carrizozo, NM

e. Legal Description:

Township (N/S)	Range (E/W)	Section	¼ ¼ ¼
9 S	9 E	3	Sw, NE, NW. NW, SE, NW
9 S	8 E	36	SE, SE, NE. NE, NE, SE
8 S	9 E	25	SW, SW, NE. SE, SE, NW
8 S	9 E	25	NW, SW, SW.
8 S	9 E	26	NE, SE, SE.
			, , .
			, , .
			, , .
			, , .

Projected legal description? Yes [X] , No [ ] Unplatted [ ]

f. Other Description (e.g. well pad footages, mile markers, plats, land grant name, etc.):

18. Survey Field Methods:

Intensity: ☐ 100% coverage ☐ <100% coverage

Configuration: ☐ block survey units ☐ linear survey units (l x w): ☐ other survey units (specify):

Scope: ☐ non-selective (all sites recorded) ☐ selective/thematic (selected sites recorded)

Coverage Method: ☐ systematic pedestrian coverage ☐ other method (describe)

Survey Interval (m): **Crew Size:** **Fieldwork Dates:**

Survey Person Hours: **Recording Person Hours:** **Total Hours:**

Additional Narrative:

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.): The site's environment is at 6040 ft and consists of juniper hills with clay loamy soils supporting vegetation such as four-wing salt bush, and a few scattered cacti.

20. a. Percent Ground Visibility: **b. Condition of Survey Area (grazed, bladed, undisturbed, etc.):**

21. CULTURAL RESOURCE FINDINGS ☐ Yes, See Page 3 ☐ No, Discuss Why:

22. Required Attachments (check all appropriate boxes):
☒ USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn
☐ Copy of NMCRIS Mapserver Map Check
☐ LA Site Forms - new sites (*with sketch map & topographic map)*
☒ LA Site Forms (update) - previously recorded & un-relocated sites (*first 2 pages minimum)*
☐ Historic Cultural Property Inventory Forms
☐ List and Description of isolates, if applicable
☒ List and Description of Collections, if applicable

23. Other Attachments:
☒ Photographs and Log
☐ Other Attachments
(Describe):

24. I certify the information provided above is correct and accurate and meets all applicable agency standards.

Principal Investigator/Responsible Archaeologist:

Signature ______________________ Date: 4/26/2016 Title (if not PI):

25. Reviewing Agency:
Reviewer's Name/Date

Accepted ( ) Rejected ( )

Tribal Consultation (if applicable): ☐ Yes ☐ No

26. SHPO
Reviewer's Name/Date:

HPD Log #:
SHPO File Location:
Date sent to ARMS:

CULTURAL RESOURCE FINDINGS

[fill in appropriate section(s)]

1. NMCRIS Activity No.:	2. Lead (Sponsoring) Agency:	3. Lead Agency Report No.:
1148953	FHWA	NMDOT CR Technical Series 2015-2/Archaeology Notes 436

SURVEY RESULTS:

Sites discovered and registered:
Sites discovered and NOT registered:
Previously recorded sites revisited (*site update form required*):
Previously recorded sites not relocated ***(site update form required):***
TOTAL SITES VISITED: 3
Total isolates recorded: **Non-selective isolate recording?** ☐
Total structures recorded (*new and previously recorded, including acequias*):

MANAGEMENT SUMMARY: All the sites were excavated following the Data Recovery Plan.

IF REPORT IS NEGATIVE YOU ARE DONE AT THIS POINT.

SURVEY LA NUMBER LOG

Sites Discovered:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)

Previously recorded revisited sites:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)

MONITORING LA NUMBER LOG (*site form required*)

Sites Discovered (*site form required*) **:** **Previously recorded sites** ***(Site update form required):***

LA No.	Field/Agency No.	LA No.	Field/Agency No.	
130331				
114462				
120792				
120973				

Areas outside known nearby site boundaries monitored? Yes ☐**, No** ☐ **If no explain why:**

TESTING & EXCAVATION LA NUMBER LOG (*site form required*)

Tested LA number(s)	Excavated LA number(s)	
130331		
114462		
120792		
120973		

Administrative Summary

In 2009 and 2010, at the request of the New Mexico Department of Transportation (NMDOT) and the Federal Highway Administration (FHWA), the Office of Archaeological Studies (OAS) completed an archaeological testing program at four sites along US 54 between Carrizozo and Three Rivers, in Lincoln and Otero Counties, in the state of New Mexico. The NMDOT, in conjunction with the FHWA, proposed to widen the shoulders and lanes of US 54 between Milepost 107 and Milepost 119.

Originally, three sites (LA 114462, LA 120972, and LA 120973) out of four were recommended for further archaeological excavation, and a data recovery plan was submitted to the NMDOT and the State Historic Preservation Division in 2009. An additional site, LA 130331, on Bureau of Land Management land, was found to require archaeological testing following completion of the Data Recovery Plan. OAS carried out testing at LA 130331 between September 8 and September 11, 2009.

Data recovery at the four eligible sites took place between 2009 and 2010 under Archaeological Excavation Permit No. SE-288, which expired Oct. 19, 2010. LA 114462, LA 120972, and LA 120973 were within the highway right-of-way, on land acquired from private sources. Excavations at LA 130331 took place on Bureau of Land Management (BLM Roswell Field Office) property and were completed under BLM Cultural Resource Use Permit No. 21-8152-10-18, which expired Oct. 13, 2010.

Principal investigator was Robert Dello-Russo. Yvonne R. Oakes and Dorothy A. Zamora served as project directors. About 580.1 cu m of soil were excavated, and 12,212 artifacts and other cultural materials were recovered. A brief description of the the four excavated sites follows.

LA 114462, also known as Oscura Siding, was a historic stop for the Southern Pacific railroad from the late 1880s to the early 1900s. Few remnants at the site were found in the right-of-way; those that were found included several foundations and trash deposits.

LA 120972, or Willow Draw, was one of three prehistoric sites examined. Several pits and a pithouse were uncovered. These features produced a mean calibrated ^{14}C date of AD 890, with evidence of subsequent use of the site around AD 980.

LA 120973, or Carrizozo Flats, contained nineteen pits, four pithouses, and two surface hearths. The site yielded a primary ^{14}C date of AD 880, with minor use also occurring around AD 1000. An outlying pit at the site dated between AD 1670 and 1780 and may have indicated use by the Mescalero Apaches. Several earlier dates were obtained from the other pits and suggested early use of the area for the cultivation of maize and squash and the harvesting of a variety of wild plants.

LA 130331 was a small, Archaic campsite with two hearths in the highway right-of-way. These hearths were radiocarbon dated to 1415 BC.

After completing the data recovery project, three of the project sites (LA 114462, LA 120972, and LA 120973) were determined eligible for the *National Register of Historic Places* under Criterion D. LA 130331 was not eligible.

NMCRIS Activity No. 118953
NMDOT Project No. AC-GRIP-BR-(NH)-054-2 (380107), CN G3a 12
MNM Project No. 41.894 (Carrizozo)
NM Archaeological Excavation Permit No. SE-288
BLM Cultural Resource Use Permit No. 21-8152-10-18

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Appendix 3: Site Location Information

1 ⸸ Introduction

In 2009 and 2010, the Office of Archaeological Studies (OAS) implemented testing and data recovery at four archaeological sites along US 54 (Fig. 1.1) in Lincoln and Otero counties, in the state of New Mexico (Oakes et al. 2009). Work was completed for the New Mexico Department of Transportation (NMDOT) and the Federal Highway Administration (FHWA), which had proposed to replace shoulders and widen the lanes of US 54 from Milepost 107 to Milepost 119, between Carrizozo and Three Rivers.

Fieldwork was initiated at the request of Laurel Wallace of NMDOT. The principal investigator for the project was Robert Dello-Russo. Project directors overseeing archaeological investigations were Yvonne R. Oakes and Dorothy A. Zamora. The alternating field crew consisted of Gavin Bird, Isaiah Coan, Jeff Cox, Lynette Etsitty, Vernon Foster, Susan Moga, Rick Montoya, Virginia Prihoda, Donald E. Tatum, Mary Weahkee, and Karen Wening. Sheila Martin assisted with research on Oscura Siding; Gary Hein supplied photographs of the Willow Springs petroglyph site. Robert Turner, Scott Jacquith, and Melissa Martinez produced the report.

Local residents provided photographs and histories of Oscura Siding including: Helen Shields; Dolly Helms; Johnson Stearns (1987); Dirk Norris; and Susan Gerke. Patsy Sanchez interacted with local media and contacted Richard Bryant, a freelance photographer, who volunteered to take pictures of LA 120973, at a height of 30 feet, with a GigaPan attachment. Paul Baca and the community of Carrizozo provided video equipment and a venue for a town meeting about the sites.

Five sites were originally tested by OAS, but only four were found eligible for further study. Data recovery plans concerning subsequent excavations were prepared for the four sites (Oakes and Zamora 2009). Sites LA 114462, LA 120972, and LA 120973 were on private land within the highway right-of-way. Site LA 130331 was on Bureau of Land Management (BLM Roswell Field Office) holdings and also was within the highway right-of-way. A portion of each site was outside the highway project area.

LA 114462 is in the historic Oscura Siding area along the Southern Pacific railroad tracks. A few foundations and trash deposits remained within the right-of-way. Remains at the site were dated from the late 1800s to the early 1900s. LA 120972 and LA 120973 represent seasonal Jornada Mogollon settlements with storage pits, pithouses, and surface hearths. Both sites were dated to AD 890, with smaller, subsequent occupations possibly occurring around AD 980. An early historic pit at LA 120973, dating between 1670 and 1780, could be related to the Mescalero Apaches' use of the area at that time. LA 130331 is an Archaic campsite in the proposed right-of-way with two hearths dated to about 1415 BC.

The project sites were first recorded by Laura Michalik (2000, 2001) as part of a cultural resource survey for proposed NMDOT highway construction activities. Parsons Brinckerhoff (Kovacik et al. 2000) resurveyed the area for a fiber-optics line and mapped several of the sites. These surveys resulted in the conclusion that three sites (LA 114462, LA 120972, and LA 120973) were eligible for listing on the *National Register of Historic Places* (NRHP; Oct. 15, 1966) under Criterion D. LA 130331 was not eligible.

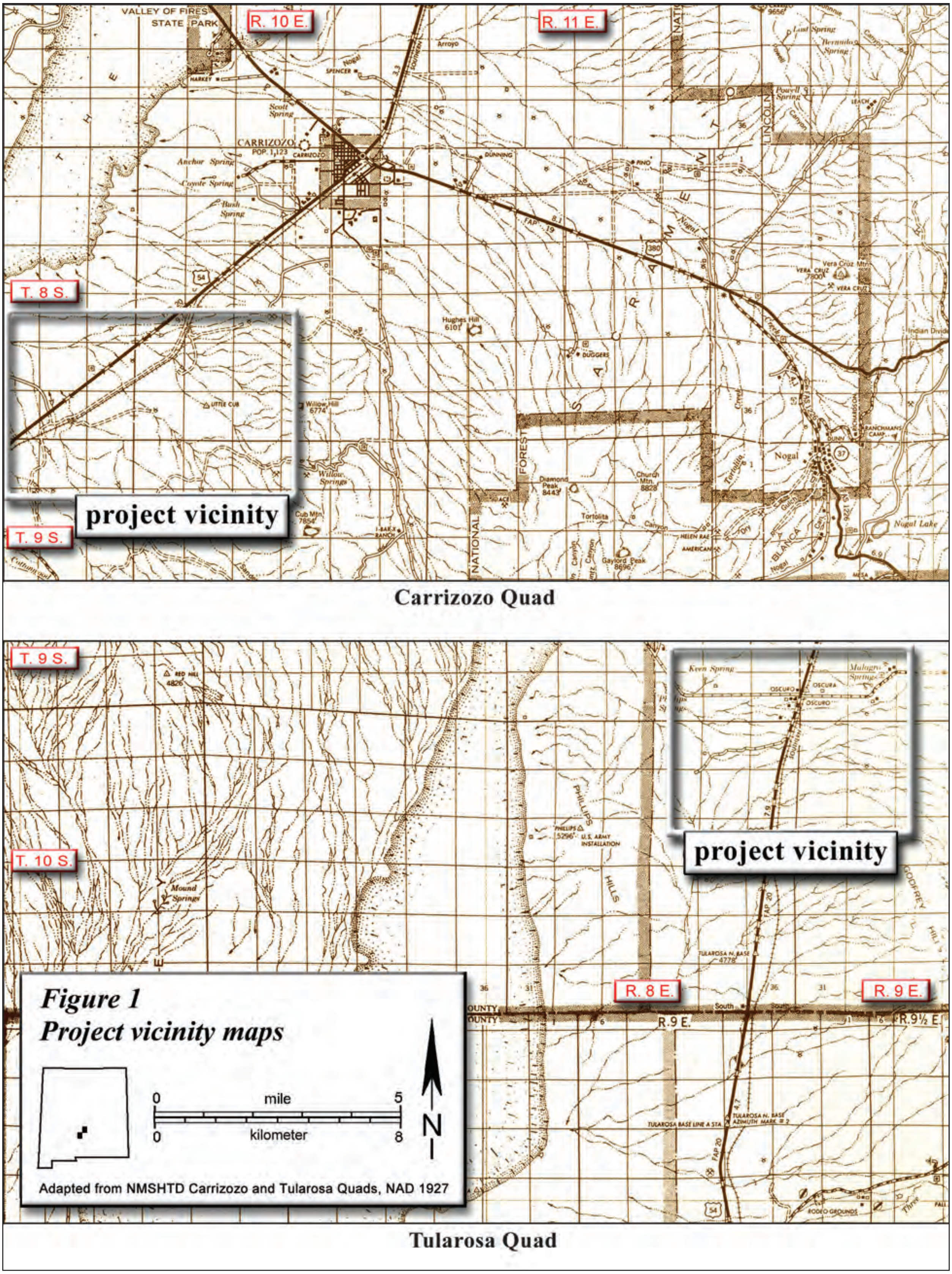


Figure 1.1. Project vicinity map.

2 ⩡ Environmental Setting

Donald E. Tatum

> Nature is seen by men through a screen composed of beliefs, knowledge, and purposes, and it is in terms of their cultural images of nature, rather than in terms of the actual structure of nature, that men act. Therefore…if we are to understand the environmental relations of men [it is necessary] to take into account their knowledge and beliefs concerning the world around them and their culturally defined motives for acting as they do. But…although it is in terms of their conceptions and wishes that men act in nature, it is upon nature herself that they do act, and it is nature herself that acts upon men, nurturing or destroying them. (Rappaport 1971)

Site Setting: Physiography and Geology

Sites excavated by the Office of Archaeological Studies (OAS) are located along the valley floor in the northeastern margin of the Tularosa Basin (Fig. 2.1). The basin, a north–south trending, elongated, endorheic structure, is bordered to the north by the Chupadera Mesa and to the east and west by fault-block mountain ranges.

The western border of the basin is formed by four distinct ranges that rise to elevations as high as 2,733 m (8,965 ft); these include the Franklin, Organ, and San Andres Mountains, as well as the Sierra Oscura.

The basin is bordered to the east by Sierra Blanca Peak, a Tertiary-period volcano, at 3,650 m (11,973 ft); the Sierra Blanca and Sacramento Mountains (Fig. 2.2); the Hueco and Jarilla Mountains; and the rich grasslands of Otero Mesa (DeLorme 1998).

The down-faulted basin, or graben, is an eastern extension of the Rio Grande Rift, a geologic province of the Mexican Highland. This province occupies portions of southeastern Arizona, southern and central New Mexico, the western Trans-Pecos in Texas, and northern Chihuahua.

The northern Chihuahuan Desert is made up of the basin areas of the Mexican Highland province (Hawley 1993). Mantled by 1,000 m (3,280 ft) thick fluvial, alluvial, and eolian deposits derived from sediment transported by ancestral Rio Grande distributaries, the basin represents the easternmost extensional fault of the Rio Grande Rift.

The basin covers an area of about 13,700 sq km (5,289 sq mi) and trends northward some 274 km (170 mi) from its southern terminus at the Hueco and Franklin Mountains (Allen et al. 2009; Hawley 1993).

The Sierra Blanca and Sacramento Mountains border the northeastern portion of the basin and constitute the largest watershed in the area, sustaining permanent wetlands on the valley floor that include critical habitat biomes at Salt Creek, Malpais Spring, and other springs throughout the foothills (Allen et al. 2009).

Malpais Spring contributes to the extensive wetlands at the southern end of the Carrizozo Malpais, about 50 km (31 mi) southwest of LA 120973. Salt Creek flows south about 92 km (57 mi) along the west side of the valley floor and from the southern edge of the Oscura Mountains to Big Salt Lake, about 34 km (21 mi) west of Tularosa.

From the middle Pliocene to the early Pleistocene, the basin's fill sediments were added to by the distributary channels of the Upper Rio Grande (Hawley 1993). By the late Pliocene, the topographic closure and development of the endorheic, depositional environment of the Tularosa Basin had begun and the ancestral Rio Grande made its way east across Fillmore Pass, just south of the Organ Mountains.

The river left a vertically extensive sequence of fluvial deposits that formed the low divide across the southern end of the basin (Allen et al. 2009). The valley became the drainage basin of Pleistocene Lake Otero—a shallow and saline pluvial lake. This

Figure 2.1. The Tularosa Basin, view southwest. The basin is bordered on the north by Chupadero Mesa and on the east and west by fault-block mountain ranges.

Figure 2.2. The Tularosa Basin is bordered to the east by the Sierra Blanca Mountains.

is indicated by the presence of extensive evaporite deposits south of the project area (Allen et al. 2005).

Alluvial deposits had already started to form in the margins of the bolson, in piedmont areas along the western slopes of Sierra Blanca, and near the eastern slopes of the San Andres and Oscura Mountains. Up valley, fluvial and deltaic distributary channels combined, expanding late Pleistocene lakes; thus, the closed-valley, depositional environment matured.

During the early to mid-Holocene, the climate fluctuated between cooler, wetter periods and warmer, drier periods. Cycles of landform stability, vegetation growth, and soil development alternated with erosion, deflation, and mass deposition of clastic sediments that destroyed, buried, or obscured former landforms, surfaces, and soil horizons. Extensive eolian erosion of the valley floor created Alkali Flat, a 420 sq km (162 sq mi) deflation basin at an elevation of 1,185 m (3,888 ft). The lowest portion of the basin formed modern-day Lake Lucero (Allen et al. 2009).

Warmer, drier periods produced extensive clastic, bolson deposits that consisted of alluvial silt, sand, and gravel (Seager et al. 1987; Hawley 1993). These materials had been derived from older, reworked alluvial fans along the margins of the basin and from newer sediments exposed and transported by erosion. Braided stream channels transported sub-angular gravel, sand, and silt; the entrenchment of arroyos and fluvial channels occurred. Evaporation of pluvial-lake waters resulted in deposition of evaporite minerals, including gypsum and selenite.

The erosion of these deposits, and the deflation of fine-grained sediments, resulted in eolian transport and deposition of downwind, dune-forming deposits like the White Sands gypsum dunes. Landslide debris was transported down piedmont slopes, increasing the sediment budget on the valley floor (Allen et al. 2005; Lovelace 1972).

During the mid to late Holocene, approximately 5,400 years ago, the Carrizozo lava flow occurred in the upper valley. Lava made its way south along the basin floor, disrupting fluvial systems and burying springs and small playas (Allen et al. 2005). It is possible that the course of Willow Draw—a prominent drainage descending into the valley from the east—was deflected at least 2 km (1.2 mi) east of its former confluence and was redirected to the basin floor from the western side of the valley, ending several kilometers north of its former outlet at Lake Otero (Hawley 1993).

The depositional history of the bolson resulted in the formation of a diverse geomorphic palimpsest. This accounts for the discontinuous, sometimes confusing stratigraphy in the cut banks of upland arroyos and drainages, as well as the white gypsum sand dunes, evaporite deposits, and playa lakes in the area.

Modern Climate: Precipitation, Temperature, and Growing Season

> Everyone talks about the weather, but nobody does anything about it. (Warner 1897)

Weather and climate are profoundly related to environment and landscape and human health, prosperity, and behavior. Despite human efforts to modify, protect, or alter the environment that comprises our habitat, the seemingly antagonistic, cause-and-response relationship of humankind to climate and environment is one of complete synthesis.

Precipitation quantity and type, temperature, humidity, quantity of frost-free and freezing days, evaporation, and storm patterns have a major impact on human behavior. Agricultural practices—grazing, dryland farming, irrigation farming, and other food-procurement practices—are controlled by the climate. Settlement patterns and the establishment of transportation routes are heavily influenced by weather patterns. Climate is also a determining factor in the establishment of vegetation communities and ecosystems and affects the viability of wild-plant foods, game animals, and fish populations (Calvin 1934; Scurlock 1998).

Human attempts to manipulate natural resources without taking into account meteorological variables have resulted in drastic ecological changes. Consider the grasslands of the southern High Plains and the Tularosa and Jornada Basins—the exploitation of vast, thriving grasslands during the mid to late nineteenth century brought short-term financial gain through grazing but resulted in widespread overgrazing and the depletion of native grasses. The arid landscape, deprived of its protective grass layer, was dramatically altered by wind deflation and erosion. This contributed to the formation of sand dunes and the colonization of the area by desert shrub species (Fredrickson et al. 2005; Allen et al. 2003).

Havstad and Beck (1996) conducted vegetation studies on 144,537 acres (58,492 ha) of land in the Jornada Basin and, after reconstructing land surveyors' notes from 1858, deduced that good grass cover had once been present on more than 90 percent of the study area. By 1963, less than 25 percent of the area had good grass cover, and the basin was occupied instead by honey mesquite, creosote bush, and tarbush, effectively altering the land's ability to support grazing animals.

Another side effect of overgrazing was arroyo cutting, caused by high volumes of runoff from seasonal, torrential rains. Runoff flowed downhill, across a denuded landscape, incising and transporting exposed soil and redepositing it in the valley. This process changed the level of the basin drainage system and resulted in an increase in flooding and erosion (Thornbury 1954).

The climate of the Mexican Highland and the Rio Grande Rift is as variable as the landscape with which it articulates. Climate variability reflects seasonal and daily weather as well as terrain dynamics. The moisture regime ranges from arid to semi-arid, allowing for rapid heat accumulation during the day and rapid heat radiation at night. This process creates pronounced, diurnal temperature fluctuations, from hot or warm summer days and cool summer nights to warm or cool winter days and freezing winter nights. Day and night temperatures fluctuate at least 4.45° C (approximately 40° F) both winter and summer.

Climate variability in New Mexico is robust for several reasons. The state spans six degrees of latitude, and for every degree, the mean temperature can change from 16.9° C to 16.4° C (1.5° F to 2.5° F). The territory also is far from coastal areas, where oceanic currents drive atmospheric currents and moderate humidity and temperature. The area also is close to regions with cooler, moister climates that influence the climate of neighboring regions. Several portions of New Mexico are at moderate or high elevations; for every 328 m (1,000 ft) of elevation gain, the temperature decreases 15.8° C to 15° C (3.5° F to 5° F).

Variations in regional landscapes can result in small-scale climate fluctuations. Two similar landforms a few dozen kilometers apart, on the same geographic parallel, separated by a geomorphically divergent land form, may have seasonally disparate temperatures and rainfall. The result is a localized variation in storm-track patterns similar to what occurs when the lee, or downwind side, of a mountain range receives less precipitation due to the blockage of prevailing weather patterns by a topographic prominence (Tuan et al. 1973; Haugland 2010).

Elevation and topographic variables like the orographic effect can also influence temperatures and precipitation. If a moisture-laden air mass is forced up over the Sacramento Mountains, moisture condenses, at altitude, as precipitation; this results in more rain or snowfall on the windward side of the mountains.

In the Tularosa Basin, the annual precipitation range is between 25.4 cm (10 in) at the central part of the basin and 65.04 cm (26 in) on higher-elevation slopes (Livingston and Associates 2002). Because higher-elevation landforms have lower temperatures and receive higher precipitation, they also have a lower rate of evaporation and are extremely important contributors to aquifer recharge (Newton et al. 2009).

The precipitation regime in the Tularosa Basin is bimodal. Most precipitation occurs in the form of higher-elevation snowfall between December and March and lower-elevation rainfall between July and September, the time of the seasonal North American Monsoon (NAM). The NAM is initiated when moist air from the Gulf of California and the eastern Pacific Ocean is brought into the Southwest by low atmospheric pressure.

An additional source of moisture can come from easterly winds blowing across the Gulf of Mexico. Tropical depressions, storms, and hurricanes originating in the eastern Pacific Ocean or Gulf of Mexico also bring significant rainfall to the Southwest. Mid-latitude frontal storms also contribute rain or snow as they track southeast from the northwest Pacific coast. (Newton et al. 2009).

Large-scale temperature variations in the Pacific Ocean have a major effect on the strength of wet-season storms in the continental United States. El Niño occurs when water off the coast of South America becomes unusually warm, causing winter storms to track further south across North America and increasing the precipitation budget in the

Southwest. In other years, cooler water develops off the South American coast, pushing the winter-storm track further north and decreasing winter moisture.

Precipitation from mountain slopes drains toward the center of the basin in intermittent streams or moves as groundwater through the alluvial sediments below. After reaching the basin's alluvial fans, some runoff infiltrates the water table. The remaining runoff reaches the valley floor where it flows into the basin, coalesces in playas, and evaporates. The gypsic solute derived from valley sediments precipitates into solid deposits. Because snowmelt achieves greater subsurface saturation than fast-flowing monsoonal precipitation, the water table receives more water from winter storms than from summer monsoons (Livingston and Associates 2002).

The mountain ranges and high mesas that make up the boundaries of the Tularosa Basin are regionally proximal but not elevationally disparate; these display considerable variations in average rainfall and frost-free days not only from region to region but from year to year.

In the San Andres Mountains, which border the Tularosa Basin to the west, the average growing season lasts 170 days. The first killing frost occurs around October 20. The last killing frost usually takes place around April 30. The range receives approximately 38.1 cm (15 in) of precipitation each year.

About 65 km (40 mi) east of the San Andres range are the Sacramento Mountains. These mountains receive an average of 77.2 cm (30 in) of precipitation each year; the growing season here lasts 150 days. The first killing frost occurs around October 10; May 10 usually marks the final date of the winter killing freeze.

At the northern end of the Tularosa Basin, Chupadera Mesa receives 35.6–45.7 cm (14–18 in) of precipitation a year. The frost-free growing season starts April 10 and usually ends 180 days later with a killing frost on or around October 15 (Freyberger 2010).

The lowest portion of the Tularosa Basin is Alkali Flat at White Sands National Monument, in the southwestern quadrant of the basin. With a growing season of 220 days, the last killing frost occurs around March 20. Between 1939 and 1999, White Sands received an average of 22.8 cm (9 in) of rainfall per year (Tuan et al. 1973; Freyberger 2010). White Sands is an arid environment in which total evaporation exceeds total precipitation, although Alkali Flat sometimes contains water for several weeks after major precipitation events (Allen et al. 2009; Tuan et al. 1973; Woodmency 2001).

At the northern end of the Tularosa Basin, the Carrizozo Weather Station has recorded precipitation and temperatures since 1914. Between 1914 and 2005, the weather station recorded an average annual rainfall of 33 cm (12.9 in). Average annual rainfall from July to September, for the 91-year span, was 16 cm (6.24 in), according to the Western Regional Climate Center (2010).

Oscura Siding Weather Stations No. 1 and No. 2 maintained precipitation records between 1908 and 1920. Between 1908 and 1920, Oscura No. 1, at an elevation of 1,542 m (5,060 ft), recorded an average annual rainfall of 27 cm (10.74 in); precipitation from July to September, for the same time span, was 12 cm (4.77 in) per year. Between 1909 and 1920, total annual rainfall for the Oscura No. 2 station, at 1,529 m (5,016 ft), was 25 cm (9.78 in). Average precipitation each year from July to September, for the 11-year span, was 12 cm (4.65 in). It is interesting to note than the lower-altitude station recorded less rainfall. (Gabin and Lesperance 1977; Woodmency 2001). The Oscura stations did not keep temperature records.

Without controlled irrigation the ability to sustain agriculture depends on spatial and seasonal dynamics. The variability of topography, of seasonal and daily temperature fluctuations, of rainfall amounts, and of long-term climate cycles contributes to a semi-arid agricultural environment in which growing conditions are marginal at best, even during more favorable seasons.

Vegetation communities show such conditions have been the norm since the mid-Holocene advancement of xeric-adapted plant and animal species. Examples from the plant and animal kingdom were summarized in the following studies.

In a multi-decade bioassay of plant-community microhabitat ecotones in the Chihuahuan Desert, Neilson (1987) determined that systematic spatial and temporal shifts in weather are related to the establishment, composition, and structure of vegetative communities. The study examined plant communities established at the end of the Little Ice Age, which occurred intermittently from the mid-sixteenth to mid-nineteenth centuries; during a 40-year warming trend, from the early to mid-twentieth century; and during a 30-year cooling trend, from the mid- to late twentieth century. The study indicated that differing climatic regimes have distinct annual weather patterns relative to the establishment of different plant communities. Temporal oscillations between climatic regimes promote the development of different life forms but do not necessarily lead to their local extinction. The study identified the ecotonal dynamic between the Chihuahuan Desert and adjacent biomes as related to large-scale, air-mass dynamics contingent upon seasonal jet-stream oscillations. Weather patterns determining ecotone position appeared directly related to seasonal, topographic influences on atmospheric circulation.

Another study examined temporal changes in a Chihuahuan Desert rodent community in response to climatic variability. Brown and Heske (1990) analyzed 10 years of monthly census data for differing patterns of intra-annual behavioral among 11 species of rodents. The study revealed that some cross-species behavioral traits were responsive to climate variations. Regarding the availability of food, the population densities of four of these species as well as the rodents' total biomass and numbers, correlated positively with annual plant density. The analysis also revealed independent patterns of variability in species composition. Final results revealed a long-term trend: a four- to five-year pattern that seemingly corresponded to the effects of El Niño and reflected similar responses to fluctuating resources.

Paleoenvironment and Dendroclimatology

Numerous paleoclimate-related studies have been conducted in the Mexican Highland area and its surrounding environs. From these investigations, the paleoclimate history of the area can be inferred. Regionally and temporally specific paleoclimate data have been derived from packrat-midden palynology and plant-macrofossil studies in the Sacramento, San Andres, and Hueco Mountains of New Mexico and Texas; in the Jornada Basin; and on Otero Mesa (Betancourt et al. 1990; Van Devender and Spaulding 1979; Holmgren et al. 2003).

Speciation studies of fossil insects extracted from packrat middens in the northern Chihuahuan Desert have provided additional insight into climate change during the transition from the early to late Holocene (MacKay and Elias 1992). Studies of Holocene alluvial fan deposits in the Organ and Sacramento Mountains (Frechette and Meyer 2009; Gile 1987; Hawley 2003) and of deflation and lag deposits at Fort Bliss (Monger 1993) also contributed to paleoclimate knowledge of the region.

Other geochronological evidence that supports climate change over time included sedimentation studies of pluvial and perennial lake basins in southern and central New Mexico and northern Mexico (Allen et al. 2009; Allen 1994; Castiglia and Fawcett 2006; Gile 2002; S. Hall 2001; Hawley 2003). Stable carbon isotope and soil geomorphology clues have been used as paleo-vegetation indicators to identify and date major climate shifts in the northern Chihuahuan Desert (Buck and Monger 1999; Monger 1993).

The most time-specific, chronologically detailed studies with implications for the recent Holocene in the Mexican Highland area included dendroclimatology data obtained from living, old-growth wood samples from El Malpais National Monument and from the San Andres, Organ, Oscura, Sierra del Nido, and Gallinas Mountains (Stahle et al. 2009; Parks et al. 2006; Grissino-Mayer 1996; Dean and Robinson 1977).

Speleochronology studies also have gleaned correlatable, high-resolution data from the late Pleistocene to the late Holocene (Brook 1999; Polyak et al. 2001). Poore et al. (2005) used comparisons of sedimentation rates and the relative abundance of planktonic foraminifer *Globigerinoides sacculifer* in cores from the Gulf of Mexico with dendroclimatology records as corroborative proxy indicators of the southwestern monsoon (Mann et al. 1999).

Regional Paleoclimate Overview

Some of the more extensively documented climate events—as related to the Tularosa and Jornada basins and the eastern Mexican Highland—were major climate shifts during the late Pleistocene and early to mid-Holocene. These events caused wide-ranging effects across much of North America.

Many climate processes that contributed to environmental conditions in these regions were rooted in the Wisconsin Glacial Episode—the most recent glacial maximum in North America. Based on studies of Pleistocene lake expansion, as indicated by relict shorelines and changes in sedimentary facies at Lake Otero and Lake Estancia, the Wisconsinan interval ended about 18,000–16,300 years ago (Allen 2005; Allen et al. 2009).

Studies of packrat-midden pollen and fossil insect assemblages (*coleoptera* and *hymenoptera*) from the northern Chihuahuan Desert indicated that, from about 42,000 years ago until about 12,875 years ago, the climate in this area was more mesic than today. During the late Pleistocene, average summer temperatures for the region were estimated to have been about 1° C to 4° C (33.8° F to 39.2° F) lower than present day (Brackenridge 1978; Hawley 1993; MacKay and Elias 1992; Mehringer and Haynes 1965; Phillips et al. 1986; Sebastian and Larralde 1989; Wendorf and Hester 1975).

Fossil pollen studies in the region indicated that piñon/juniper/oak woodlands dominated upland slopes. Shrubs, including sage, steppe grass, and sparsely scattered, non-coniferous trees, grew on lowland landscapes (Betancourt et al. 1990; MacKay and Elias 1992; S. Hall 2001; Holliday 1987; Van Devender et al. 1984).

The presence of *cienega* and spring deposits dating to the late Pleistocene indicated there was more surface water than there is at present (S. Hall 2001). Perennial and pluvial lakes occupied closed-playa basins in the southern High Plains and the ancestral Rio Grande Valley of southern New Mexico. Wetlands and shallow lakes first developed on the valley floor of the Tularosa Basin around 49 kya, or 49,000 years ago.

About 35,400 years ago, wetlands and lake systems supported dense stands of emergent aquatic vegetation, attracting Pleistocene mammals as indicated by fossiliferous plant fragments and mammalian skeletal remains and footprints preserved in fine-grained gypsum deposits (Allen et al. 2005, 2009; Allen 1994; Gile 2002; Holliday et al. 2008; Hawley et al. 1976; Lucas et al. 2002, 2007; Morgan and Lucas 2002, 2005).

Geochronology studies of the depositional facies of three lakes in the region indicated that lake freshening occurred repeatedly, starting around 29.3 kya (29.3 thousand years ago) at Lake Otero, in the Tularosa Basin; around 28.7 kya (28.7 thousand years ago) at Lake Estancia, just north of the Tularosa Basin; and around 27.6 kya (27.6 thousand years ago) at Lake King in the Salt Basin, southeast of the Tularosa Basin (Allen and Anderson 2000; Allen et al. 2005, 2009; Allen 1994; Gile 2002; Hawley et al. 1976). This time frame was consistent with playa high stands across western North America during the late Wisconsinan interval (Polyak and Asmerom 2005; Smith and Street-Perrott 1983).

Sedimentation records indicated periods of drought and minimization of lake pooling. At Lake Estancia, a severe drying period occurred between 18,100 and 16,340 years ago, when the lake shrank to its minimum size. Lake Otero may have dried up completely. Wind deflation and erosion either obliterated or obscured the sediment record from this time, and any subsequent mesic-period deposits would probably have been inset in the eroded areas.

At Llano Estacado, sedimentation rates—based on ^{14}C date extrapolation at White Lake—indicated desiccation around 16,400 years ago (S. Hall 2001). The lake-sediment record of a drought occurring between 18,100 and 16,340 years ago has been corroborated by groundwater isotope studies in northwestern New Mexico that inferred a short period of higher temperatures (+3° C, or +37° F, higher than the rest of the late Wisconsinan interval) and decreased precipitation between 20,000 and 17,000 years ago (Phillips et al. 1986).

Two additional periods of pluvial expansion, between 16,340 and 14,480 years ago, were indicated in the Lake Estancia sediment record. Magnetic-susceptibility measurements recorded in sediments from Hall's Cave on the Edwards Plateau in Texas indicated a period of milder temperatures and increased rainfall. This mesic interval correlated with an influx of fresh water from melting Northern Hemisphere ice shelves (Heinrich Event H1).

The reduced salinity of seawater resulted in changes to oceanic currents, atmospheric temperatures, and weather patterns (Maslin et al. 2001), indicating a climatic event of global proportions. Event H1 has been geochronologically dated to between 16.5 and 17.5 kya (Ellwood and Gose 2006). The termination of the cooling period around 17,000 years ago signaled the transition from the mesic Wisconsinan interval to a more xeric, post-glacial period in the late Pleistocene and early Holocene.

In the eastern Mexican Highland and Basin and Range areas, fossil insects and plant and pollen evidence from packrat middens indicated the full-glacial Wisconsinan interval was followed by successively warmer and drier intervals alternating with multi-decadal periods of greater effective moisture, cooler temperatures, and diminished evaporation (Van Devender and Spaulding 1979;

Betancourt et al. 1990; Hawley 1993; Holmgren et al. 2003).

Similar short-term, cool, wet weather cycles have been linked to Pacific Decadal Oscillation and El Niño-Southern Oscillation (ENSO) climate cycles, as well as to related southward shifts of winter-storm tracks (Asmerom et al. 2007; Castiglia and Fawcett 2006; Collier and Webb 2002; Rasmussen et al. 2006).

About 14.5 kya, or 14.5 thousand years ago, the first xeric-adapted ant species appeared on the Mexican Highland (MacKay and Elias 1992). Sedimentation rates in drainages leading to playas increased shortly thereafter, indicating that increasing sediments from drying playa basins were being redeposited into drainage channels (S. Hall 2001; Holliday et al. 2008). Piñon began to disappear from lower-elevation woodland assemblages and retreated to the highlands, leaving oak, juniper, and desert-adapted grasses to take over (Van Devender and Spaulding 1979; Van Devender 1990).

Younger Dryas

During the Folsom period, in the late Pleistocene, the warming, drying climate returned to near-glacial conditions (Haynes 2008). This dramatic climate shift, known as the Younger Dryas, lasted from about 12.9 kya–11.2 kya. Sediment records from the Lake Estancia basin indicate renewed lake freshening between 12.9 kya and 11.5 kya.

It has been theorized that this cooling episode was the result of a glacial meltwater pulse, from a thawing Antarctic ice sheet, which caused the sea level to rise about 20 m (66 ft). This influx of fresh water altered the flow of the salinity currents in the North Atlantic Deep Water (NADW) formation, warmed the North Atlantic region, and triggered the Bolling-Allerod interstadial around 14.6 kya. This meant the end of the Wisconsin Glacial Episode and the melting of the Fennoscandian and Laurentide ice sheets. The NADW response spurred the Younger Dryas cooling event in the Northern Hemisphere (Weaver et al. 2003).

The Younger Dryas saw a 900-year period of climatological vacillation during the Clovis-Folsom transition. The Folsom period saw fluctuating water levels in playas and marshes and the start of sand-sheet deposition in upland areas (Holliday 2000).

These cooling episodes were accompanied by the resurgence of higher precipitation levels and the recharging of aquifers. Favorable rainfall led to the re-emergence of wetlands and cienegas, environments conducive to riparian plant growth. Wetland and cienega deposits are dark, organically enhanced, sometimes-peaty deposits that have been recorded across North America. These deposits can be associated with the Younger Dryas period but are sometimes Holocene related.

Younger Dryas-aged deposits are referred to as black mat deposits (Haynes 2008). These are sometimes immediately underlain and overlain by eolian silt or fine-sand facies indicative of warmer, drier depositional environments. The stratigraphic sequence represents more-xeric climate conditions, which prevailed after the end of the Wisconsinan interval and during the sudden onset of Younger Dryas cooling. This was followed by an abrupt shift back to more-xeric conditions.

When present in Clovis-period deposits, black mat deposits may signify the end of Clovis culture and the demise of many *Rancholabrean* faunal species (Firestone et al. 2007; Haynes 2008; Polyak et al. 2004; Stuiver et al. 1995; Taylor et al. 1997).

In the Mexican Highland, and its adjacent environs, some extinct paleofauna were represented in the faunal assemblage from Pendejo Cave—in the western foothills of the Sacramento Mountains. These were examined by Harris in 2003. The assemblage included *Equus spp.* (horse), *Capromeryx* (midget goat), *Stockoceros* (Stocks pronghorn), *Coragyps occidentalis* (Western vulture), *Hemauchenia* (lamine camelid), *Camelops* (camel), and *Aztlanolagus agilis* (hare).

Scharbaauer Interval

After the Younger Dryas, the climate in the southern High Plains and the northern Chihuahuan Desert, continued to warm and dry out from 11.2 kya—10.2 kya; this period was known as the Scharbaauer Interval (Wendorf and Krieger 1959; Sebastian and Larralde 1989).

Piñon and juniper disappeared from lowland areas (Holmgren et al. 2003) and moved further upslope to the highlands (Sebastian and Larralde 1989). As a result of the increased eolian movement of sediment, soil deflation occurred, creating accretions of coarse-grained particles known as lag deposits. These deposits were dated to this period (Monger 1993).

Lubbock Subpluvial

Around 10.9 kya, the region experienced increasing rainfall and cooler temperatures during a period that would become known as the Lubbock Subpluvial. Pollen preserved in packrat middens indicates a brief re-advance of piñon and juniper into lowland areas (Betancourt et al. 1990; Sebastian and Larralde 1989).

Working in caves in the Guadalupe Mountains, climate researchers conducted geochemical and geochronological tests to measure the growth of oxygen-stable isotope concentrations and speleothems over time. Asmerom and Polyak (2004) and Asmerom and Polyak et al. (2007) recorded resurgence in speleothem growth between 11.1 kya and 10.8 kya.

Stratigraphic associations at the Blackwater Draw and Lindenmeir sites, and at other locations on the southern High Plains, indicated that the climate continued to fluctuate between pluvial and increasingly arid intervals. Marsh and pond deposits with thin, discontinuous eolian layers indicate climatic vacillation between 10 kya and 7.5 kya. Eolian deposits dating from 7,500–4,500 years ago revealed a lengthy period of xeric conditions that marked the beginning of the Holocene Altithermal (Haynes and Agogino 1960; Holliday 1995).

Altithermal Period

In the mid-Holocene, the southern High Plains and Llano Estacado experienced long-term drying and warming conditions during a time known as the Altithermal Period (Antevs 1948, 1952; Holliday 1989; Meltzer 1991).

Eolian reworking of playa-basin sediments continued as lake replenishment slowed (Allen et al. 2005, 2009; Holliday et al. 2008; Langford 2002). Drought-related accretionary lag deposits and erosional alluvial fans dating to this time have been recorded at Fort Bliss and in the Organ Mountains (Monger 1993).

More xeric-adapted plant and animal species appeared in the southern High Plains and the northern Chihuahuan Desert in the time leading up to modern climate regime about 4,000 years ago (Elias 1987; Holmgren et al. 2003). Pollen records indicate that the final demise of the late Wisconsin Glacial Episode happened during this period (Betancourt et al. 1990). Desert-grass species continued to thrive in a territory previously dominated by piñon, juniper, and oak; this was followed by the arrival of Chihuahuan Desert scrub vegetation (Buck and Monger 1999).

Xeric-adapted ant species began replacing more mesic species (MacKay and Elias 1992), and, perhaps for the first time on the southern High Plains since the Clovis period, people began digging wells to replace surface-water sources. Period wells have been recorded near former playas, springs, and valley floor streambeds at Blackwater Draw, NM, and at Mustang Springs in Texas (Meltzer and Collins 1987; Meltzer 1991).

Charcoal-rich alluvial fans in the Sacramento Mountains—dating between 5.8 kya and 4.2 kya—indicated episodic forest fires and slope failure during the Altithermal (Frechette and Meyer 2009). This period was punctuated by increasingly mesic intervals. Castiglia and Fawcett (2006) recorded the mid-Holocene (approximately 7 kya–7.6 kya) development of constructional beach ridges at Laguna El Fresnal and Laguna Santa Maria and at closed-playa basins to southwest of Jornada.

Poore et al. (2005) compared the relative abundance of the planktic foraminifer *Globigerinoides sacculifer* in sediment cores from the Gulf of Mexico to the relative abundance of packrat middens as indicators of the summer monsoon in the southwestern United States. *G. sacculifer* increased in abundance in gulf sediments during an enhanced monsoon. Conversely, packrat middens, having been found unstable and susceptible to damage by insects, decreased in abundance during enhanced monsoon periods (Spaulding et al. 1990).

Research indicated enhanced monsoonal activity during the time of pluvial lake enhancement recorded for Laguna El Fresnal and Laguna Santa Maria sub-basins. Speleoclimatology data from caves in the Guadalupe Mountains provided correlative proxies of increased effective rainfall during the mid-Holocene. Asmerom et al. (2007) recorded a resurgence of speleothem growth around 7.27 kya.

Neoglacial and Post-Neoglacial Periods

Numerous proxy records including stalagmite-growth and stable oxygen-isotope records from speleothems in Guadalupe Mountain caves; dendroclimatology records from northern Mexico and central and southern New Mexico; and sediment cores from the Gulf of Mexico have provided a somewhat correlative and chronologically specific, sub-decadal record of the climate during the mid to late Holocene.

Tree-ring records from El Malpais National Monument, on the southeastern edge of the Colorado Plateau (the El Malpais Long Count), begin around 136 BC. Dendrochronology records from the Sierra del Nido Mountains, in north central Mexico; the Gallinas, Organ, Sacramento, Oscura, and San Andres Mountains; and the Sevilleta National Wildlife Refuge in southern New Mexico, begin in the late sixteenth century and continue through the mid to late seventeenth century.

Marine-sediment cores from the Gulf of Mexico provided data from the early Holocene on and revealed an overall drying trend, with lower effective precipitation after 7000 BC, with multi-decadal and multi-century periods of increased precipitation (Polyak et al. 2001; Betancourt et al. 1990; Grissino-Mayer 1996; Stahle et al. 2009; Poore et al. 2005).

Some climatic researchers place the final establishment of the modern climate regime in the Mexican Highland area as occurring about 3,000–4,000 years ago. Beginning around 4,000 years ago, another cycle of slightly moister, cooler weather took hold. Researchers have recorded magnetic susceptibility variations from about 4.4 kya in Hall's Cave sediments and have linked these variations to a North American climate event described as the Neoglacial period (Ellwood and Gose 2006). During the Neoglacial, a resurgence of alpine glacial activity occurred in the North American Cordillera (Pielou 1991; Wood and Smith 2004).

The contemporaneous formation of constructional, playa beach ridges from 4.2 kya–4.8 kya coincided with playa lake level high stands in the northern Chihuahuan Desert and provided corroborative evidence for a mesic interval, this time during the Neoglacial (Castiglia and Fawcett 2006).

Goodfriend and Ellis (2000)—in a study of stable carbon isotopes from the shells of gastropods recovered from Hinds Cave on the southern High Plains—recorded a period of progressively moister conditions dating to the onset of the Neoglacial. Geomorphology and geochemistry studies in the Tularosa Basin revealed geomorphic surfaces with stable, pedogenic carbonate isotopes dating to the Neoglacial, between 4 kya and 2.2 kya (Buck and Monger 1999).

Asmerom et al. (2007) recorded low, stable, oxygen-isotope signatures that corresponded to an increase in speleothem development during the Neoglacial. Post-Neoglacial speleothem growth data compared favorably to speleothem growth data from the recent Holocene. Lengthy intervals of slightly more mesic conditions interrupted by intervals of true drought were indicated.

A mid-Holocene pluvial started around 7 kya and continued until about 4.6 kya. This was followed by a 1,300-year period of decreased annual precipitation. About 3.3 kya, more-pluvial conditions returned to the Guadalupe Mountains area, lasting another 200 years. Decreased moisture and increasingly arid conditions returned for another 300 years. Pluviality returned about 2.8 kya, remained for half a millennium, and was followed by the onset of further aridity in 340 BC.

According to speleothem data, this less-mesic interval lasted until 10 BC (Asmerom et al. 2007). The final decades of the interval were revealed in dendrochronology records from the El Malpais Long Chronology, which showed that the effects of this interval seem to have persisted several more decades (Grissino-Mayer 1996). Another pluvial record appeared in speleothem growth data during the first decade AD and persisted until about AD 265. This period was reflected in the El Malpais chronology, as was the xeric period that follows. Stalactite records showed this period continuing until about AD 470.

Tree-ring chronology indicated a period of near-perfect drought lasting between AD 250 and AD 500 punctuated by brief pluvial intervals lasting several years with most decades being sere. This dry period was also apparent in sediment-core records from the Gulf of Mexico (Poore et al. 2005).

One notable period of reduced tree-ring growth apparent in the El Malpais record was not reflected in the stalactite record; this may be due to small-scale, regional-climate variations or the fact that the events affecting tree-ring growth had little effect on speleothems. The years AD 536–543, AD 560–570, and AD 577–585 showed markedly reduced tree growth at El Malpais.

Tree-ring chronologies from three old-tree sites in Colorado—Almagre Mountain 1, Almagre Mountain 2, and Mount Goliath—indicated a time of greatly reduced growth spanning three to four decades during the same period. Historic accounts and dendroclimatic evidence from Europe indicate a major climate event around 536 AD, which inhibited vegetative growth. Baillie (1994) has referred to the event as a "dust veil" thought to have been the result of a major volcanic eruption or of the collision of a cosmic object with the Earth (Larsen et al. 2008).

The so-called Medieval Warm Period may be evident in the stalagmite record as a period of reduced speleothem development occurring between AD 1047 and AD 1180. This somewhat-xeric interval also appears in the El Malpais Long Chronology, although it has been intermittently punctuated by several multi-year pluvial periods.

Another lengthy xeric period with pluvial intermissions occurred in the early to mid-fifteenth century, according to El Malpais dendrochronology records, gulf-sediment cores, and stalagmite-growth data (Poore et al. 2005; Grissino-Mayer 1996; Polyak et al. 2004).

Also evident in gulf-sediment cores and several dendroclimatology records—including the El Malpais tree-ring record, the Sierra del Nido record, the Gallinas Mountains record, and the Organ Mountains record—was the AD 1660–1670 drought believed to have contributed to the abandonment of the Salinas pueblos and other cultural upheavals (DeMenocal 2001; Stahle et al. 2009; Parks et al. 2006; Poore et al. 2005; Grissino-Mayer 1996).

Parks et al. (2006) contributed additional dendroclimate data from tree-ring samples collected in Sevilleta National Wildlife Refuge near Socorro, from Chupadera Mesa, and from Mountainair, NM. The evidence from these samples indicates a xeric interval spanning about a decade beginning around 1660. This dry period was not quite as apparent in speleothem data, although a xeric blip did occur in the record around AD 1680. This could be because the mid- to late seventeenth century drought lasted only 10 years and the sampling interval for the speleothem was 32 years (Asmeron et al. 2007).

Major historic, xeric-climate episodes visible in previously cited dendroclimatology records and in Gulf of Mexico sediment core records indicated a mid-eighteenth century drought and a mid-twentieth century interval of significant drought, which were documented in dendroclimate studies conducted in Northern Mexico by Cleaveland (2006) and Villanueva et al. (2006).

Spanish colonial settlers and religious officials recorded eighteenth-century drought episodes as the cause of mass livestock die-offs, river desiccation, and cultural-abandonment events in northern Mexico and the area that is now Texas. The drought from 1950–1960 also had disastrous effects on the trans-Pecos and borderlands regions (Cleaveland 2006; Holden 1928; Villanueva et al. 2006).

Major pluvial periods with implications for human occupation and adaptation in the Mexican Highland have been documented through dendroclimatology research and can be correlated with Gulf of Mexico sediment cores and, to a lesser extent, with speleothem stable isotope research.

Some lag between the appearance of a pluvial period in annular tree rings and its appearance in the annular rings of stalactites was apparent, possibly because of a delay between the onset of the pluvial event, the rate of rainfall absorption into the ground, the dissolution of calcium carbonate, and the occurrence of mineral deposition and resolution on the speleothems.

Based on gulf-sediment cores, an abundance of *G. sacculifer* forams, the absence of packrat middens, and annular tree-ring growth, major pluvial events of multi-decadal duration occurred from the late second to mid-third century AD, the late sixth to mid-seventh century AD, the early to mid-eleventh century, and from AD 1825 to the 1920s.

The last pluvial event reached its peak around the turn of the nineteenth century. Monsoonal indicators from Gulf of Mexico sediment core records suggest this was the strongest pluvial period since the late fifteenth century (Poore et al. 2005). Scurlock (1998) compiled documentation of 13 major-to-moderate floods, with flows of 10,000 cu ft per second or more, between 1890 and 1911. Tree-ring records from El Malpais and from the Oscura, Sierra del Nido, Gallinas, and San Andres Mountains indicated a pluvial period beginning around 1890 and continuing through the 1910s.

Paleoresources

The USDA Forest Service Ecological Classification and Mapping Task Team (ECOMAP) was formed to provide forest managers with basic classification tools to assist in the definition, mapping, and description of parcels of the environment with increasingly uniform ecological potentials.

Biotic Zones and Vegetation

Ecological types are classified and ecological units mapped by determining biotic and environmental factors that directly affect or indirectly express energy, moisture, and nutrient gradients. These factors include climate, physiography, water, soil, air, hydrology, and natural communities (McNab and Avers 1994).

Using this classification system, Middle Rio Grande Rift Zone sub-basins are classified as the Central Rio Grande Intermontane ecological section of the Basin and Range sub-region.

The Sacramento Mountains fall under the Sacramento Manzano section of the Basin and Range sub-region, while the San Andres, Oscuro, Organ, and Franklin ranges also fall under the Basin and Range sub-region.

The North American classification of biotic communities (Brown 1994) is based on Merriam's life-zone concept (1898) and on the geography-based system of North American biotic provinces of the ECOMAP system. Biomes, or biotic communities, are described by distinctive vegetation physiognomy occurring within a biotic province.

Biotic communities represent the response of living organisms to climate; actual boundaries are defined by elements of the environment as influenced by climate, slope exposure, elevation, soil porosity, longitude, solar exposure, and more. Combinations of these factors contribute to biodiversity and result in the existence of multiple biomes in one ecological section, sub-region, or biotic province (Brown 1994).

The Central Rio Grande Intermontane ecological section is an arid to semi-arid biotic province, which encompasses the floor and lower *bajada* of the Tularosa and Jornada Basins. These basins either flank the Rio Grande River or are included in the Rio Grande Rift geologic province.

The most prolific biotic community includes Chihuahuan Desert scrub that occupies elevations 1,100–1,500 m (3,600–5,000 ft) above sea level (The Nature Conservancy 2010; Brown 1994). Dominant species in the Chihuahuan Desert Scrub community include: creosote bush (*Larrea tridenta*); honey mesquite (*Prosopis glandulosa*); four-wing saltbush (*Atriplex canescens*); sand sage (*Artemisia filifolia*); broom snakeweed (*Guitierrezia sarothrae*); cane cholla (*Opuntia imbricate*); various species of prickly pear cactus; and soaptree yucca (*Yucca elata*). Also common along the roadsides and in disturbed or eroded areas are coyote gourd (*Cucurbita palmata*) and Russian thistle (*Salsola* sp.). Species of potential economic importance in the Chihuahuan Desert Scrub biome include: prosopis; atriplex; yucca; prickly pear; and plants in the genus *Chenopodium* sp. and *Amaranthus* sp. (Brown 1994; Bowers and Wignall 1993).

At LA 120973, the Chihuahuan Desert Scrub community encompasses Willow Draw, an arroyo riparian biome that bisects the basin floor. Desert willow (*Salix* sp.) is one of the dominant species here, along with cottonwood (*Populis* sp.), littleleaf sumac (*Rhus microphylla*), Apache plume (*Fallugia paradoxa*), and hackberry (*Celtis* sp.) (Dick-Peddie et al. 1993).

The upper reaches of the Chihuahuan Desert Scrub biome are more variable than the rest of the valley floor and receive more rainfall. There is a greater variety of vegetation, enabling some species to become established in these microhabitat ecotones (Brown 1994; Neilson 1987). Upslope areas are able to host a variety of scrub community plants, including leaf and stem succulents, cacti, and large, woody shrubs.

At the upper limits of the desert scrub community, ecotone-inhabiting species grade into semi-desert grassland species. The elevation range of this community can extend as high as 1,900 m (6,232 ft). Desert scrub species occasionally intermingle with semi-desert grassland species, especially in areas where overgrazing, deflation, and erosion have taken a toll on grassland species and have allowed shrub species, like the one-seed juniper (*Juniperus monosperma*) and mesquite (*Prosopis* sp.), to co-dominate.

This trend has impacted the viability of grassland-adapted animal species, drastically reducing their numbers. Consequently, the range of scrubland and shrubland adapted species—like javelina and mule deer—has increased (Briggs et al. 2006; Fredrickson et al. 2005; Allen et al. 2003; Havstad and Beck 1996; Brown 1994).

Dominant semi-desert grasses include bunch grasses and sod grasses like curly mesquite (*Hilaria belangeri*), black grama (*Bouteloua eriopoda*), slender grama (*Bouteloua filiformis*), chino grama (*Boutelous breviseta*), three-awn (*Artisida* sp.), and others. Black grama and tobosa are the most diagnostic grasses of the semi-desert grassland (Brown 1994; Bowers and Wignall 1993).

The lower range of the Great Basin conifer/woodland biome sometimes overlaps with the upper range of the semi-desert grasslands, forming savanna- and park-like landscapes with shrub and grass understories.

The dominant woodland biome, between 1,500 m and 2,500 m (4,900 and 8,050 ft), is *Pinus edulis-Juniperus monosperma*, or piñon/juniper, forest. Subdominant shrub species include: cliff rose (*Cowania mexicana*); Apache plume (*Fallugia paradoxa*); barberry or algerita (*Berberis fremonti* or *haematocarpa*); and four-wing saltbush (*Atriplex canescens*). Species of potential economic importance here are *Pinus edulis*, red raspberry (*Rubus idaeus*), Western chokecherry (*Prunus virginiana*), skunkbrush (*Rhus aromatica*), Oregon grape (*Mahonia repens*), white snowberry (*Symphoricarpos albus*), and New Mexico locust (*Robinia neomexicana*).

The higher-elevation biome receives more precipitation, particularly snowfall; hence, woodland species are more adapted. Freezing temperatures occur at least 150 days a year in the northern portion of the range.

In the southern part of the Tularosa Basin, the dominant Great Basin conifer woodland species, *Pinus edulis* and *Juniperus monosperma*, have been replaced by Madrean, evergreen woodland species. Alligator juniper (*Juniperus deppeana*), gray oak, Emory oak, and Arizona oak (*Quercus* sp.) dominate.

At the upper reaches of the Great Basin, conifer and Madrean evergreen biomes and the oak/juniper/piñon forests fasciate with *Pinus ponderosa*, Gambel oak (*Quercus gambelii*), and New Mexico locust (*Robinia neomexicana*.

This evergreen-dominated biome extends to elevations of almost 3,050 m (9,532 ft) on slopes with a southerly aspect; Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), limber pine (*Pinus flexilis*), and aspen (*Populus tremuloides*) inhabit the upper reaches.

In the ponderosa pine-dominated, lower tier of the Rocky Mountain evergreen forest grow understory plants of potential economic importance, including: Gambel oak; currant and gooseberry (*Ribes* sp.); blue and velvet elderberry (*Sambuscus* sp.); smooth sumac (*Rhus glabra*); dandelion (*Taraxacum officinalis*); and wild strawberry (*Fragaria ovalis).*

Petran Subalpine Conifer Forests can grow at elevations as low as 2,450 m (8,036 ft), in colder, moister sites, like steep canyons with a northerly aspect. The upper reaches of Petran Subalpine Conifer Forests extend to the timberline, approximately 3,500–3,800 m (11,480–12,464 ft), depending on forest latitude. Dominant tree species include the Engelmann spruce (*Picea engelmanni*) and the subalpine fir (*Abies lasiocarpa)* and, in more southerly ranges, the corkbark fir (*Abies lasiocarpa var. arizonica*). Subalpine forests can receive an excess of 1 m (3.28 ft) of precipitation each year. Here, the growing season lasts less than 75 days; late and early frosts are not uncommon.

At lower elevations, aspen colonize disturbed areas, especially burn sites, where blue spruce (*Picea pungens*) grow alongside Engelmann spruce. Other deciduous trees present in more sheltered, wetter areas include the Rocky Mountain maple (*Acer* gl*abrum*), Bebb and Scouler willow (*Salix ss.*), and bitter cherry (*Prunus emarginata*).

Lower elevations within the Subalpine Conifer biome support Douglas fir, white fir, and the upslope pioneering *Pinus ponderosa,* making delineation of lower-range growth indistinct.

Economically useful species of understory shrubs live in natural openings and marginal areas of the subalpine forest, where more sunlight filters through. These include: Oregon grape; red elderberry; currants; raspberry; snowberry; blueberry; and Kinnikinnick (*Arctostaphylos uvaursi*). Flowering herbaceous species are more abundant in aspen stands, while moss, lichens, fungi, liverwort, and sedges inhabit the evergreen understory (Brown 1994).

Fauna

In the Chihuahuan Desert Scrub biotic zone of the basin, the two most commonly visible, large, native mammalian species are the pronghorn antelope (*Antilocapra Americana*) and the coyote (*Canis latrans)*. The former uses the area as a breeding ground during the summer months.

During the winter months, mule deer (*Odocoileus hemionus*) travel from the foothills to the grasslands in search of easier forage.

Oryx (*Oryx gazelle*) were introduced to the area in the late 1970s as potential big-game animals. Since that time, they have become something of a nuisance at the White Sands National Monument, the White Sands Missile Range, and the San Andres National Wildlife Refuge due to their competition with antelope and other big-game animals for habitat and forage.

Smaller mammals common in the Tularosa Basin include the desert cottontail rabbit (*Sylvilagus audubonii*) and the blacktail jackrabbit (*Lepus californicus melanotis*). Hog-nosed, spotted, and striped skunks are very common in the region.

Other common, more secretive mammals in the area include: the American badger (*Taxidea taxus berlandieri*); the common gray fox (*Urocyon cinereoargenteus*); the kit fox (*Vulpes macrotis neomexicanus*); the bobcat (*Lynx rufus*); and the ringtail (*Bassariscus astutus*).

Various species of rodent are present and include the pocket gopher, the pocket mouse, the deer mouse, the grasshopper mouse, the cactus mouse, the house mouse, and various types of kangaroo rats and wood rats. Several different species of ground squirrel may be present, as well as the rock squirrel and the Texas antelope squirrel.

Bat species include the brown bat, the California bat, the cave bat, the fringed bat, the long-legged bat, and the small-tailed myotis bat. Also present are the big bat, the Brazilian free-tailed bat, the hoary bat, the western pipistrelle, and the pallid bat.

Some of the more common birds include: the common raven (*Corvus corax*); the American crow (*Corvus brachyrhynchos*); the mourning dove (*Zenaida macroura*); the golden eagle (*Aquila chrysaetos*); the zone-tailed hawk (*Buteo albonotatus*); the Swainson's hawk (*Buteo Swainsoni*); the lesser night hawk (*Chordeiles acutipennis texensis*); the red-tailed hawk (*Buteo jamaicensis*); the great horned owl (*Bubo virginianus*); and the cliff swallow (*Petrochelidon pyrrhonota*).

Two of the more common reptile species here are the side-blotched lizard (*Uta stansburiana)* and the eastern fence lizard (*Sceloporus undulates*).

One fish species of note in the Tularosa Basin is the White Sands pupfish (*Cyprinodon Tularosa*), a threatened species due to habitat depletion and alteration from groundwater pumping, reduced spring discharge, and the increasing salinity of its habitat.

Soils

In some parts of the project area—particularly at Oscura Siding—the upper 10–50 cm (4–20 in) of soil consisted of fill material, created by historic construction and trenching, and debris derived from surface and structure leveling.

The fill matrix was composed of cinders, coal debris, fragments of burned and unburned brick and rock, burned and oxidized soil, and rotting wood. Inclusions of glass, wire, nails, historic ceramics, and other debris were common. Most materials were loose and unconsolidated. In most cases, the contact of the fill with the underlying intact matrix was abrupt, smooth or wavy, and was readily visible in profile, or by feel, when excavating with hand tools.

At LA 120972 and LA 120973, the top 10–40 cm (4–16 in) of the soil profile consisted of fill deposited during highway work, bar-ditch construction, and utility trenching (Fig. 2.3). The disturbed nature of these deposits was indicated by a lack of soil structure, an intermixing of matrices, the inclusion of organic debris and roadside trash from the surface, and soil compaction.

The upper, intact stratigraphic profiles revealed in some trenches and hand-excavated units consisted primarily of massive silt with very fine to fine grained sand and variable clay development. The soil profile ranged from silty, clay loam to loamy sand. Intact deposits exhibited strongly developed soil structures with medium to coarse pediments in sub-angular blocky to blocky prismatic form.

Silty soils often showed early stage, carbonate precipitate along ped faces, root pores, and worm or insect tunnel casts. Development increased with depth.

Deeper excavations showed a greater degree of carbonate precipitation and cementation, particularly along boundaries between fine and coarse grained deposits. Horizons with more pronounced carbonate development sometimes featured small pellets or nodules of calcium carbonate and a greater degree of grain cementation (Buck and Van Hoesen 2005; Weider and Yaalon 1982).

Except for areas with coarse, sand and pebble alluvial deposits, pebbly inclusions comprised a fraction of the total matrix. Inclusions of fine roots and decomposing, organic materials were common in upper profiles. The frequency of these materials

Figure 2.3. Soil profile of LA 120973, BHT 6. The upper, intact stratigraphic profiles revealed in some backhoe trenches and hand-excavated units consisted predominantly of massive silt with very fine to fine grained sand and variable clay development.

diminished with depth. Larger decomposing root material occurred with greater frequency at depth.

Bioturbation, in the form of root, rodent, and insect disturbances, was prevalent throughout the profile. In some cases, larger root casts and decomposing root fragments were visible in deeper profiles. This was probably due to the prevalence of *Yucca* and *Larrea* in the project area.

Boundaries between fine grained materials were gradual or diffuse. Boundary geometry was smooth or wavy with broad periodicity. In some cases, boundaries displayed localized, exaggerated irregularities and vertical interdigitation from root growth and rodent tunneling.

Across the project area, the silty-soil profiles of upper deposits were typically underlain by sequences of gravelly, alluvial deposits embedded with sand and silt layers. These coarse grained deposits were found in the deeper profiles of backhoe trenches. Notable exceptions to this generalization occurred in trenches excavated at LA 120972 just north of the northern bank of Willow Draw, where coarse alluvium occurred close to the surface.

Coarse alluvial deposits showed poorly sorted, fine to coarse pebbles in a matrix of sandy clay. Grain sphericity ranged from rounded-tabular to sub-angular rounded to sub-rounded. The sedimentary profile of coarse alluvium consisted of gravelly strata embedded in thin layers of fine to coarse grained sand and silty clay. Layers of fine grained sand and clay were aggregated into couplet-forming bands.

Gravel deposits sometimes showed late to early (Stage 1/2) carbonate development along upper and lower boundaries, as indicated by stronger cementation between sediment particles. This sometimes gave boundary horizons a diffuse laminar effect. Indications of carbonate development include weak pebble cementation. Carbonate development was rare in middle horizons of coarse alluvial deposits.

Fine root inclusions were widely dispersed in coarse grained deposits near the surface, and in deeper deposits, inclusions were largely lacking. Organic inclusions in coarse alluvial deposits were absent or not visible. Irregularities due to bioturbation were rare or entirely lacking.

Backhoe trenches revealed laterally discontinuous, coarse grained alluvial deposits. Boundaries between coarse grained materials were often clear or abrupt. Boundary geometry was smooth, discontinuous, or wavy, or displayed irregular, lateral interdigitation.

Deposition of coarse alluvial materials required an environmental shift from one of high-transport energy to one of lower-transport energy. Isolation from the dynamic transport regime is required for stability, soil formation, and vegetation growth.

Fluctuations in transport energy often result in the deposition of differing particle sizes, hence, the alternating sand-and-gravel sequences in sediment profiles, particularly at Willow Draw, where fluctuations in particle size transport resulted in the deposition of sand and silt couplets or varved sequences. This type of deposition may reflect hourly, daily, or seasonal variations in precipitation.

As is typical of southwestern monsoons, the sudden onset of torrential rains often results in flash floods and a dynamic transport mechanism capable of moving large boulders. Within a few hours, the transport regime diminishes abruptly, to the degree at which only fine particles were moved. These pulse-like fluctuations often resulted in paired depositional sequences.

The presence of carbonates and clays in the soil profile indicated a degree of landscape stability that enabled soil development (Weider and Yaalon 1982). The presence of intact archaeological horizons, which characteristically occurred in silty soils, was another indicator of landscape stability. Areas in which the silt mantle extended to the full depth of excavation had a greater probability of holding deeply buried, intact cultural materials and deposits.

Throughout the Carrizozo project area, archaeological sites and materials, including artifacts, pit excavations, and thermal features, were prevalent in areas with fine grained soil or sediment profiles. Cultural activities were often indicated by the presence of inclusions from cultural objects, including ceramic sherds, lithic debitage, and ground stone tools and fragments.

Archaeological inclusions of non-material cultural items included: fire-cracked rock; charcoal fragments; zones of burned, oxidized earth; faunal remains, often burned and calcined; and charred ethnobotanical remains. Many archaeological deposits were intrusive and included cultural features excavated into the pre-extant soil profile by human hands. These included storage pits, pit-based dwellings, other subterranean structures, thermal pits, and post holes.

Cultural materials and deposits occurred, without exception, in upper silt and fine sand profiles. These materials were not found in lower-sediment profiles represented by coarse alluvial fractions. One effect cultural activities imparted to soil profiles within archaeological horizons was a characteristic trend toward a darker coloration of the soil matrix, a dark grayish-brown hue and chroma, as opposed to the dark yellowish-brown hue and chroma typical of soil matrices outside the archaeological domain.

At some sites, particularly LA 120972 and LA 120973, feature fill from pit-structure interiors had a harder, more malleable, or plastic structure than soil from the matrix surrounding the features.

In feature fill, metal tools tended to bounce more and penetrate less when striking the fill. Peds tended to hold their shape rather than crumble easily when struck. Feature fill displayed greater strength and cohesion than materials outside of feature boundaries (Foster and Tatum, personal communication, 2010).

Day-to-day cultural activities carried out at permanent or seasonal-habitation sites have a great impact on the environment and can affect the development of the soil matrix. Soils with characteristics added during human activity are called anthrosols.

Anthrosols are formed by the addition of anthropogenically derived ingredients to the soil matrix and include charcoal, cooking byproducts, food waste, and human waste. Inorganic materials derived from cultural activities, fire-cracked rock, ceramic sherds, and byproducts from tool manufacturing or sharpening also contribute to anthrosol development (Stein 1992; Holliday 1992, 2004).

Physical alterations occurring as a result of human activities are manifold. Alterations include the darkening or blackening of the matrix due to the addition of charcoal, ash, and humate materials. When combined with naturally occurring minerals, soil bacteria, and other soil-dwelling microorganisms, these alterations increase cohesiveness and molecular bonding between pedons and can cause structural changes in the soil matrix (Stein 1992; Holliday 1992).

Other alterations caused by human activities include soil or sediment compaction, which results from construction activities or repeated travel over the same route. This also occurs during the development of activity surfaces (Larson et al. 2004).

In backhoe excavations, the upper soil profile was underlain by coarse alluvial deposits interbedded with sand and silt. In some cases, Stage 2 carbonate development was indicated by strongly cemented sediment particles, including pebble cementation (McLemore and Bowie 1987). Interbedded strata of coarser alluvial sediments indicated a fluctuating depositional environment in which the energy of transport alternates from one of greater to lesser turbidity. Carbonate development and soil structure was not prevalent in coarse alluvial or sandier sediments.

Soils have been associated with typic calciorthids and fluventic haplustolls, loamy soils occurring on gently sloping valley bottoms and plains (Maker et al. 1978).

History of Land Use in the Tularosa Basin

> To live there has always been a risky business, a matter of long chances and short shrifts; of privation and danger. (Sonnichsen 1960)

Dendrochronological evidence suggested a long period of dry weather after about AD 1050. A period of intense drought occurred around AD 1380 and continued until the early nineteenth century (Grissino-Meyer 1996).

Agrarian settlements, like those in the Jornada Mogollon, were abandoned by AD 1350 (Eidenbach 2010). Settlements established near springs, streams, and other reliable water sources—such as those documented by Spanish explorers in the Salinas Province—persisted (Scurlock 1998).

Following the collapse of dryland farming communities, the region saw a resurgence of nomadic hunter-gatherer lifestyles. Athabaskan-speaking peoples, related to the Mescalero Apaches, arrived in the seventeenth century to take advantage of upland bounty (Eidenbach 2010; Gibbs 2003).

As opportunistic, nomadic raiders, the Athabaskans preyed on settlers and travelers struggling to survive in a marginally supportive environment. Raids inhibited settlement by Spanish, Anglo, Native American, and others until the end of the nineteenth century.

The area was exploited by outside interests. Salt-seeking Hispanic merchants from the El Paso area traveled north to the Lake Lucero and northeast into the Salt Flats environs. Records indicate silver miners from Parral in Chihuahua, Mexico, may have been exploiting the area as early as 1657. In the eighteenth century, El Pasoans began traveling north under the protection of soldiers. By 1824, the San Andres Salt Trail was established by merchants hoping to supply salt from the Lake Lucero Salinas to communities along the Rio Grande south of El Paso (Eidenbach 2010; Gibbs 2003).

In 1845, the first Mexican settlement was established at Tularosa Creek. In an attempt to exploit extensive timber reserves in the Sacramento Mountains, a water-powered sawmill was constructed.

Three years later, in February 1848, the Treaty of Guadalupe Hidalgo ended the U.S. war with Mexico. Soon after, the U.S. military established outposts in the region in an attempt to gain dominance over the territory. Fort Stanton was established in the valley south of the Capitan Mountains and east of the Tularosa Basin. Within a year, the Mescalero Apaches and the timber of the Sacramento Mountains had attracted the attention of the U.S. military. By 1849, the first Sacramento Mountains military survey was undertaken; the first exploratory ventures into the Tularosa Basin had occurred, and numerous deadly pursuits and clashes with the Mescalero Apaches had been initiated.

The San Andres Salt Trail and the many springs in Tularosa Basin figured prominently in military forays into the area. Military estimations of the inhospitable terrain and the presence of Native American tribes precluded most exploration and settlement for another 10 years. However, in an observation, which must have figured prominently into future of land use in the basin, Capt. Randolph Marcy remarked on a luxuriant growth of grama grass in the area (Gibbs 2003; Kirkpatrick et al. 2000; Wimberly 1979).

Around the time of the Civil War, the San Andres Salt Trail fell into disuse as the salt trade shifted into Salt Flats southwest of Guadalupe Peak. This may have occurred as a response to the privatization of surface mineral rights by American business interests following the war with Mexico. It also may have been a response to continuing Mescalero Apache encounters and skirmishes in the area (Sonnichsen 1960; Schneider-Hector 1993).

Between 1860 and 1861, another attempt at establishing a settlement in the basin along the Tularosa River resulted in catastrophe at the hands of the Mescalero Apaches (Schneider-Hector 1993; Sonnichsen 1960). Two years later, another attempt was made by intrepid, enterprising settlers determined to settle the fertile Tularosa River Valley. This attempt was more successful, and settlers from La Mesilla constructed fortifications to protect the newly established villages of Tularosa and La Luz from marauders (Sanders 1990).

Over the next 10 years, the U.S. Army and the Mescalero Apaches engaged in repeated battles in the Tularosa Basin and the surrounding mountains, particularly Dog Canyon on the western flank of the Sacramento Mountains. Between the late 1840s and mid-1860s, the U.S. military established several outposts in the region to protect roads and citizens from Native American attacks. The Mescalero Apaches were not subdued until 1880, when the death of Chief Victorio and the forced relocation of his people occurred (Gibbs 2003; Sonnichsen 1960).

The 1870s brought the arrival of Texas cattlemen. Headed for an established railhead at Engle, New Mexico—in the southern portion of Jornada del Muerto—they brought herds up through the Rio Hondo Valley, over the Sacramento Mountains, and across the Tularosa Basin south of White Sands. Attracted by grasslands left thriving after a pluvial climatic interval, cattle were brought by the tens of thousands to graze in the Tularosa Basin.

However, the unpredictable climate could not sustain the more than 85,000 head of stock that one cowboy witnessed rolling through the area in 1889 (Sonnichsen 1960). Widespread overgrazing took its toll, resulting in the depletion of native grasses. Deprived of the protective grass layer that had taken thousands of years to evolve the semidesert landscape was dramatically altered by wind deflation and erosion; this contributed to the formation of sand dunes and the accelerated the colonization of the land by desert shrub species (Fredrickson et al. 2005; Allen et al. 2003).

In 1897, attracted by prospective cargos of gold from the White Oaks mines, coal from the Chupadera Mesa and the Sacramento Mountains, cattle from the Tularosa Basin, and timber from the Sacramento Mountains, the railroad came to the basin. New towns—Oscura, Alamogordo, and Carrizozo—were platted and built to supply the railroad with labor, lodgings, water, coal, mechanical service, and repairs.

The water issue would prove to be problematic not only for the railroad but for every other economic interest in the region (Livingston and Associates 2002; Sonnichsen 1960). Needing water for steam locomotion, the railroad began acquiring water rights from cattle ranchers, initially agreeing to allow ranchers in the Sacramento and Three Rivers systems to retain some water for their own use. But when the railroad purchased water rights for Bonito Canyon, no such agreements were made. Many farmers, ranchers, and homesteaders were forced to move elsewhere, but still the mining, farming, and timbering industries continued to grow.

Most of the groundwater was highly alkaline and laden with gypsum, making it corrosive to steam engines and unfit for humans and stock. Pipelines bringing water from the Bonito River and Sacramento River drainages were constructed shortly after the turn of the twentieth century. Reservoirs were built in mountain canyons during the Great Depression. Utilization of surface water and spring water continued, requiring the development of *acequias*, ditches, and pipelines.

There was not enough water to go around. Settlers began arguing over water rights. The courts intervened, attempting to settle disputes by brokering agreements and contracts. The territorial legislature established laws to help settle disputes and protect the rights of early settlers. For the next 30 years, the railroad remained the main competitor for water, buying rights and developments by any means possible. This continued until the advent of the diesel locomotive in the early 1950s.

The establishment of the railroad, development of nearby towns, and a number of road improvements made possible the next major industry in the basin—tourism.

In 1933, in the interest of preserving the cultural, natural, scenic, and scientific wonders of the White Sands gypsum dunes, the U.S. Department of the Interior established the White Sands National Monument under the authority of the Antiquities Act of 1906. In the first year, at least 12,000 visitors traveled to the dunes. In 1948, 100,000 people visited, and, in

1965, more than 500,000 visited. Since 1986, the National Park Service has welcomed more than 600,000 visitors each year to the 275 sq mi, white gypsum, sand dunes (Schneider-Hector 1993).

In 1941, Japanese aircraft bombed the U.S. Naval Base at Pearl Harbor and the United States countered with a declaration of war; these events altered land-use history of the Tularosa Basin by further impacting the availability of water. Six months before the Japanese attack, the U.S. War Department requested from the U.S. Department of the Interior the withdrawal of nearly 1.25 million acres of land in the Tularosa Basin for the training of military personnel. More than 100 ranchers and their families were evicted from leased lands to make way for what would become the Alamogordo Bombing Range, now known as the Holloman Air Force Base.

The establishment of military bases precipitated an instant water shortage. New wells were drilled, new pipelines constructed, and additional sources developed in La Luz Canyon. Water was purchased from the city of Alamogordo (Livingston and Associates 2002). In 1945, the War Department, again, asked for and received additional land totaling almost 5,100 sq mi, for rocket testing and the development of military technology. The White Sands Proving Ground was established.

In 1945, Jornada del Muerto was chosen as the testing ground for the world's first atomic bomb. Today, the Trinity Site is another regional attraction (Gibbs 2003; Schneider-Hector 1993; M. Sullivan 2010).

In modern times, the economy of the Tularosa Basin remains dependent on military facilities—White Sands Missile Range, Holloman Air Force Base, and Fort Bliss Military Reservation—as important sources of revenue. The establishment of the missile range as a testing ground for rocket technology put Alamogordo on the map, as did the New Mexico Museum of Space History.

The White Sands National Monument and the Bureau of Land Management's Valley of Fires Recreation Area bring tourism dollars to the area. Many are drawn to the thousands of petroglyphs at the Three Rivers Petroglyph Site, also managed by the BLM Roswell Field Office. The slopes and trails of the Lincoln National Forest, in the Sacramento Mountains, attract skiers, hikers, fishermen, and hunters.

Some towns, like Alamogordo, which were established by the railroad, have much to gain from tourists, military employees, and the aerospace and service industries. Other towns, like Oscura, are gone for good. Carrizozo remains the county seat and is trying to re-invent itself as a haven for artists looking for an unconventional atmosphere and an inexpensive place to live.

Although the ranching business faded with the decline of the grasslands, agriculture and livestock operations continue to play an important role. Many large cattle-ranching operations established in the late nineteenth and early twentieth centuries are still functional. Some of these, like the O-Bar-O Ranch near Carrizozo, have subdivided their holdings into smaller lots in the hopes of selling off parcels to homebuilders.

Studies commissioned in part by the New Mexico Interstate Stream Commission indicate current rates of aquifer and surface-water production will be unable to meet growing demands in the region. This is partially due to a decline in aquifer- and spring-recharge systems. Estimations of population growth in the region, which extend into the middle of the twenty-first century, show increasing challenges in meeting water demands. Making matters worse is the depletion of potable water from aquifers and from the surface. Much of the remaining water in aquifers is high in total dissolved salts and unsuitable for consumption (Livingston and Associates 2002).

The Tularosa Basin is not the only part of the world facing a diminishing supply of fresh water. This situation, coupled with the presence of an already well-established military and scientific base, makes the basin an ideal place to develop economically efficient desalination procedures. The Tularosa Basin National Desalination Research Center opened in Alamogordo in 2007 to develop technology for the desalination of brackish and impaired groundwater in the inland United States.

3 ⊻ Classificatory Systems and the Project Area

Yvonne R. Oakes

In the Jornada Mogollon region, project sites do not fit neatly into defined classificatory systems (Lehmer 1948; Kelley 1984). Located in the northern Tularosa Basin, just outside of the Sierra Blanca region, these sites remain apart from the defined schematic-phase boundaries of the Jornada Mogollon (Fig. 3.1). Therefore, as a basis for comparison, the majority of this discussion will focus on adaptations in the adjoining Sierra Blanca Mountains.

Documentation of the region began with Lehmer's 1948 concept of a Jornada branch of the western Mogollon culture in south-central and southeastern New Mexico. Lehmer divided the Jornada branch into northern and southern regions that extended north of Carrizozo and south into Mexico (Lehmer 1948:84). Distinctions between the two were based on differences in brown ware ceramics, with El Paso Brown Ware in the south and Jornada Brown Ware in the north.

The northern area, where this project is located, went largely unstudied until Kelley's work in the Capitan area in 1966 and 1984. Kelley defined the Sierra Blanca region, east of the project area, as extending from the Peñasco River in the south to the Corona area in the north and from the Sierra Blanca Mountains in the west, to Roswell in the east. Kelley (1948) developed a three-phase classification system specifically for the area. This system is still in use today.

Kelley's three phases extend chronologically from the introduction of ceramics at early sites to the abandonment of the region. Lehmer's and Kelley's delineations, along with those of other classificatory systems, are described below.

Paleoindian Period

The Paleoindian period in New Mexico began ca. 12,000 BC and ended around 6000 BC. However, based on investigations at Pendejo Cave east of Orogrande, NM, there are possible exceptions to the start date mentioned above (MacNeish 1991; Harris 1997). These exceptions resulted from the acquisition of radiocarbon dates as early as 25,000 BC. The association of these dates with the human occupation of Pendejo Cave is controversial.

No Paleoindian materials (ca. 12,000–6000 BC) were found at the Carrizozo sites, and few findings have been recorded within the northern Jornada region. The small number of surveys and excavations conducted in the area may be to blame for the lack of substantial data. One exception was Mockingbird Gap, a large Paleoindian site on the northern border of the Jornada area (Miller and Kenmotsu 2004).

Most sites reveal caves and rockshelters at elevations between 1,524 and 1,829 m (5,000 and 6,000 ft) (Spoerl 1983). Others are deeply buried. Several sites also have been discovered in the sands of the Tularosa Basin (Beckett 1983; Laumbach 1985; Carmichael 1986; Elyea 1988).

Findings include lithic artifact scatters with identifiable Paleoindian dart points. Folsom points have been found in the Sacramento Mountains (Broster 1980:97), in the Rio Bonito drainage (Sebastian and Larralde 1989:30), at Three Rivers (Duran and Crotty 1999:7), at Pendejo Cave (MacNeish 1991), and at Rhodes Canyon, which yielded several Clovis points (Eidenbach 1983).

Kirkpatrick et al. (2000:69) suggested that the Paleoindian population covered a variety of environmental settings—grasslands, mesas, high mountains, river valleys, and dry lake beds—as its people are generally characterized as being well adapted to foraging and big-game hunting.

Large, finely worked dart points of this period prove the importance of viable hunting strategies. Dependence upon wild-plant resources is not so easily identified yet may have been just as crucial. Points found in the region include Clovis, Folsom, Midland, Plainview, Meserve, and Cody (Beckett 1983). Faunal remains found in cave settings are most likely asso-

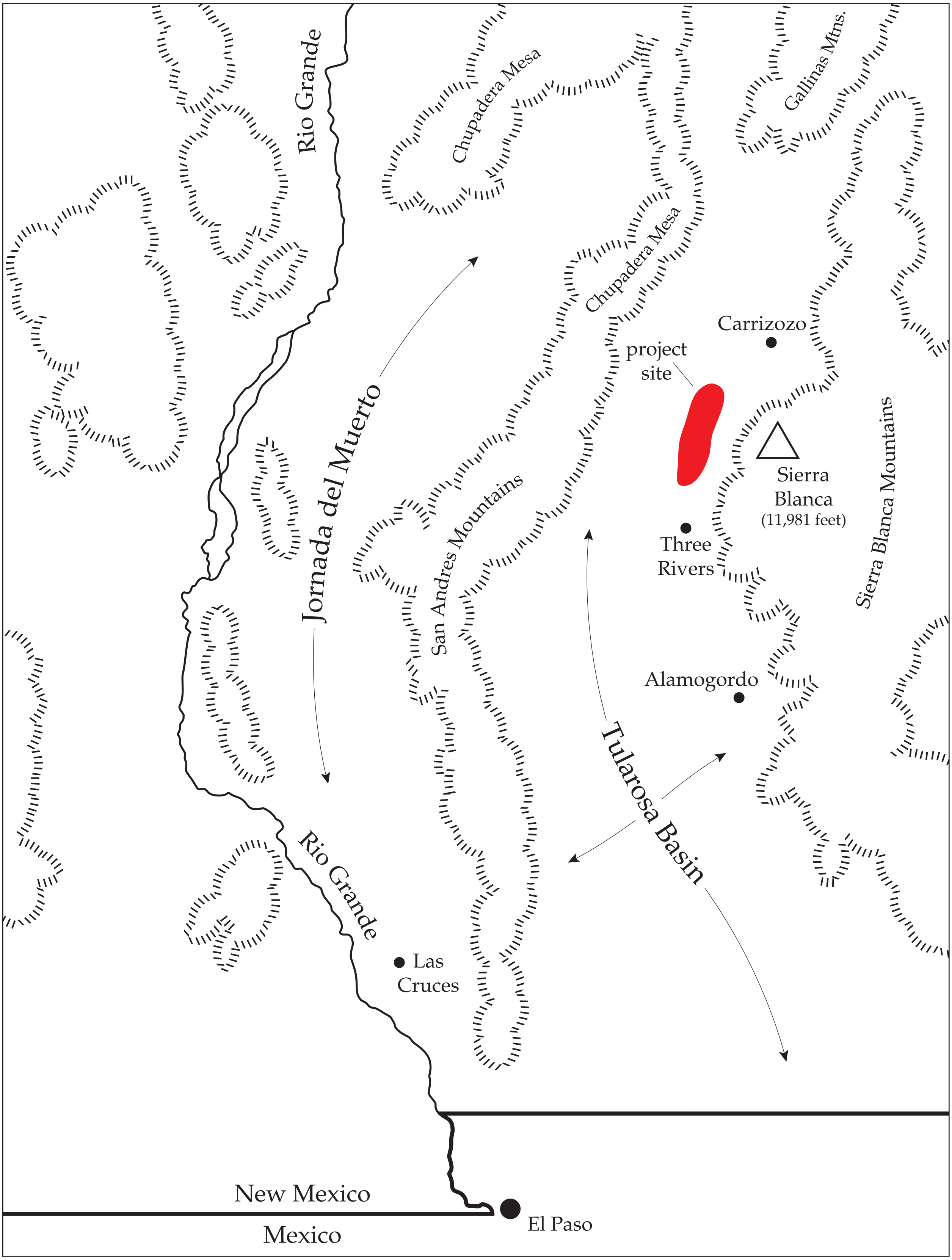


Figure 3.1. Location of project sites within the Tularosa Basin. These sites are outside all defined schematic phase boundaries for the Jornada Mogollon.

ciated with human populations and include horse, llama, tapir, salamander, ring-tailed weasel, spotted skunk, and magpie (MacNeish 1991).

Archaic Period

The Archaic period lasted from approximately 6000 BC to AD 300, but probably later in many cases. Southern New Mexico has frequently been referred to as a "catch-all" area for the several southwestern Archaic traditions.

Currently, there is a trend toward the concept of a pan-regional, culture system with an emphasis on the similarities between the areas instead of on the differences (Huckell 1996). Based on ethnobotanical data, the occupation of Archaic sites in the region appears to have involved the seasonal use of specific locales.

A variety of sites and locales indicate a viable hunter-gatherer population and a dependence on economic plant resources. This would suggest a highly mobile, adaptive strategy in which people shifted from resource to resource as climate, dietary needs, or population pressure dictated, or, possibly, that different groups of people selected different environmental niches for their bases.

There are suggestions that the occurrence of residential mobility may have decreased by the Late Archaic (Fish et al. 1992; Roth 1992). The discovery of shallow pit structures at some Late Archaic sites may indicate a reduction in mobility or in the presence of a local resource.

It is difficult to determine how far northern Jornada, Archaic-period, hunting-and-gathering ranges may have extended without additional chronometric data and further excavation.

Archaic sites are characterized by smaller diagnostic points than those usually found at Paleoindian sites, by a lack of ceramics, and by the occasional use of maize for subsistence. The lack of absolute dating for sites in this region makes it difficult to assess Archaic adaptation.

While containing only two hearths, LA 130331 yielded a mean calibrated radiocarbon date of 1415 BC. Other undated Archaic sites—LA 56945, LA 79115, LA 85708, and LA 99888—have been recorded to the east, closer to the Sierra Blanca Mountains. The large area around LA 130331 is privately owned and has not been surveyed; this hinders the accurate assessments of Archaic settlement patterns in this region.

Due to a consistent lack of absolute dates, the origins of the Archaic occupations in the area cannot be determined. Archaic sites consist mostly of numerous hearths and rock shelters and include the Fresnal Shelter (Sebastian and Larralde 1989:66), the High Rolls Cave east of Alamogordo (Lentz 2006), and the Fallen Pine Shelter southwest of Ruidoso (Oakes 2004).

The only extensively surveyed Archaic sites include the Three Rivers area (Wimberly and Rogers 1977; Gerow 1995) and a large area of the Mescalero Apache Reservation (Broster 1980). This survey yielded projectile points of the Oshara, Chiricahua, and San Pedro traditions, suggesting that the region is made up of a mix of Archaic derivations. Several Archaic sites have also been recorded in the Lincoln National Forest.

In 2000, Office of Archaeological Studies (OAS) staff studied 96 quadrants in NMCRIS files in search of Archaic sites in the Sierra Blanca region (Oakes 2000). Ninety-two Archaic sites were found within a 15,180 sq km (5,861 sq mi) area, about one site for every 165 sq km (3.7 sq mi). This suggests that large areas of the region are undersurveyed. Several Archaic sites were found along major drainages as low as 1,097 m (3,600 ft); others were in high mountain areas up to 2,438 m (8,000 ft).

Ceramic Period

Lehmer (1948) was the first to organize ceramic-bearing sites in the region into three sequential phases. These phases—the Capitan, the Three Rivers, and the San Andres—start around AD 900 and were patterned after southern New Mexico classifications based mostly on the frequency of various styles of brown ware.

In her work in the Capitan area, Kelley (1984) developed three different phase sequences specific to the northern Sierra Blancas. Kelley's system included the Glencoe, the Corona, and the Lincoln phases, which started around AD 900 and continued until about. AD 1450. There is, however, considerable chronological and boundary overlapping of these phases.

In an independent study, Oakes (2000:15) used ARMS files to plot on area maps the coordinates of sites as based on the chronological appearance of certain ceramic types. NMCRIS files and site reports were also checked for type and frequency of ceramics found at each site. Six sequentially ordered ceramic categories—Types I through VI—were created from the database. The first three, which fall into the general time frame of the project sites, are listed in Table 3.1.

The plotting of these occurrences on base maps revealed chronometrically dated Type I sites (n = 14) at two locations—the Rio Bonito/Rio Hondo drainages and the Gallo Drainage near Corona (Fig. 3.2). These may be the earliest ceramic sites in the region.

Type I sites match project sites in every respect, except dating. The Carrizozo sites date back to AD 900, with the same array of ceramic types described in Kelley's system. Thus, Kelley's Type I category should be modified to include ceramics created around AD 900 or earlier.

The 20 sites in the original study indicate the movement of the population into the Capitan area, the Rio Peñasco drainage, and the Jicarilla Mountains. Type II sites (Fig. 3.3) contained simple pit structures and no ceremonial units. Southern-derived ceramics did not appear in the region until the following Type III sequence.

This breakdown demonstrates the problems with current classification systems: phases based on geographic zones can be ambiguous and can create overlapping phases, dates, and boundaries.

Table 3.1. Ceramics, by site type and date.

Site Type	Ceramic	Date Range (AD)
I	Jornada Brown	450–1400
II	Mimbres wares	1000–1200
	Red Mesa Black-on-white	1050–1125
	Chupadero Black-on-white	1050–1125
III	El Paso Polychrome	1050–1550
	Gila Polychrome	1100–1450
	Three Rivers Red-on-terracotta	1150–1450

Athabaskan Period

Early Athabaskan sites are rare in this region. However, in 1590, sightings of Athabaskan people by Spanish explorers were documented in the region; these people may have been related to the Apaches in the Sierra Blanca Mountains or, more specifically, to the Mescalero Apaches (Opler and Opler 1950).

By 1672, the Salinas pueblos to the northwest had been attacked by the Apaches (Schroeder 1974); by the 1700s, there were constant conflicts between the two (Thomas 1974). Conflict continued up until at least 1855, when Fort Stanton was established on the Rio Bonito. The Mescalero Apache Reservation was established on May 29, 1873, and boasts 460,384 acres (186,311 ha) of mountain land with steep canyons and deep valleys.

The last military engagement with the Mescalero Apaches occurred in 1880 in Dog Canyon, an Apache stronghold south of Alamogordo. The U.S. military presence on the reservation continued until 1883, and in 1922 Congress confirmed the existence of the Mescalero Apache reservation (Dobyns 1973:80). In 1924, the Mescalero Apaches were granted U.S. citizenship.

There are few recorded occurrences of Apache sites in the region, although a hilltop fort on the Mescalero reservation could be Athabaskan (Kelley 1984:298); Feather Cave near Lincoln may contain Apache material goods (Kilby and McNally 1994:31); and the Gore Site near Nogal contained a probable Ocate Micaceous sherd and a Toyah projectile point (Farwell et al. 1992:189). The nearby Angus Site yielded three Athabaskan Plain sherds and eight radiocarbon dates between AD 1400 and 1450, at least 100 years after the abandonment of the site (Oakes 2000). An isolated pit structure at LA 120973, the Carrizozo Flats site (Chapter 8, this report), revealed two calibrated ^{14}C dates of AD 1670 and AD 1780; this suggests Athabaskan use of the structure.

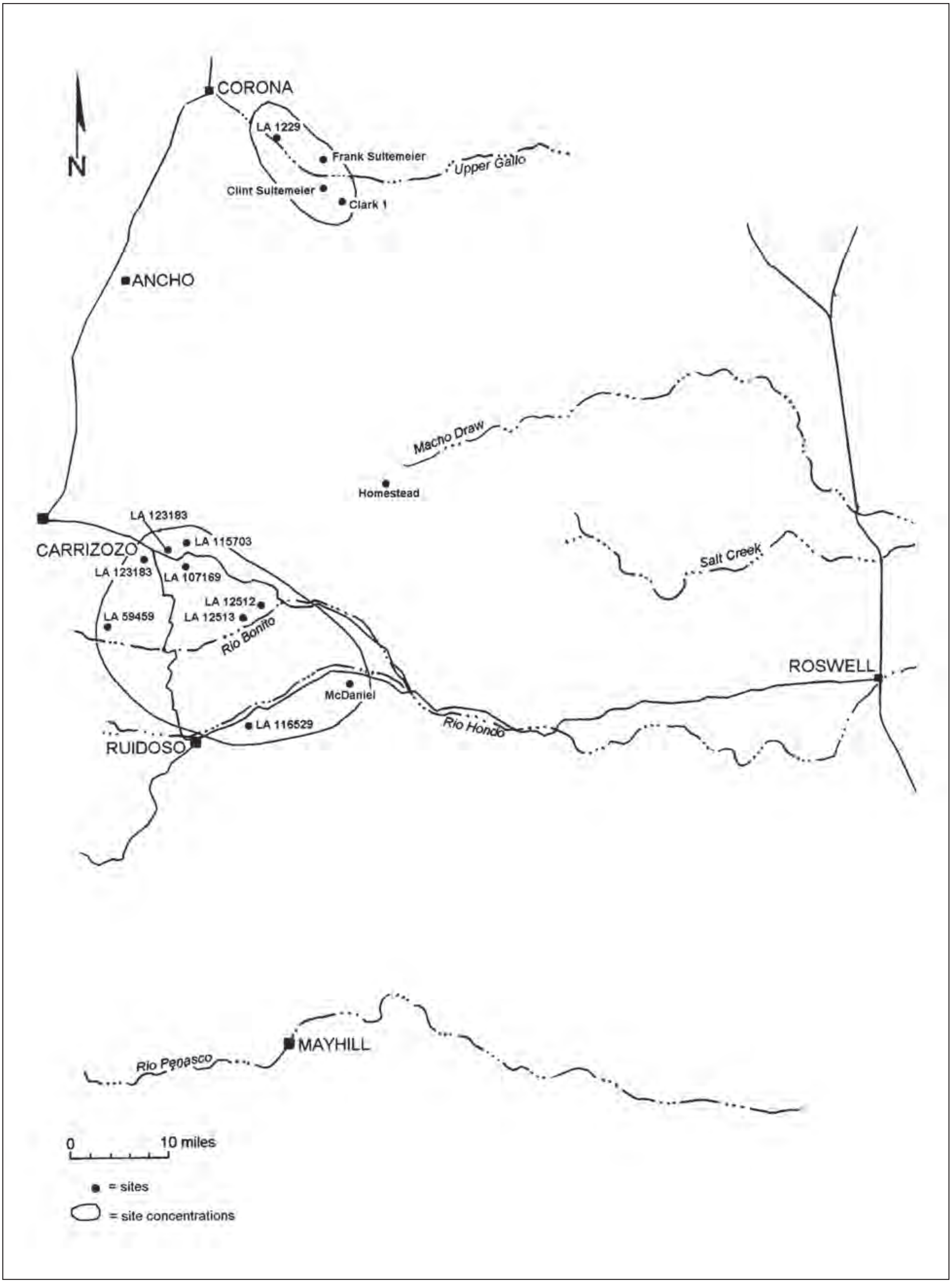


Figure 3.2. Type I sites, with Jornada Brown Ware only. These may be the earliest dated ceramic sites in the region.

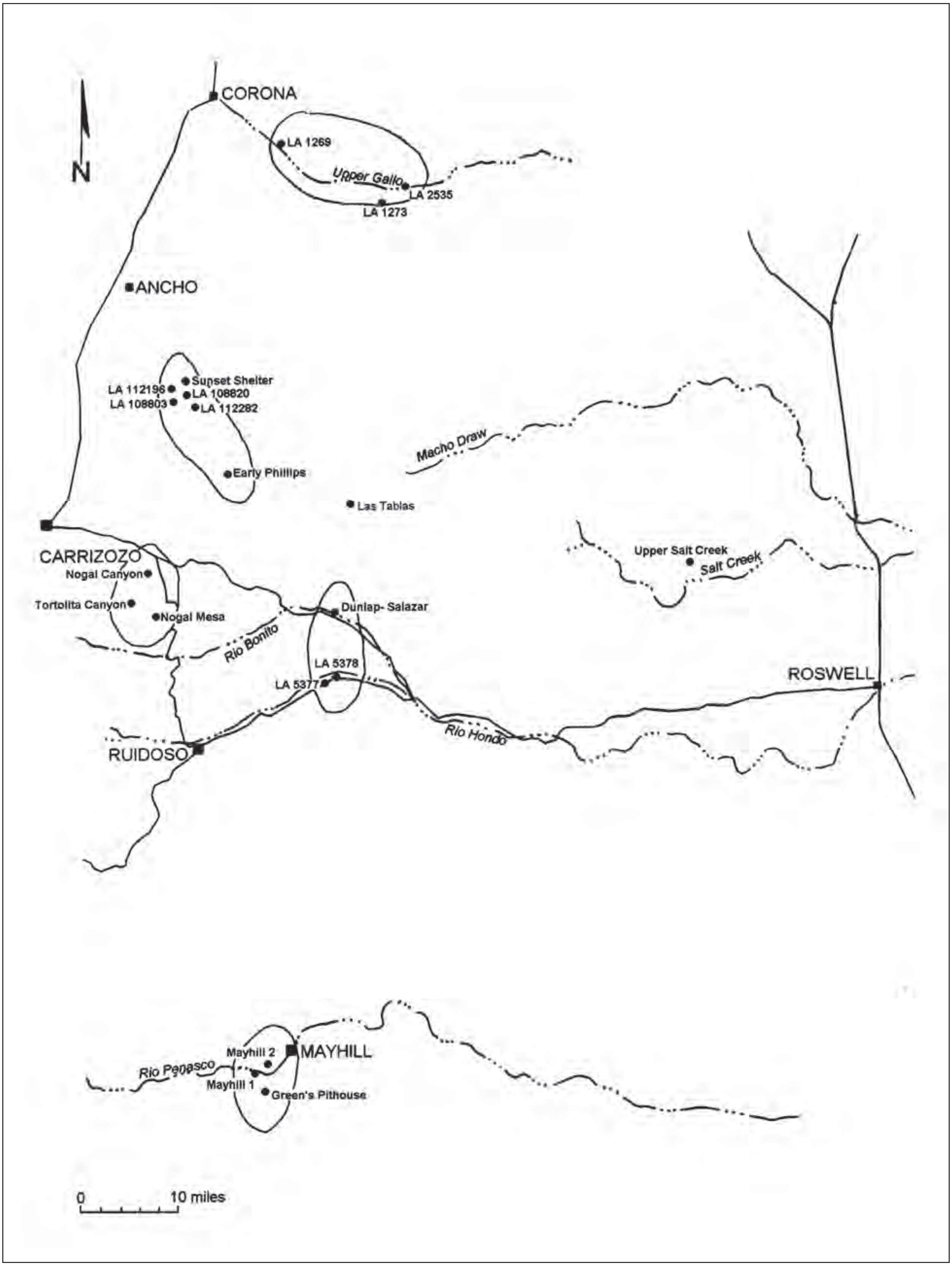


Figure 3.3. Type II sites with Mimbres Ware, Red Mesa Black-on-white, and Chupadero Black-on-white. Southern-derived ceramics do not appear in the region until the following Type III sequence.

4 ⩡ Historical Overview

Virginia L. Prihoda and Sheila Martin

Range stock, including sheep, cattle, and horses, were present in the New Mexico area more than two centuries before the territory was annexed to the United States. Sheep were prime stock during the Spanish occupation and were favored by the priests—who became instrumental in teaching sheep husbandry to the Native Americans—and by the *ricos*, wealthy ranchers who operated feudal ranching networks throughout the area until the end of the nineteenth century.

Between 1821 and 1846, Santa Fe merchants began a wool trade with California. Later, the population explosion brought on by the discovery of gold on the West Coast opened a new market for the meat of New Mexican sheep. In 1856, flocks in the area had peaked at 200,000 head, and by 1860, the territory of New Mexico was the top sheep producer in the United States.

Sheep ranching in the late nineteenth century was influenced both by American merchants and by the arrival of the railroad to the area. Merchants began investing in breeding stock, acquiring herds, and establishing contracts with the ricos. These same merchants also began work on wool-scouring mills at a number of towns served by railroads.

In many communities this was an early base industry. The railroad helped to create large wool-and-sheep export centers in the towns and villages of Chama, Las Vegas, Española, Albuquerque, and Socorro. By 1880, the sheep population had surpassed cattle by an estimated 4 million head. The railroad also proved a boon to the expansion of the cattle industry. By 1888, cattle in the area had increased to around 1.25 million; the sheep count was estimated at 3.5 million.

Cattle ranchers entered the New Mexico territory after the Civil War. Initially, ranchers used the area as a trade route from southern Texas, which had a large supply of cattle, to high-demand areas—forts, mining camps, and railroad towns—in Colorado and areas further north. The largest, single, cattle drive in New Mexico took place in 1874, when 110,000 head were driven north from Roswell to Colorado.

Farmers, as well as ranchers, were drawn to the abundant grasslands in the eastern half of the territory. The 1880s witnessed the rise of huge cattle empires in eastern New Mexico; many were defined only by rights to water holes and the establishment of drift fences to keep cattle on a home range. Ranching and rangeland began to diminish by 1900, and although the railroad opened up major stock towns and shipping destinations—including Clovis, Clayton, Tucumcari, Chama, Carrizozo, and Magdalena—herd sizes failed to increase during the early twentieth century; the grasslands became public domain, with large portions subdivided for homesteading (Williams 1986).

Between 1820 and 1850, merchants, mountain men, and prospectors came to the territory in search of economic opportunities. Others came with the wagon trains—invalids seeking a dry-climate cure for the fevers and epidemics that ravaged the early settlers of the Mississippi Basin.

So many health-seekers came to the area during the period of Mexican rule, between 1821 and 1846, that the U.S. Congress designated specific depots for collecting invalids along the Santa Fe Trail. After 1825, the U.S. Army provided escorts to the territory's border.

Later, between 1860 and 1890, the territory was recognized as a sanitarium for tubercular patients, and while healthy migrants from the East added to the increasing flow of individuals into the area, it is estimated that health-seekers constituted about 20 percent to 25 percent of total immigrants to the area during the nineteenth century. Thermal springs, abundant in New Mexico, were thought to hold healing waters, and by 1912, practically every hot spring in the area had become an established resort. Military stations Fort Bayard and Fort Stanton would eventually be transformed into sanitariums for military patients (Williams 1986).

Socioeconomic Development in the Tularosa Basin

The development of the Tularosa Basin (Fig. 4.1) where Oscura—or Oscuro, as it was known in earlier days—is today began in 1861 and 1862, when heavy rains and flooding in the Rio Grande Valley forced a group of Mexican farmers to relocate.

The first permanent settlement in the valley was Tularosa, west of the Sacramento Mountains. Irrigation water flowed through the small community for the first time on April 2, 1863. A second, permanent settlement was established between 1863 and 1864 at La Luz, about 16 km (10 mi) south of Tularosa.

Cattle ranching in the valley began between 1870 and 1880. The most notable rancher was Oliver Lee, whose ranching empire included irrigated lands in the Dog Canyon and Alamo Canyon areas.

The history of LA 114462, or Oscura Siding, began around 1867, when a small settlement known as Milagra was established within several hundred yards of where the future El Paso and Northeastern Railroad Company would soon be built. Milagra was approximately 45 km (28 mi) north of Tularosa, and residents were able to grow crops while taking advantage of nearby spring water from the Godfrey Hills, a small range that ran parallel to the Sierra Blanca Mountains. The springs were named Milagra; the same as the early settlement.

The Railroad Act of 1862 put the support of the U.S. government behind the Transcontinental Railroad. Officially titled "An Act to Aid in the Construction of a Railroad and Telegraph Line from the Missouri River to the Pacific Ocean, and to Secure to the Government the Use of the Same for Postal, Military, and Other Purposes," the act was approved and signed into law by President Abraham Lincoln.

It took only six years, between 1863 and 1869, to connect the eastern portion of the United States to its western shores. Also in 1869, Lincoln County was carved out of Socorro County. Up until then, Socorro County had been one of the two largest counties in the territory. The two counties would reshape several times and split again, before finally settling into their present-day borders.

As the population increased, county jurisdictions downsized, making for more manageable enforcement of law and justice. Small counties were sometimes created only to avoid testy legal matters and get on with progress, as was the case with the commissioning of Otero County in 1899 (Ericson 1997). It was on this premise that, on May 27, 1873, by Executive Order of President Ulysses S. Grant, the Mescalero Apache Reservation was first established at Fort Stanton on an area of 28,221 acres (11,420 ha).

Railroads were also on the move, closing in on the rich resources of the Southwest. In 1883, the Mescalero Apache Reservation was moved again, to a location just west and south of Fort Stanton, allowing the railroad a more sizable holding of approximately 1,865 sq km (720 sq mi) in a county that, by 1903, had already achieved its modern-day size of 12,067 sq km (4,659 sq mi). Though small in ratio, the increase in land decreased raiding in the area and left investors to win or, from another perspective, steal the west.

Gold to Coal in the Sierra Blanca Mountains

This dangerous, mineral-rich mountain territory did not discourage locals or eastern conglomerates looking to strike a claim in the area. Wilmer (1989) stated that mining in Lincoln County was initially established for the extraction of gold and other mineral deposits and later for the mining of coal needed to supply energy to those operations. Principal mining districts could be found in the mountainous areas of the Basin and Range province, especially within the Sierra Blanca region.

By 1883, the Nogal Mining District had become one of the first ore-concentration plants in the United States (Griswold 1959; Wilmer 1989). Placer prospecting continued as well. Griswold (1959) contends that lode gold was first found in the White Oaks district in 1879; no fewer than five ore-treating plants were in operation in the district by the turn of the twentieth century.

So much precious metal had been mined early on that, by the turn of the century, most of it had been played out. White Oaks and Nogal folded; however, Estey City, between Oscura and Carrizozo, remained. Between 1901 and 1910, Estey City was home to a milling-and-processing plant and an assay office, with narrow-gauge rail service running east–west to Oscura Siding (Eidenbach and Hart 1997).

But it was the abundant coal fields in the Sierra Blanca Mountains that sustained economic growth in the basin. Wegeman (1914) stated that

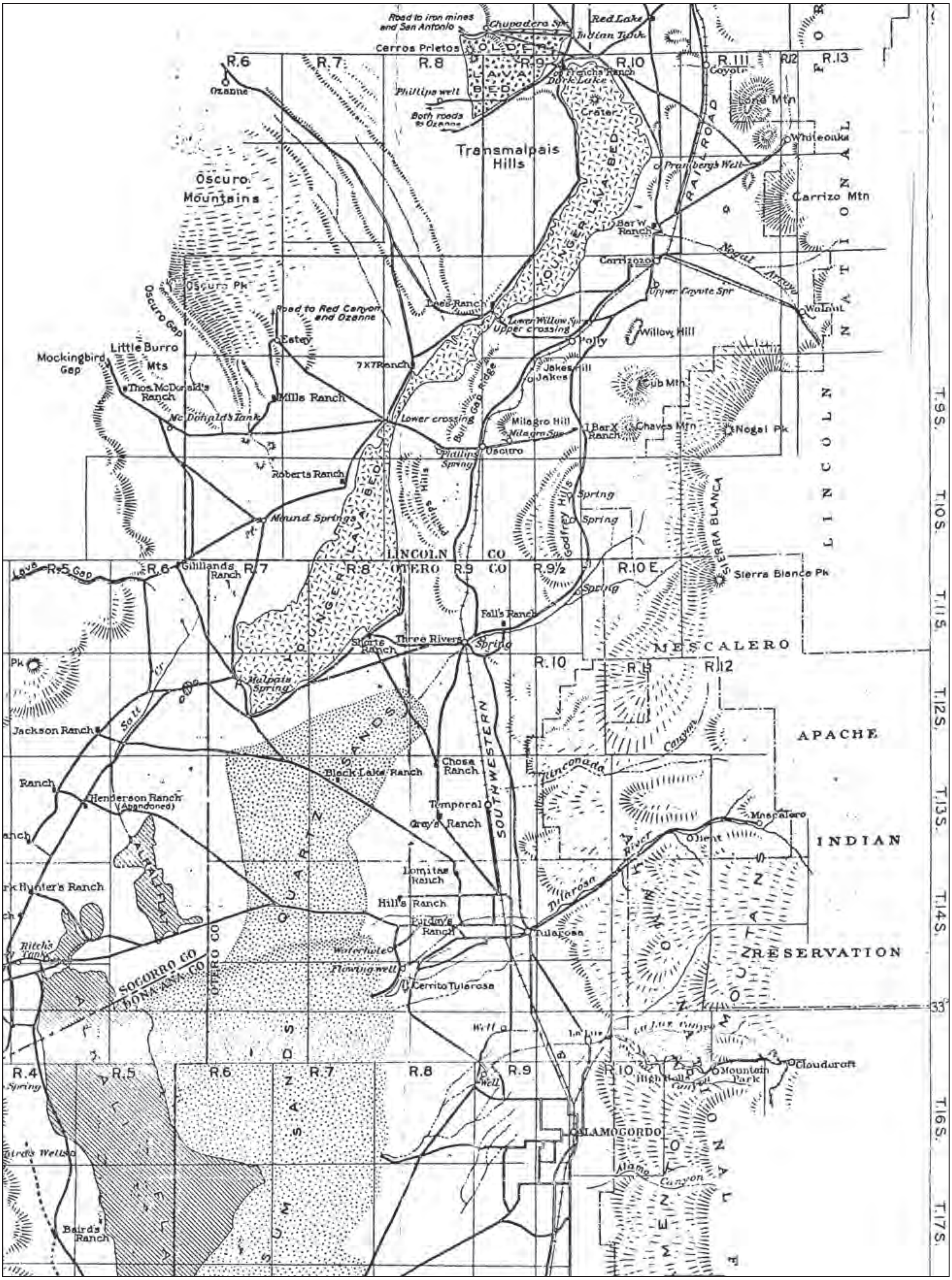


Figure 4.1. Map of the Tularosa Basin, 1914 (USGS).

"coal mining in Lincoln County was once a prosperous industry. Coal extraction was particularly active in Capitan (the Salado Coal Fields), White Oaks, Oscura, and Willow Hill. In the Sierra Blanca coal fields, coal was first mined in the vicinity of Capitan in the mid-1880s to supply Fort Stanton; it was not until 1899 that the large-scale mines of the New Mexico Fuel Company were opened. In 1901, Lincoln County was the third-ranking producer of coal within New Mexico."

Wegeman went on to explain that the development of coal mines at White Oaks was dependent on the growth of the gold-mining industry, also in that district. Coal supplied power to mines and sawmills. Smelters used large amounts of coking coal, powdered bituminous coal, sub-bituminous coal, and slag coal; lead blast furnaces used coke; and copper smelters used powdered bituminous coal (Kottlowski and Beaumont 1965; Zamora 1997). White ash coal in the Salado district, near present-day Capitan, was ideal for domestic use and was in high demand throughout the Southwest.

The Oscura mine was approximately 3.2 km (2 mi) northeast of present day Oscura, at Milagro Hill. Wilmer (1989) described the mine as "a small-scale coal mining operation that was opened in 1921 by the Consumer Coal Company of El Paso." The mine is often confused with mining operations in the Oscura Mountains, to the northwest, about 24 km (15 mi) away. It is here that Estey City sprang up, becoming the center of the mining district's operations between 1901 and 1910 (Anderson 1957).

Though small in scale, the mine was hailed in an article published in the *White Oaks Eagle* in June, 1899: "When the EP&NE [El Paso and Northeastern Railroad Company] reaches Malagra [sic] forty-five miles north of Alamogordo the people of this section will see the order of things reversed. Instead of shipping coal northward from El Paso, Alamogordo will be shipping coal southward to El Paso. There is an abundance of good coal at Malagra as well as at Salado and it is not necessary that the railroad should be completed to Salado before El Paso has cheap fuel. The company has a force of men at work at the Malagra mines." At this point, the mine had been in operation for quite some time. The article also suggests that the mine was producing coal prior to the railway being built.

Coal mining in the Salado fields lasted only a few years, since the coal veins had been pinched off by massive volcanic intrusions. The railroad, however, continued to operate. As early as 1921, the line functioned on a twice-weekly schedule of mixed passenger and freight trains, a practice that continued almost until the line was abandoned (Springer 1997).

Advent of the Railway in the Southeastern Territory of New Mexico

A dusty trail had been cut north through the Tularosa Basin around 1850, when the regional Overland Stage provided the only means of passenger service. Even with the arrival of the railroad, the land route continued to make travel by mobile transport possible. By 1880, most stage lines were being used for business. The roads, however, were maintained as feeders into the mining camps or as connections between rail-service areas.

In 1865, a crossing at Oscura, off the state road, was built by a lieutenant from Fort Craig to establish an easier route for the army to take to Fort Stanton (Stearns, personal communication, 2010). The primary route from Nara Visa, at the New Mexico-Texas state line—via Tucumcari, Santa Rosa, and Vaughn—was named State Road 3 in the early 1900s and remains in use today; however, with the decline of rail-passenger service, and the popularity of automobiles on the rise, Congress decommissioned NM 3 in 1925, redesignating it US 54 (NMDOT 2009).

The railroad itself had a far more convoluted history in the area. Gold and silver mining had all but played out by the turn of the twentieth century. Copper was still being mined, but coal remained the more abundant resource and was in high demand.

The most influential businessmen in the history of socioeconomic development in southeastern New Mexico were Charles B. Eddy, his brother John A. Eddy, and their trusted lawyer William A. Hawkins.

From Barbara Ericson's research (1997) we learn that Charles B. Eddy had not originally set out with big plans for the Tularosa Basin. Instead, he contacted Hawkins in 1888 to act as his lawyer during the initiation of another venture in the Pecos Valley in the lower southeastern portion of New Mexico.

Charles B. and John A. Eddy came from New York with big plans for developing the West. Charles B. Eddy's ever-growing enterprises included the railroad; the Eddy townsite, now Carlsbad; cattle ranching; irrigation projects; and a number of land schemes.

According to Ericson (1997), Charles B. Eddy told Hawkins he was going to Europe to bring back farmers of Italian, French, Yugoslavian, and Greek descent, and that he would construct a dam across the Pecos River, build a railroad from Texas to Roswell, and establish a city at Seven Rivers, bringing government, civilization, agriculture, and thousands of people to the deserts of southeastern New Mexico.

Due to personal reasons, and soil problems, Charles B. Eddy's Pecos Valley development project did not go as well as expected. He abandoned his plans, turning his attention to what would instead be his largest New Mexico project (Ericson 1997).

Norman Hall, former superintendent of the Southern Pacific Railroad at El Paso, contended that Charles B. Eddy had three major goals in mind while planning and building the El Paso and Northeastern Railroad Company: the first was to tap the vast lumber forests at the crest of the Sacramento Mountains east of Alamogordo; the second was to find a permanent source of coal for his railroad, for the Southern Pacific, for other railroads in the territory and for the smelters in El Paso, Arizona, and New Mexico, and for other coal-consuming industries in the southwest; and the third was to establish a new rail route from Chicago to El Paso and interior Mexico (N. Hall 1956).

Hall (1956) explained why the Atchison, Topeka and Santa Fe Railway never even considered the challenge, "the Southern Pacific at El Paso, about 160 miles to the south, and the Santa Fe at Socorro, about 100 miles to the west, were the nearest railroads. Consequently, most of the supplies for the camp, as well as the output of ores and coal from the mines, had to be freighted in wagons to and from El Paso, or over to Socorro, on the Santa Fe Railroad. Due to the lack of rail service to the mining district, a clamor arose for the building of a railroad to White Oaks. The Santa Fe, according to rumor, carefully surveyed the situation, but concluded that the building of a line from San Antonio to White Oaks was not feasible due to high costs of construction as balanced against potential revenues."

Rail development in the Tularosa Basin is best explained using Springer (1997) and N. Hall (1956) as sources. It began in El Paso on June 27, 1888, when a group of citizens formed a corporation called the Kansas City, El Paso and Mexican Railway Company of Texas, which was better known locally as the White Oaks railroad. Very little was accomplished over the next four years for various reasons, including litigation and a lack of finances.

In 1892, the Kansas City, El Paso and Mexican Railway Company of Texas was purchased by the Texas and Pacific Railway Company and renamed the El Paso Northern Railway Company. The El Paso Northern Railway Company would become defunct by 1895, but it would resurface again in September 1897, when Charles B. Eddy contracted it from owners J. Gould and the Texas and Pacific Railway Company.

It is important to note that the El Paso and Northeastern Railroad Company was chartered under Texas law on June 12, 1896, to build a line from El Paso to the Texas/New Mexico boundary, a distance of 31 km (19.22 mi). Interests involved in chartering the line are not known, but shortly thereafter the railroad came under the control of the New Mexico Railway and Coal Company, a firm chartered on May 15, 1897, with interests held by Charles B. Eddy.

On June 23, 1897, the New Mexico Railway and Coal Company acquired all capital stock and the first mortgage bonds of the New Mexico Fuel Company. Poor's *Manual of Railroads for 1899* shows Charles B. Eddy as second vice-president and general manager of the El Paso and Northeastern Railroad Company, with offices in El Paso. It seems the financial interests behind the company were centered in the anthracite region of Pennsylvania and in the New York City banking community. Charles B. Eddy and his brother, John A. Eddy, played the roles of promoter and general manager of construction, respectively.

According to Springer (1997), work on the El Paso and Northeastern Railroad Company began on October 21, 1897. Work started at the Texas border and continued north to the Salado coal fields in Capitan, NM. Also around this time, all stocks and first mortgage bonds were transferred to the New Mexico Railway and Coal Company owned by Charles B. Eddy. The capital stock of the El Paso and Northeastern Railroad Company was transferred as well.

The Daily New Mexican ran a front-page story on October 21, 1897, with a headline that seemed more like an advertisement: "C. B. Eddy's Sagacity, Pluck and Perseverance Carry the Day—Organization of a Company to Build 150 Miles of Railroad in New Mexico; Money on Hand for its Completion;

Extensive Coal Fields, Magnificent Agricultural Lands, Vast Mineral Regions & Fine Lands Reached by New Line; Trains to Run in 12 Months; First Sure Harbinger of Prosperity and Development After a Long Depression in Sunny New Mexico."

By February 5, 1898, the line had reached the Texas/New Mexico boundary at Newman. Sometime in early 1898, Charles B. Eddy purchased a large tract of land, and the appurtenant water rights, in Alamo Canyon for $5,000 from cattle rancher Oliver Lee. Title was taken in the name of the Alamogordo Improvement Company, a Charles B. Eddy corporation, and on June 14, 1898, the railway reached Alamogordo.

N. Hall (1956), in an interview with W. A. Hawkins, said that, on July 4, 1898, the railroad ran an excursion train from El Paso to Alamogordo to show off the new railroad and townsite, and from February to August of 1899, track was laid north from Alamogordo to Carrizozo, which was known as Carrizo Flats at the time. The Salado coal fields at Capitan were reached on September 30, 1899, having bypassed the town of White Oaks.

Springer, in 1997, wrote that "although the promotion of the White Oaks route was almost an article of faith, the fact was that the gold mines were in a state of decline by the time the EP&NE [El Paso and Northeastern Railroad Company] neared the area. This, combined with the desire to mine the New Mexico Railway and Coal Company's own coal in the Salado fields, dictated the bypassing of White Oaks."

Capitan served as a terminal for the El Paso and Northeastern Railroad Company until February 1, 1902, when the El Paso and Rock Island Railway, from Carrizozo to Santa Rosa, was completed. The line from Carrizozo to Capitan became a branch and, in later years, a relatively unprofitable one. The line was abandoned in 1943 (Springer 1997).

Following lengthy negotiations, New Mexico Railway and Coal Company railroads were sold to Phelps, Dodge & Company on July 1, 1905. In December, 1905, the New Mexico Railway and Coal Company was renamed the El Paso and Northeastern Railroad Company.

A reorganization of Phelps, Dodge & Company interests in 1908 resulted in the formation of the El Paso and Southwestern Railroad Company, which soon acquired and began operating railroad lines comprising the El Paso and Northeastern Railroad Company. All lines were leased to the El Paso and Southwestern Railroad Company on May 1, 1908.

On January 1, 1924, the El Paso and Northeastern Railroad Company was leased to the El Paso and Southwestern Railroad Company, which became the main operating company under a consolidation plan of the El Paso and Southwestern Railroad Company (Springer 1997).

Water Issues

In New Mexico history books, more men have died over water than over gold, silver, or any other resource. The building of the railway helped end some of the lawlessness endemic to the frontier; however, railroads in the Tularosa Basin had a special water problem.

The high gypsum content in basin water wreaked havoc on steam engines. Most runs would go through as many as six engines from Santa Rosa to Alamogordo, and Charles B. Eddy spent more than $1 million on well-drilling, chemical purification, and other schemes in hopes of solving the conundrum, all without success (Townsend 1985).

After the connection of the El Paso and Northeastern Railroad Company with Rock Island at Santa Rosa, and the completion of the line into Dawson, carloads of freight began to flow in huge quantities along the new route. From the start of operation, the company was plagued by water difficulties. While building northward from El Paso, good water had been obtained by the sinking of a well at Newman, but supplies were limited. Wells from Newman to Santa Rosa produced water completely unfit for locomotive consumption.

At Alamogordo, water was obtained from Alamo Canyon. This water was of such poor quality for steam-generating purposes that it required additional treatment in order to obtain higher efficiency. Even so, it was the best water then obtainable, and for several years it was hauled in railroad tank cars in both directions from Alamogordo.

Water obtained by boring wells from Carrizozo northward was so saturated with gypsum, alkali, and other chemicals that locomotives using it became utterly inefficient and were barely able to generate enough power to pull a few carloads of freight. Trains sat stalled on the tracks from one end of the district to the other, resulting in delays, great expense, and the demoralization of operating forces.

Operating expenses increased due to the small tonnage of the trains, and delayed trains meant overtime payments. New engines wound up in bad shape after just a short time and had to be put in shops for overhaul. Shop expenses increased. Paradoxically, the more traffic the railroad took on, the greater its losses became (N. Hall 1956).

Two Oscura railroad wells, at 489 ft and 965 ft deep, were among the few railroad wells in that part of the state used to supply water to locomotives. The 489 ft well was completed in 1903, and its total mineral content measured only half as much as that of the Carrizozo well. The soft, black, alkali water deposited little scale but tended to foam in boilers. Oscura Siding's second well was drilled in 1906; its water was soft and charged with hydrogen sulphide (Meinzer and Hare 1915).

It was finally forced upon the minds of El Paso and Northeastern Railroad Company management that water fit for railroad purposes could only be had by tapping the pure water of the Bonito River high on the eastern slopes of White Mountain and by piping the water to the railroad at Carrizozo and northward toward Santa Rosa. Work on the pipelines was completed between 1907 and 1908, but by then, having spent at least $1 million remediating the company's water problems, Charles B. Eddy's financial sources were starting to dry out. He approached Phelps, Dodge & Company regarding the El Paso and Southwestern Railroad Company and on July 1, 1905, after several months of negotiations, was awarded full asking price (N. Hall 1956).

Stimulated by the increasing demand for coal during World War I, 1918 became the peak year for coal mining in New Mexico. By the second decade of the twentieth century, oil had been introduced as a new fuel for heavier tasks. Smelters changed to oil in the 1910s and 1920s, as did locomotives. The change had a direct impact on the coal-mining and railroad industries, and water sourcing and quality ceased to be a major concern (Kottlowski and Beaumont 1965).

Oscura Siding and the El Paso and Northeastern Railroad Company

LA 114462 is located at the old El Paso and Northeastern Railroad Company siding. As a pump station, the siding had many names. First referred to as the Milagro Station on early railroad timetables the early settlement was about 8 km (5 mi) east of the tracks. When Estey City was established at the base of the Oscura Mountains, 24 km (15 mi) to the west of the El Paso and Northeastern Railroad Company tracks, the station was referred to as the Estey Station, meaning that it was the stop from which supplies and goods were transported to Estey City. Estey Station itself never appeared on company timetables.

At the time of the siding's construction, between 1899 and 1902, the two names were most likely used interchangeably. When a station was built in 1903, the name changed again to Oscura. The station was a single-story, frame depot measuring 24 by 53 ft in size and was built in typical El Paso and Northeastern Railroad Company style with standard roof and bay-window detail. A stockyard was also built near the railroad.

To confirm that the communities of Milagro and Oscura were one and the same, early railway timetables were examined. Timetables for the El Paso and Northeastern Railroad Company show that mileage from El Paso to the Milagro settlement was exactly the same as to present-day Oscura.

In November 2009, resident Dolly Onsrud Lee said there was a water tank for the railroad and four section crew houses at the location, including the section foreman's house, the labor section house, and the signal section house (dates unknown); little additional information was given on the fourth house. Names associated with the railroad (dates also unknown) were Eli or Ed Harkey; Roy Kent, section foreman; Vent Smith, signal master; Pat Trudeau; and Jack Turner.

In 1900, an experienced businessman named George A. Galucia came to the community and established corrals, a hotel, and a general store, where he stocked mine and ranch supplies, animal feed, clothing, hardware, and other provisions. Galucia was a commissioned justice of the peace and served as the town's first postmaster when the Oscura Post Office was established in 1901.

Chicago businessman Elias G. Raffety founded an official townsite at Oscura and, in 1906, purchased land on both sides of the track. Raffety's interests did not end there, however. Raffety was also president, treasurer, and general manager of the Chicago Copper Mining Company. H. H. Miller was vice-president; H. E. Riddle was secretary; and, H. R. Raffety and M. Loquis were directors.

Organized January 31, 1906, under the laws of

Figure 4.2. Hotel Ashford in Oscura, 1910. Joe Ashford's frame hotel and general store was on Fourth Street, which ran east to west (courtesy Dolly Onsrud Lee).

New Mexico, the company recorded a copper mine in the Oscura Mining District, with 22 unpatented claims, just 28 km (18 mi) from the railway in the Oscura Mountains. The mine had a 60 ft shaft and tunnels 60, 120, 222, and 1,550 ft in length, with approximately 3,000 ft of workings from which former owners shipped several loads of ore. These loads were said to have returned $270 per ton. The mine had steam power and a two-drill, Sullivan air compressor (Stevens 1911).

Raffety built a home three blocks west of the tracks and kept large orchards on both sides. In the *1909 Business Directory*, Raffety was listed as proprietor of the Oscura Hotel, and by the time the 1913 directory came out, he was listed as a real-estate professional.

However, on November 1, 1930, Raffety wrote to potential investors in Oscura from Alhambra, California, selling big dreams: "ARE YOU READY TO BOOM OSCURO! If so we can put it over in a big way. I have succeeded in signing up two very large oil drilling companies to drill at Oscuro. They are willing to come in and take a chance, providing you are willing to do your part by giving them your leases." The two page, legal-sized sales pitch failed to go anywhere, as the country was in the throes of its greatest depression ever.

The layout of the streets of Oscura was typical of most turn-of-the-century towns with streets named alphabetically running east to west and numerically north to south, or, in this case, vice versa.

In 1910, Joe Ashford's frame hotel and general store opened on Fourth Street, which ran east to west. The general store was connected to the hotel with a door between the two enterprises; both businesses also opened onto the street (Fig. 4.2).

The town's other hotel, the Oscuro Hotel, was a two-story, gray quarry-stone building, which also opened to Fourth Street. The second floor had eight rooms, and the ground floor had two smaller guest rooms, a dining room, and a kitchen (Fig. 4.3).

In 1914, the Oscura Development Association advertised 18 acres (7.2 ha) of townsite with 14,000 fruit trees (Fig. 4.4), a two-story hotel, a school with 80 children enrolled (Fig. 4.5), and several merchant businesses. One of the smaller houses in Oscura is shown in Fig. 4.6. There also was an Oscura Women's Society, ca. 1914 (Fig. 4.7).

Efforts to keep the community of Oscura alive were in vain. The mining industry would eventually tap out. The poor quality of local water and the overgrazed grasslands brought any further development to a halt by the early to mid-twentieth century.

Figure 4.3. Oscuro Hotel, ca. 1915. The second floor had eight rooms; the ground floor had two smaller guest rooms, a dining room, and a kitchen (courtesy Helen Shields).

Life in Oscura

Tables 4.1 and 4.2 list census data, including birth places, number of households, number of residents, and occupations between 1890 and 1930. The occupation listing for the 1920 census in Table 4.1 was nearly illegible due to the poor quality of the copy available and, therefore, does not provide a complete picture of community activity.

James H. Kimmons owned a ranch east of Oscura in the 1920s and 1930s. He had a daughter, now Viora Andren, who was 94 years old in 2001. Kimmons ran the pump station at Varney, where Andren was born in 1906. Kimmons was later transferred to Oscura, where Andren's brothers, Virgil and Gene, were born. There were six children in all. According to Andren (personal communication, 2001):

> All the company houses, depot, section foreman's house were right by the tracks. The pump station was across the tracks. The town was very small. There was a saloon across the tracks a little ways. Dad was the barber for the town. He did his barbering in the pump station. He had a shelf where each man had his own shaving mug and brush.
>
> There were two stores in Oscuro, the Edwards Mercantile and Mr. and Mrs. Joe Ashford ran the other one [Ashford General Mercantile]. Mr. and Mrs. Ashford had two sons, Alfred and Volney, my first little sweetheart. [There was] the post office and stable. There was a dance hall there, and the people gave a dance for a young fellow that was leaving for the army.
>
> The Edwards family was considered wealthy. They had a surrey with a fringe on top. I got to ride in it one time. We had a wagon and two horses. Dad was sent to Luna, New Mexico, near the town of Ancho to run the big pumping station there. He was with the Southern Pacific for 27 years and seven months.

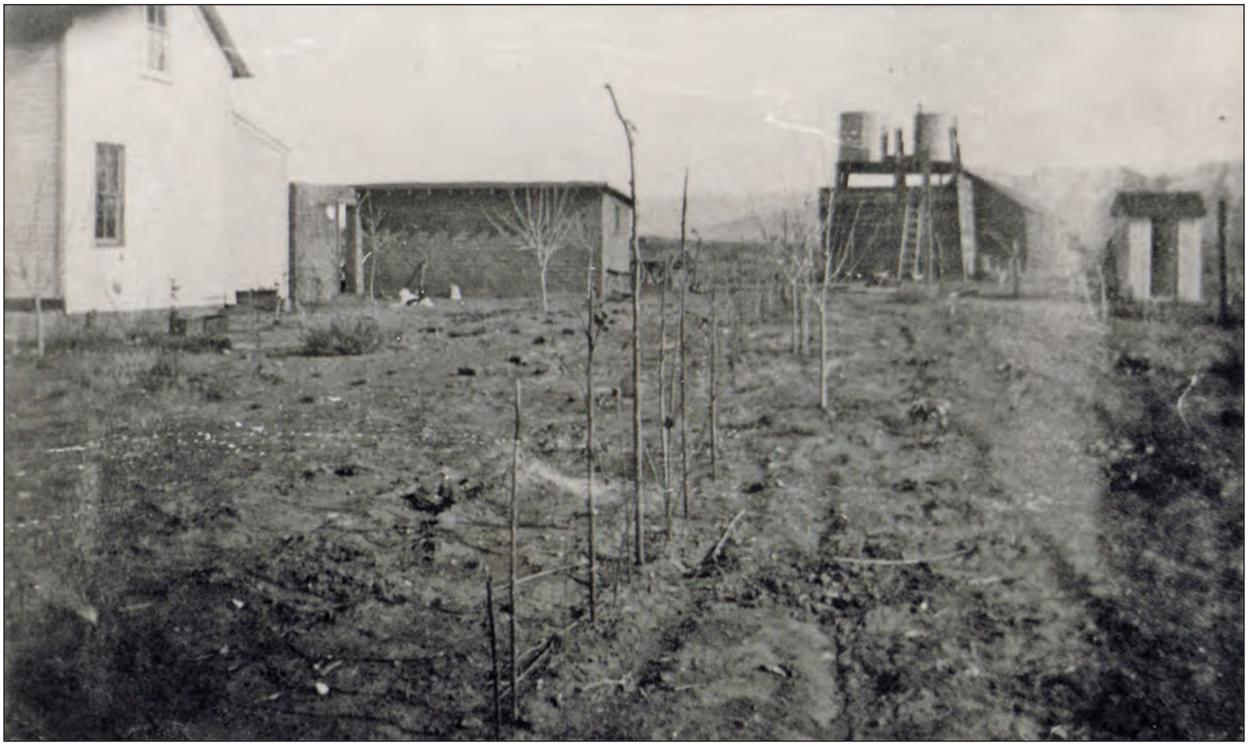


Figure 4.4. Some trees, which may have been planted in 1914. In 1914, the Oscura Development Association advertised 18 acres of town site and 14,000 fruit trees (courtesy Helen Shields).

Figure 4.5. Oscura schoolhouse, ca. 1915. According to the Oscura Development Association, 80 children were enrolled at the school in 1914 (courtesy Helen Shields).

Figure 4.6. Aunt Allie's shack in Oscura, ca. 1915 (courtesy Helen Shields).

The next memories I have was when dad was transferred back to Oscuro. Mom could pack like an expert. I guess she had to; we moved so much.

We were at our former house. Then, Dad bought a farm, 140 acres up above Malagra (Milagro) Springs. So we moved up on the hill, even though dad still worked for Southern Pacific. He bought a well-drilling outfit and drilled wells for miles around. This was in his spare time. One day I went with him when he was drilling. The outfit was the kind that made a big wheel go around with horses. They'd go round and round in a circle all day.

I was riding on the wheel like a merry-go-round and got my foot caught in the spokes. I screamed and dad stopped the horses fast. It cut a big place in my left ankle. Dad put axle grease on it till we got home. Kerosene was one of his stand-by remedies—all the way from lice on cattle to a centipede sting. He was also an agent for Aermotor Windmills. Our two wells were artesian wells. We had two windmills with a big cement tank in between.

Life on this little farm was the happiest time in my life though we didn't have many worldly goods. Dad made good money, but he spent a lot on patents that never turned out. Mom had a huge garden each year. We had fruit trees, and mom canned and dried fruit. The way she dried it was she would spread a clean sheet on the top of the cellar roof [corrugated tin], put fruit on it, cover it with cheesecloth, and weigh down the corners and sides with stones. The hot sun did the rest.

The folks raised corn, alfalfa, pumpkins, and all kinds of vegetables. Dad liked okra. They raised huge watermelons—so sweet. We kids would go into the field and break one open and eat the hearts of them and leave the rest for the birds. Dad sold melons to neighbors and trainmen for 10 cents each. We had blackberries, raspberries, and wonderberries, which I have never seen since, anywhere. They made the best pies and cobblers.

Figure 4.7. Oscura Women's Society, ca. 1915 (courtesy Helen Shields).

We always had milk cows that gave all the milk, cream, clabber, and butter we needed. We didn't have much beef, but we had pigs to butcher and lots of chickens. When the folks butchered a pig, since we didn't have a refrigerator, they packed the patties of sausage in crocks in the fat and kept it in the cellar. To keep our milk and butter cool, dad made a box on a shelf in one corner of our concrete tank where the water pipe from the windmill came through. Mom put a curtain on the front, so everything kept well. We churned with an old-fashioned crock churn with a wooden dash. I wish I had a glass of that good buttermilk right now.

Skeet and I played paper dolls by the hour, and sometimes Mabel played. Our paper dolls were cut from old catalogs, our doll furniture from cardboard. Our dishes were broken pieces of glass, and we made mud pies.

We had to walk about a mile to school. We'd go down through the orchard, down to Malagra Springs, and on to school. We used to find arrowheads and broken pottery there at Malagra Springs and holes in the rocks where Indians long ago had pounded their corn. Old timers always thought there was buried treasure around a rock that had Indian writing on it, but it was never found.

There were two doctors at Oscuro who had land near ours. Dr. Ranniger had a rock house that we thought then was a mansion [Fig. 4.8]. It was a nice house. The place next to theirs belonged to Judge Crews. He had his practice at Carrizozo, I think.

Dr. Blainey and his wife had a place just over the hill from us. His wife taught school. My dad later bought the Blainey place. Our other neighbors were the Gschwind family, the Thorntons [Fig. 4.9] and Mrs. Black and her son, Earl. He was in the army. This was in about 1916, I think.

Mom had some gray-speckled granite plates. We seldom had ice cream, and when we did, it was a rare treat. It seldom snowed, but when an inch or two fell, we would scoop it up and make snow ice cream. We'd put sugar and vanilla in it and thought it was good. Also, we made soda pop out of water, vinegar, soda, and sugar—yum, yum. The gum we bought in those days came five little round discs in a round tin. The Cracker Jacks had better prizes than they put in them now.

The family made monthly trips into town in the horse-drawn wagon to stock up on flour, meal, sugar, coffee, and lard. Arbuckle brand coffee beans were preferred and were ground in a hand-cranked coffee

Table 4.1. Occupations in Oscura, from 1910, 1920, and 1930 census data.

Industry	Occupation	1910	1920*	1930
Farm/ranch	homesteader	23	15	2
	laborer - farm	1	10	–
	laborer - cattle ranch	1	–	1
	rancher - sheep	1	–	–
	rancher - goats	4	–	–
	rancher - cattle	2	–	10
	cowhand	9	–	–
	pumper	1	–	–
	foreman - sheep	1	–	–
	stockman - cattle	2	–	–
	stockman - horses	2	–	–
	mechanic - sheep camp	1	–	–
	herder - sheep	19	–	–
	herder - goat	4	–	–
	teamster - sheep camp	1	–	–
	cook - sheep camp	1	–	–
	servant - ranch	2	–	–
Railroad	agent	1	1	–
	foreman	1	–	–
	section foreman	1	1	1
	section laborer	9	8	7
	pump station watchman	1	–	1
Communications	newspaper editor	1	–	–
	telegraph operator	1	–	–
	telephone laborer	1	–	–
	postmaster/mistress	–	–	1
Professional	physician	1	1	–
	dentist and surgeon	1	–	–
	teacher	1	1	1
	governess	1	–	–
	lawyer	–	–	1
Sales/service	realtor	1	–	–
	saloonkeeper	1	–	–
	merchant - general	2	1	1
	laborer - store	–	2	–
	laborer - townsite	1	–	–
	painter	1	1	–
	well driller	2	–	–
	laborer - well driller	–	1	–
	plasterer	1	–	–
	electrician	–	1	–
	carpenter	–	–	1
	state hatchery attendant	–	–	1
Mining	miner - copper	2	–	–
	miner	1	–	1
	prospector	2	–	–
	blacksmith	1	–	–
	laborer	–	2	–
Other	none	132	79	51
	retired	–	–	1

*Illegible due to poor copy; there are many more laborers but the count was not discernible.

Table 4.2. Birthplace of Oscura residents, in Precinct 15; from 1910, 1920, and 1930 census data.

		1910	1920	1930
Birthplace (Region)	**Territory/State/ Country**	**100 Households**	**52 Households**	**26 Households**
Southwest	Arizona	1	5	0
	New Mexico	67	41	34
West	California	1	1	1
	Colorado	4	5	3
	Oregon	1	–	–
	Texas	34	31	23
	Utah	1	–	–
	Washington	1	–	–
Midwest	Arkansas	8	–	2
	Illinois	33	12	5
	Indiana	9	7	–
	Iowa	1	–	–
	Kansas	2	–	–
	Michigan	5	3	–
	Minnesota	1	–	–
	Missouri	8	2	–
	Nebraska	2	–	–
	Ohio	3	–	–
	Oklahoma	–	–	4
	Pennsylvania	2	2	–
	Wisconsin	5	–	–
Northeast	Connecticut	1	–	–
	Massachusetts	1	–	–
	New York	8	3	–
South	Alabama	3	–	–
	Kentucky	1	–	–
	Louisiana	2	2	–
	Mississippi	6	–	2
	North Carolina	3	1	–
	Tennessee	–	4	–
United States	United States	–	2	–
Europe	Bohemia	1	–	–
	Denmark	1	–	–
	England	–	–	1
	Germany	1	–	1
	Norway	2	1	–
	Sweden	3	–	–
	Switzerland	1	1	–
Canada	Canada	3	1	–
Mexico	Mexico	23	22	5
Total		**249**	**146**	**81**

grinder. Each pound paper bag contained one stick of candy, which mom divided among us. Then, when the bag was empty, she would clip the coupon on the side to save. She got some nice prizes, including Rogers silverware [recovered during the OAS excavation], scissors, et cetera. Another chore we hated was cleaning the chimneys of our kerosene lamps each day.

A couple of times a rattlesnake got in the hen house, but mom was an expert with a .22, and she would shoot their heads off. Dad had put in a hedge of salt cedar bushes. He put them on the end and along one side of the garden. There came a terrible sandstorm and wind one day. Mom grabbed the kids and headed into the salt cedars for refuge.

Figure 4.8. Dr. Ranniger's house in Oscura, 1911 (courtesy Helen Shields).

Figure 4.9. The Thornton house in Oscura, 1915 (courtesy Helen Shields).

Summary

Excavated foundations, related features, and artifact concentrations from what used to be Oscura Siding will be described later in Chapter 6. It is not clear as to when the depot was razed, along with the entire town. There was, however, evidence of heavy mechanical blading at the site, probably post-occupation. Due to blading, surface collections were unable to yield a true account of structure placement.

Dr. Clarence Rehorn, a Santa Fe dentist, said he stopped at Oscura often while conducting surveys in the Oscura Mountains in 1951 and 1952. Rehorn said one building sold general merchandise and was very well stocked. The building also contained a bar, where the mounted head of a jackalope hung on the wall.

Today, all that remains of the small town of Oscura is located to the west of the highway and rail tracks. There are two standing structures, including the old bar, and a house. Various outbuildings remain and are associated with the existing structures.

5 ⯓ Recovery Plan, Excavation and Analytical Methods

Yvonne R. Oakes and Dorothy A. Zamora

Between June 22 and July 15, 2009, OAS completed archaeological testing and recommended data recovery at three sites—LA 114462, LA 120972, and LA 120973—along US 54 near Oscura. These three sites covered two distinct time periods: the mid to late Formative (ca. AD 1000–1200) and the Historic period (ca. AD 1890–1930). These sites were within the NMDOT right-of-way on land acquired from private owners. The prehistoric sites contained extensive ceramic and lithic artifact scatters, at least one pit structure, and a storage pit.

An additional site, LA 130331, on Bureau of Land Management land, was found to require archaeological testing following completion of the Data Recovery Plan. OAS carried out testing at LA 130331 between September 8 and September 11, 2009. An addendum was submitted as part of the plan already completed for the three previously tested sites. LA 130331 was determined to contain a prehistoric hearth with associated fire-cracked rock on a compact, utilized surface. The research plan was established as follows:

Research Objectives

LA 120972, LA 120973, and LA 130331: Prehistoric populations of the Formative period (AD 400–1450) in this area of the Jornada Mogollon are thought to have been sparse. The lack of systematic surveys in the region precludes the accurate assessment of site density. Known sites, mostly in the Sierra Blanca Mountains, show evidence of permanent and logistical resource acquisition where overnight or short-term camping occurred.

In the Jornada Mogollon, Hogan (2006) identifies five types of sites: residences, field camps, stations, caches, and locations. Residences are self-defining and reveal a variety of activities; field camps reflect short-term occupation both in artifacts present and in style and expediency of associated features. Stations involve task groups engaged in information gathering, while caches involve temporary storage facilities. Locational sites are the actual loci of resource procurement and have very low visibility. Attempts to fit these three project sites into classification categories will be made.

Storage facilities allow for collection of resources from outside the immediate environment as well as transport, in either processed or unprocessed form, to a residential base depending on the amount of resources, the preservability of those resources, and the distance to be traveled. Extended resource monitoring may have required the use of fieldhouses in some cases (Oakes 1998:17).

The degree of dependence on agriculture versus hunting and gathering varies greatly among Formative period groups. Therefore, sedentism of these people cannot be automatically assumed; seasonal mobility is thought to be more common than previously realized (Kelly 1992; Young 1993; Nelson and Anyon 1996). Degrees of mobility detected at these project sites were examined in terms of storage-facility use, permanence of architecture, the occurrence of interior hearths, types of artifacts found, and seasonality of subsistence resources. For example, expedient lithic-tool manufacture is often considered characteristic of more-sedentary groups (Moore 1993).

LA 114462: Research objectives for the historic railroad siding at Oscura include delineation of the community size and population demographics, determination of the siding's role in the hierarchy of stations along the El Paso and Northeastern Railroad Company, and an exploration of the function and chronological placement of several structures within the right-of-way.

Research Domains

Because the potential of LA 120972, LA 120973, and LA 130331 to address specific theoretical questions had yet to be determined, three basic concerns were fleshed out if substantive data was recovered. These domains included accurately dating the sites, assessing site function and type, and examining subsistence adaptations between project sites and other sites in the region. Research domains for Oscura Siding, LA 114462, are presented at the end of this section.

Dating LA 120972, LA 120973, and LA 130331

The correct placement of sites within a regional-settlement system is necessary when trying to determine temporal trends in ceramic use, development of trade, fluctuations in subsistence resources, and general systemic change through time.

Ceramic sites in the Jornada Mogollon are dominated by a variety of brown wares that are often too broadly dated to accurately place the site in a tight diachronic sequence. However, there is definite change through time in decorated wares and in architectural styles as well. Thus, the majority of dates for the Formative period have been derived solely from ceramic cross-dating; although painted and white ware evolve systematically, these dates will provide a basis for chronometric site placement. Presently, there is only a sampling of temporally diagnostic sherds from the sites to indicate time of occupation.

Cultural features including hearths, roasting pits, and storage units should provide charcoal or burned surfaces for radiocarbon or archaeomagnetic sampling.

Projectile point chronologies are not as well defined as in other regions. The matter is further complicated by the presence of three separate cultural traditions in the region: the Oshara of northern New Mexico (Irwin-Williams 1973), the Cochise of southern Arizona and southwestern New Mexico (Sayles 1983), and the newer Chiricahua tradition proposed for southern New Mexico (MacNeish and Beckett 1987). The reason why these diverse traditions coexist within one region remains unclear.

Site Structure and Mobility Patterns at LA 120972, LA 120973, and LA 130331

Due to the limited nature of the testing program, it is unclear if LA 120972, LA 120973, and LA 130331 are short-term campsites, specialized resource-acquisition areas, or small residential sites of unknown duration. Data recovered from these excavations regarding the types of artifacts and structures present, and the range of activities represented, should resolve this issue and provide means to assess site function. An examination of subsistence items, including floral and faunal remains, will provide information on the availability of resources, the seasonality of use, and the degree of processing that occurred at these sites.

Existing-feature types will also allow for determination of site function. Were there walled habitation units with ancillary hearths, storage pits, and roasting ovens? Were there interior and exterior hearths? The analysis of structural diversity at these sites should reflect the potential mobility strategies of the sites' occupants. Expedient investment of labor in dwellings, hearths, and storage facilities should indicate more mobile adaptations. More mobile artifact assemblages should contain less diversity and density than sedentary assemblages.

Also, types and amounts of artifact debris—ceramic and lithic artifacts, ground stone, nonhuman bone—can be used to determine which activities were carried out at these sites and how long these sites were occupied (Varien and Mills 1997). Length of occupation is always related to site function. Knowing how long each site was occupied is critical when assessing activities that occurred there. The intensity of investment in architectural construction, the variety and amount of ceramic artifacts, and the amount of lithic artifact types will be examined in this regard.

Subsistence Adaptations at LA 120972, LA 120973, and LA 130331

The recovery of macrobotanical and palynological remains is crucial to understanding subsistence adaptations at these sites. Flotation and pollen samples will be taken from all obtainable cultural features. Data from the project sites and other excavated sites in the region (Kelley 1984; Farwell et al. 1992; Zamora and Oakes 2000) should further enable the creation of meaningful comparisons.

The morphology of ground stone implements, and their relative abundance, will also be studied in light of Hard's (1990) model of changing form and function through time as related to the dependency of site inhabitants on agriculture. Hard uses a mean mano-length index to show that, through time, manos increased in length and grinding-surface size. Hard believes this suggests a greater dependence on cultigens. Calamia's (1991) study of variations in ground stone as related to residential mobility will also be taken into account. Also of interest is whether site inhabitants relied solely on regional resources or traded for subsistence goods with groups from other areas.

It will be difficult to determine if economic stress was a factor in any resource-utilization strategies because of the restriction of data to a seemingly single period in the Jornada Mogollon cultural sequence. Therefore, focus will be on intersite variability within that particular period and on the hope of arriving at some broad adaptational conclusion while still remaining aware of possible site anomalies.

The degree of dependence on agriculture at these sites is unknown; Hogan (2006) notes that only regional sites dating after AD 1200 show much evidence of agriculture. Hearths, roasting pits, and storage facilities will be carefully sampled to ensure recovery of any cultigens. Ground stone implements may retain traces of previously ground materials; therefore, pollen samples or washes will be taken from as many ground stone surfaces as possible. Wild plant foods remained a staple in the Formative period, supplemented primarily by the taking of rabbits, deer, antelope, and the occasional bison.

Sebastian and Larralde (1989) suggest that southern New Mexico was occupied by both hunter-gatherers and farmers during this period. However, hunter-gatherers often employed a wide range of subsistence strategies. One involved full mobility with the movement of populations from one subsistence resource to another. Another strategy consisted of seasonal movements to different areas as specific resources became available. There was also the logistical movement of specified persons to resource-acquisition areas for a certain period of time (Binford 1980). Combinations of any of these strategies may have occurred frequently during the existence of any group. We will examine where the project sites fit along this continuum.

If the mobility of site residents was limited, subsistence activities would have been more labor intensive and would have included planning for the future. If the sites were maintained in seasonal rounds between the mountains and the surrounding lowlands, only seasonally specific resources should be present. However, resource items may include those brought to or traded from a greater distance.

Certain foods, like maize and squash, require intensive, scheduled monitoring, harvesting, and processing before being consumed or stored. If site assemblages indicate a stronger dependence on other floral and faunal resources, we may assume that site dwellers were not constrained by agricultural pursuits.

We will examine the percentage of storage and cooking vessels present, mano lengths and grinding surfaces, amount and kind of storage facilities, and the relative percentage of faunal resources to assist in determining the degree of dependence on other food items.

Plants include piñon nuts, acorns, walnuts, and berries found near the Sacramento Mountains, and grasses, pigweed, four-wing saltbush, sunflower, mesquite, beans, cactus, purslane, wild potato, and agave in the immediate project area. However, the use of many of these resources would depend on availability, the amount of precipitation, seasonality, shifting resource locales, yield amounts, and overutilization by humans. The question then becomes whether these resources would have been enough to maintain a temporary or year-round residence.

Speth and Scott (1985) examined more than 4,500 faunal remains from Crockett Canyon site near Angus in the Sacramento Mountains. They noted an increasing use of faunal resources, like larger mammals and turkeys, between AD 1100 and 1350. Eliminating climatic perturbations and a decrease in the population, Speth and Scott concluded that this increase was due to changes in settlement and socioeconomic systems as exemplified in site aggregation.

Oscura Siding, LA 114462

Research domains for the historical site of Oscura Siding, LA 114462, include: chronometric dating, determining community layout, assessing function of excavated units, and the describing of demographics. Placement of Oscura Siding in a chronological framework will occur partially through analysis and dating of artifacts present. Archival research will also help pinpoint the time of occupation to a much tighter time span.

Papers, newspaper articles, and photographs will be accessed at the New Mexico State Records Center and Archives and at the Museum of New Mexico History Library in Santa Fe and at the Tularosa Historical Museum. Archival information will be gathered at the National Archives in the ICC Railroad Valuation Records files. Oral histories and personal photographs will also be sought from persons in Carrizozo and Alamogordo who once worked at or lived in Oscura.

This research will provide information about community layout, the function of specific structures, and demographics. Artifact and architectural comparisons will be made with other excavated railway stations along the El Paso and Northeastern Railroad Company, including Temporal (Laumbach et al. 2002) and Valmont.

Excavation Methods

After site boundaries were identified at each site, a baseline, primary datum, and one or more sub-data were established in a total station within the 1 by 1 m Cartesian grid system used during earlier testing (Oakes et al. 2009). Elevations were recorded along the baseline, at each grid corner, and at each feature excavated.

Prehistoric sites LA 120972 and LA 120973 were bladed using a front-end loader and Bobcat excavator and were hand-stripped to remove loose surface soils. Artifacts were collected by grid unit within these areas. LA 130331, a very small site, was not bladed.

Extensive artifact-concentration areas revealed during testing at LA 120973 were hand-stripped by shovel to a depth of 20–40 cm to expose subsurface cultural features. Profiles of each trench were sketched; if no features were found, only a 2 m segment was drawn. Mechanical blading occurred around areas where artifact scatters were found in order to further the search for buried features and, in several cases, to remove overburden from archaeological features.

At LA 120972, the entire western side of the right-of-way north of Willow Draw was bladed to expose compacted soil. Areas around features were stripped by hand. A blade was also employed on the eastern portion of the site to create a 2 m wide exploratory swath through an area where no artifacts had been encountered. Around features, the average depth of soil removed was 40 cm.

The western side of Willow Draw was bladed to ensure that no artifacts or features were present. At LA 120973, the same methods were used. At LA 114462, Oscura Siding, blading was restricted due to the presence of a cable line and bar ditch. Areas around features uncovered during testing were stripped by hand.

Hand tools—including trowels, shovels, picks, brushes, and dental tools—were used during excavation. Each 1 m grid unit was excavated in 10 cm deep levels except where natural stratigraphy was present; this was rare. General site soil was screened through ¼ inch wire hardware cloth, while soil from within features was screened through ⅛ inch cloth.

Artifacts recovered from each level were bagged separately by type with all proveniencing information and were assigned a field specimen (FS) number. Features were excavated in halves to expose any stratigraphic layering. If stratigraphic breaks were present, a soil profile was drawn. Soil from unexcavated portions of hearths and storage pits was collected for flotation or pollen samples. Soil from each excavated grid was identified by type and matched to the Munsell soil-color chart.

Photographs of each site were taken before, during, and after excavation. Radiocarbon samples were collected from every feature found to contain burned corn, charcoal, or wood. Archaeomagnetic samples were also taken, but the soil did not hold together well. After a feature had been excavated, a plan and profile were drawn and a photograph was taken. An individual feature form was completed for each excavated feature and included stratigraphy type and a description of the artifact.

A total of 580.1 cu m of soil was removed during the combined testing and excavation phases. This includes 33 mechanically excavated trenches 10–12 m in length and about 1.2 m deep. The depth of hand excavations on 717 grids ranged from 33–68 cm.

After archaeological investigations were completed, the sites were charted using a total station to produce detailed maps indicating cultural features, artifact scatters, backhoe trenches, and site boundaries. The sites were then backfilled by mechanical means.

Analytical Methods

Artifacts from the Carrizozo project were washed, sorted by type, and assigned to specific analysts. Data on these artifacts were entered into a computer database on SPSS and Microsoft Excel along with information regarding type, provenience, measurement, and description. Site maps were generated on ArcGIS using data from the total station used in the field. Specialized studies were conducted on specific categories of artifacts or remains. Radiocarbon samples were sent to Beta Analytic, Inc. Pollen samples were sent to the Palynological Laboratory at Texas A&M University. Specialized analysts at OAS conducted analyses on macrobotanical and faunal remains and on ceramic, lithic, and other artifacts.

6 ⊻ LA 114462, Oscura Siding

Virginia L. Prihoda and Matthew J. Barbour

LA 114462, also known as Oscura Siding, served as a rail stop along the El Paso and Northeastern Railroad Company line from around 1900 to the 1940s. Oscura Siding was a small, flourishing community on an open and gradually sloping alluvial plain. However, by the 1950s, the settlement had been deserted and mechanically bladed; only a few foundations were left behind.

A portion of the site (Fig. 6.1) remained within the US 54 right-of-way and was excavated by OAS. Oscura Siding was investigated by OAS in 2009, exposing 120 m (394 ft) of backhoe trenches and pits excavated to depths of 1.2 m (Oakes et al. 2009).

For this report, the site (Figs. 6.2a and 6.2b) was excavated and 163.4 cu m of soil removed. Depth of subsurface features ranged from 23 cm–1.2 m. The size of the excavated site size was 188 m (617 ft) north–south by 16 m (52 ft) east–west with a bar ditch and two fiber-optic lines limiting the western edge and the right-of-way boundary defining the eastern edge.

Eight features and eight artifact concentrations were excavated, recorded, mapped, and photographed at LA 114462. These included pits, a privy, a root cellar, and postholes. However, most of the structures in the former community were outside the right-of-way. As a result of the excavations, 5,734 historic artifacts were recorded as artifact concentrations and features. Historic artifacts found at the site yielded a mean date of 1912.0 with a standard deviation of 10.5 years.

Feature Descriptions

Feature 1, Root Cellar: Feature 1 at LA 114462 was a wood-lined root cellar measuring 1.5 by .90 by .90 m. At its deepest, overburden above the feature was 32 cm. Feature fill was compact, with pebbles, slag, wood fragments, coal flecking, burned rock, historic artifacts, animal bone, and a few stone tools of probable prehistoric origin.

The root cellar was framed with horizontal wooden planks at a height of 36 cm above the floor. Above the wood were the remains of an adobe wall. A row of cobbles was aligned along the eastern edge of the wall and set in concrete (Figs. 6.3a, 6.3b, and 6.4).

The 1.6 m row of cobbles suggested that the base of a structure once existed above the root cellar. Another small pile of cobbles at the southern end of the cellar was probably pushed off the southern foundation of the former structure. To the west, about 40 cm, was another cobble alignment 1.75 m long that may have indicated another wall foundation.

Feature 2, Trash Pit: A shallow pit measuring 1.4 by 1.8 by .27 m was uncovered in Backhoe Trench 4, a 1.4 m wide swath that extended further east and outside right-of-way boundaries (Figs. 6.5 and 6.6). Gravel, coal, wood, historic artifacts, and animal bone were found in the pit.

No layering of materials was present, except on the northern end of the western half of the feature, where the upper 20 cm was composed of ash and charcoal. The lower portion was composed of coal; no ash was present. The northern end of the eastern side of the pit had been disturbed by rodents, obscuring the feature boundary.

The remainder of the pit contained a fine-grained, silty loam (Munsell 10YR 5/2, grayish brown). On top of the pit was a 10 cm thick concrete slab. It appears the pit was filled with coal, ash, and other artifacts, likely refuse from a possible nearby structure.

Feature 3, Trash Pit: This pit also served as a repository for trash and measured approximately 1.9 m north–south by 1.3 m east–west by 30 cm deep. The boundaries of the pit were limited by the right-of-way's eastern edge and by a previously placed narrow trench.

The pit was cut by BHT 4 (Figs. 6.7 and 6.8). The narrow trench, which was 38 cm wide and 46 cm deep, may have once held pipes placed by Oscura residents and was most likely dug after work on the pit was complete.

Seventeen centimeters of overburden covered

Figure 6.1. LA 114462, view north.

the pit. Fill consisted of a grayish-brown (Munsell 10YR 5/2), semi-consolidated, fine-grained, silty loam with inclusions of coal, wood fragments, and pea gravel.

Feature 4, Natural Drainage with Trash: Stratigraphic layering and the presence of historic artifacts were evident in this area as investigations proceeded. Rather than a man-made construct, this area seemed to have been a natural drainage channel later filled with soil and a few artifacts, perhaps to stop erosion.

Two meters north–south and 1 m east–west were excavated to a depth of 33 cm (Fig. 6.9). Under a 2–4 cm layer of eolian topsoil (Fig. 6.10) was a lens of brown soil (Munsell 7.5YR 5/3) about 4–7 cm thick, containing pebbles, cinder, slag, and two historic artifacts. Below this was a pinkish-gray layer (Munsell 7.5YR 6/2) of sterile soil with light charcoal flecking but no historic artifacts.

A 3 cm lens of dark brown soil (Munsell 7.5YR 3/3) ran across the northern half of the profile, with charcoal inclusions and some carbonate development. Sterile soil with carbonate granules was found below this layer. Excavations were halted when it was determined that this was a filled-in channel.

Feature 5, Re-deposited Trash: This area had been greatly disturbed. Coal and a number of historic artifacts were evident at this locale. Upon excavation, it appeared as though these artifacts, along with the coal, had been re-deposited here possibly by a mechanical blade used to either level the landscape or fill in a low-lying area. An area of 4 m north–south by 2.5 m east–west was excavated to a maximum depth of 50 cm. Fill consisted of brown soil (Munsell 7.5YR 4/2).

Feature 6, Pit: This small, square pit, measuring 36 by 36 by 21 cm, was 1 m south of Feature 2. Feature fill consisted of burned rocks, cinder, coal, and a number of historic artifacts. The function of this pit was unknown.

Feature 7, Privy: The privy was dug into sterile soil to a depth of 1.06 m; the ledge around it measured 25–50 cm wide (Fig. 6.11) at a depth of 70–94 cm from the bottom, which measured 88 by 60 cm. The privy pit had been expanded to 1.24 by 1.60 m

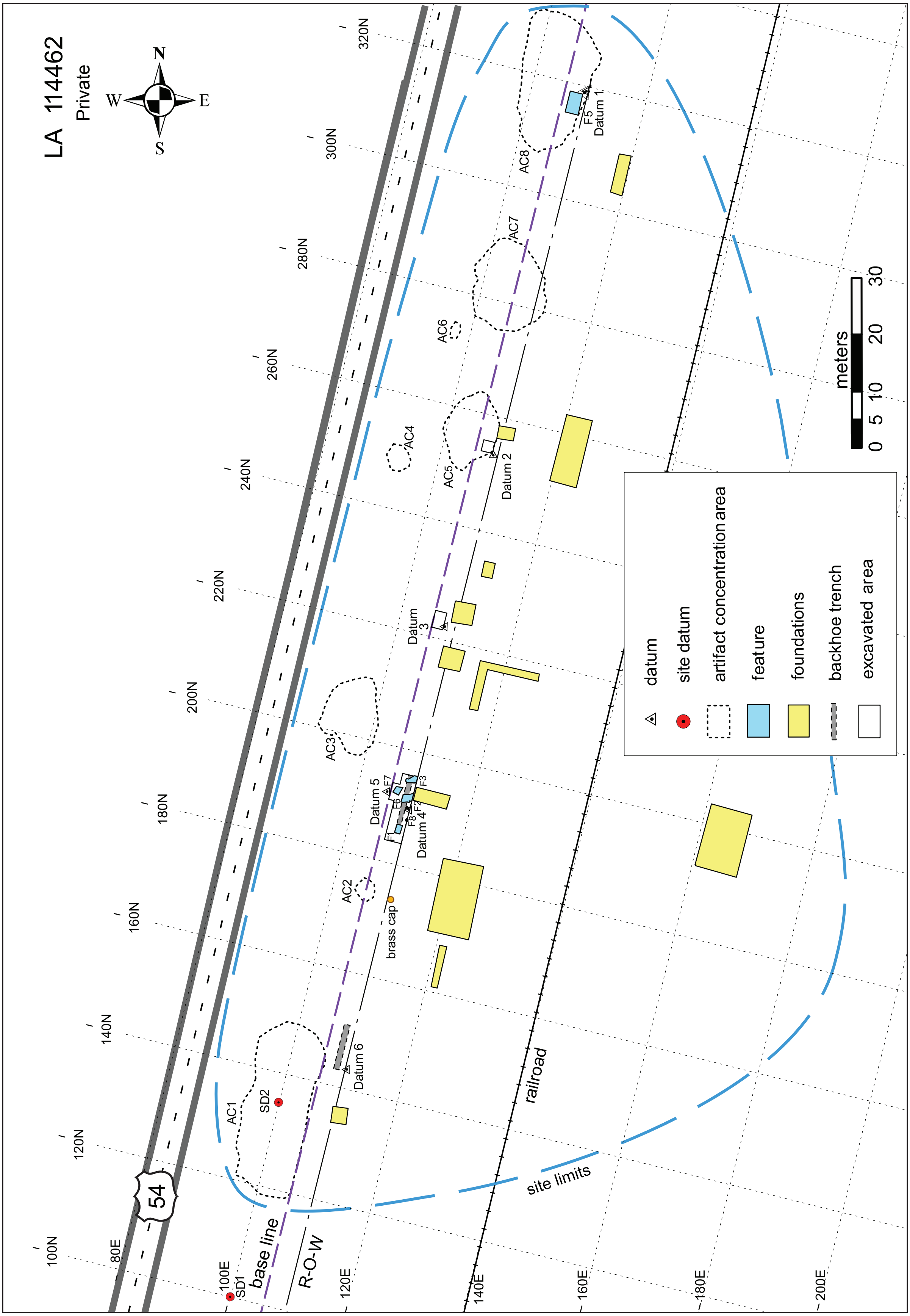


Figure 6.2a. LA 114462, site plan.

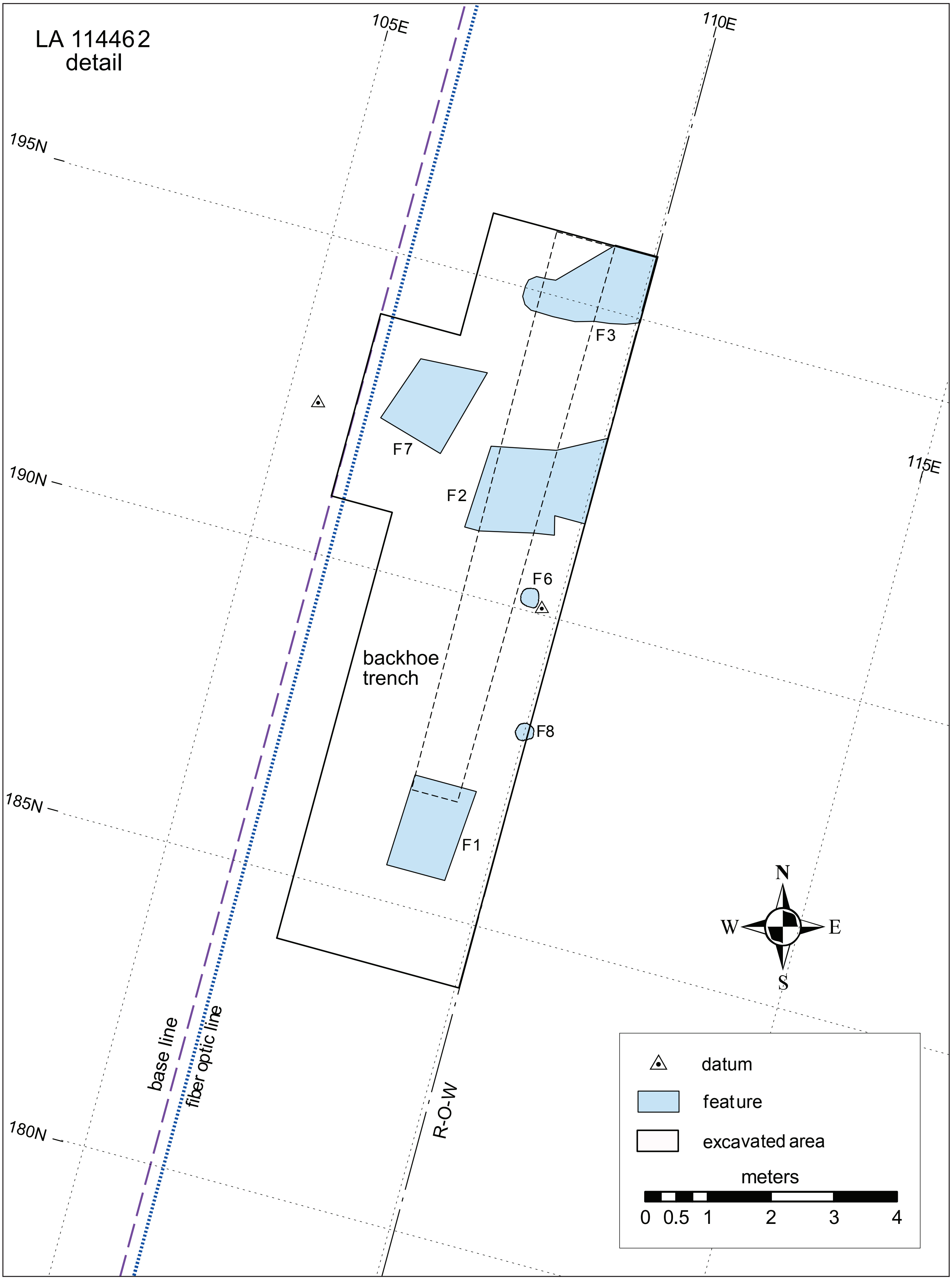


Figure 6.2b. LA 114462, site plan, detail.

Figure 6.3a. LA 114462, Feature 1, root cellar, view north.

as it opened up at the surface (Fig. 6.12). Feature fill was composed of loose, dark, reddish-gray soil (Munsell 5YR 4/3) with a great deal of charcoal, historic artifacts, and dried human waste.

Feature 8, Posthole: The posthole once held a railroad tie and measured 28 cm in diameter by 35 cm deep. It was located 1 m northeast of Feature 1, the root cellar. Fill consisted of a loose matrix of fine sand, burned pebbles, coal fragments, slag, and historic artifacts. Deposition within the posthole appeared to be the result of mechanical blading at the site.

Artifacts

Eight concentrations of artifacts were found along the western edge of the site (Figs. 6.2a and 6.2b). These concentrations were apparently formed during mechanical blading of the site, which took place in the 1950s. Seven hundred sixty-four artifacts from these units were documented in full and are presented here. Table 6.1 lists the eight areas, the dimensions of these areas, and the number of artifacts found at each. Tables 6.2–6.9 detail the artifacts from each concentration.

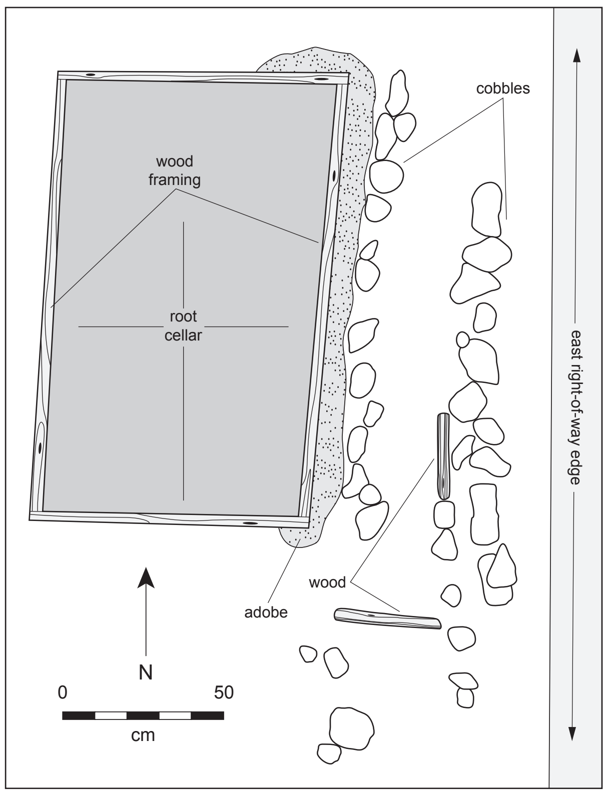


Figure 6.3b. LA 114462, Feature 1, root cellar, plan view.

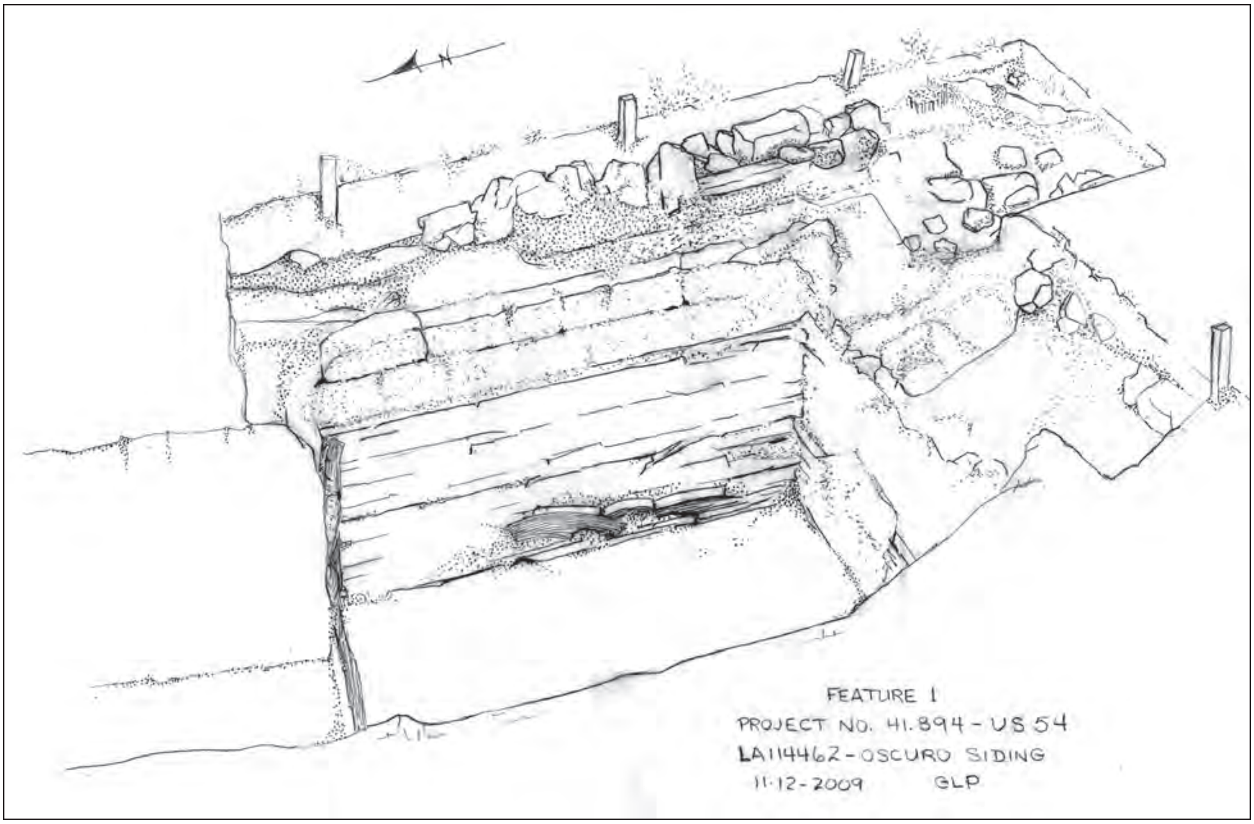


Figure 6.4. LA 114462, Feature 1, root cellar, sketch.

Euroamerican Artifact Analysis

Euroamerican artifacts represent objects not available in the Southwest prior to the establishment of European settlements in the sixteenth century. Assemblages typically include a variety of artifacts like glass bottles, can and metal fragments, and wheel-thrown ceramics.

A total of 5,734 Euroamerican artifacts were analyzed from LA 114462. The majority of these artifacts (n = 5,606 or 97.8 percent) were small, non-diagnostic fragments that were subjected to in-field analysis and were not collected. The remaining 128 Euroamerican artifacts (2.3 percent of the total assemblage) were either intact or considered significant enough to collect for in-house analysis and photographing.

Analysis dates were cut off at 1943, referencing the town's demise. Materials were analyzed according to standards and methodology outlined by Boyer et al. (1994), which were specifically created to quantify Euroamerican assemblages.

Analysis Methods

OAS Euroamerican analysis formats and procedures incorporate a range of variables found at sites throughout New Mexico dating from the sixteenth to twentieth centuries (Boyer et al. 1994). These methods are loosely based on South's Carolina and Frontier artifact patterns (1977) and on the function-based analytical framework described by Hull-Walski and Ayres (1989).

This format allows for the examination of temporal and spatial contexts and for direct comparisons between contemporaneous assemblages from other parts of New Mexico and the greater Southwest. Recorded attributes have been entered into the Statistical Package for the Social Sciences, or SPSS, an electronic database, for analysis and comparison to similar databases on file at OAS. Both this section of this report and the section that follows have been adapted from Barbour (2010).

Functional in nature, the Euroamerican artifact analysis format focuses on quantifying the utilization of various objects. One benefit of this type of

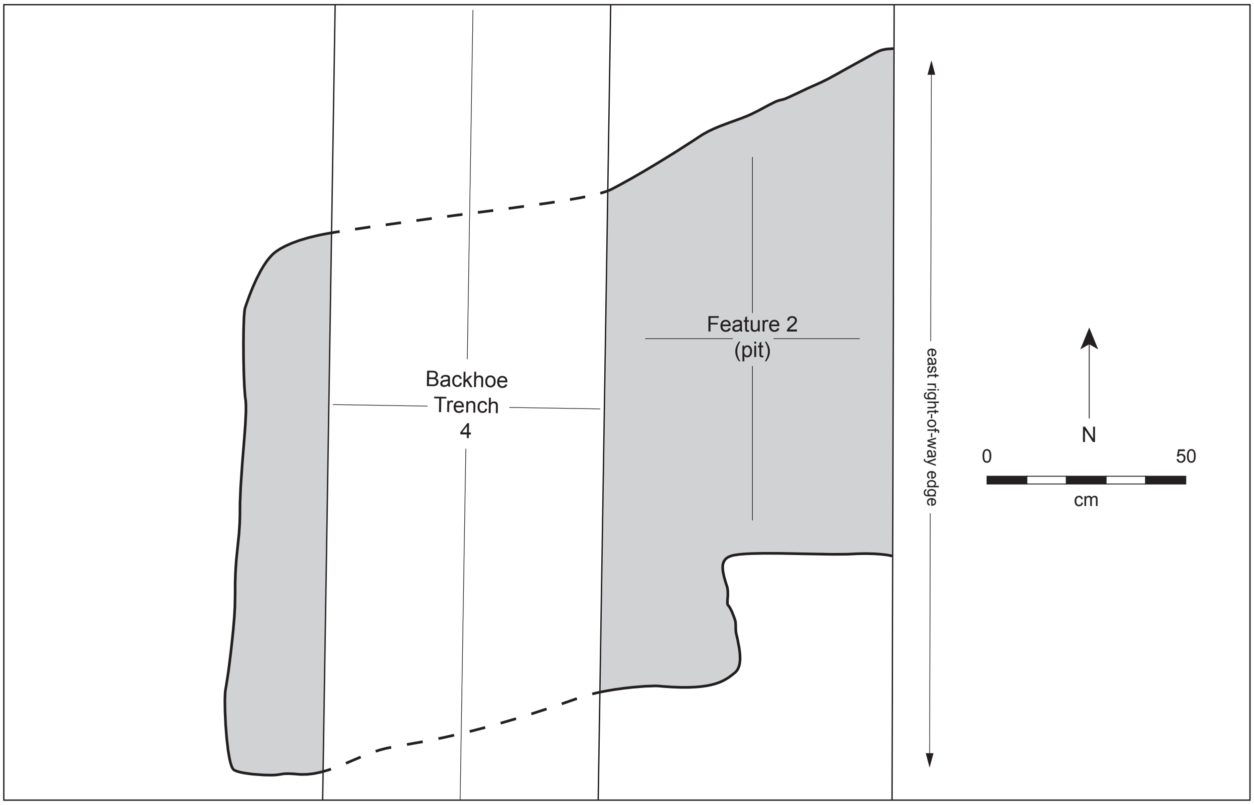


Figure 6.5. LA 114462, Feature 2, pit, plan view.

Figure 6.6. LA 114462, Feature 2, pit, BHT 4, view east.

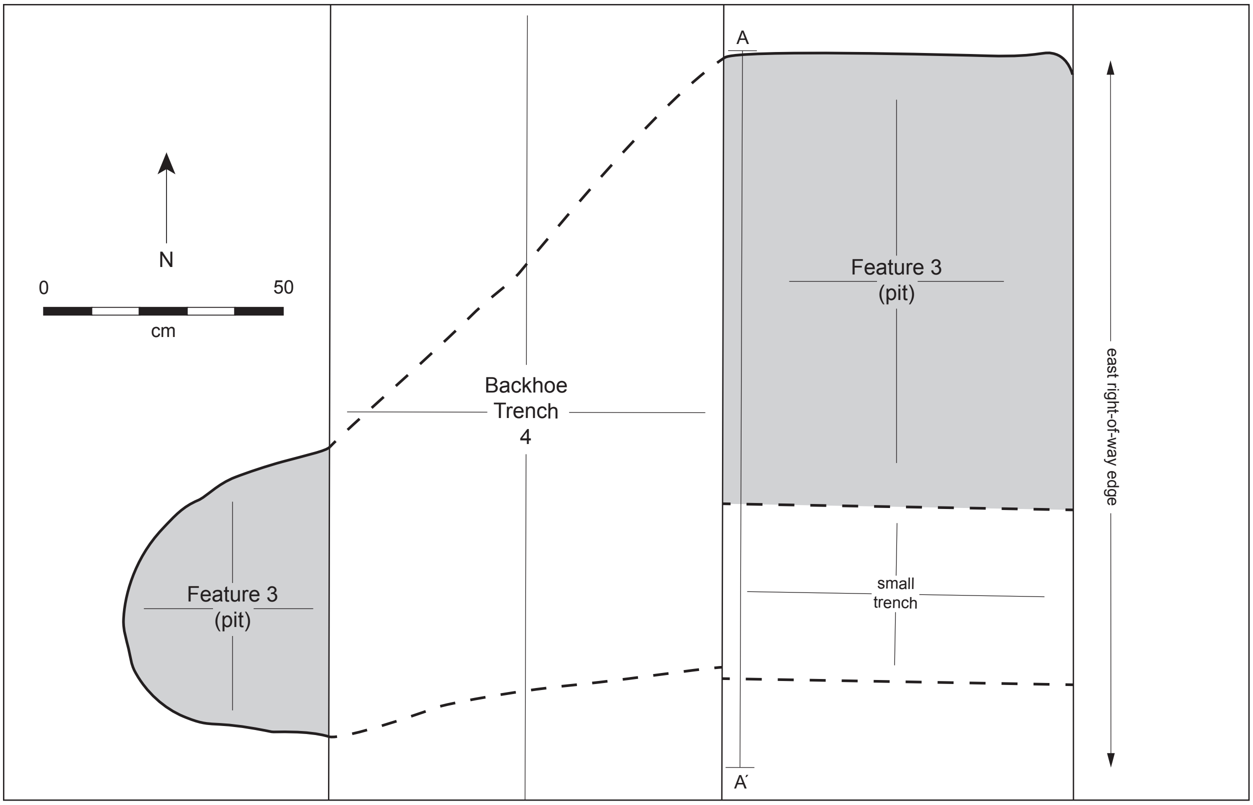


Figure 6.7. LA 114462, Feature 3, pit, plan view.

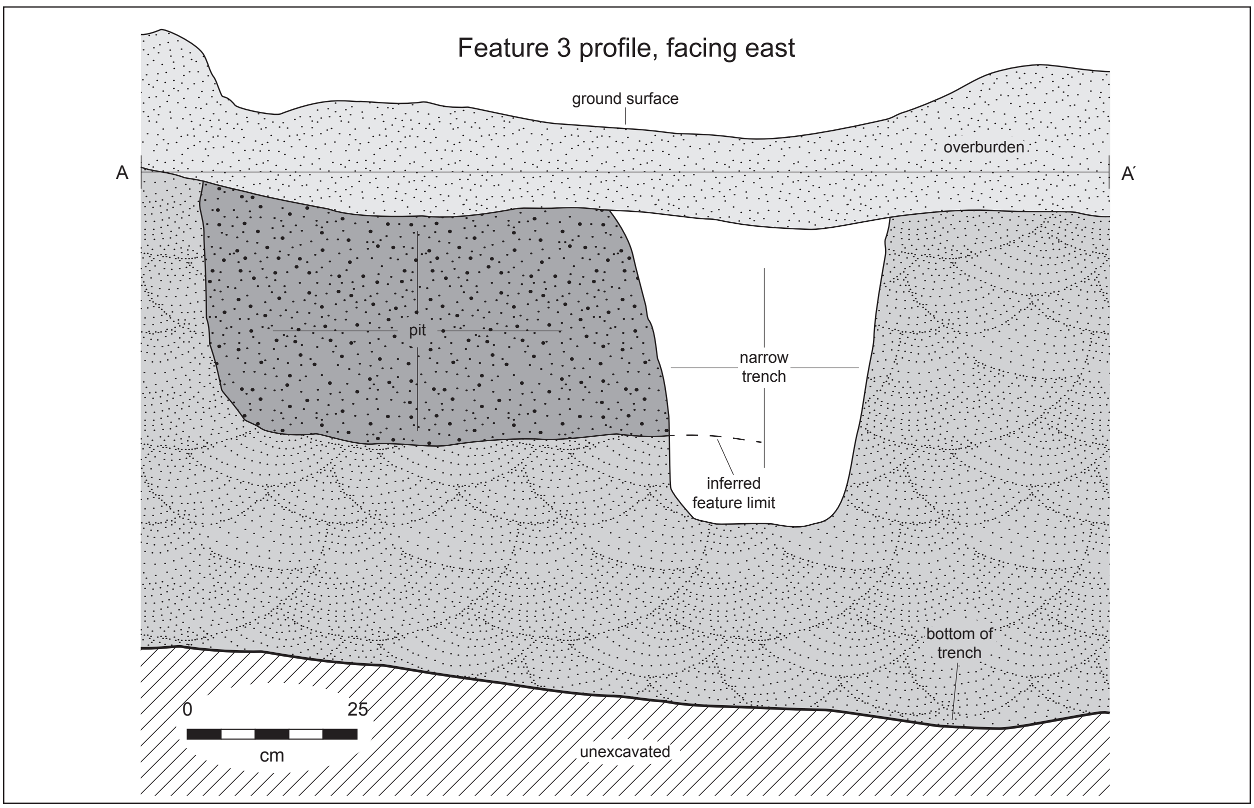


Figure 6.8. LA 114462, Feature 3, pit, profile, view east.

Figure 6.9. LA 114462, Feature 4, view east.

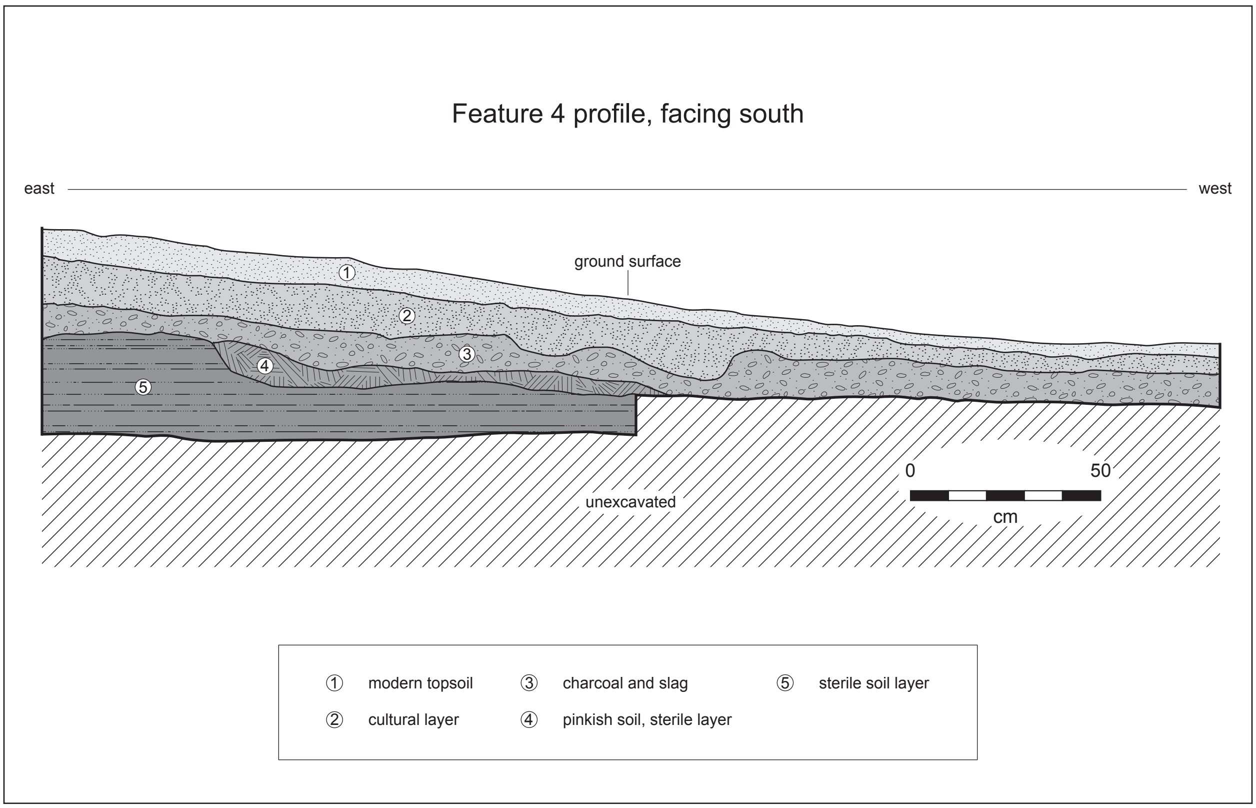


Figure 6.10. LA 114462, Feature 4, profile, view south.

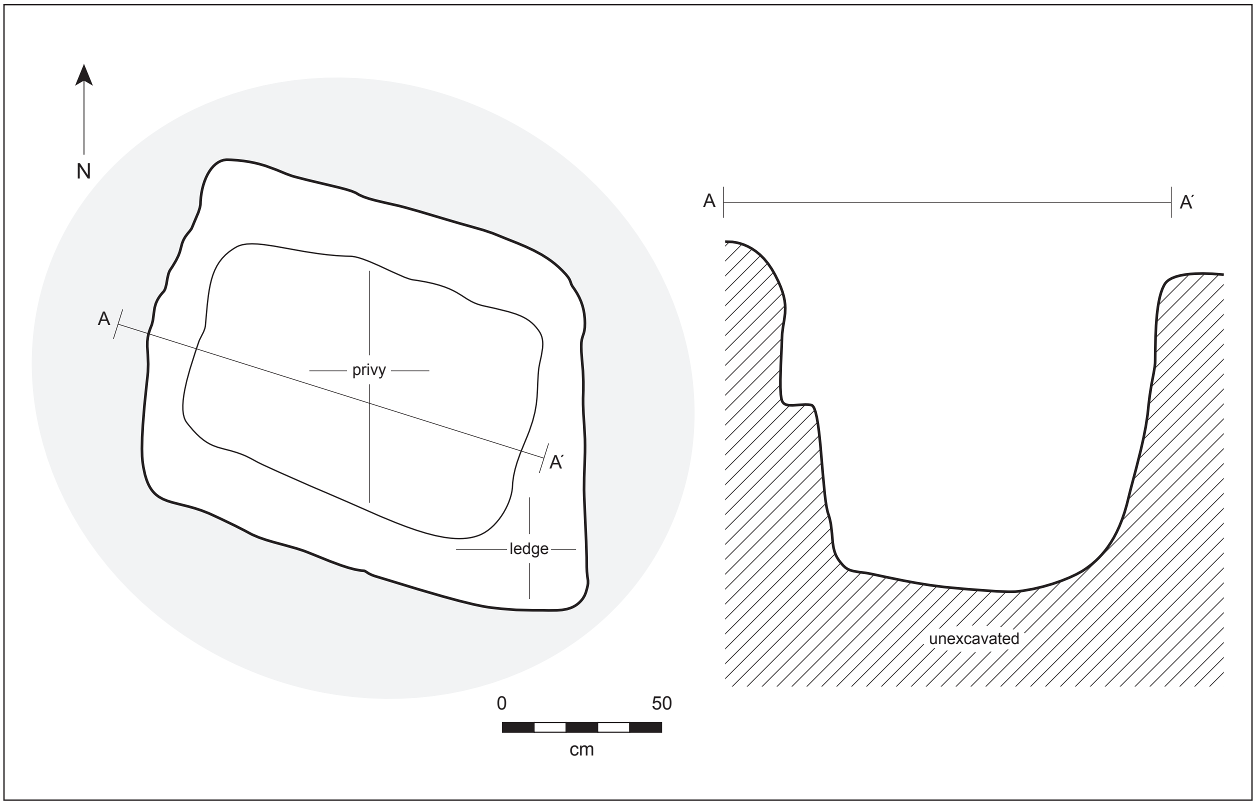


Figure 6.11. LA 114462, Feature 7, plan view and profile of privy, view east.

Figure 6.12. LA 114462, Feature 7, privy, view east.

analysis is that various functional categories often reflect a wide range of human activity and allow additional insight into the behavioral context in which artifacts were used, maintained, and discarded (Hannaford and Oakes 1983:70). It also helps analysts avoid pitfalls associated with categorizing artifacts based strictly on artifact attributes.

OAS analytic framework was designed to be flexible, documenting not only the qualities of each type of material but also the functional role of particular items and the time period in which these materials came into use.

As in all analysis, inherent assumptions are made that require explicit explanation. In functional analysis, each artifact is assigned a hierarchical series of attributes that classify the object based on assumed functional category, artifact type, and specific role within that matrix. These attributes are closely related and provide the foundation for additional variables that, with increasingly more detail, specify an artifact's particular function.

In this analysis, 12 functional categories were used, including: economy/production; food; indulgences; domestic; furnishings; construction/maintenance; personal effects; entertainment/leisure; transportation; communication; military/arms; and unassignable.

Each category encompasses a series of material types with specific functions that may be different but are still related. For example, a pickle jar and a meat tin are both assumed to have initially contained food. Both items would be included in the functional category for food even though each container is made from a different material and its contents have different functions.

In essence, function based analysis represents an inventory of different artifact attributes in which variables are recorded hierarchically to emphasize functional categories and provide a detailed description of each artifact, when possible. Attributes commonly provide detailed information about individual artifacts; functional categories include material type, date and location of manufacture, and artifact form and portion.

Chronometric data can be derived from descriptive and manufacturing attributes. If an artifact retains enough information to derive beginning or end dates those variables are recorded under the date attribute. The manufacturer attribute records the name of the company that produced a particular object. Together these data can be used to assign specific date ranges to an artifact based on known manufacture periods or dates of operation of manufacturing companies.

Table 6.1. LA 114462, Oscura Siding, artifact concentrations.

Concentration Area	Dimensions North/South (m)	Count
1	30 by 11	212
2	3 diameter	14
3	3 diameter	249
4	5 diameter	52
5	19 by 9	61
6	2 by 1	13
7	15 diameter	71
8	25 by 12	92
Total		**764**

Another related attribute is brand name. Many brand names have known production periods that provide temporal information. Brand name is generally listed on labeling or lettering on an artifact and is used to advertise the product, describe its contents, or inform the purchaser of its suggested use.

When evident, manufacture technique—such as wheel-thrown or forged—is also recorded. Since some manufacturing techniques have changed over time, this attribute can provide a general period of manufacture. A related attribute is seams, which records how sections of an artifact, particularly cans and bottles, were joined together during the manufacturing process. Through time these processes were altered; this is reflected in the types of seams used to construct various containers.

The type of finish/seal is recorded to describe the opening of a container before its contents were added and that container was sealed closed. Like seams, many finish/seal types have known manufacturing periods that offer general temporal information. In addition, opening/closure attributes describe the mechanism used for extracting the contents of a container.

For some artifacts, attributes such as color, ware, and dimension also provide information on the period of manufacture. The current color of an artifact is often recorded if it is determined to be of diagnostic value. A good example is glass, where the relative frequency of various colors in an assemblage can provide some temporal information,

Table 6.2. LA 114462, Concentration Area 1, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Unassignable				
Red plastic fragment	3	–	–	–
Clear bottle glass	2	–	–	–
Food				
White plastic food container	1			
Condensed milk can top	1	1814	1920	1867.00
Modern vegetable or fruit sanitary can	1	1990*	2000*	1995.00*
Soldered vegetable or fruit can seam	1	1814	1920	1867.00
Clear food bottle glass - Owens-Illinois	2	1941	1963	1952.00
Clear condiment jar glass	1	–	–	–
Clear pepper sauce bottle glass	1	–	–	–
Indulgences				
Green beverage bottle glass	1	–	–	–
Aqua beverage bottle glass	8	1880	1920	1900.00
Clear beverage bottle glass with seeds	28	1880	1943	1911.50
Amethyst beverage bottle glass	11	1880	1920	1900.00
Clear beverage bottle glass with seeds	10	1930	1943	1936.50
Modern clear beverage bottle glass, whole	1	1963*	2000*	1981.50*
Aqua soda bottle glass - Coca-Cola	1	1915	1943	1929.00
Modern green PET bottle, whole	1	1970*	2000*	1985.00*
Brown beer bottle glass	38	1880	1943	1911.50
Aluminum beer can - Schlitz Brewing Company, whole	1	1963*	1975*	1969.00*
Aluminum beer can, Anheuser-Busch, Whole	1	1963*	1975*	1969.00*
Aluminum beer can, whole	1	1963*	1983*	1973.00*
Clear liquor bottle glass	1	1880	1943	1911.50
Domestic				
Brown crockery	1	1850	1943	1896.50
Traditional white ware	1	1800	1943	1871.50
Ironstone dishware fragment	21	1854	1920	1887.00
Decalcomania white ware	2	1908	1930	1919.00
Ironstone cup rim with blue band	1	1880	1943	1911.50
White plastic Solo cup	1	1940	1943	1941.50
Orange glazed plate - Homer Laughlin Fiestaware	2	1936	1943	1939.50
Ironstone plate rim	13	–	–	–
White milk glass glassware	5	1890	1910	1900.00
Yellow glassware, possibly Depression glass	1	1928	1941	1934.50
Green glassware	1	1887	1913	1900.00
White milk glass cup fragment	1	–	–	–
Clear decorative object glass	1	–	–	–
Light green glass coaster fragment	2	1887	1913	1900.00
White milk glass canning lid cap, whole	1	–	–	–
Furnishings				
Clear glass vase fragment	1	–	–	–

Table 6.2 (continued)

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Construction/Maintenance				
Smooth wire	1	–	–	–
Ogee washer	1	–	–	–
Bolt/nut/washer	1	–	–	–
1931 date nail	1	1931	1931	1931.00
Aqua window pane	1	1878	1920	1899.00
Aqua window pane	5	1878	1943	1910.50
Clear window pane	9	1878	1943	1910.50
Porcelain electrical housing, Knox Electric Company	1	–	–	–
Barbed wire	1	–	–	–
Personal Effects				
White shell 2-hole button	1	1900	1943	1921.50
Black rubber heel	1	1890	1943	1916.50
Cobalt glass jar fragment	12	1890	1943	1916.50
White milk glass pomade jar fragment	1	1900	1943	1921.50
Entertainment/Leisure				
Porcelain doll head fragment	2	–	–	–
Transportation				
Rubber tire tread	1	–	–	–
Railroad spike	1	–	–	–
Communication				
Clear glass insulator fragment	1	1871	1936	1903.50
Total	**212**			
Mean average				1910.00
Standard Deviation				21.00

* not included in means and standard deviations

since manufacture and preservative processes have changed over time.

Ware refers to china artifacts and categorizes the specific type of ceramic represented. Because temporal information exists for most major ware types, this attribute provides more refined dating information as compared to seams and color. Dimensions of complete artifacts also can provide chronometric data, especially for artifacts like nails or windowpane glass, where thickness or length of an object can be temporally sensitive.

In addition to temporal information, the manufacturing process by which a particular object was created can be used to support functional inferences. Material records the type of material, or materials, from which an object was manufactured—glass, metal, paper, clay, etc. Paste describes the texture of the clay used to manufacture ceramic objects and can be further defined by porosity, hardness, vitrification, and opacity. The decoration and design category describes the technique used to apply distinctive decorative motifs to an object.

In addition to the attributes discussed above, several others are used to quantify the condition and use-life of each object. For each item, the fragment/part variable describes which portion of a particular form is represented. Fragments fitted together to form complete or partial objects recovered from a single excavation context are recorded together as a minimum number of vessels (mnv) of one. The number of specimens present is represented by count.

Cultural alteration of an item to extend its use-life is recorded as reuse; this variable describes any evidence of a secondary function. The condition/modification variable monitors any physical modifications associated with secondary use. If environmental conditions have altered the surface of

Table 6.3. LA 114462, Concentration Area 2, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Indulgences				
Clear beverage bottle glass, nfs*	10	1880	1943	1911.50
Clear beverage bottle glass, nfs	1	1928	1943	1935.50
Construction/Maintenance				
Washer	1	–	–	–
Metal elbow pipe connector	1	–	–	–
Personal Effects				
White glass 2-hole button, whole	1	–	–	–
Total	**14**			
Mean average				1923.00
SD				12.00

* not further specified

an artifact through either glass patination or metal corrosion, this is recorded as aging.

The appearance of an artifact is monitored using the shape variable. This variable is used to describe physical contours of complete objects. Finally, quantitative data are recorded and included as volume, length/height, width/diameter, thickness, and weight.

Artifact and Assemblage Dating Methods

Begin and end dates of artifacts were based on a number of attributes such as the sealing and closure methods used for bottles and cans, invention dates, stylistic changes in design, and advances in manufacturing techniques with known dates.

The begin date for an artifact is the earliest possible date that can be documented for its existence. These dates can come from patents, factory inventories, newspapers, and company records. An end date is the last documented date of that attribute or artifact production. These dates are often determined through newspapers, magazines, industry newsletters, or announcements of the introduction of new manufacturing techniques or inventions.

Sometimes a change in production materials or the termination of a certain pattern, as related to a company's glass or ceramic wares, will establish an end date for the production of an item or of a manufacturing technique. This is particularly true for mass-produced items, for which attribute changes form a kind of chronological sequence. Examples of datable attributes include the locations of seams on bottles, the kinds of seams on cans, identifiable maker's marks on glass and ceramic vessels, the colors of glass, or the forms of nails. Using a combination of the earliest and most-recent known dates, a bracketed time range can be obtained.

Bracketed time ranges based on manufacture dates are often used to identify mean ceramic and mean bottle glass manufacture dates using mean ceramic dating. Mean ceramic dating is a method of calculating the date of a deposit based on the frequency of recovered ceramic types. Since a wide variety of ceramic types have been assigned median manufacture dates, data can be used to approximate the periods of manufacture for certain types and, in turn, for archaeological deposits.

Simply put, the mean ceramic date is generated by multiplying the frequency of each type by the median manufacture date for that type, adding those products together, and then dividing that sum by the total number of individual types. Unlike more impressionistic dating methods that require an analyst to offer a date based on the overall assemblage, this method generates a date that can be independently verified if the same reported median manufacture date is used. In this case, the reported median manufacture date is the same as the mean because only begin and end manufacture dates were used.

While mean ceramic dating has proved fruitful

Table 6.4. LA 114462, Concentration Area 3, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Food				
Amethyst condiment bottle glass	3	1880	1920	1900.00
Aqua berry jar glass Canton Glass Co.	9	1916	1930	1923.00
Indulgences				
Aqua beverage bottle glass	12	1880	1920	1900.00
Clear beverage bottle glass with seeds	2	1880	1920	1900.00
Brown beverage bottle glass	11			
Amethyst beverage bottle glass	1	1870	1920	1895.00
Clear beverage bottle glass	5	1892	1920	1906.00
Clear beverage bottle glass	1	1870	1920	1895.00
Clear beverage bottle glass, possibly 6 bottles	54			
Amber beverage bottle glass, possibly 3 bottles	57	1845	1913	1879.00
Modern clear beer bottle glass	1	1966*	2000*	1983.00*
Aqua beer bottle glass, possibly 3 bottles Chattanooga Glass Co.	27	1927	1943	1935.00
Aqua beer bottle glass, possibly 2 bottles - Cunninghams and Company, Pittsburgh, Pennsylvania, PA - C Company	18	1879	1909	1894.00
Amber beer bottle glass, possibly 2 bottles - Atlantic Bottle Company	38	1916	1930	1923.00
Aluminum beer can - Anheuser-Busch	1	1963*	2000*	1981.50*
Domestic				
White ware dish rim	1	1800	1943	1871.50
Ironstone dishware	3	1854	1920	1887.00
Brown beverage bottle glass, Owens-Illinois	1	1941	1963	1952.00
Construction/Maintenance				
Roofing paper	1	–	–	–
Entertainment/Leisure				
Porcelain doll head fragments	3	–	–	–
Total	**249**			
Mean average				1907.00
Standard Deviation				22.00

* not included in the means and standard deviations

in Colonial period assemblages throughout the New World (Hume 1970; South 1977) there are some drawbacks. For example, ceramic dishes can be curated by individuals for significant periods of time. This curation behavior can lead to mean ceramic dates far earlier than the period of occupation.

To mitigate this effect, a more acceptable method of mean ceramic dating for nineteenth and twentieth century assemblages is to focus on container material types such as bottle glass or can fragments most often used and discarded during a site's occupation history.

This allows for a greater sample size and truncates curation periods to derive a more precise occupation date. These data can then be compared to the mean ceramic date to scale the effects of curation, if any, on the overall assemblage. When possible, mean ceramic, mean bottle glass, and mean can manufacture dates were calculated for each Euroamerican artifact assemblage.

In most cases, precise manufacture dates for many artifacts could not be ascertained due to the highly fragmented nature of the Euroamerican assemblage; also, manufacture dates were sometimes too few in number to provide statistically meaningful samples.

In these instances, more impressionistic means were employed to approximate the date of the Euro-

Table 6.5. LA 114462, Concentration Area 4, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Unassignable				
Metal machine part fragment	1	–	–	–
Rubber housing for mechanical part	1	–	–	–
Food				
Vegetable or fruit can	1	1955	1955	1955.00
Indulgences				
Aqua beverage bottle glass	1	1880	1920	1900.00
Aqua beverage bottle glass	2	1915	1943	1929.00
Clear beverage bottle glass	14	1880	1930	1905.00
Brown beverage bottle glass	1			
Green beverage bottle glass	1	1880	1920	1900.00
Amethyst liquor bottle glass	6	1880	1920	1900.00
Olive green wine bottle glass	1	1880	1920	1900.00
Domestic				
Blue- and buff-colored crockery	2	1850	1943	1896.50
Ironstone dishware	6	1854	1920	1887.00
Yellow ware mixing/serving bowl rim	1	1830	1950	1890.00
Flo-Blue whiteware sugar bowl fragment	1	1752	1850	1801.00
Amethyst glass goblet fragment	1	1880	1920	1900.00
Construction/Maintenance				
Finishing nail	1	–	–	–
Clear window pane	4	1878	1943	1910.50
Personal Effects				
Cobalt glass jar fragment	1	1802	1943	1872.50
Amethyst medicine bottle glass	7	1880	1920	1900.00
Total	**52**			
Mean average				1897.00
SD				28.00

american artifact assemblage. This involved looking for the presence or absence of machine-made bottle glass, to determine if an assemblage dated to the nineteenth or twentieth centuries, and examining the ratio of machine-cut or square nails to wire-drawn nails in order to determine whether the assemblage could be dated to the 1880s or the 1920s.

One of the most useful impressionistic dating methods is the examination of container types. Relative frequencies of glass, metal, and plastic containers can, over time, be used to form a chronology by which assemblages from various contexts can be ordered temporally. In the nineteenth century, glass containers were the most heavily used relative to other material types; utilization of glass declined with the rise of the canning industry in the early twentieth century.

Similarly, by the late twentieth century, plastics surpassed metal as the dominant material type used in packaging containers (Rathje and Murphy 2001). This method does not provide decade-specific resolutions of the discussion of chronology within the late nineteenth and early twentieth centuries, but it can provide base information for gauging the relative age of any assemblage. For this analysis, multiple methods were used to date the variable assemblages.

Analysis Results

Analysis of the 5,734 collected and field-quantified, Euroamerican artifacts from eight features and eight artifact concentration areas were distributed over 12 broad functional categories used in Euroamerican artifact analysis. Collected artifacts, mostly intact, were subjectively chosen and brought in from the

Table 6.6. LA 114462, Concentration Area 5, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Unassignable				
Green plastic container	1	–	–	–
Clear glass bottle	18	–	–	–
Indulgences				
Amber beverage bottle glass, nfs*	1	1880	1920	1900.00
Clear beverage bottle glass, nfs	2	1924	1943	1933.50
Brown beverage bottle glass, nfs	2	1880	1943	1911.50
Amethyst beverage bottle glass, nfs	4	1880	1920	1900.00
Clear soda bottle glass	1	1934	1943	1938.50
Yellow soda bottle glass	1	1934	1943	1938.50
Domestic				
Clear glass percolator cover knob	1	–	–	–
Blue glazed ironstone fragment	2	1752	1850	1801.00
White ironstone fragment	2	1854	1920	1887.00
Ironstone cup handle	1	1854	1920	1887.00
Decalcomania plate rim	3	1908	1943	1925.50
White ware platter fragment	1	1800	1943	1871.50
Clear glassware fragment	1	–	–	–
Furnishings				
White ware figurine fragment	3	1800	1943	1871.50
Construction/Maintenance				
Sheet metal	8	–	–	–
Clear window pane	5	1878	1943	1910.50
Orange brick	1	–	–	–
Personal Effects				
Cobalt glass jar fragment	1	1802	1943	1872.50
Clear glass liniment bottle - Dr. J. H. McLean	1	1900	1920	1910.00
Communication				
Aqua glass insulator fragment	1	1871	1936	1903.50
Total	**61**			
Mean average				1899.00
Standard Deviation				33.00

*nfs = not further specified

field for further analysis based on diagnostic and documentable significance. Artifacts from each category are discussed below.

Functionally Unassignable Items: A total of 1,735 items, or 30.25 percent of the total Euroamerican assemblage, could not be assigned to a particular activity. The majority of Euroamerican artifacts analyzed at this site was of this functional category. It is possible to speculate that many of the goods considered unassignable represent indulgence and food items as the category is comprised primarily of highly fragmented bottle glass (n = 766, 44.15 percent) and metal can (n = 517, 29.80 percent) fragments that had not retained enough diagnostic attributes to assign to a specific function. Objects such as machine-made bottle glass provided temporal indicators of the early twentieth century.

Construction and Maintenance Items: Construction and maintenance items were used in building and maintaining structures and machinery. Nearly 26 percent of the total assemblage represented is in this category (n = 1,486 artifacts). The common wire nail (n = 606) had the highest count. Other functional items included building materials (n = 489); electrical materials (n = 35); fencing materials (n = 54), which included fence staples and

Table 6.7. LA 114462, Concentration Area 6, artifacts, by category and date.

Artifacts	Count	Begin Date (AD)	End Date (AD)	Mean
Indulgences				
Aqua beverage bottle glass	1	1880	1920	1900.00
Domestic				
Ironstone dishware	3	1800	1943	1871.50
Decalcomania plate	3	1908	1943	1925.50
Ironstone casserole dish fragment	2	1854	1920	1887.00
Amethyst glassware cup fragment	1	1880	1920	1900.00
Modern polystyrene cup	1	1941*	2000*	1970.00*
Personal Effects				
Glass ointment jar	2	1890	1943	1916.50
Total	**13**			
Mean average				1900.00
Standard Deviation				19.00

* not included in means and standard deviations

barbed wire presumably used in the installation and maintenance of the fence line along the US 54 right-of-way; and, finally, plumbing items (n = 34).

Indulgence Items: Indulgences (n = 1,091, mnv = 252) represent items that are not a necessity for human subsistence but are consumed for pleasure or recreation. These types of items represented 19.03 percent of the total Euroamerican assemblage.

The majority of items identified within this functional category were related to the consumption of alcoholic beverages (n = 426, mnv = 84) or 39 percent of the indulgence category. Alcohol containers were subdivided to include beer (n = 308, mnv = 57); wine (n = 23, mnv = 7); and liquor (n = 95, mnv = 20) represented by both complete and fragmented bottles and cans. Common brand names identified included Schlitz (mnv = 13); Budweiser (mnv = 8); Gallo-Flavor Guard (n = 3); and Jim Beam Bourbon (n = 1). The Schlitz containers were highly diagnostic. The manufacturing dates of Schlitz aluminum cans, introduced in 1959, and the advent of the pull-tab, suggest that these cans date between the early 1960s and 1974.

Small quantities of other indulgence types were recovered in low frequencies. Unidentifiable indulgence items (n = 448) consisted of crown caps and bottle shards. Soda bottles and cans represented 3 percent of the total Euroamerican assemblage. Brands associated with these artifacts included Nesbitt's, Vernors Ginger Ale, Shurfine Soda, Dr. Pepper, 7 Up, Sprite, Coca-Cola, Crush, and Pepsi. A Copenhagen chewing tobacco can lid (n = 1) fragment was also present.

Food Items: Euroamerican artifacts typically classified as food items are represented by inorganic containers and qualitative characteristics such as container shape and size. Only 451 Euroamerican artifacts were identified as being food related. These artifacts comprised of 7.9 percent of the Euroamerican artifact assemblage at the site. Artifacts in the food items category can be further categorized by container type: cans or bottles.

The majority of can fragments were identified as cylindrical cans that may have contained vegetables or fruits (n = 246, mnv = 20, Table 6.1). Remaining canned products (n = 75) included coffee; evaporated milk (n = 1); lard buckets (n = 5); meat cans (n = 24); and spices (n = 3). One Gebhardt's Chili Powder label was identified.

Bottled food items (n = 129) included glass food containers, not further specified (n = 36); mustard or pepper sauce bottle fragments (n = 40) of the King Peppersauce brand; vinegar bottles (n = 6); and jam jar glass fragments (n = 16). Bridgewood & Clark, of Burslem, England, makers of glass containers for preservatives, and Canton Glass Co., a manufacturer of berry jars was also identified. Milk bottles, both whole and broken, labeled A. J. Olson Company, were also recovered. An unidentifiable extract bottle was collected as well.

Domestic Items: Domestic items include products used in food service, preparing or pre-

Table 6.8. LA 114462, Concentration Area 7, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean
Unassignable				
White plastic mold	1	–	–	–
Clear bottle glass	5	–	–	–
Orange rubber fragment	1	–	–	–
Food				
Sanitary food can	1	1904	1943	1923.50
Clear bottle goods glass	1	1930	1943	1936.50
Indulgences				
Modern aluminum beverage cans	2	1963	1983	1973.00
Aqua beverage bottle glass	11	1880	1920	1900.00
Clear beverage bottle glass	6	1904	1943	1923.50
Brown beverage bottle glass	11	–	–	–
Green beverage bottle glass	1	–	–	–
Aqua soda bottle glass - Coca Cola	1	1915	1943	1929.00
Olive green wine bottle glass	1	1880	1943	1911.50
Domestic				
Brown and cream crockery	3	1850	1943	1896.50
Ironstone fragments	3	1854	1920	1887.00
Red clay vessel, indeterminate	1	1850	1943	1896.50
Green white ware plate brim	1	1820	1900	1860.00
Green milk glass plate fragment	1	–	–	–
Construction/Maintenance				
Shingle	1	–	–	–
Concrete fragments	12	–	–	–
Brown salt-glazed sewer pipe	3	1900	1943	1921.50
Personal Effects				
Leather boot fragment	1	–	–	–
White milk glass jar fragment	1	1890	1943	1916.50
Amethyst medicine bottle glass	2	1893	1920	1906.50
Total	**71**			
Mean average				1910.00
Standard Deviation				21.00

serving food, child care, or in the care of the household. Items in this category represented 7.57 percent (n = 435) of the total Euroamerican assemblage and were comprised mostly of ceramic dishware fragments (n = 239).

Artifacts consisted of eight Mexican lead-glaze sherds indicating at least one hand-painted vessel and one plain vessel. Four of the eight sherds were recovered from Feature 5, a small pit. A few ironware fragments were identified as Fiestaware, which was produced by Homer Laughlin and manufacturer S. W. Dean.

Glassware (n = 100) included tumblers (n = 25, mnv = 13) originally manufactured as jam jars by Capstan Glass Company and Hazel Atlas Glass Company. Manufacturers of glass canning jars (n = 6) were represented by the Alexander H. Kerr & Company; Ball; Mason Fruit Jar Co.; and Schram of St. Louis.

Other domestic items included cutlery and silverware (mnv = 2), one piece of which was clearly identified as a Rogers nickel silver teaspoon; pots and pans (n = 3); one cleaning item (n = 1); a brown Clorox bottle; and two sewing items (mnv = 2), a thimble and safety pin.

Personal Effects: Personal effects are portable items belonging to individuals presumed to have lived or worked at a site. In this instance, they may also be associated with passenger, motorized vehicles traveling along US 54, commissioned in 1925.

Table 6.9. LA 114462, Concentration Area 8, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean
Unassignable				
Clear bottle glass	19	–	–	–
Food	–	–	–	–
Sanitary meat can	1	–	–	–
Spice can	1	–	–	–
Vegetable can	1	1918	1943	1930.50
Indulgences				
Aqua beverage bottle glass	1	1880	1920	1900.00
Amethyst beverage bottle glass	4	1880	1920	1900.00
Brown beverage bottle glass	19	1880	1943	1911.50
Domestic				
Enamel ware	1	1874	1943	1908.50
Ironstone dishware	3	1854	1920	1887.00
Blue and white ironstone plate fragment	5	1854	1920	1887.00
Gilded white ware pitcher fragment	1	1800	1943	1871.50
Green milk glass dishware	1	–	–	–
Amethyst glassware fragments	11	1880	1920	1900.00
Clear glass candy dish fragment	1	–	–	–
Construction/Maintenance				
Common wire nail	1	–	–	–
Shingle	6	–	–	–
Aqua window pane	2	1878	1943	1910.50
Clear window pane	6	1878	1943	1910.50
Yellow fire brick - LaClede Company	1	–	–	–
Personal Effects				
Amethyst glass pill bottle, whole - Illinois Glass Company	1	1916	1929	1922.50
Entertainment/Leisure				
Porcelain tea set miniature sugar bowl	1	–	–	–
Transportation				
Railroad spike	1	1899	1943	1921.00
Total	**92**			
Mean average				1901.00
Standard Deviation				18.00

The number of artifacts belonging in the personal effects category make up 3.1 percent (n = 179) of the total assemblage. Buttons, made mostly of shell, and various closures associated with clothing were prevalent (n = 57). Medicine and health effects (n = 41) included liniments, ointments, cough syrup, tinctures, pill bottles, and a broken thermometer. Grooming and personal hygiene items (n = 30) consisted of a lipstick tube and perfume, pomade, rouge and toiletry containers.

Furnishing Items: Furnishing items are typically represented as non-consumptive consumer products—fragments of furniture, light fixtures, or appliances—found within domestic structures or dwellings. This category is generally represented not by major appliances and furniture, but by fasteners, hardware, or decorative items that were once attached to larger objects. Functional analysis can be problematic, since most hardware and fasteners are recorded as construction/maintenance items and not as furnishing items. This can diminish the frequency of furnishing items found within the greater Euroamerican assemblage.

Furnishing artifacts for LA 114462 accounted for 2 percent (n = 114) of the total Euroamerican artifact assemblage. The majority of artifacts recorded as furnishing items were associated with heating, cooking, or lighting.

Transportation Items: Transportation items are used for the transfer of people or freight from one place to another. The total Euroamerican artifact assemblage identified as transportation items was 1.81 percent, or n = 104. These items consisted of car/truck items, a coil point (n = 1), wheel weights (n = 2), a headlight lens fragment (n = 1), and several disintegrating pages from a mechanics manual. Among railroad artifact types were rail spikes (n = 13), rail markers (n = 3), and red signal lens fragments (n = 3). A bicycle tire fragment was also recorded.

Communication: Communication items involve the long-distance transfer of information and include telephone, telegraph, postal, and radio communication items. The last type is comprised of various two-way radios, but does not include radios used for entertainment; these are listed as appliances in the furnishing items category. Items in this category accounted for 1 percent (n = 59, mnv = 16) of the total number of the Euroamerican artifact assemblage.

Half of the recorded communication items were stems—either wooden or iron—used to screw into glass insulators. The other half were glass insulators, either fragments or intact. Two were positively identified as Hemingray Company products; these were very popular insulators and were used by several different electric companies. A third insulator was manufactured by A. M. Tel & Tel Co., who made a deal with Hemingray, 1870–1967, and the Brookfield Glass Company, 1864–1906, to make glass insulators. Brookfield was later re-named Bushwick Glass Works. A. M. Tel & Tel Co. later became known as AT&T.

Entertainment, Leisure, and Educational Items: Artifacts in the entertainment, leisure, and educational category indicate activities intended to entertain, amuse, and provide relaxation or recreation. These items constituted only 0.8 percent (n = 47, mnv = 35) of finds at the site and included several miniature figurines (mnv = 7), porcelain doll fragments (n = 10), a jack from the game of Jacks (mnv = 1), and rubber ball fragments (n = 5). Games also included marbles (mnv = 2). Music was represented by vinyl record-album fragments (n = 4). Stationery equipment lists a pencil, rubber band, and mucilage. A piece of chalk also was recovered. A fishing hook was categorized as an outdoor sports and recreation item, since it is unlikely a commercial fishing endeavor was feasible in the Tularosa Basin.

Military & Arms Items: Military and arms items include objects associated with or used in warfare, self-protection, or hunting activities. These items include firearms, munitions, explosive devices, military uniforms, and various accoutrement. At LA 114462, no military artifacts were found. However, small arms ammunition was recovered, constituting 0.56 percent (mnv = 32) of the total Euroamerican artifact assemblage. It was not uncommon, and was usually necessary, to utilize arms for self-protection and game hunting in the remote high desert.

Economy/Production Items: Economy/production items represent items associated with subsistence and industrial and commercial endeavors. The acute absence of economy/production items here is not surprising. The initial impetus for the development of the Tularosa Basin was inspired by the discovery of coal deposits and gold in the outlying towns of White Oaks and Capitan. Agriculture in the area could not thrive due to poor environment, low water quality, and badly managed grazing practices.

It is possible to incorporate construction and maintenance items within economy/production. For instance, baling wire would have had its uses in shipping and ranching. Rail spikes analyzed were standard size (7 in), indicating that standard rail was used for passenger and freight service and ore shipping over long distances. Narrow gauge (5 in) spikes were not recovered, perhaps due to the limits of the APE, but this does not mean they did not survive demolition. These items would have been explicitly associated with mining activity.

Euroamerican Artifact Assemblages

Contextual examination in this section is focused exclusively on Euroamerican artifacts; however, the presence of ground stone, lithic artifacts, fauna, and macrobotanicals will be mentioned when appropriate.

Feature 1, Root Cellar: A total of 281 artifacts were recovered from Feature 1, a root cellar with a cobble-and-mortar foundation and adobe walls. Seven artifacts were collected. Ten of the 12 functional categories were represented in Feature 1. They are described according to descending frequency. The mean date average is 1913 with a standard deviation of 17 years, which validates the presence of the siding at this time.

Table 6.10 is a compilation of the Euroamerican artifacts and their category, function, count, begin and end dates, mean, and sub-table percentage per Feature 1. Items are described below according to the descending order of frequency for each category.

Construction/maintenance related items totaled 185, representing 65.83 percent of the feature's assemblage. Wire nails, badly decomposed (n = 80) and intact, well worn, and rusted (mnv = 29), made up the largest artifact group.

Clear windowpane fragments (n = 23) were common and were given a date of 1878–1943 based upon technology used in production; this plate-glass manufacturing technique eliminated the rippling effect seen in earlier products. Aqua window glass accounted for three pieces of the 26 recovered. The color indicates an older formula used in an attempt to achieve a clear product while still using the same plate-glass manufacturing technique. Date of manufacture ranges from 1878–1920, when the aqua tint was mostly phased out.

The list of hardware artifacts included a number of single items—washers, nuts, screws, a grommet, a brass lever, and a date nail. Unfortunately, the stamped date on the head of the date nail had rusted away. Electrical wire made of aluminum—for grounding—and copper also was present.

A piece of salt-glazed, brown sewer pipe was recovered as well. Salt-glazed sewer pipe was used to ensure public health; glazing guards against diseases like cholera and keeps waste from leaching through pipe walls into the water table tapped to supply water to domestic wells. In some cases, these wells are only 30–40 ft deep.

Unassignables accounted for 9.3 percent, n = 26 of the total assemblage. These are items made of material that has been so badly destroyed as to render only non-diagnostic information. A white milk glass fragment may not reveal an item's function as a personal item or as glass dishware, but its material type implies a date between 1870 and 1943, with a mean date of 1906.5. This mean coincides with the housing development that ensued shortly after the railroad put in the siding.

Body fragments from a clear glass bottle—no color, no seeds, no leaching—indicate that a more modern glass formula was used in production; this item was likely produced between 1930 and 1943, with a mean date of 1936.50. (By this time Oscura's population was waning, but the town still maintained a post office.) The bottle's function, however, remains a mystery: Was it a beverage bottle or possibly a container for food or cleaner?

The only furnishing items found were fragments of glass from a kerosene lantern (n = 15, 5.3 percent).

Food and domestic categories each represented 3.9 percent, n = 11, of the feature's assemblage. Food items (n = 6) appeared as sanitary can fragments, a paper cap liner, a clear condiment jar fragment identified by shape, and a Gebhardt's condiment glass jar. In the domestic category, ceramic dishware fragments (n = 5) and glassware fragments (n = 4) were combined with items from a home-style canning apparatus—zinc and cork rings, and a lid with a self-sealing rubber gasket. These items suggested that the cultural environment endorsed long-term housekeeping.

Indulgences and entertainment items accounted for 3.6 percent (n = 10) each of the feature's assemblage. The low frequency of items in the indulgences category, n = 5, would normally be surprising; however, there are two factors that must be considered. First, the area of potential effect, or APE, is specific to railroad properties. Excavations targeted section housing for the men—and the families of the men—who maintained the station. Second, the major developer of the railway through Oscura was Charles B. Eddy, who was strongly set against alcohol and went so far as to set specific demands on the burgeoning town as to the saloon's distance from the railway station.

Personal effects—though having a very low frequency of n = 4, 3.2 percent of the feature's assemblage—were among the most intact artifacts at the feature and were also the most collected of all the represented categories. Items collected included a two-hole shell button with a fish-eye design dated between 1902 and present; a plain, two-hole shell button; a possible religious crucifix pendant in extremely poor condition; and, in the same condition, a pocket knife made of brass, steel, green plastic, and Bakelite.

Transportation and military and arms items accounted for two items each and yielded modern dates and functions most likely associated with US 54. Traffic would have begun to pick up when Holloman Air Force Base was installed in 1952. The two

Table 6.10. LA 114462, Feature 1, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean	Col.%
Unassignable					
Black rubber fragments	3	–	–	–	9.3%
White milk glass fragment	1	1870	1943	1906.50	
Yellow plastic fragment	1	–	–	–	
Orange plastic fragment	1	–	–	–	
Brown bottle glass	1	–	–	–	
Clear bottle glass	5	1930	1943	1936.50	
Steel spring	2	–	–	–	
Aluminum scrap	2	–	–	–	
Iron scrap	3	–	–	–	
Metal lid (1 lid)	4	–	–	–	
Tin lid (1 lid)	3	1904	1943	1923.50	
Total	**26**				
Food					
Sanitary food can	6	1904	1943	1923.50	3.9%
Paper cap liner	1	1900	1943	1921.50	
Clear condiment jar fragment	1	1930	1943	1936.50	
Amethyst condiment jar glass-Gebhardt's	3	1902	1943	1922.50	
Total	**11**				
Indulgences					
Crown cap, whole	3	1892	1943	1917.50	3.6%
Clear beverage bottle glass	1	1930	1943	1936.50	
Amber beer bottle glass	4	1880	1943	1911.50	
Brown liquor bottle glass	1	–	–	–	
Candy wrapper	1	–	–	–	
Total	**10**				
Domestic					
White ware vessel	3	1800	1943	1871.50	3.9%
Ironstone cup or bowl	2	1854	1920	1887.00	
Clear glass platter foot ring	4	1880	1930	1905.00	
Whole zinc and cork canning jar ring	1	1858	1943	1900.50	
Canning jar lid with gasket	1	–	–	–	
Total	**11**	–	–	–	
Furnishings					
Clear kerosene lantern glass	15	1850	1943	1896.50	5.3%
Total	**15**				
Construction/Maintenance					
Iron scrap	3	–	–	–	65.8%
Brass lever	1	–	–	–	
Iron plate fragments	15	–	–	–	
Brad	3	–	–	–	
1-inch S hook	1	–	–	–	
Iron roofing nail, whole	1	–	–	–	
Whole wire nails	29	–	–	–	
Wire nail fragments	80	–	–	–	
Square nuts, whole	2	–	–	–	
Spikes, whole	3	–	–	–	
Iron washer	1	–	–	–	
Iron lock washer	1	–	–	–	

Table 6.10 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Col.%
Wood screw, whole	1	–	–	–	65.8%
Screw, indeterminate	3	–	–	–	
Grommet	1	–	–	–	
Date nail, indeterminate	1	–	–	–	
Clear window pane	23	1878	1943	1910.50	
Aqua window pane	3	1878	1920	1899.00	
Roofing paper	5	–	–	–	
Fence staple	4	–	–	–	
Electrical aluminum wire	1	–	–	–	
Electrical copper wire	2	–	–	–	
Salt-glazed sewer pipe	1	1900	1943	1921.50	
Total	**185**				
Personal Effects					
2-hole metal button	1	1800	1943	1871.50	3.2%
2-hole, fish-eyed shell button	1*	1902	1943	1922.50	
2-hole shell button	1*	1900	1943	1921.50	
Copper jean stud/rivet	1	1873	1943	1908.00	
Leather shoe welting	1	–	–	–	
White milk glass pomade jar, whole	1	1870	1943	1906.50	
Clear patent medicine bottle fragment	1	–	–	–	
Crucifix	1*	1849	1943	1896.00	
Green and brown pocket/pen knife	1*	–	–	–	
Total	**9**				
Entertainment/Leisure					
Red vulcanized rubber ball fragments	5	1880	1943	1911.50	3.6%
Porcelain doll head fragments	2	1840	1943	1891.50	
White and blue swirled glass marble	1*	1890	1943	1916.50	
Mucilage	2	–	–	–	
Total	**10**				
Transportation					
Brass car/truck tire valve	1	–	–	–	0.7%
Brass spark coil part - Ford Fairmont vibrator F4166	1*	1941**	1998**	1969.50**	
Total	**2**				
Military/Arms					
Rim fire cartridge, A head stamp	1*	–	–	–	0.7%
Rim fire cartridge, H head stamp	1	1887**	2006**	1946.50**	
Total	**2**				
Table Total	**281**				**100.0%**
Mean average				1913.00	
Standard Deviation				17.00	

* Count indicates collected artifacts.

** Dates were not included in mean average and standard deviation calculations.

buildings across the highway mark what is left of Oscura. The larger building used to be a bar and was later changed into an auto-repair garage. There is more evidence from Feature 7, the privy, to indicate auto-repair activity within or near the site. A brass tire valve was recorded, and a brass spark coil for a Ford Fairmont was collected. Live ammunition from a .22 long was collected and a spent .22 cartridge recorded. These items would not be considered out of the ordinary for such a remote area.

Fauna and bone were also found in the fill. Nine bone fragments from large and small mammals, a bird bone fragment, and an oyster shell were retrieved. Peach pit hulls were recovered as well. Ground stone tools and lithic artifacts included a mano, a polishing stone, and chipped stone.

Feature 2, Pit: A total of 195 artifacts were recovered from Feature 2, a trash pit exposed by an 80 cm wide trench cut. Seven of the 12 categories were represented. The mean date of these artifacts is 1921, with a standard deviation of 17 years. Table 6.11 depicts a compilation of Feature 2 Euroamerican artifacts as well as their category, function, count, begin and end date, mean, and sub-table percentage. Items are described below according to descending order of frequency for each category.

Construction/maintenance items make up 65.1 percent, (n = 127) of the Feature 2 Euroamerican artifact assemblage. Wire nails (n = 101) represent the functional category and the highest frequency of this category. An illegible date nail was recorded, along with copper wire, aqua windowpane fragments, and a sundry of hardware items (see Table 6.11), none of which were collected.

Unassignable items could not be classified into any particular functional category. Even with a manufacturer's mark, it was impossible to determine if the clear bottle glass recorded was for beverage, canning, or cleaner use. Clear bottle glass made up the most items in this category (n = 26). Iron scrap accounted for 19 of the 49 items classified as unassignable.

Food items represented 3.1 percent (n = 6, mnv = 2) of the feature's assemblage, with only two assignable items recorded, including clear glass fragments from a condiment jar, which was most likely manufactured using an automatic-bottling technique dating from 1904 to the present, and fragments from a food can with sanitary seams also dated within the same time frame.

Personal effects accounted for 3.1 percent (mnv = 6) of the assemblage. Two shell buttons and a bone button were collected and dated from 1900 to present. A brass grommet, a self-shank shell button, and a shoe cleat rounded out the count.

There were three domestic-related items. These included amethyst glassware and white (milk glass) glassware, possibly Fenton Ware; however, there was not enough material to identify the piece as such. The third item was a teaspoon, intact, with the manufacturer's label of Rogers nickel silver.

In the Historic Overview section of this report (Chapter 4), is a reference to this brand name during Viora Andren's story of her youth in Oscura at the beginning of the twentieth century. According to Andren, her mother redeemed coupons found in bags of coffee purchased for the family. These coupons could be traded in for Rogers flatware.

Indulgences and entertainment/leisure items each represented only 1 percent of the assemblage. Hazel Atlas Glass Company, known for a stippling pattern on the base of glass bottles, was a recorded manufacturer. Known to produce bottles for consumption, two items were classified as an indulgence.

In the entertainment category, a toy wagon or vehicle wheel was collected and photographed. Five sheep-bone fragments also were found.

Feature 3, Pit: Two hundred seventy-two (n = 272) Euroamerican artifacts were recorded at this feature. Four items were collected to be analyzed and photographed. Although 11 of the 12 categories were represented, the economy/production category, associated here with copper ore recovered from the pit, does not qualify as a Euroamerican artifact. It does, however, provide evidence of mining activity in the area; therefore, the mineral was kept in the statistical count. The mean date is 1912, with a standard deviation of 17 years.

Table 6.12 is a compilation of Euroamerican artifacts found at Feature 3 and their category, function, count, begin and end date, mean, and sub-table percentage. Items are described below according to descending order of frequency for each category.

Construction/maintenance related items totaled 135, 49.6 percent of the assemblage. Wire nails accounted for most of the category items (n = 102). Galvanized roofing nails, 1901–1943 (Fontana et al. 1962:50); linoleum, 1863–1943; and clear windowpane fragments suggesting a more modern manufacturing technique, ca. 1878–1943, were of

Table 6.11. LA 114462, Feature 2, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean Date	Col. %
Unassignable					
Tin scrap	1	–	–	–	**25.1%**
Plastic fragment	1	–	–	–	
Clear bottle glass, Owens-Illinois	2	1939	1963	1951.00	
Clear bottle glass	22	–	–	–	
Clear bottle glass	2	1903	1930	1916.50	
Black rubber tubing	1	–	–	–	
Cotton cloth	1	–	–	–	
Iron scrap	19	–	–	–	
Total	**49**				
Food					
Clear condiment jar glass	2	1904	1943	1923.50	**3.1%**
Food canned good fragments	4	1904	1943	1923.50	
Total	**6**				
Indulgences					
Clear beverage bottle glass - Hazel Atlas Glass Company	2	1939	1963	1951.00	**1.0%**
Total	**2**				
Domestic					
Teaspoon - Rogers nickel/silver	1*	–	–	–	**1.5%**
White domestic glassware	1	–	–	–	
Amethyst domestic glassware	1	1880	1920	1900.00	
Total	**3**				
Construction/Maintenance					
Brad	1	–	–	–	**65.1%**
Cotter pin	1	–	–	–	
Wire nail, indeterminate	101	–	–	–	
Washer	2	–	–	–	
Wood screws, whole	2	–	–	–	
Industrial iron chain	3	–	–	–	
Tack, Indeterminate	2	–	–	–	
Metal wood screw	3	–	–	–	
Ogee washer	1	–	–	–	
Date nail, indeterminate	1	–	–	–	
Shingle	2	–	–	–	
Aqua window pane	3	1878	1920	1899.00	
Electrical insulated copper wire	2	–	–	–	
Fence staple	2	–	–	–	
Brass coupling	1	–	–	–	
Total	**127**				

Table 6.11 (continued)

Artifacts	Count	Begin Date	End Date	Mean Date	Col. %
Personal Effects					
4-hole shell button	1*	1900	1943	1921.50	**3.1%**
2-hole bone button	1*	–	–	–	
2-hole shell button	1	1900	1943	1921.50	
Self-shank shell button	1*	1900	1943	1921.50	
Brass grommet	1	–	–	–	
Steel shoe heel cleat	1	–	–	–	
Total	**6**				
Entertainment/Leisure					
Red rubber band	1	–	–	–	**1.0%**
Toy iron wheel	1*	–	–	–	
Total	**2**				
Table Total	**195**				**100.0%**
Mean average				1921.00	
Standard Deviation				17.00	

* Count indicates collected artifacts.

some diagnostic value. Various hardware items, copper insulated wire, and a fence staple made up the remaining count. No further artifacts were collected from this category.

Ninety-six food items made up 35.3 percent of the assemblage, including: vegetable or fruit can fragments with sanitary seams (n = 62); canned food goods, unidentifiable as to their brand or manufacturing technique (n = 15); and unidentifiable canned food goods with evidence of soldered seams (n = 12) made up most category items. A milk bottle also was collected (Fig. 6.13a); because it was intact, the manufacturer, Owens-Illinois Glass Company, could be identified. The brand name was also visible, A. J. Olson Company. This item was in production between 1911 and 1913.

Unassignables were few in number (n = 20), representing 7.4 percent of the assemblage. Clear, non-diagnostic bottle glass (n = 17) accounted for most of the category assemblage. A curious green-painted lead ring, a tin-foil scrap, and a tin bottle-cap seal were included.

Indulgence-related items accounted for only seven items (n = 7). In three of the four items, color dating was used for aqua bottle glass and amber bottle glass. The green glass, however, was not dated because, unless an item is a modern green color or a distinctive olive color, sources have a hard time agreeing on even a general time frame.

Domestic items (n = 5) included two samples: a clear glass tumbler fragment and clear glass fragments from a decorative object or other glassware. Several fragments from glass tumblers were discovered in other features. These were all related to the Capstan Glass Company, its maker's mark a chess piece or pawn. Capstan was noted for producing jam and jelly jars designed to be used as drinking glasses once the original product had been consumed.

The communication category was represented by a fully intact aqua glass insulator and two threaded iron stems for electrical insulators, one of which was attached to the glass insulator at the time of its recovery (Fig. 6.13b). Hemingray Glass Company, 1870–1967, was the manufacturer often used to string up wire in the West, thus creating the communications infrastructure.

The remaining categories can be found in Table 6.12. A surface survey encompassing the feature overburden yielded one Mexican *centavos* dated 1940 that was collected for analysis and photographing. Fauna included a rabbit bone, three pieces of eggshell, a small-mammal bone, and a cut beef bone possibly used in soup making.

Feature 4, Pit: Two artifacts were recorded representing the indulgences and construction/maintenance categories. Both items—a crown cap to a beverage bottle, ca. 1892–1943, and an aqua windowpane fragment, ca. 1878–1920—yielded dates.

Feature 5, Pit: There were 1,792 Euroamerican artifacts recorded for Feature 5, a pit. This large count is striking in comparison to other features and

Table 6.12. LA 114462, Feature 3, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean Date	Col. %
Unassignable					
Clear bottle glass	17	–	–	–	**7.4%**
Green lead ring	1	–	–	–	
Tin foil	1	–	–	–	
Tin bottle cap seal	1	–	–	–	
Total	**20**				
Economy/Production					
Copper and indeterminate nonferrous metal ore	1	–	–	–	**0.4%**
Total	**1**				
Food					
Lard bucket	5	1920	1943	1931.50	**35.3%**
Vegetable or fruit can	62	1904	1943	1923.50	
Canned goods, nfs**	15	–	–	–	
Canned goods, nfs**	12	1880	1920	1900.00	
Metal condiment jar lid	1	1924	1943	1933.50	
Milk bottle, intact, Owens-Illinois, A.J. Olson Company	1*	1911	1913	1912.00	
Total	**96**				
Indulgences					
Metal and cork crown cap	1	1892	1943	1917.50	**2.6%**
Aqua bottle glass	2	1880	1920	1900.00	
Green soda bottle glass	1	–	–	–	
Amber beer bottle glass	3	1880	1920	1900.00	
Total	**7**	–	–	–	
Domestic					
Clear glass tumbler	1	1930	1943	1936.50	**1.8%**
Clear glass decorative object	4	–	–	–	
Total	**5**				
Furnishings					
Glass Christmas ornament	1	–	–	–	**0.4%**
Total	**1**				
Construction/Maintenance					
Iron scrap	1	–	–	–	**49.6%**
Wire, indeterminate	1	–	–	–	
Brad	2	–	–	–	
Galvanized roofing nail	7	1901	1943	1922.00	
Wire nails	102	–	–	–	
Spike	6	–	–	–	
Washer	1	–	–	–	
Wood screw	3	–	–	–	
Tack	1	–	–	–	
Linoleum	4	1863	1943	1903.00	
Mortar	1	–	–	–	
Clear glass window pane	3	1878	1943	1910.50	
Roofing paper	1	–	–	–	
Electrical copper insulated wire	1	–	–	–	
Fence staple	1	–	–	–	
Total	**135**				

Table 6.12 (continued)

Artifacts	Count	Begin Date	End Date	Mean Date	Col. %
Personal Effects					
Metal jewelry pin, soldered clasp	1	–	–	–	**0.4%**
Total	**1**				
Entertainment/Leisure					
Red rubber ball fragment	1	–	–	–	**0.7%**
Porcelain doll part, left foot	1	–	–	–	
Total	**2**				
Communication					
Aqua glass insulator with iron stem, Hemingray Glass Company	1*	1870	1967	1918.50	**1.1%**
Iron-threaded stem to insulator, Hemingray Glass Company	2*	–	–	–	
Total	**3**				
Military/Arms					
Brass rim fire cartridge	1	1871	1943	1907.00	**0.4%**
Total	**1**				
Artifact Total	**272**				**100.0%**
Mean average				1912.00	
Standard Deviation				17.00	

* Count indicates collected artifacts.
** nfs = not further specified

artifact concentration areas. It does not seem likely that Feature 5 would have been a community dump site so close to the siding and highway, and it would appear that the refuse had a high structural content due to the high frequency of construction materials and the abundance of glass found not only among unassignable items but also associated with indulgences.

Several unassignable artifacts were collected: a wall-mounted, bottle opener; a glass button with a metal bar shank (Fig. 6.14); a glass pill bottle produced by Owens Bottle Company (1904–1929); a 1912 penny; a 1944 Mexican centavos; a miniature brass U.S. Mail horse-and-buggy figurine; and a miniature rooster figurine. Eleven of the 12 functional categories were represented in the assemblage. Mean date is 1913 with a standard deviation of 18 years.

Table 6.13 represents a compilation of the Euroamerican artifacts from Feature 5 along with category, function, count, begin and end date, mean, and sub-table percentage. The items are described below according to descending order of frequency for each category.

Construction/maintenance items accounted for 22.14 percent (n = 395) of the total count. Aqua windowpane fragments had the highest frequency (n = 141) within the category, followed by wire nail fragments (n = 59), metal screening fragments (n = 45), and clear windowpane fragments (n = 42). A diagnostic date nail, 01 (1901) was collected. Date nails were often hammered into the ends of railroad ties to mark when they were last replaced.

Food items numbered 365. None were collected. This category represented 20.46 percent of the features assemblage and contained a large quantity of soldered seam, food can fragments (n = 119) and a hole-in-top can fragment. A clear glass, jam jar fragment was identified as being manufactured by Capstan Glass Company. These containers were designed for reuse as drinking glasses or tumblers and were very popular. This function is cited under the domestic category in Table 6.13 with two asterisks to show that this is a one-in-the-same artifact.

Indulgence items totaled 353 and made up 19.79 percent of the assemblage. This is the highest frequency of bottles associated with indulgence items. It is difficult to assign function within this category due to the multipurposing, trial-and-error period of these items, for example the aqua beverage bottle

Figure 6.13a. LA 114462, Feature 3, milk bottle.

manufactured for water, soda, and beer early on. Hence, these aqua bottle fragments (n = 21) could not be placed in any category other than Unidentifiable; the fragments are still considered an Indulgence item based upon size, shoulder, and body curvature.

Beer bottle glass and a clay, ale bottle fragment (n = 121) account for the highest consumption of alcoholic beverages seen. The count could be higher, but the brown bottle glass, listed among Unassignables, is not diagnostic enough to tell for certain. Such was the case for other colored-glass functional listings in indulgences. Soda bottle fragments (n = 60) were the next highest count. Wine and liquor bottles were also represented (n = 20; n = 26, respectively). Several indulgence glass manufacturers or brands were identified and included the Illinois Glass Company, Owens-Illinois Glass Company, Dr. Pepper, Coca-Cola, Oil City Glass Company, Fairmont Glass Works, and Obear-Nestor Glass Company, giving the feature viable dating diagnostics.

Unassignable items accounted for 19.51 percent (n = 348) of the feature's assemblage. Assigned dates were determined by color and glass-manufacturing and bottling techniques. High frequency counts came from bottle glass fragments, most of which were clear.

Domestic-related items totaled 114 artifact fragments and represented 6.39 percent of the assemblage. Fragments of Mexican, lead-glazed earthenware (n = 5) were recorded, as well as a large assemblage of ironstone dishware. Decoration techniques included Flow Blue, gold gilding, decalcomania, hand-painted pieces, and colored glazes. The glass tumblers recorded were produced by Capstan Glass Company (1918–1938) and Hazel Atlas Glass Company (1923–1964).

Personal effects accounted for 3.25 percent (n = 58) of the assemblage. Six items were collected for in-house analysis and photographing. Seven manufacturers were matched to the artifacts found. Cones Boss was a construction workers' clothier, and Trappey Company was associated with the cologne bottle glass found at the site. Ploughs, Inc., made cosmetics and accounts for the production of the lipstick tube cover found here. The Whitall-Tatum Company, known for its quality glass medicine bottles used in laboratories, produced a glass stopper with a faceted head for household use. The

Figure 6.13b. LA 114462, Feature 3, aqua glass insulator.

Owens Bottle Company also made medicine bottles. Coinage recovered from the feature included one U.S. penny (1912) and one Mexican five-cent piece.

Furnishing items totaled 52 and made up 2.92 percent of the assemblage. Most of this assemblage was related to clear, glass fragments associated with kerosene lanterns or lamps. Cast-iron handles that had been broken off of iron flat-plates used on wood or coal burning cook stoves to regulate the heat of frying pans or kettles by adding or taking away the round, iron flat-plates were also found.

Transportation, entertainment/leisure, communication, and arms items made up the remaining 4.56 percent of the assemblage (n = 107). Among artifacts collected were a carbide rail marker with finger grooves and several .38 caliber lead bullets.

In the entertainment/leisure category, one brass miniature U.S. Mail horse-and-buggy figurine was uncovered (Fig. 6.15). Arms manufacturers represented in this assemblage were Remington-United (1867–1946) and Winchester (1873–1919).

Fauna included 97 bones ranging from bird and rabbit to large mammal. Eggshells and six peach pits were also part of the assemblage.

Feature 6, Posthole: Feature 6, posthole fill, yielded 179 Euroamerican artifacts. These were assigned to five of the 12 functional categories; however, no artifacts were collected. Date average was 1930, with a standard deviation of 12 years.

Table 6.14 is a compilation of the Euroamerican artifacts found in Feature 6 as well as category, function, count, begin and end date, mean, and sub-table percentages. Found items are described below according to descending order of frequency.

Food items (n = 110) represented 61.45 percent of the assemblage. Within this category, food can fragments, with sanitary seams, represented the highest count (n = 80). Identified manufacturers were Owens-Illinois Glass Company, 1941–1954/63, (n = 26) and Hazel Atlas Glass Company, 1923–1943.

Unassignable items (n = 35) were mostly clear, glass bottle fragments (n = 33). Furnishing items (n = 17) were mostly clear, glass, kerosene-lamp fragments (n = 15). Indulgences accounted for 16 artifacts from soda and beer bottle fragments. Construction/ maintenance had only one item, a common wire nail, assigned to this category.

Feature 7, Privy: Four hundred thirteen Euroamerican artifacts were recorded at Feature 7, a privy. Artifacts were sorted by function into nine of

Figure 6.14. LA 114462, Feature 5, glass button with a metal bar shank.

the 12 defining categories. Date average was 1923, with a standard deviation of 15 years.

Table 6.15 is a compilation of the Euroamerican artifacts and their category, function, count, begin and end date, mean, and sub-table percentage. These items are described below according to descending order of frequency for each category.

Construction/maintenance related items (n = 151) had the highest frequency, 36.56 percent, of the feature assemblage. Unidentifiable metal scrap made up most of the count. There were also a large number of wire nail fragments (n = 60). Dates for 18 artifacts, including galvanized roofing nails (1901–1943), aqua and clear windowpane fragments (1878–1920/1943), and salt-glazed sewer pipe (1900–1943), helped establish a cohesive time of occupation.

The transportation category accounted for 13.08 percent (n = 54) of the assemblage. This consisted of a metal machine part, a red plastic headlight cover, two railroad spikes, and 50 page fragments from a mechanic's manual. In researching the history of the siding, no mention of any of the local structures being used as an auto garage was found. There was, however, a mechanic's garage across the highway in the town of Oscura, dates unknown.

The indulgence category comprised 12.11 percent (n = 50) of the assemblage. Thirty-eight clear glass fragments were associated with one liquor bottle manufactured by Hazel Atlas Glass Company. Another manufacturer identified in the assemblage was Limmared, the maker of liquor bottles from Europe (1741–1920). Soda and beer bottles were equally represented (n = 3 each).

Unassignable artifacts (n = 48) accounted for 11.62 percent of the items taken from the feature fill. Mostly, clear bottle fragments were recorded (n = 31) with one fragment of aqua bottle glass listed. Can fragments and one mechanical part made up the remaining count.

Food items accounted for 10.65 percent of the assemblage (n = 44). A triangular-shaped, glass, condiment bottle manufactured by the Owens-Illinois Glass Company for Norwich brand (1929–1947) was collected. Other items included a soldered meat tin. Many of the items were from desiccated sanitary vegetable or fruit cans.

Domestic-related items represented 9.9 percent of the assemblage (n = 41). A glass canning jar, produced by Alexander H. Kerr & Company, was collected. Three fragments of a clear glass tumbler, likely reused after serving as a jam or jelly glass container for market, were found; three pieces of ironstone dishware were recovered. Decalcomania decoration was noted on one piece. A plastic bleach bottle and colored glassware were included in the assemblage. These artifacts reflect more housekeeping activity than industrial functions.

Personal effects made up 5.33 percent of the assemblage (n = 22, mnv = 18). The artifacts recovered were all buttons, 11 made of shell material, six made of plastic, and one made of metal.

Arms items represented less than a half percent of the assemblage (n = 2). These small arms, one rim-fire cartridge and the other a center-fire cartridge, were likely used for small game hunting or protection. However, being close to the highway, their presence proposes a speculative function.

The least represented category function was entertainment/leisure. The metal ferrule at the end of a pencil was recorded. This pencil could have been a school supply or an artist's tool; it is also possible that it was used by the station attendant or conductor. With a pencil's multiple uses and its insig-

Table 6.13. LA 114462, Feature 5, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean	Category %
Unassignable					
Unidentifiable:					19.4%
Clear bottle glass, nfs	185	–	–	–	
Clear bottle glass, nfs	43	1899	1930	1914.5	
Clear bottle glass fragments, nfs	45	1930	1943	1936.5	
Brown bottle glass, nfs	12	1860	1943	1901.5	
Blue bottle glass, nfs	3	1844	1905	1874.5	
Yellow bottle glass, nfs	1	1915	1930	1922.5	
Amethyst bottle glass, nfs	6	1890	1920	1905.0	
Lead scrap	1	1850	1943	1896.5	
Iron scrap	25	–	–	–	
Rubber scrap	1	–	–	–	
Plastic scrap	7	–	–	–	
Blue plastic scrap	1	1880	1943	1911.5	
Iron mechanical part	3	–	–	–	
Clear glass jug fragments	12	1930	1940	1936.5	
Aluminum foil	2	1944	2000	1972.0	
Key - bow fragment, nfs	1	–	–	–	
Category subtotal	**348**				
Food					
Canned goods:					20.4%
Can fragments, nfs	209	–	–	–	
Can rim fragments, nfs	38	1904	1943	1923.5	
Can top or bottom, nfs	5	1880	1920	1900.0	
Can top or bottom, nfs	2	1935	1943	1939.0	
Meat can lid	3	1896	1943	1919.5	
Meat can rim and body	5	1872	1943	1907.5	
Vegetable or fruit can body and soldered seam fragments	15	1845	1920	1882.5	
Vegetable or fruit can fragments w/lining	2	1920	1943	1931.5	
Vegetable or fruit can, soldered seam top or bottom	64	1883	1920	1901.5	
Vegetable or fruit can, soldered seam top or bottom	1	1810	1920	1865.0	
Total	**343**				
Bottled goods:					
Clear condiment bottle glass	2	–	–	–	
Metal condiment jar lid	5	–	–	–	
Clear pepper sauce bottle glass	2	1930	1943	1936.5	
Clear pepper sauce bottle glass, King Pepper sauce brand	5	1880	1920	1900.0	
**Clear jam or jelly jar glass - Capstan Glass Company	1	1918	1938	1928.0	
Clear extract bottle glass	1	1867	1915	1891.0	
Clear glass jar fragments, nfs	4	1880	1943	1911.5	
Aqua glass jar base, nfs	1	1880	1920	1900.0	
Total	**21**				
Category subtotal	**365**				
Indulgences					
Miscellaneous:					19.7%
Whole aluminum caps	2	1924	1943	1933.5	
Whole foil cap seal	1	–	–	–	
Aqua bottle glass, nfs	21	1880	1920	1900.0	
Whole wall-mount bottle opener	1	–	–	–	
Clear beverage bottle glass	30	–	–	–	

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
Clear glass bottle shoulder & threaded lip	1	1924	1930	1927.0	
Clear glass bottle, 2 pieces Lip & neck	1	1845	1913	1879.0	
Brown beverage bottle glass	5	–	–	–	
Clear beverage bottle glass	41	1880	1930	1905.0	
Brown bottle glass, base fragments, Illinois Glass Company	10	1915	1929	1922.0	
Brown bottle glass, base fragments, Owens-Illinois Glass Company	4	1947	1954	1950.5	
Crown cap with cork	1	1892	1943	1917.5	
Clear beverage bottle glass lip and collar, automatic seam	1	1904	1930	1917.0	
Total	**119**				
Soda/carbonated beverage:					
Modern green soda bottle glass	12	1928	1943	1935.5	
Modern green bottle glass body and stippled base	1	1961	2000	1980.5	
Clear soda bottle glass with applied color labeling	13	1934	1943	1938.5	
Clear soda bottle glass, Dr. Pepper	1	1934	1943	1938.5	
Clear soda bottle glass, Dr. Pepper	18	1940	1943	1941.5	
Clear soda bottle glass, Coca-Cola	1	1892	1943	1917.5	
Clear soda bottle glass, Dr. Pepper	5	–	–	–	
Aqua soda bottle glass	3	1880	1920	1900.0	
Green soda bottle glass	5	–	–	–	
Clear soda bottle glass with orange ACL	1	1934	1943	1938.5	
Total	**60**				
Wine:					
Clear wine bottle glass base	3	1930	1943	1936.5	**19.7%**
Brown wine bottle glass	10	–	–	–	
Clear wine bottle glass base, Oil City Glass Company	6	1939	1952	1945.5	
Green bottle glass	1	1880	1920	1900.0	
Total	**20**				
Beer:					
Clear beer bottle glass base, Fairmont Glass Works	1	1889	1906	1897.5	
Amber beer bottle glass	2	–	–	–	
Amber beer bottle glass	19	1844	1920	1882.0	
Amber beer bottle glass	7	1904	1920	1912.0	
Amber beer bottle glass base, Obear-Nestor Glass Company	15	1915	1943	1929.0	
Brown beer bottle glass	76	1941	1961	1951.0	
Yellow and cream Clay Ale bottle	1	1870	1895	1882.5	
Total	**121**				
Liquor:					
Clear brandy bottle glass	13	1924	1930	1927.0	
Clear whiskey bottle glass	13	–	–	–	
Total	**26**				
Tobacco/smoking:					
Tobacco tin, rim and body	7	1900	1920	1910.0	
Total	7				
Category subtotal	**353**				
Domestic					
Dishes:					
White ware spout	1	1900	1930	1915.0	
White ware dish fragments	4	1810	1943	1876.5	**6.4%**
Ironstone dishware fragments	8	1854	1920	1887.0	
Flow Blue spall	1	1845	1925	1885.0	
Ironstone bowl	6	1854	1920	1887.0	

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
White ware bowl with Decalcomania	11	1908	1943	1925.5	
Ironstone cup rim	2	1854	1920	1887.0	
Gold gilded white ware cup	8	1830	1943	1886.5	
Mexican lead-glazed dishware, orange and green	1	1850	1943	1896.5	
Mexican lead-glazed dishware, orange	1	1850	1943	1896.5	
Mexican lead-glazed dishware, polychrome	2	1850	1943	1896.5	
Mexican lead-glazed plate, orange	1	1854	1920	1887.0	
White ware plate fragments	2	1810	1943	1876.5	
Ironstone plate fragments	4	1854	1920	1887.0	
Gold gilded white ware plate rim	2	1900	1930	1915.0	
White ware plate brim with Decalcomania	2	1908	1930	1919.0	
Ironstone plate rim with blue band	6	1900	1930	1915.0	
White ware saucer fragment	1	1810	1943	1876.5	
Ironstone soup bowl with blue band	1	1900	1930	1915.0	
Ironstone cup or bowl	3	1900	1930	1915.0	
White ware cup or bowl	1	1850	1943	1896.5	
Ironstone platter fragments	2	1854	1920	1887.0	
Total	**70**				
Glassware:					
Pink glassware fragments	5	1890	1920	1905.0	
Amethyst glassware fragments	3	1880	1917	1898.5	
White milk glass glassware	1	1870	1943	1906.5	**6.4%**
Clear glassware	3	1930	1943	1936.5	
Clear goblet glass	1	–	–	–	
Clear glass tumbler body and base, Hazel-Atlas Glass Company	3	1923	1964	1943.5	
Pink glass decorative object	3	1890	1920	1905.0	
Amethyst glass decorative object	1	1890	1920	1905.0	
Aqua glass serving dish	1	1880	1920	1900.0	
Clear glass candy dish	6	–	–	–	
Amethyst glass compote	3	1890	1920	1905.0	
Total	**31**				
Canning/Storage:					
Zinc canning jar lid	1	–	–	–	
Clear glass canning jar, Ball	3	1939	1963	1951.0	
White milk glass canning jar seal	1	1869	1943	1906.0	
Metal and rubber canning jar seal	1	–	–	–	
Zinc canning jar lid with gasket seal	1	–	–	–	
White ceramic jar seal	1	–	–	–	
Brown glazed crockery	4	1850	1943	1896.5	
Buff glazed crockery	1	1850	1943	1896.5	
Total	**13**				
Category subtotal	**114**				
Furnishings					
Heating/cooking/lighting:					
Iron handles to wood/coal cook stove	2	–	–	–	
Iron plate to wood/coal cook stove	2	–	–	–	
Brass kerosene lamp collar	11	1867	1941	1904.0	
Clear glass kerosene lamp chimney	28	1850	1943	1896.5	**2.9%**
Ceramic polychrome light globe	2	–	–	–	
Total	**45**				
Furniture:					
Iron bed spring	1	–	–	–	
Ceramic polychrome figurine	3	–	–	–	

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
Total	**4**				
Appliances:					
Clear glass refrigerator shelf	3	1930	1943	1936.5	**2.9%**
Total	**3**				
Category subtotal	**52**				
Construction/Maintenance					
Unidentifiable:					
Metal plate	8	–	–	–	
Iron rod	1	–	–	–	
Rubber and cloth tie-down strap	1	–	–	–	
Steel wire	14	–	–	–	
Total	**24**				
Hardware:					
Iron strap/strip	5	–	–	–	
Steel wire	5	–	–	–	
Brass cable clamp	1	–	–	–	
Brass bracket/brace	1	–	–	–	
Bolt, screw	2	–	–	–	
Brad	1	–	–	–	
Leather hinge, strap	1	–	–	–	
Whole wire nail	59	–	–	–	
Box nail	1	–	–	–	
Nut	1	–	–	–	
Spike	4	–	–	–	
Staple, indeterminate	2	–	–	–	
Washer	3	–	–	–	
Nut/bolt	2	–	–	–	
Lag bolt	1	–	–	–	
Common nail shanks	8	–	–	–	
Shingle nail shank	1	–	–	–	**22.0%**
Date nail	1	1901	1901	1901.0	
Philips-head screw	1	–	–	–	
Total	**100**				
Building materials:					
Linoleum	2	1863	1943	1903.0	
Metal 16-gauge screen fragments	45	–	–	–	
Blue 1-inch tile	1	–	–	–	
Aqua window pane	141	1878	1920	1899.0	
Pink window pane	1	1878	1920	1899.0	
Clear window pane	37	1878	1943	1910.5	
Clear window pane	5	1878	1920	1899.0	
White milk glass flat glass	1	1878	1943	1910.5	
Amethyst flat glass	1	1880	1920	1900.0	
Olive flat glass	2	1860	1920	1890.0	
Roofing paper	2	–	–	–	
Brick, highly vitreous	1	–	–	–	
Yellow fire brick	1	–	–	–	
Total	**240**				
Electrical:					
Porcelain electrical disc	2	–	–	–	
Copper washer	1	–	–	–	
Metal wire relay	1	–	–	–	
Clear light bulb glass	6	–	–	–	

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
Copper wire	3	–	–	–	22.0%
Total	**13**				
Fencing:					
Barbed wire	6	–	–	–	
Whole fence staples	8	–	–	–	
Intact iron strand spacer	1	1926	1943	1934.5	
Iron fence stay	1	–	–	–	
Total	**16**				
Plumbing:					
Salt-glazed sewer pipe	1	1900	1943	1921.5	
Brass water coupling	1	–	–	–	
Total	**2**				
Category subtotal	**395**				
Personal Effects					
Clothing:					3.2%
Brass rivet, overalls - Cones Boss	1	–	–	–	
Whole shell buttons, 4 hole	2	1900	1943	1921.5	
Whole buttons, 2 hole	5	1900	1943	1921.5	
Whole shell buttons, fish-eyed 2 hole	2	1902	1943	1922.5	
Brown plastic button, 2 hole	1	1930	1943	1936.5	
White glass button with bar shank	1	1854	1920	1887.0	
Total	**12**				
Boots and shoes:					
Shoe leather	5	–	–	–	
White painted shoe eyelet	2	–	–	–	
Leather heel	2	–	–	–	
Rubber and metal heel	1	–	–	–	
Leather and metal sole	13	–	–	–	
Total	**23**				
Grooming and personal hygiene:					
Metal lipstick cap/tip, Plough's Incorporated	1	1908	1943	1925.5	
Clear glass toiletry bottle	2	1890	1920	1905.0	
Clear glass toiletry bottle base, Trappey Company	2	1953	1954	1953.5	
Total	**5**				
Medicine/health:					
Cobalt blue ointment jar glass	2	–	–	–	
Clear glass faceted stopper, Whitall-Tatum tincture bottle	1	1898	1939	1918.5	
Aqua glass pill bottle, Owens Bottle Company	1	1904	1929	1916.5	
Clear medicine bottle glass	4	1951	1954	1952.5	
Cobalt blue glass container fragment	3	1802	1943	1872.5	
White milk glass jar fragments	3	1870	1943	1906.5	
Total	**14**				
Money/tokens:					
Penny, US Mint	1	1912	1912	1912.0	
Mexican cinco centavos	1	1944	1944	1944.0	
Total	**2**				
Miscellaneous:					
Pocket/pen knife	2	–	–	–	
Total	**2**				
Category subtotal	**58**				
Entertainment/Leisure					
Toys:					

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
Red rubber ball	1	–	–	–	0.8%
Porcelain doll head	2	1840	1943	1891.5	
Rubber doll arm	1	–	–	–	
Porcelain doll foot	1	–	–	–	
Orange rubber miniature rooster	1	–	–	–	
Cast iron Horse 'n' Buggy miniatures	2	–	–	–	
Total	**8**				
Music:					
Vinyl record	4	1930	1985	1957.5	
Total	**4**				
Arts and crafts/hobby:					
White chalk	1	–	–	–	
Total	**1**				
Outdoor sports and recreation:					
Iron fishing hook	1	–	–	–	
Total	**1**				
Category subtotal	**14**				
Transportation					
Cars and trucks:					2.3%
Rubber tire tube	1	–	–	–	
Black vulcanized rubber car/truck tire	4	1851	1943	1897.0	
Total	**5**				
Railroad:					
Railroad spike	23	1899	1943	1921.0	
Railroad spike shank fragments	9	–	–	–	
Carbide rail marker	1	–	–	–	
Red glass signal lens fragment	1	–	–	–	
Total	**34**				
Animal and man power:					
Harness buckle	1	–	–	–	
Bicycle tire	1	1900	1943	1921.5	
Total	**2**				
Category subtotal	**41**				
Communication					
Telephone:					1.7%
Clear glass insulator	2	1871	1936	1903.5	
Iron insulator stem fragments	29	–	–	–	
Total	**31**				
Category subtotal	**31**				
Military/Arms					
Small arms:					1.2%
Center fire cartridge	1	–	–	–	
Rim fire cartridge, Winchester rim fire	7	1873	1919	1896.0	
Rim fire cartridge, U head stamp, REM-UMC	7	1867	1946	1906.5	
Copper rim fire cartridge	1	1869	1936	1902.5	
Brass rim fire cartridge	1	1871	1943	1907.0	

Figure 6.15. LA 114462, Feature 5, miniature cast-iron toy.

Table 6.13 (continued)

Artifacts	Count	Begin Date	End Date	Mean	Category %
Brass rim fire cartridge	1	1869	1936	1902.5	
Brass rim fire cartridge	1	1898	1943	1920.5	
Lead bullets, .38 caliber	2	–	–	–	**1.2%**
Total	**21**				
Category subtotal	**21**				
Category total	**1792**				**100.0%**
Mean average				1913.0	
Standard Deviation				18.0	

* nfs = not further specified

** This item was reused by consumers as a glass tumbler.

nificant count in relation to Feature 7, it can only be noted.

Feature 8, Posthole: Feature 8, a posthole, yielded 32 Euroamerican artifacts. Artifacts in the fill were not in situ nor were they purposely placed in the cavity prior to filling. Most likely, fill was composed of debris bladed into the hole after the removal of the post. Nine of the 12 categories were represented here. Mean date is 1914 with a standard deviation of 19 years.

Table 6.16 is a compilation of the Euroamerican artifacts and their category, function, count, begin and end date, mean, and sub-table percentage per Feature 8. Items are described below according to descending order of frequency for each category.

Construction and maintenance was represented as 42.42 percent (n = 14) of items found in this feature; these were nail fragments (n = 6) and barbed wire fragments (n = 4). One fragment each of clear and aqua window glass contributed to the only dating in the category.

Indulgences (n = 6) made up 18.18 percent of the

Table 6.14. LA 114462, Feature 6, artifacts, by category and date.

Artifact	Count	Begin Date	End Date	Mean	Category %
Unassignable					
Aluminum spout	1	–	–	–	**19.6%**
Glass bottle fragment	33	–	–	–	
Can fragment	1	–	–	–	
Total	**35**				
Food					
Sanitary vegetable or fruit can	80	1904	1943	1923.50	**61.5%**
Clear bottle glass, Hazel-Atlas Glass Company	4	1923	1943	1933.00	
Clear bottle glass, Owens Illinois Glass Company	20	1941	1963	1952.00	
Clear vinegar bottle glass, Owens Illinois Glass Company	6	1941	1954	1947.50	
Total	**110**				
Indulgences					
Clear soda bottle glass	6	1930	1943	1936.50	**8.9%**
Brown beer bottle glass	10	1899	1943	1921.00	
Total	**16**				
Furnishings					
Clear kerosene lamp chimney glass	15	1850	1943	1896.50	**9.5%**
Green lamp shade glass	2	–	–	–	
Total	**17**				
Construction/Maintenance					
Common wire nail	1	1899	1943	1921.00	**0.6%**
Total	**1**				
Artifact Total	**179**				**100.0%**
Mean average				1930.00	
Standard Deviation				12.00	

feature's assemblage and suggested the consumption of soda and beer (n = 1 each). A clear, soda bottle, glass base served as a diagnostic marker with an early stippling technique dated between 1939 and 1961.

Domestic and personal effect items (n = 2 and 3, respectively) comprised 9.09 percent each of the features assemblage. Single fragments of a Flow Blue rim and a decalcomania decorated rim were the only ceramic pieces recovered.

Capstan Glass Company made the jam and jelly glass containers that were presumably reused or modified as tumblers. Personal effects included a brass gear that may have been a part of a pocket watch. A rubber button and a leather shoe fragment completed the collection.

Unassignable and furnishing categories represented 6.06 percent; each item present possessed no diagnostic attributes and gave only a vague impression of functional value.

Items of functional value, placed in food, entertainment, and transportation categories, represented 3.03 percent of the feature assemblage.

The one glass item listed under the food category revealed manufacturer Capstan Glass Company, a maker of jam or jelly glass containers. The artifact produced a date of 1918–1938.

The other categories listed were a rubber band and a lead car or truck wheel weight. As previously mentioned, there is no evidence that any of the station buildings were ever used as an auto mechanic's garage. It is possible that the town may have had one, but that those buildings were located outside of the APE.

Table 6.15. LA 114462, Feature 7, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean Date	Category %
Unassignable					
Aqua bottle glass	1	1880	1920	1900.00	**11.6%**
Clear bottle glass	16	1880	1920	1900.00	
Clear bottle glass	15	1930	1943	1936.50	
Can fragments	15	–	–	–	
Steel mechanical part	1	–	–	–	
Total	**48**				
Food					
Soldered seam meat can	1	1845	1943	1894.00	**10.7%**
Metal spice can lid	2	1925	1943	1934.00	
Vegetable or fruit sanitary can	37	1904	1943	1923.50	
Clear food bottle glass	2	–	–	–	
Clear glass condiment bottle, Owens-Illinois/ Norwich brand	1*	1929	1947	1938.00	
Milk bottle paper cap	1	–	–	–	
Total	**44**				
Indulgences					
Plastic cork stopper	1	–	–	–	**12.1%**
Clear beverage bottle glass	1	1930	1943	1936.50	
Aqua beverage bottle glass	2	1880	1920	1900.00	
Aqua soda bottle glass	3	1915	1943	1929.00	
Amber beer bottle glass	3	1880	1920	1900.00	
Aqua liquor bottle glass	1	1880	1920	1900.00	
Clear brandy bottle glass, Limmared, manufacturer	1	1741	1920	1830.50	
Clear liquor flask glass, Hazel-Atlas Glass Company	38	1902	1964	1933.00	
Total	**50**				
Domestic					
Ironstone dishware	1	1854	1920	1887.00	**9.9%**
Decalcomania plate	2	1908	1943	1925.50	
Plastic bleach bottle	1	1928	1943	1935.50	
White milk glass glassware	1	–	–	–	
Amethyst glassware	1	1880	1920	1900.00	
Clear tumbler glass/jelly jar	3	1921	1941	1931.00	
Clear platter glass	1	1930	1943	1936.50	
Clear canning jar glass	30	1924	1943	1933.50	
Whole clear glass canning jar, AHK - Alexander H. Kerr Company	1*	1924	1943	1933.50	
Total	**41**				
Construction/Maintenance					
Metal scrap	53	–	–	–	**36.6%**
Iron rod	1	–	–	–	
Wire strand, nfs**	3	–	–	–	
Ice pick shank	1	–	–	–	
Brad	1	–	–	–	
Roofing nail, zinc coated	3	1901	1943	1922.00	
Wire nail fragments	60	–	–	–	
Spike	1	–	–	–	

Table 6.15 (continued)

Artifacts	Count	Begin Date	End Date	Mean Date	Category %
Washer	2	–	–	–	36.6%
Bracket	2	–	–	–	
Brick	1	–	–	–	
Aqua window pane	4	1878	1920	1899.00	
Clear window pane	4	1878	1943	1910.50	
Electrical porcelain item	1	–	–	–	
Copper wire connector	1	–	–	–	
Clear light bulb glass	1	–	–	–	
Chicken wire	4	–	–	–	
Metal water pipe collar	1	–	–	–	
Salt-glazed sewer pipe	7	1900	1943	1921.50	
Total	**151**				
Personal Effects					
Metal 2-hole button	1	1880	1943	1911.50	5.3%
Black rubber 4-hole button, whole	3*	1855	1943	1899.00	
Pink rubber 2-hole button, whole	1*	1855	1943	1899.00	
Shell 4-hole button, whole	2*	1900	1943	1899.00	
Shell 2-hole button, whole	4*	1900	1943	1899.00	
Fish-eyed shell 2-hole button, whole	2*	1902	1943	1922.50	
Shell button fragment	1	1900	1943	1899.00	
Shell button shank	2*	1900	1943	1899.00	
White fish-eyed plastic 2-hole button	2*	1930	1943	1936.50	
Blue fish-eyed plastic 2-hole button, whole	1*	1930	1943	1936.50	
Brown plastic 2-hole button, whole	1*	1930	1943	1936.50	
Black plastic 2-hole button, whole	2*	1930	1943	1936.50	
Total	**22**				
Entertainment/Leisure					
Metal pencil ferrule	1	–	–	–	0.2%
Total	**1**				
Transportation					
Metal machine part, nfs	1	–	–	–	13.1%
Red plastic headlight cover	1	–	–	–	
Page fragments from a mechanics manual	50*	–	–	–	
Railroad spike	2	–	–	–	
Total	**54**				
Military/Arms					
REM-UMC center fire cartridge	1*	1911	1943	1927.00	0.5%
REM-UMC rim fire cartridge	1	1867	1946	1906.50	
Total	**2**				
Artifact Total	**413**				**100.0%**
Mean average				1923.00	
Standard Deviation				15.00	

* Count indicates collected artifacts.
** nfs = not further specified

Table 6.16. LA 114462, Feature 8, artifacts, by category and date.

Artifacts	Count	Begin Date	End Date	Mean	Category %
Unidentifiable					
Metal banding	1	–	–	–	**6.3%**
Leather scrap	1	–	–	–	
Total	**2**				
Food					
*Clear jam or jelly jar glass, Capstan Glass Company	1	1918	1938	1928.00	**3.1%**
Total	**1**				
Indulgences					
Clear beverage bottle glass, nfs**	4	1880	1930	1905.00	**18.8%**
Clear soda bottle glass, stippled base	1	1939	1963	1951.00	
Brown beer bottle glass	1	1880	1930	1905.00	
Total	**6**				
Domestic					
Flow Blue dishware	1	1835	1925	1880.00	**6.3%**
Decalcomania dishware	1	1908	1943	1925.50	
Total	**2**				
Furnishings					
Pink plastic desk trim	2	–	–	–	**6.3%**
Total	**2**				
Construction/Maintenance					
Wire nail fragments	6	–	–	–	**43.8%**
Clear window pane	1	1878	1943	1910.50	
Aqua window pane	1	1878	1920	1899.00	
Barbed wire strand	4	–	–	–	
Fence staple	1	–	–	–	
Black rubber tie-down	1	–	–	–	
Total	**14**				
Personal Effects					
Brass gear, 1-inch diameter	1	–	–	–	**9.4%**
Black rubber 2-hole button, whole	1	1855	1943	1899.00	
Leather shoe fragment	1	–	–	–	
Total	**3**				
Entertainment					
Red rubber band	1	–	–	–	**3.1%**
Total	**1**				
Transportation					
Lead car/truck wheel weight	1	–	–	–	**3.1%**
Total	**1**				
Artifact Total	**32**				**100.0%**
Mean average				1914.00	
Standard Deviation				19.00	

* This item was reused by consumers as a glass tumbler.
** nfs = not further specified

Table 6.17. LA 114462, Backhoe Trench 1, artifacts, by color and date.

Artifacts	Color	Count	Begin Date	End Date	Mean
Glass bottle, nfs*	–	1	–	–	–
Total		**1**			

* nfs = not further specified

Table 6.18. LA 114462, Backhoe Trench 3, artifacts, by color and date.

Artifacts	Color	Count	Begin Date	End Date	Mean
Glass bottle, nfs*	Clear	3	1930	1943	1936.5
Glass beverage bottle, nfs	Aqua	2	1880	1920	1900.0
Glass beverage bottle, nfs	Clear	37	1930	1943	1936.5
Glass beverage bottle, nfs	Green	1	–	–	–
Ironstone, nfs	White	1	1854	1920	1887.0
Ironstone bowl	White	3	1854	1920	1887.0
Ironstone cup	White	1	1854	1920	1887.0
Screw	–	1	–	–	–
Sheet metal	–	1	–	–	–
Window pane	Clear	1	1878	1943	1910.5
Fish-eyed 2-hole shell button	White	1	1902	1943	1922.5
Glass jar, (personal effects)	–	1	1802	1943	1872.5
Porcelain toy tea set miniature dish	White	1	1840	1943	1891.5
Glass insulators, American Telephone and Telegraph Company	Aqua	2	1871	1936	1903.5
Total		**56**			
Mean average				1926.4	
Standard Deviation				18.7	

* nfs = not further specified

Backhoe Trench Artifacts

Seven backhoe trenches were excavated at Oscura Siding during the testing program. Depths reached an average of 1.2 m; trench length averaged 120 m. The artifacts from these trenches are listed in Tables 6.17–6.21.

Not all trenches contained artifacts. Mean dates range from 1915.00–1926.4 and encompass the occupation dates of the site.

Summary

Only a portion of the foundations and pits that comprised the remains of the razed site of Oscura Siding were within the highway right-of-way. These included a root cellar, a privy, and various pits and artifact concentrations. No commercial structures were among the features excavated.

However, the site contained extensive trash deposits both within the features and also dispersed throughout the landscape. The recording of these artifacts enables OAS to determine mean dates for the features and for the total number of remaining material items at the site (Table 6.22). Weighted mean dates for the eight features and artifact concentrations are listed in individual tables for each feature.

The resulting mean date of 1912.0, with a standard deviation of 19.0 years, matches well with peak occupation numbers for Oscura Siding during the 1910s and 1920s. More than 60 percent of the artifacts found relate to construction and maintenance activities probably associated with the tearing down of all of the community's structures in the 1950s.

The second most common items found were discarded food and drink containers, with fragmented beer bottles being the most prevalent container type. A total of 369 historic artifacts had maker's marks on them (Table 6.23). Most of these were beer bottles

Table 6.19. LA 114462, Backhoe Trench 4, artifacts, by color and date.

Artifacts	Color	Count	Begin Date	End Date	Mean
White milk glass, nfs*	–	1	1870	1943	1906.5
Rubber fragment, nfs	black	3	–	–	–
Rubber fragment, nfs	red	4	–	–	–
Glass bottle, nfs	clear	4	1930	1943	1936.5
Glass bottle, nfs	brown	6	1880	1943	1911.5
Glass bottle, nfs	aqua	2	1880	1920	1900.0
Sanitary can, nfs	–	7	1904	1943	1923.5
Aluminum fragment, nfs	–	1	–	–	–
Metal lid, nfs	–	3	1904	1943	1923.5
Paper food cap liner	–	1	1900	1943	1921.5
Glass condiment jar, Gebhardt's Chili Powder	amethyst	3	1902	1943	1922.5
Glass condiment jar	clear	1	1930	1943	1936.5
Crown cap	–	1	1892	1943	1917.5
Glass beverage bottle, nfs	clear	2	1930	1943	1936.5
Metal beverage bottle cap	–	1	1892	1943	1917.5
Beer bottle	amber	3	1880	1943	1911.5
Candy wrapper	–	1	–	–	–
Ironstone, nfs	white	2	1854	1920	1887.0
Ironstone, nfs	white	2	1800	1943	1871.5
Ironstone cup or bowl	white	2	1854	1920	1887.0
Zinc and cork canning jar ring	gray	1	1858	1943	1900.5
Canning jar metal lid with gasket	–	1	–	–	–
Kerosene lamp glass chimney	clear	15	1850	1943	1896.5
Iron scrap	–	5	–	–	–
Brass lever	–	1	–	–	–
Iron mechanical plate, nfs	–	15	–	–	–
Copper wire	–	1	–	–	–
Brad	–	3	–	–	–
Hook	–	1	–	–	–
Nail, roofing	–	1	–	–	–
Common wire nail	–	102	1890	1943	1926.5
Nut	–	1	–	–	–
Nonferrous wire	–	1	–	–	–
Spike	–	1	–	–	–
Washer	–	1	–	–	–
Lock washer	–	1	–	–	–
Screw, wood	–	1	–	–	–
Screw	–	1	–	–	–
Grommet	–	1	–	–	–
Date nail	–	1	–	–	–
Window pane	clear	18	1878	1943	1910.5
Window pane	aqua	1	1878	1920	1899.0
Roofing paper	black	5	–	–	–
Plastic pellet	orange	1	–	–	–
Fence staple	–	1	–	–	–
Metal button, 2 hole	–	1	1800	1943	1871.5
Shell button, 2 hole	white	1	1900	1943	1907.5
Fished-eyed shell button, 2 hole	white	1	1902	1943	1922.5
Copper jean stud/rivet	–	1	1873	1943	1908.0
Leather shoe welt	–	1	–	–	–
White milk glass pomade jar	–	1	1870	1943	1906.5
Glass patent medicine bottle	clear	1	–	–	–

Table 6.19 (continued)

Artifacts	Color	Count	Begin Date	End Date	Mean
Metal crucifix	silver	1	1849	1943	1896.0
Pocket/pen knife	green and brown	1	–	–	–
Porcelain doll head	polychrome	2	1840	1943	1891.5
Glass marble	white and blue	1	1890	1943	1916.5
Mucilage	–	2	–	–	–
Brass tire valve	–	1	–	–	–
Brass coil point plate	–	1	1931	1943	1937.0
Rim fire cartridge	–	1	–	–	–
Total		**248**			
Mean average				1918.8	
Standard Deviation				12.7	

* nfs = not further specified

and liquor flasks produced by the Atlantic Bottle Company and the Hazel Atlas Glass Company.

The development of the community was tied to readily available access to goods via train service that allowed for items to be obtained from distant manufacturing centers, rather than local ones.

Historical research and excavation data show that Oscura Siding was a thriving railroad community in the early 1900s with a school, stores, a saloon, hotels, a post office, and a number of homes. While recorded architectural features were few in number, associated artifacts indicate a full range of goods necessary for such a community to sustain itself on the barren plains south of Carrizozo.

Table 6.20. LA 114462, Backhoe Trench 5, artifacts, by color and date.

Artifacts	Color	Count	Begin Date	End Date	Mean
Glass container, nfs*	clear	29	–	–	–
Can, nfs	–	99	–	–	–
Iron buckle	–	1	–	–	–
Lead scrap	–	1	1850	1943	1896.5
Spring, nfs	–	1	–	–	–
Aluminum foil	–	1	1944	1944	1944.0
Key, nfs	–	1	–	–	–
Vegetable or fruit can	–	2	1810	1920	1865.0
Glass extract bottle	clear	1	1867	1915	1891.0
Glass beverage bottle, nfs	aqua	2	1880	1920	1900.0
Glass beverage bottle, nfs	clear	2	1880	1930	1905.0
Glass beverage bottle, nfs	clear	2	1880	1913	1896.5
Glass beverage bottle, nfs	clear	1	1904	1943	1923.5
Crown cap	–	1	1892	1943	1917.5
Glass beverage bottle, nfs	green	1	modern	modern	modern
Beer bottle	amber	1	1867	1920	1893.5
Beer bottle	amber	1	1880	1910	1895.0
Beer bottle	brown	20	1941	1943	1942.0
Ironstone, nfs	orange and green	1	1850	1943	1896.5
Ironstone, nfs	white	1	1854	1920	1887.0
Ironstone, nfs	white	2	1890	1943	1916.5
Ironstone, nfs	blue and white	1	1845	1925	1885.0
Ironstone plate	white	1	1900	1930	1915.0
Ironstone plate	white and blue	4	1900	1930	1915.0
Glassware, nfs	amethyst	3	1880	1917	1898.5
Glassware, nfs	pink	2	1890	1920	1905.0
Glassware, nfs	clear	3	1930	1943	1936.5
Glass goblet stem	clear	1	–	–	–
Glass canning jar cap	white	1	1869	1943	1906.0
Zinc canning jar lid with gasket	–	1	–	–	–
Crock	brown	1	1850	1943	1896.5
Leather hinge strap	–	1	–	–	–
Common wire nail	–	8	1890	1943	1926.5
Nut	–	1	–	–	–
Window pane	clear	6	1878	1943	1910.5
Window pane	pink	1	1878	1920	1899.0
Window pane	aqua	9	1878	1920	1899.0
Yellow fire brick	–	1	–	–	–
Light bulb	clear	6	–	–	–
Bailing wire	–	2	–	–	–
Fence staple	–	1	–	–	–
Shell button, 2 hole	–	2	1900	1943	1899.0
Leather shoe part	–	1	–	–	–
Pocket/pen knife	–	2	–	–	–
Porcelain doll head	–	2	1840	1943	1891.5
Brass miniature figure, nfs	–	1	–	–	–
Fishing hook	–	1	–	–	–
Railroad spike	–	1	1899	1943	1921.0
Rim fire cartridge, U head stamp, REM-UMC	–	1	1867	1946	1906.5
Rim fire cartridge, Winchester	–	1	1873	1919	1896.0
Total		**237**			
Mean average				1915	
SD				19.9	

nfs = not further specified

Table 6.21. LA 114462, Backhoe Trench 6, artifacts, by color and date.

Artifact	Color	Count	Begin Date	End Date	Mean
Glass insulator	aqua	1	1871	1936	1903.5
Total		**1**			

Table 6.22. LA 114462, Oscura Siding, mean artifact dates, by feature, artifact count, and artifact concentration.

Feature No.	Artifact Count	Mean Date	Standard Deviation (yrs)
1	281	1913.0	17.0
2	195	1921.0	17.0
3	272	1912.0	17.0
4	2	1909.0	10.0
5	1792	1913.0	18.0
6	179	1930.0	12.0
7	413	1923.0	15.0
8	32	1914.0	12.0
Artifact Concentrations			
Concentration Area	**Artifact Count**	**Mean Date**	**Standard Deviation (yrs)**
1	212	1910.0	21.0
2	14	1923.0	12.0
3	249	1907.0	22.0
4	52	1897.0	28.0
5	61	1899.0	33.0
6	13	1900.0	19.0
7	71	1910.0	21.0
8	92	1901.0	18.0
Total	**3930**		

Table 6.23. LA 114462, manufacturer and brand, by category and function.

Function	Manufacturer	Brand Name	Count
	Unassignable		
Bottle, nfs*	Owens-Illinois	–	2
Bottle, nfs	Obear-Nestor Glass	–	1
Disc	AP and Cie Brevete	–	1
	Food		
Bottle	Owens-Illinois	–	22
	Hazel-Atlas Glass Company	–	4
	Bridgewood and Clark, Burslem, England	–	1
	Owens-Illinois	Norwich	1
	–	Gebhardt's Chili Powder	3
Pepper sauce bottle	–	King Pepper sauce	5
Vinegar bottle	Owens-Illinois	–	6
Unidentifiable	Bridgewood and Clark, Burslem, England	–	7
	Capstan Glass Company	–	7
Milk bottle	Owens-Illinois	A. J. Olson Company	1
Berry jar	Canton Class Company	–	9
	Indulgences		
Bottle	Owens-Illinois	–	4
	Hazel-Atlas Glass Company	–	2
	American Bottle Company	–	1
	Illinois Glass Company	–	10
	Wooster Glass Co	–	1
Soda bottle	–	Dr. Pepper	1
	–	Seven-Up	1
	Coca-Cola	–	6
	–	Pepsi	1
Wine bottle	Oil City Glass Company	–	6
	Obear-Nestor Glass	–	15
	Fairmont Glass Works	–	1
	Cunninghams and Company, Pitts. PA - C Co or CandCo	–	18
	C' in a circle (Chattanooga Glass Company)	–	27
	Atlantic Bottle Company	–	38
Beer can	–	Anheuser-Busch	2
Beer can	–	Schlitz Brewing Company	1
Brandy bottle	Limmared Glassworks	–	1
Liquor flask	Hazel-Atlas Glass Company	–	38
	Domestic		
Ceramic	S.W. Dean	–	1
	Solo	–	1
Plate	Homer Laughlin	Fiestaware	2
Tumbler	Hazel-Atlas Glass Company	–	1
	Capstan Glass Company	–	14
Canning	AHK, Alexander H. Kerr and Company/Kerr Manufacturing	–	36
	Ball	–	3
	Mason Fruit Jar Company	Mason Fruit Jar Company	7
	Schram St Louis	–	2
Bleach bottle	Owens-Illinois	Clorox	1

Table 6.23 (continued)

Function	Manufacturer	Brand Name	Count
Construction/Maintenance			
Brick, yellow fire	LaClede Company	–	1
Electrical housing	Knox Electric	–	1
Personal Effects			
Unidentifiable	Cones Boss	Cones Boss	1
Pin, indeterminate	Unidentifiable	Lorillard's Climax Plug	1
Lipstick	Plough's Incorporated	–	1
Perfume/cologne bottle	Illinois Glass Company	–	1
Toiletry bottle	Illinois Glass Company	–	6
Toiletry bottle	Trappey	–	2
Compact/rouge pot	Hazel-Atlas Glass Company	–	1
Liniment bottle	–	Dr. J. H. McLean	1
Cough syrup	Foley and Company	Foley and Company	1
Tincture bottle	Whitall-Tatum	–	1
Pill bottle	Owens Bottle Company	–	1
Pill bottle	Illinois Glass Company	–	1
Penny	US Mint	–	1
Communication			
Insulators	–	AMTEL and Tel. Company	1
	H.G. Company (Hemingray Company)	–	16
Military/Arms			
Center fire cartridge	Smith and Wesson	–	1
	REM-UMC	–	1
Rim fire cartridge	Winchester	Winchester Magnum Rim fire	8
	REM-UMC	U head stamp for Remington	9

* nfs = not further specified

7 ⩡ LA 120972, Willow Draw

Richard Montoya

LA 120972, at Willow Draw, was situated on BLM Roswell Field Office land just within the eastern right-of-way of US 54 in low mesquite, yucca, cactus, and grass-covered dunes. One of the larger drainages in the area, Willow Draw cut through the site at depths of up to 10 m.

According to ARMS files, several sites and petroglyphs can be found along the upper reaches of the draw. The site sits at 1,572 m (5,157 ft) with the White Mountain wilderness to the east and the White Sands Missile Range to the west.

Willow Draw was tested by OAS (Oakes et al. 2009) with 11 backhoe trenches and two test pits, producing a total excavation area of 275 sq m, with an average depth of 1.2 m. During excavation, another 110 units, 1 by 1 m in size, were dug at an average depth of 29 cm. Two backhoe trenches, 10 m in length and 60 cm deep, also were examined.

In all, 523 sq m were excavated at a depth of 68 cm; 168.6 cu m of soil was removed. Within the right-of-way, the site covered 1,600 sq m (Fig. 7.1). The site extended west outside the right-of-way another 30 m (98 ft) and at least 20 m (66 ft) east.

LA 120792 had two concentration areas separated by 275 m (902 ft). The areas were defined as one site by Michalik (2000). OAS divided the site into Component A (Features 1–2) and Component B (Features 3–7) during excavation (Figs. 7.2 and 7.3). Component A was on the northern side of Willow Draw; Component B was on the south.

Seven features were recorded. One pollen, five macrobotanical, and 15 flotation samples were retrieved, as well as three radiocarbon dates. Numerous sherd and lithic artifacts also were recovered.

Feature Descriptions

Feature 1, Fire Pit: Feature 1, in Component A at LA 120972, was found during the stripping of grids at the northwestern end of the site after artifacts on the ground had been noted. As work on grids continued, a large 3 by 1 m charcoal stain was revealed; a depth of 52 cm was reached before the edges of a pit were located. It is likely that this feature was a fire pit.

The fire pit was bell-shaped and excavated into the native, sterile soil at the site (Figs. 7.4a and 7.4b). It measured 110 by 82 by 52 cm and was unlined. The sides of the fire pit consisted of natural soil; fill consisted of dark gray, silty clay, with inclusions of abundant charcoal and 5 percent gravel. A few pieces of fire-cracked rock were also uncovered.

The base of the fire pit contained reddish sand that appeared oxidized or burned. Recovered from the feature were 35 lithic artifacts, 204 ceramics, 6 ground stones, and 75 non-human bones, as well as two flotations, one radiocarbon sample, and some mineral samples. Numerous other artifacts were scattered near the fire pit. Test pits and mechanical blading of the surrounding area revealed no additional features in Component A other than Feature 2.

Feature 2, Pit: Feature 2, at Component A, consisted of a small, circular pit dug into the native, sterile soil of the site (Fig. 7.5). The pit measured 22 by 20 by 10 cm. Fill consisted of a silty, semi-consolidated loam with inclusions of less than 1 percent pea gravels and numerous charcoal flecks. Two lithic artifacts were recovered. A few pieces of fire-cracked rock were nearby, but these may have been from Feature 1. The pit served an unknown function and seemed too small for a storage unit.

Feature 3, Pithouse: The pithouse was located at Component B, at the southern end of the site, on the eastern side of US 54. It was oval in shape and measured 3.6 by 3.0 by 65 cm deep with a floor area of 10.8 m (Figs. 7.6 and 7.7). The pithouse was first discovered in Backhoe Trench 3 during the testing program.

The pithouse was unusual in that four small oval pits were superimposed over the outer edges of the feature. The dark-stained soil of the pithouse first appeared 60 cm below the ground surface.

The only floor feature was a crude, basin-shaped hearth (Fig. 7.8) on the western side of the pithouse,

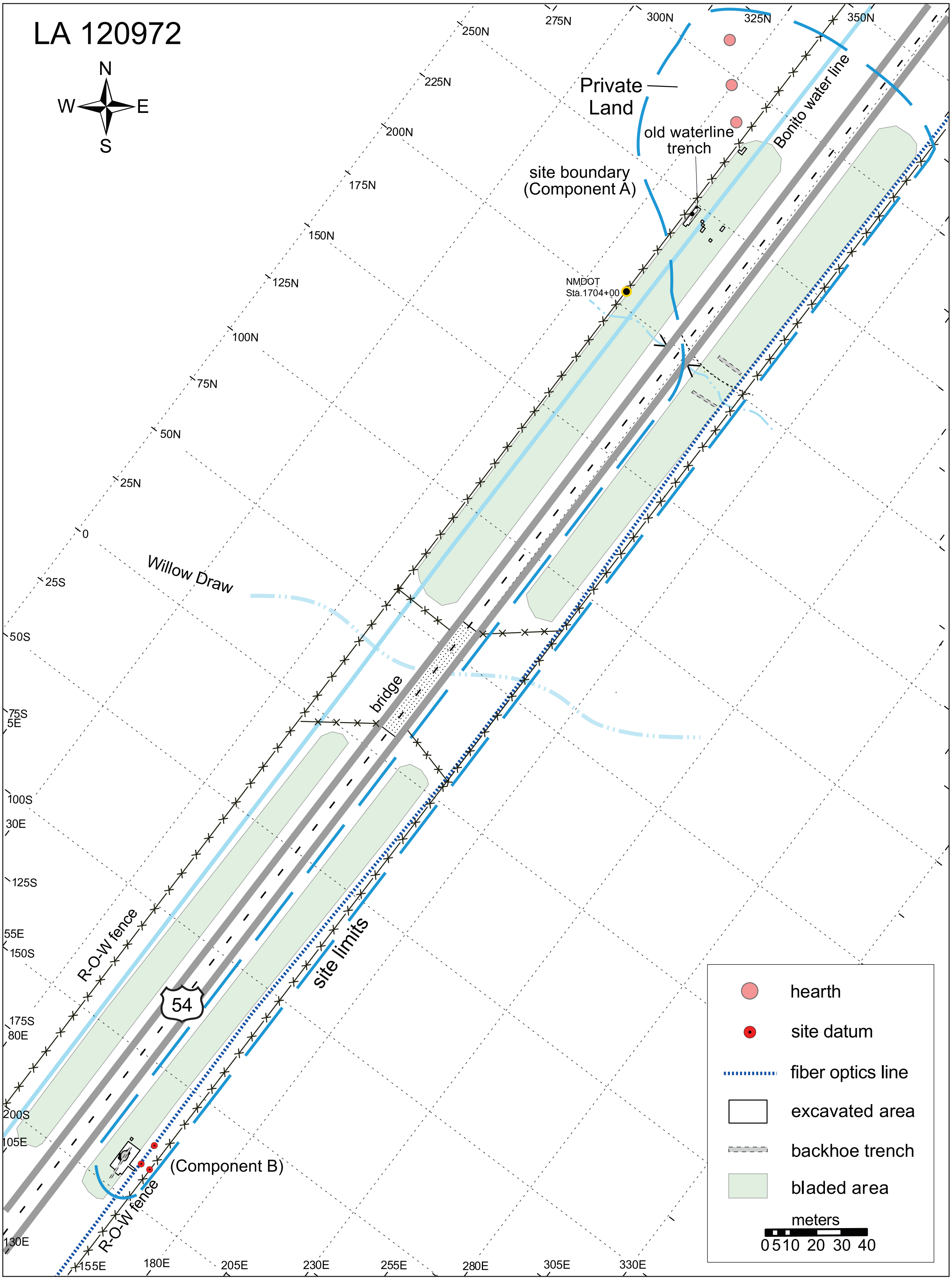


Figure 7.1. LA 120972, site plan.

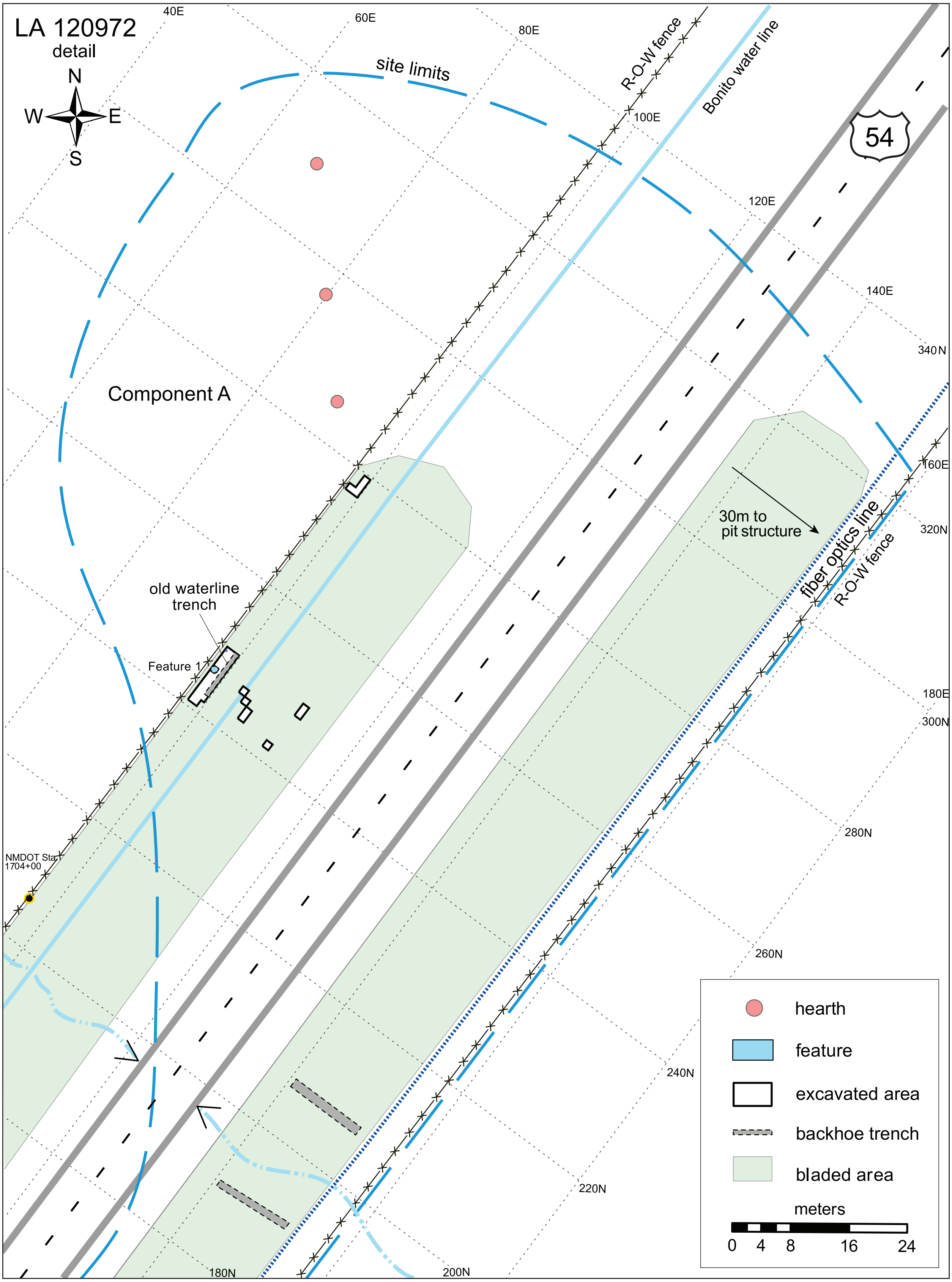


Figure 7.2. LA 120972, site plan, detail, Component A.

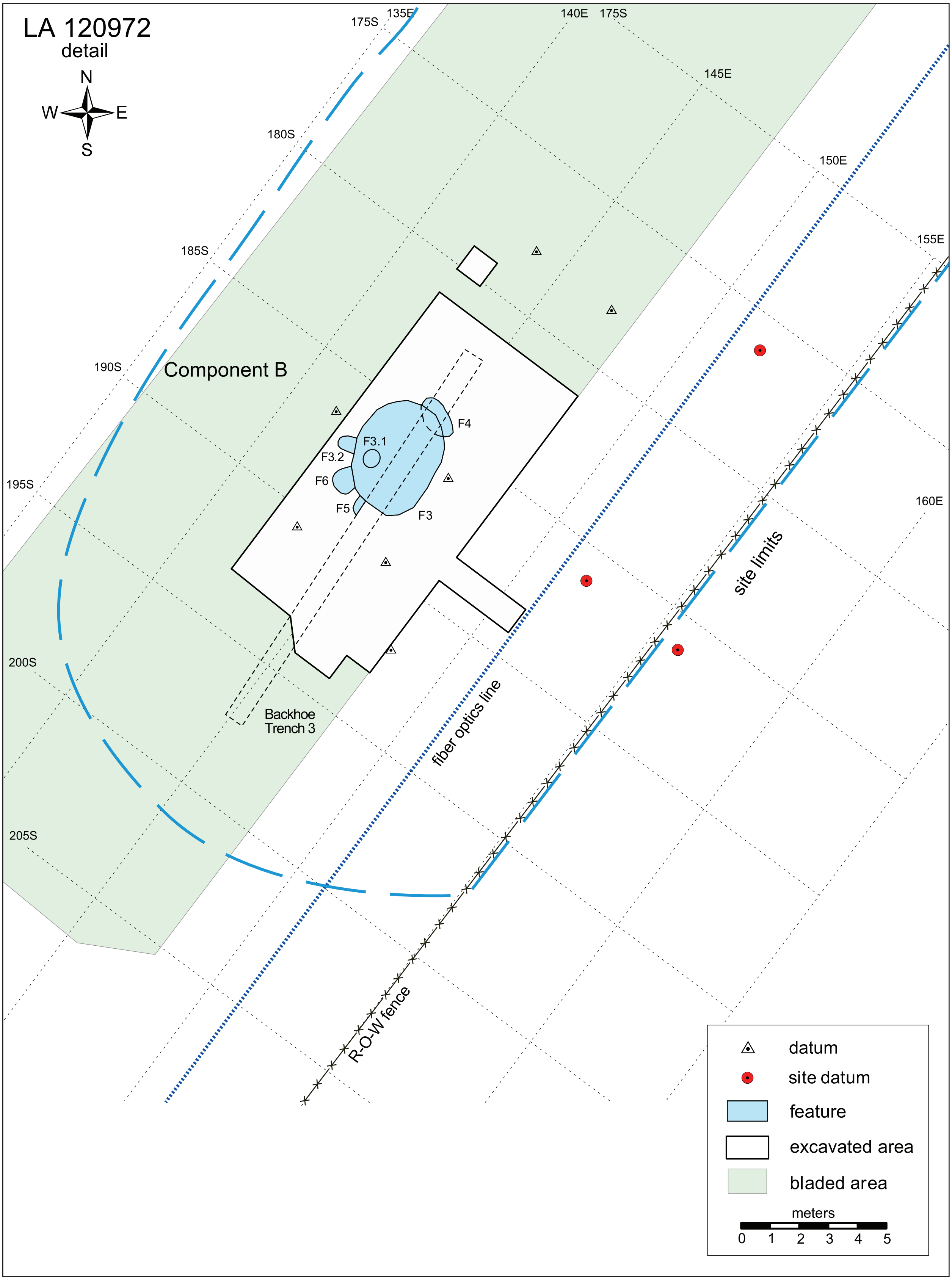


Figure 7.3. LA 120972, site plan, detail, Component B.

Figure 7.4a. LA 120972, Feature 1, pit.

about 40 cm from an air vent in the wall. The hearth measured 60 by 54 by 8 cm, which was very shallow and may suggest fair-weather use. Fill exhibited mottled oxidation with several small pieces of fire-cracked rock and fine charcoal flecking.

Features 4–7, Pits: Features 4–7, four pits, were located around the western half of the pithouse (Fig. 7.7). Three of these were constructed after the occupation of the pithouse and were cut by either the backhoe or pithouse excavation.

Features 4–6 were shallow basin pits. Feature 4 was cut by the backhoe trench but measured 1.32 by .92 by .32 m. Fill consisted of compacted clay and contained sherds and lithic artifacts with some small pieces of charcoal. A flotation sample was taken. The soil did not appear to have been burned here.

Feature 5 was also cut by the backhoe trench (Fig. 7.7), and a complete measurement was not possible. It was at least .58 by .40 by .31 m. The soil was silty loam with inclusions of small gravel, some ash, and very small pieces of charcoal. Two sherds were found in the pit.

Feature 6, another pit, was partially cut by the excavation of the pithouse (Fig. 7.9). This pit had minimum measurements of .82 by .45 by .18 m. The soil was a silty clay loam; no artifacts or charcoal were present. A flotation sample was taken.

Feature 7 was above the hearth in the western wall of the pithouse, at 40 cm distance (Fig. 7.10). This feature was an air vent that began 13 cm above floor level and sloped upward for 60 cm until it opened to the surface. The air vent had been constructed as an oval pit, 60 cm long by 62 cm wide, which sloped down into a keyhole-shaped hole about 23 cm wide. Several sherds and lithic artifacts were found within the vent. Two flotation samples were taken.

Artifacts

LA 120972 contained 1,757 artifacts that were broken down according to types in Table 7.1. The 1,404 ceramics consisted of mostly Jornada Brown Ware (93.9 percent), followed by El Paso Brown Ware (3.8 percent), unknown Cibola White Ware (1.0 percent), Red Mesa-style black-on-white (.5 percent), and .4 percent Mogollon Brown Ware (Alma Plain). The

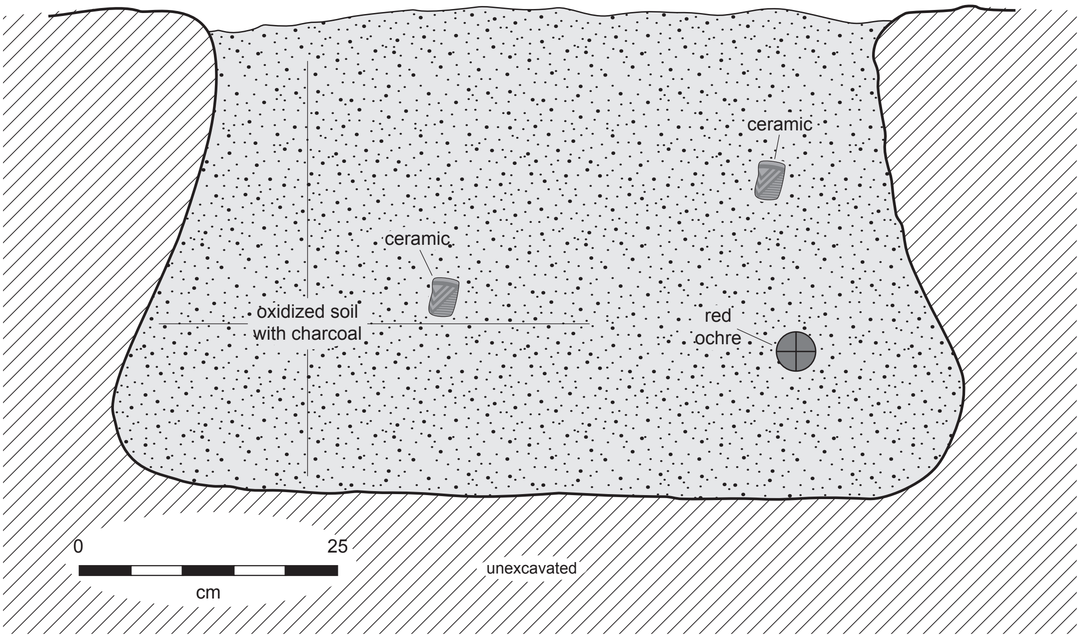


Figure 7.4b. LA 120972, Feature 1, profile.

Cibola White Ware, likely all the Red Mesa-style black-on-white, and the Mogollon Brown Wares were not indigenous to the Jornada area and seem to have been imported from the Mogollon, the Rio Abajo, and the Cibola areas, all to the west.

An examination of the distribution of these ceramic types across the site indicated that they were found in both Components A and B, in or near the three features (Table 7.2). The known dates of these items matched radiocarbon dates for the site of AD 890, overall, and for later pits dated at AD 980. Types of unknown origin were not included in this table.

Of the 221 lithic artifacts recovered from LA 120972, 82.3 percent came from Component A, while 11.7 percent originated from Component B. The remaining 6.0 percent was from surface stripping and mechanical blading. Most of the material was chert, at 34.0 percent, followed by andesite at 24.0 percent.

Most lithic artifacts came from an extensive artifact scatter in Component A. The few examples of utilized lithic artifacts came from Component A, while three cores came from the pithouse in Component B.

Thirty-three ground stone items were recovered from LA 120972; however, most of the ground stone (57.5 percent) came from the Feature 3 pithouse in the form of handstones. One fragment of a metate also was found at Feature 3. Component A featured no metates, but instead had handstones, a polishing stone, paint stones, a manuport, and an abrader. The grinding of items may be inferred as an activity in the pithouse.

A single land snail was found in Feature 1; this may or may not have been cultural. Also within the Feature 1 pit were seven pieces of yellow and red ochre. One piece of ochre was found in the pithouse.

Table 7.1. LA 120972, artifacts.

Artifacts	Count	Col. %
Ceramics	1404	79.9%
Chipped stone	221	12.6%
Ground stone	33	1.9%
Shell	1	0.1%
Ocher	7	0.4%
Fauna	91	5.2%
Total	**1757**	**100.0%**

Figure 7.5. LA 120972, Feature 2, pit.


Figure 7.6. LA 120972, Feature 3, pithouse, with features.

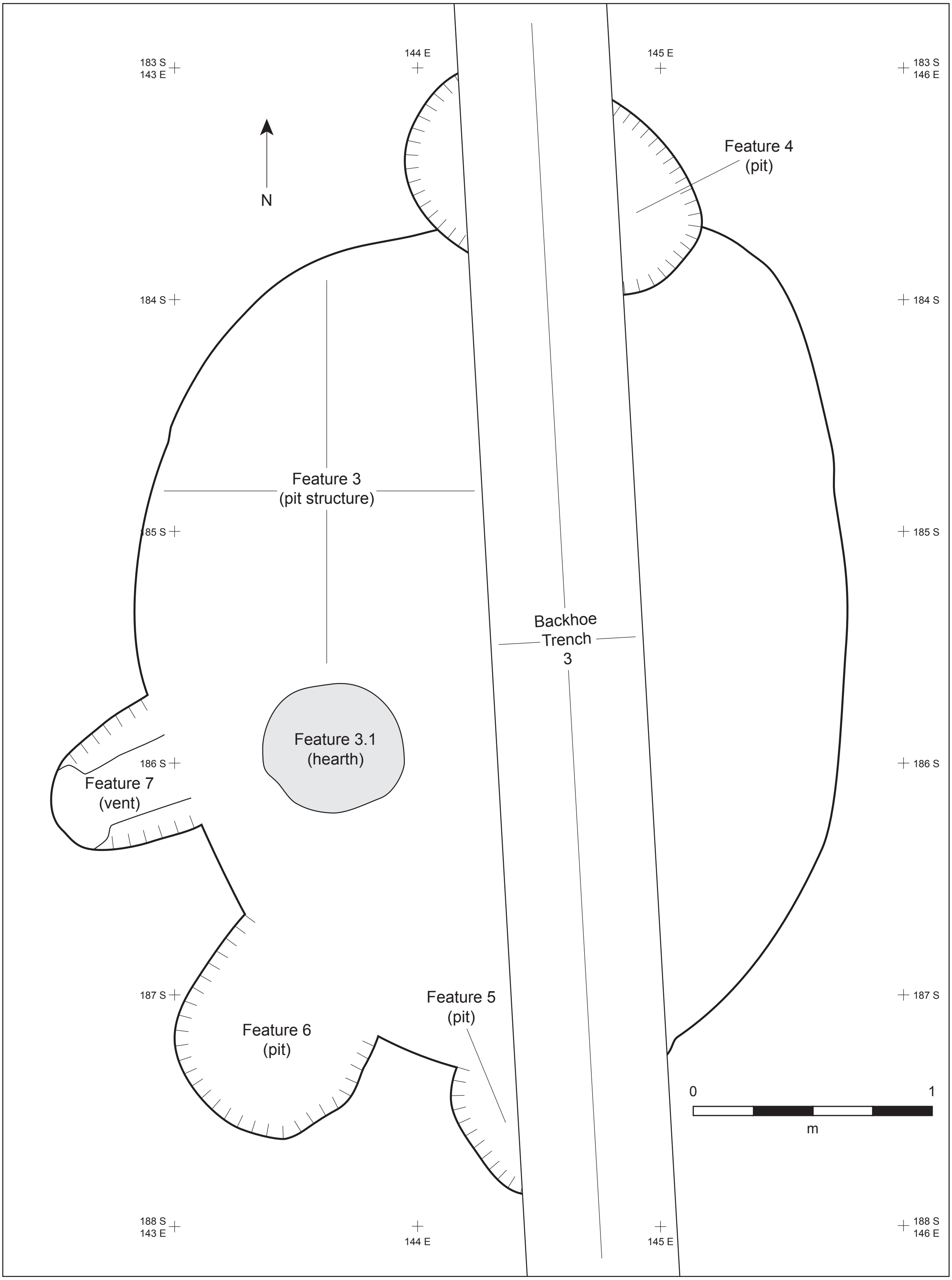


Figure 7.7. LA 120972, Feature 3, pithouse, plan view.

Figure 7.8. LA 120972, Feature 3, pithouse, hearth.

Faunal remains included 91 pieces, most of these from Component A. The remains were highly fragmented and were mostly from rabbits, as was the fauna from the pithouse.

Ancillary Studies

Five samples from Willow Draw site were submitted for pollen analysis: four from the pithouse and one from the Feature 1 fire pit. One sample from a mano found on the surface at the northern end of the site produced abraded cheno-am pollen.

The remaining samples were from the Feature 3 pithouse. An abrader from the structure also yielded cheno-ams and a high level of grass pollen. Two samples from the pithouse and the hearth yielded pine pollen, which have may indicated later deposits. A vent sample indicated a weedy grassland environment with regional pine and juniper woodlands nearby. The pithouse samples also contained starch granules, mostly of maize.

Forty soil samples underwent flotation processing and wood identification, when possible. Only the fire pit in Feature 1 yielded a good representation of cultural materials. The pit contained numerous amaranth seeds, false purslane, and sunflower seeds. It also had maize cob fragments and kernels

Table 7.2. LA 120972, ceramic artifacts, by component.

Ceramic Type	Count
Component A	
Jornada Brown	643
Red Mesa	3
Mimbres ware	9
El Paso Brown	2
Total	**657**
Component B	
Jornada Brown	512
Red Mesa Black-on-white	8
El Paso Brown	3
Plain slipped red	1
Mimbres ware	2
Total	**526**
Total	**1183**

Figure 7.9. LA 120972, Feature 6, pit.

Figure 7.10. LA 120972, Feature 7, vent.

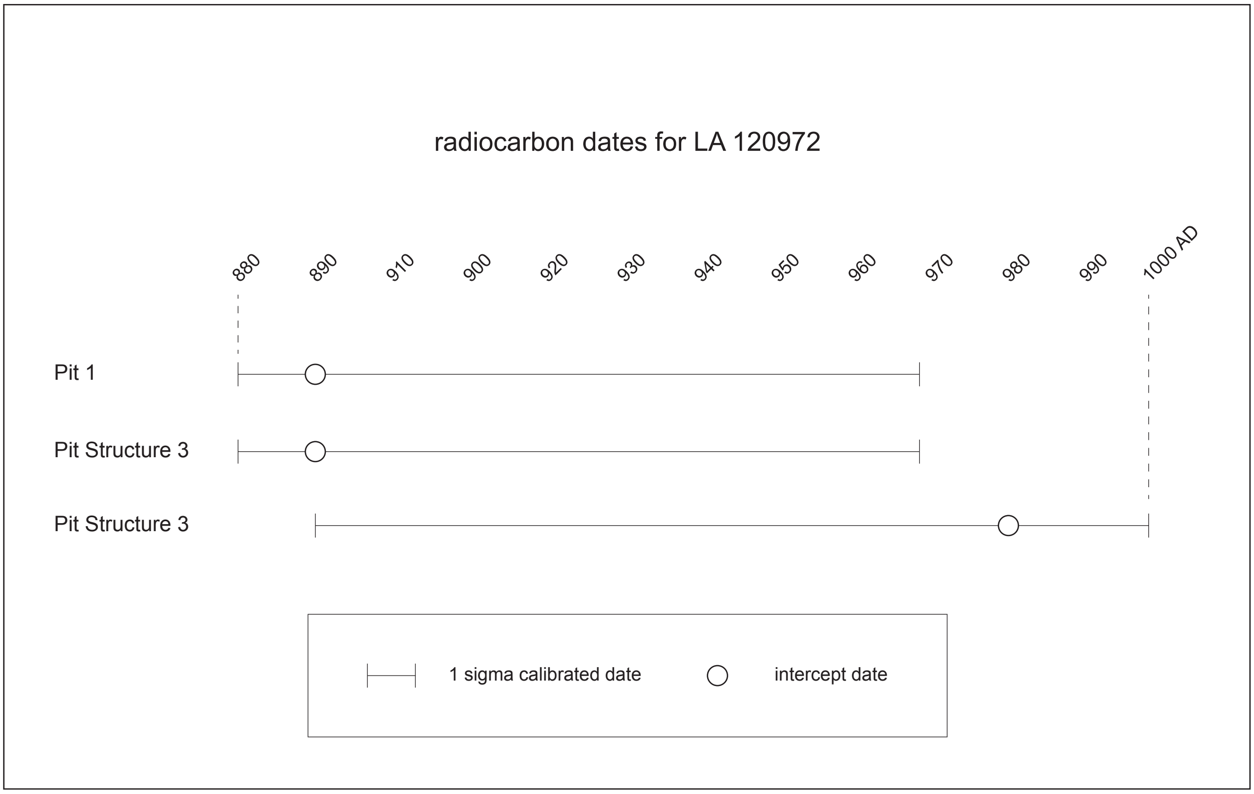


Figure 7.11. LA 120972, radiocarbon dates.

and squash rinds. A large number of dropseed grass seeds were also recovered. The dominant fuel wood on the site was four-wing saltbush, along with lesser amounts of mesquite and juniper twigs. From this analysis, it is reasonable to assume that the site's population had been growing maize and squash and gathering wild plant food and grasses.

Dating of the Site

Three radiocarbon samples were submitted for AMS dating to Beta Analytic, Inc., one of charcoal from the Feature 1 fire pit and two from the Feature 3 pithouse (Fig. 7.11). Both the Feature 1 fire pit and the Feature 3 pithouse were found to have intercept dates of AD 890, while one of the later pits in Feature 3, built over the pithouse, had an intercept date of AD 980. These two time frames were exactly the same as those found at LA 120973, nearly 1.6 km (1 mi) to the south. The Feature 1 charcoal sample consisted of four-wing saltbush/greasewood, as did the wood from the pithouse. The latter pit, above the pithouse, contained mesquite, four-wing saltbush/greasewood, and a trace of an unknown non-conifer.

Summary

The Willow Draw drainage extended outside of the right-of-way to the east and west, with only a small portion within project boundaries. Features were found on both sides of the drainage. It was thought that these features represented different occupations; however, they seem to have occurred at the same time.

On the northern side (Component A), a fire pit and another pit were found; artifacts and several hearths extended further west. On the eastern side, a pithouse was found approximately 30 m (98 ft) outside the right-of-way fence.

South of Willow Draw (Component B) was a pithouse with later pits superimposed over it. Both the Component A pit and the Component B pithouse produced calibrated radiocarbon dates of AD 890 with a standard deviation of 40 years.

A later utilization of the area was suggested by superimposed pits dating to AD 980. The extensive artifact area around Willow Draw seems to indicate that this area was the focus of seasonal activity, with the growing of maize and squash and the processing of plants and dropseed grasses.

8 ⩡ LA 120973, Carrizozo Flats

Dorothy A. Zamora

LA 120973, at Carrizozo Flats, was situated on a gently sloping, grassy plain with numerous areas of eroded soil. The site was 0.05 km (0.03 mi) south of LA 120972, on the same alluvial plain as the Sierra Blanca Mountains, 1.6 km (9 mi) to the east (Fig. 8.1). The site was an extensive pit structure village containing 19 storage pits, four pithouses, two hearths, and one fire-cracked-rock concentration (Figs. 8.2 and 8.3).

Five of the storage pits had adobe collars and associated exterior postholes surrounding them. Feature 16, a pithouse, had interior postholes, as did Pithouses 7 and 27. Feature 11, another pithouse, had five exterior postholes on the northern side of the structure. Hearths were absent in the pithouses; however, a mealing area, which contained a metate-rest and a large trough metate, was present on the floor of Feature 11.

Vegetal materials were collected from several features; these materials consisted of burnt corn and various seeds. Twenty-five radiocarbon samples were recovered, along with 108 flotation, 28 pollen, 34 macrobotanical, and 2 dendrochronlogical samples. Attempts at archaeomagnetic sampling failed due to a lack of soil oxidization and crumbling soil conditions.

Carrizozo Flats, or LA 120973, was recorded by Michalik in 2000. Michalik noted artifacts on the surface, mostly outside of the existing highway right-of-way, with a few small scatters in the right-of-way. The site extends 28 m (92 ft) to the west of the US 54 right-of-way and 16 m (52 ft) east of the right-of-way.

The site was tested by OAS in July 2009. A total of 14 test pits were placed at the site on both sides of US 54 in areas of concentrated artifacts. Test pit excavation depths ranged from 30–80 cm, with an average of 60 cm. Artifacts were recovered from all but one test pit.

In addition to hand-excavated units, six backhoe trenches were also excavated on the site; each trench was 12 m long and 1.2 m deep. The selection of trench locations was based on proximity to surface artifact concentrations. Representative stratigraphic profile sections from each trench were mapped, described, and photographed.

Two distinct cultural areas were present at LA 120973 and were separated by a distance of about 50 m, or 164 ft (Figs 8.4 and 8.5). The northern area contained Features 1–31; this was where most of the site's features were concentrated. The southern area had two small pits with several postholes. Postholes also were associated with many of the collared pits in the northern area. The postholes could have been proof that a roof had been built over a large portion of the activity area, probably for protection from the elements.

Artifacts collected from the excavations included ceramics, lithic artifacts, ground stone, a turquoise pendant, a shell with paint, several small snail shells, and other macrobotanical items.

Feature Descriptions

Feature 1, Natural Deposit: At the start of the excavation phase of Feature 1 at LA 120973, the backhoe trench from the testing program was cleaned out in order to define a potential pithouse at the site. Once the trench was cleaned out and the profile made clear, soil-color changes indicated the possibility of a feature on the southern edge of the trench. However, during excavation it was determined that this was a natural deposit.

Feature 2, Pit: The feature was a small pit measuring 62 cm north–south by 80 cm east–west and 28 cm deep (**Fig. 8.6**). The fill of the pit consisted of dark, charcoal-stained, sandy clay. No artifacts were recovered from the feature; however, a ^{14}C sample was collected and two flotation samples taken. The function of the feature was unknown, but it may have served as an expedient fire pit.

Feature 3, Pit: This feature was immediately west of Feature 2 and was 92 cm north–south by 3.85 m east–west and 10 cm deep (Fig. 8.7). The fill

Figure 8.1. LA 120973, Sierra Blanca Mountains.

Figure 8.2. LA 120973, the crew at Carrizozo Flats (courtesy Richard Bryant).

was consistent with Feature 2, being dark, charcoal-stained, sandy clay. Ceramic artifacts were recovered and were plain-slipped red and Jornada Brown Ware. The function of the pit was unknown, but it may have served as an expedient fire pit or pot rest.

Feature 4, Pit Fill: Originally, this feature was believed to have been a small shallow pit; however, it continued into the fill of Feature 7 and was described with that feature.

Feature 5, Hearth: This was an extramural, slab-lined hearth, where the tops of the upright slabs were uncovered by scraping the surface with a Bobcat TM. The hearth was square in shape with three upright schist slabs and a flat limestone cobble for the base (Fig. 8.8). It measured 46 cm north–south by 46 cm east–west with a depth of 16 cm. Fill consisted of white ash with minute charcoal flecks and fine, sandy silt. When the upright slabs were removed, ash was present on the clay sides and the underside of the slab. There was no evidence of prior use of the hearth due to an absence of oxidization and charcoal. Ash included a mixture of three types of wood—mesquite, cholla, and four-wing saltbush. No artifacts were recovered. A charcoal sample, for ^{14}C dating, and a flotation sample were collected.

Feature 6: Large Pit: Feature 6 was a large storage pit almost circular in shape, that measured 1.54 m north–south by 1.71 m east–west and 81 cm deep (Fig. 8.9). The fill of the pit consisted of a brown, silty sand with charcoal flecks and small patches of ash. Nine exterior postholes were present around the pit. The postholes averaged 20 cm in diameter with an average depth of 46 cm.

Artifacts recovered from the feature included 18 flaked-stone artifacts, 3 ground stone, 26 ceramics, 10 faunal bone fragments, 1 ochre fragment, and 2 land snail shells. Several macrobotanical samples were collected from the pit and from each posthole, along with pollen and charcoal samples for ^{14}C dating. Burned corn kernels were identified in the pit during excavation.

Feature 7 and 7A, Pithouse and Storage Pit: Feature 7 was an irregularly shaped pithouse with a storage pit at the northeastern corner (Feature 7A). The pithouse was discovered in a backhoe trench during the testing phase. The southern edge of the structure was removed by trenching. The feature measured 1.86 m north–south by 2.20 m east–west with a depth of 50 cm (Figs. 8.10, 8.11, and 8.12).

The fill of the pit structure was very compact sand, reading 3/4 YR, or dark brown, on the Munsell soil-color chart. Charcoal and charcoal flecking was present in the fill, along with some artifacts. The floor of the structure was yellowish, compact clay with rodent activity throughout. The walls of the feature were dry, compact clay similar in color to the floor.

Below the floor was a subfloor with two postholes. One was in the northeastern corner, 20 cm west of Feature 7A; the other was in the center of the pithouse. Postholes were 12 cm in diameter and averaged 15 cm deep. Rodent activity had disturbed the postholes, making it difficult to find the bottom of each feature. Artifacts found in the subfloor fill consisted of one Jornada Brown Ware piece and one small fragment of non-human bone. Artifacts consisted of ceramics, lithics, and non-human bone; charcoal samples for ^{14}C dating and pollen and flotation samples were collected from both floors.

A large storage pit (Feature 7A) was excavated in the northeastern corner of the pithouse. The pit was bell-shaped with ash fill. The pit measured 75 cm north–south by 73 cm east–west and 70 cm deep. Large burned wood fragments were recovered from the pit; flotation and charcoal samples for ^{14}C dating were collected. Artifacts consisted of ceramics, mostly Jornada Brown Ware with some El Paso Brown Ware, early Red-on-tan (Mogollon-like), and plain-slipped red.

Feature 8, Storage Pit: The feature was an oval basin 1.4 m north–south by 1.12 m east–west and 30 cm deep (Fig. 8.13). The fill of the pit was very fine silt and sand, reading 7.5 YR 2/5, or very dark brown, on the Munsell soil-color chart. Small charcoal inclusions were dispersed throughout the matrix along with minute inclusions of oxidized soil. Artifacts consisted of one lithic artifact, one abrading stone, and two ceramics. Charcoal, pollen, and flotation samples were collected.

Feature 9: Possible Postholes: Feature 9 may have been two postholes with one superimposed upon the other. Fill consisted of a 5 cm thick lens of dark, charcoal-rich soil underlain by light brown, sandy clay (Fig. 8.14). The second posthole was truncated by the latter posthole. The first posthole, to the east, was 25 cm north–south by 30 cm east–west and 11 cm deep. The western posthole was 7 cm in diameter and 6 cm deep. No artifacts were

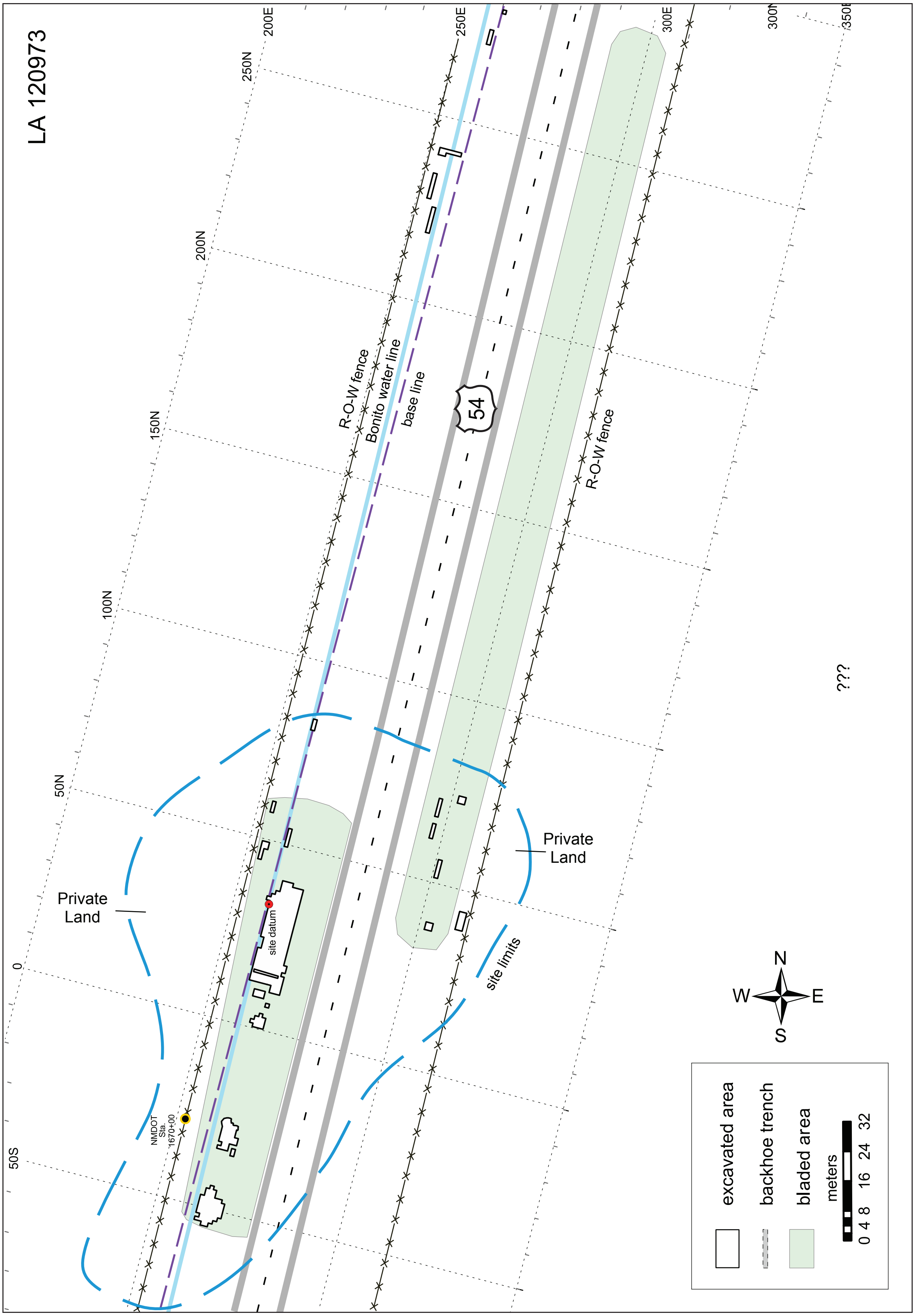


Figure 8.3. LA 120973, site plan.

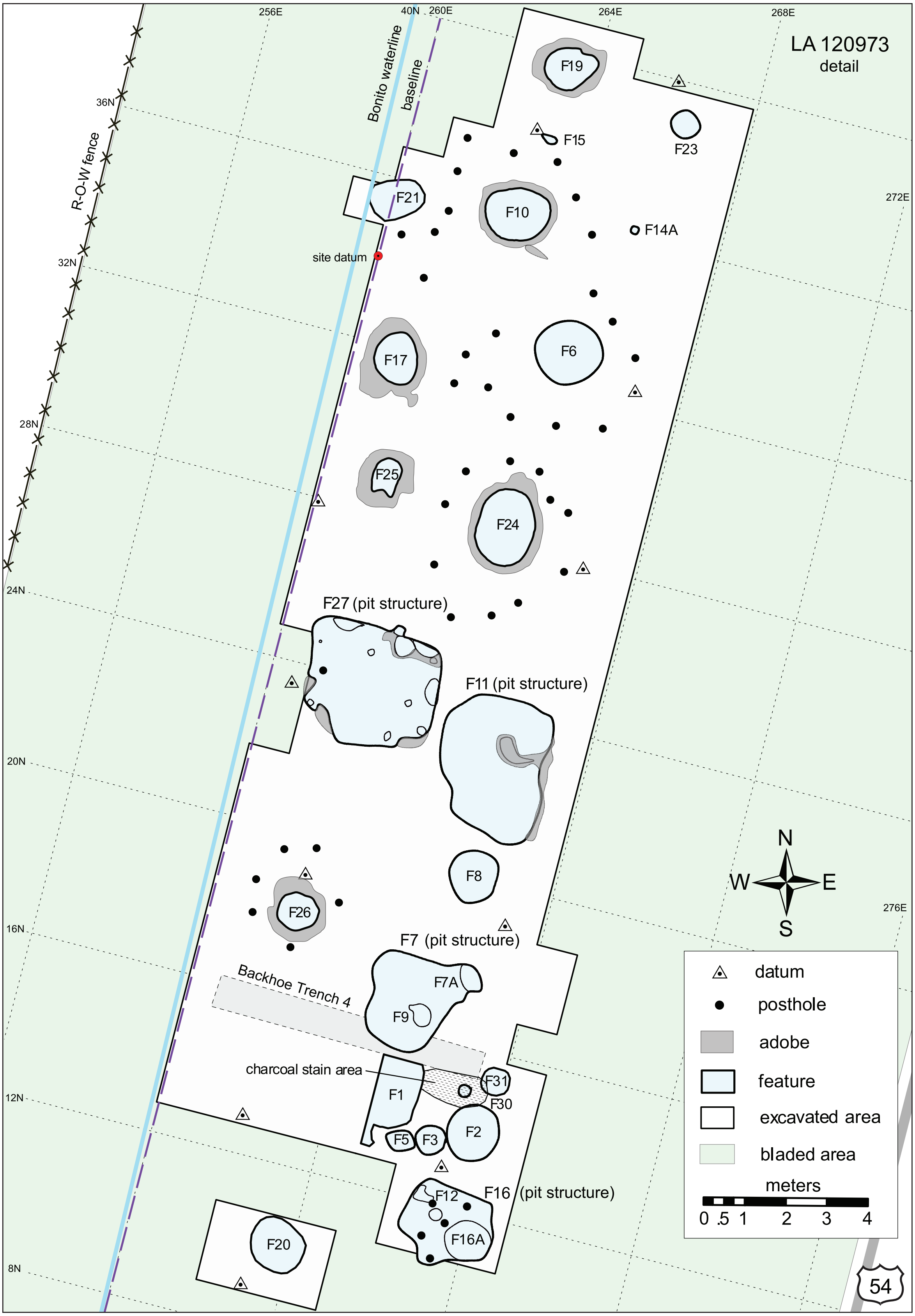


Figure 8.4. LA 120973, north excavation area.

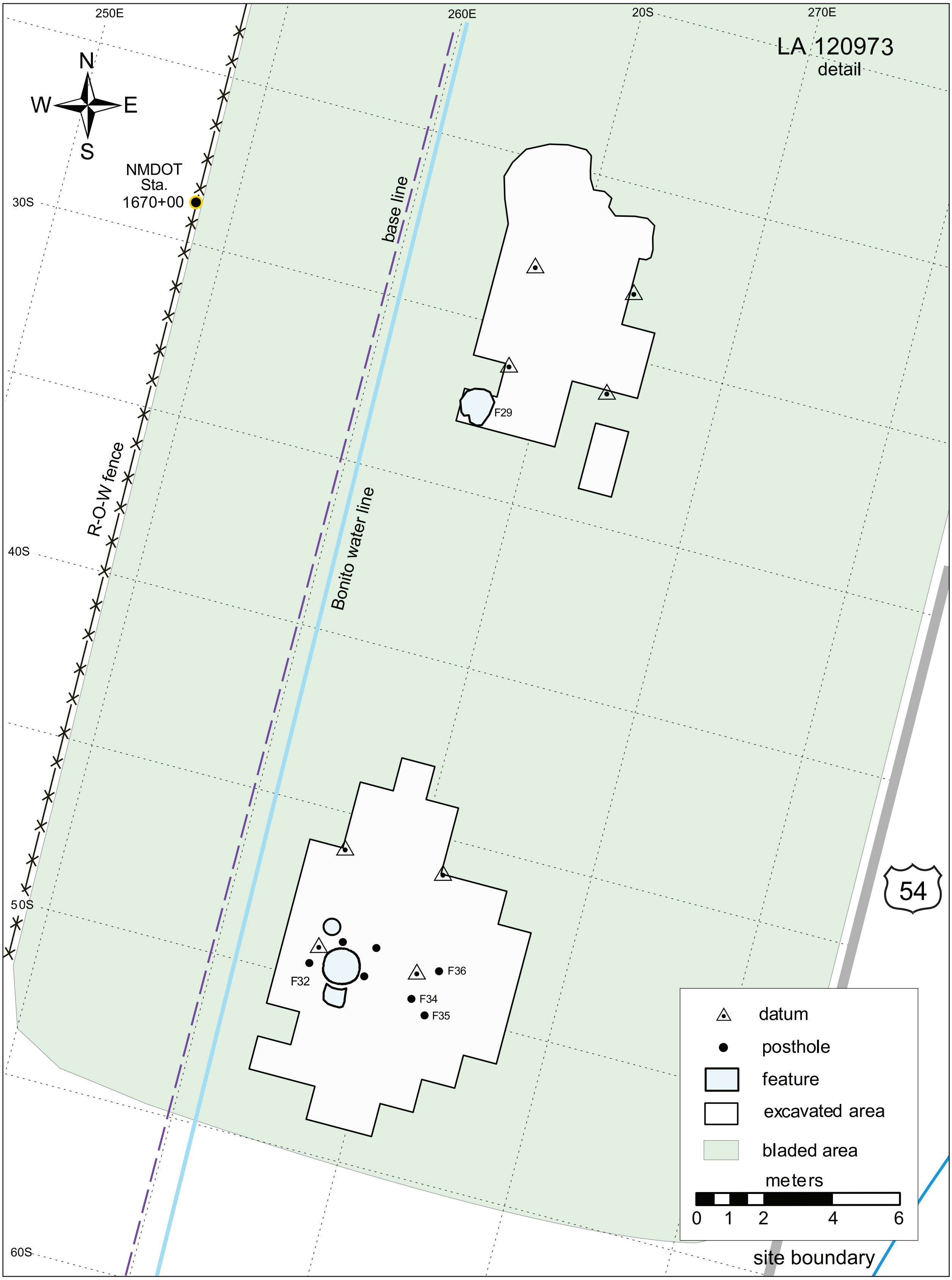


Figure 8.5. LA 120973, south excavation area.

recovered from the feature. Charcoal and flotation samples were collected.

Feature 10, Adobe-Collared Storage Pit: This storage pit was the first adobe-collared pit to be excavated (Figs. 8.15a and 8.15b). The pit was oval in shape and measured 1.24 m north–south by 1.54 m east–west and 98 cm deep. The storage pit had been dug into the native, compact clay. Both the walls and floor were compact clay. Rodent activity was present, and several rodent burrows had been made in the walls of the feature. Large adobe balls had been used, prehistorically, to plug holes made in the walls by rodents. An adobe collar surrounded the opening of the pit; the collar was 2 cm wide and 15 cm high.

The fill of the feature consisted of sandy clay with charcoal and ash. Small nodules of oxidized soil were found in the fill suggesting that burning had occurred; however, the pit did not exhibit any evidence of burning. Burned corn kernels were found in the fill mixed with the ash. Artifacts recovered from the feature included: 19 lithic artifacts; 5 ceramic pieces, including Jornada Brown, Mimbres Black-on-white and plain-slipped red; charcoal; pollen; and macrobotanical samples.

To the southeast, an adobe-collar extension was present; the collar was 60 cm long and 12 cm wide tapering down to 4 cm and then to a stop. It is possible that some adobe was removed during excavation before it was discovered that the collar was made of adobe and was not frozen soil. Excavation north of the adobe extension revealed no other features; heavy rodent activity was noted. Fill consisted of charcoal and very little ash. No artifacts were recovered.

Exterior features consisted of a small pit along the southern edge of the Feature 10 and Feature 12 postholes. The small pit (Feature 10B) was round in shape; most of it had been destroyed by rodent activity. Fill consisted of sandy, clay soil with charcoal and ash, probably from the storage pit (Feature 10). The walls were compact clay. The feature measured 20 cm diameter and 32 cm deep. No artifacts were recovered from the pit; charcoal and macrobotanical samples were collected.

The postholes (Features 10A–10L) averaged 18 cm in diameter and 43 cm in depth. A macrobotanical sample was collected from each posthole. Postholes 10F and 10H each contained a Jornada Brown sherd. The area around the features contained both charcoal and ash. One 1 by 1 m unit was excavated east of the adobe extension down to solid clay but did not yield any artifacts. Charcoal and ash were present in a rodent burrow, but beyond that, the unit was culturally sterile.

Feature 11, Pithouse: This pithouse was irregular in shape and was 3.30 m north–south by 2.5 m east–west and 21–32 cm deep. Fill of consisted of sandy clay with charcoal and charcoal-stained soil. Soil oxidization was present, suggesting burning; however, the feature floor and walls did not exhibit evidence of burning. The pithouse floor had been remodeled. The first floor was heavily disturbed by rodents and was made of compact clay.

A mealing area was present in the eastern quarter of the feature (Fig. 8.16). A metate was found resting on top of mealing residue on the floor. An adobe shelf was surrounded by an adobe wing wall that separated the mealing area from the rest of the feature. Below the residue was an indentation, which probably once held a container for ground material. Some of the materials found below the metate were burned corn and a variety of seeds, along with ash and charcoal. Above the bowl rest were two cloudblower pipes, one missing an end and the other fragmentary (Figs. 8.17 and 8.18). Both artifacts were found on the southern side of the metate, in the fill. One other ground stone artifact found in the fill was a pigment-grinding stone. Recovered artifacts consisted of 54 items of flaked stone and 52 ceramics, with the majority being Jornada Brown.

Floor 2 was 10–15 cm below the upper floor and consisted of sandy clay with charcoal flecking. The second floor was fairly even; however, there was evidence of heavy rodent activity, especially below the mealing area on the upper floor. Two floor features were excavated; one was a small, shallow, clay-lined pit, possibly a pot rest, measuring 16 cm north–south by 20 cm east–west and 6 cm deep (Figs. 8.19a and 8.19b). The other feature was a posthole 8 cm in diameter and 15 cm deep. No artifacts were recovered from this level. Charcoal, pollen, and flotation samples were collected.

In all, five postholes were excavated north of the pithouse (Table 8.1). Fill consisted of sandy loam with charcoal flecking. The walls of the postholes were natural, sterile, compact clay and exhibited no signs of remodeling. No artifacts were associated with the postholes. Flotation samples were collected.

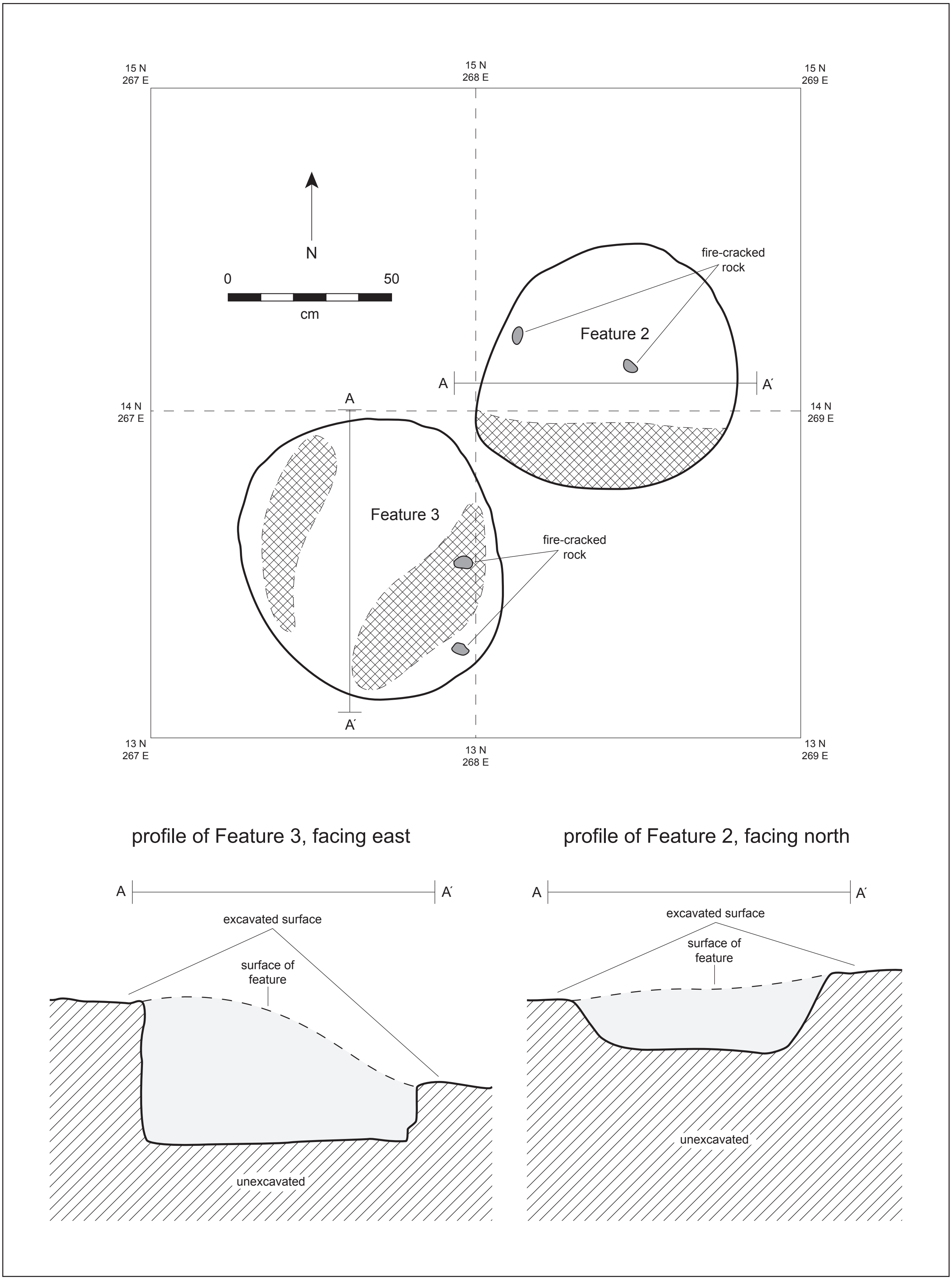


Figure 8.6. LA 120973, Features 2 and 3, profiles.

It is possible this feature was used only for processing vegetal materials and not as a living area. The metate, along with the cloudblowers, suggests this theory may be true. According to Mary Weahkee (personal communication, 2010) this method remains in use today—a woman grinds and processes the meal, while keeping in rhythm with the male's chants as he smokes the cloudblower.

Feature 12, Hearth: During stripping around Features 2, 3, and 5, a small hearth was discovered 3 m to the south. The hearth was 44 cm north–south by 54 cm east–west and 10 cm deep. It was filled with limestone and andesite stones and showed evidence of burning. Fill consisted of dark, loamy, sandy clay with charcoal and ash. Below the rocks, the hearth continued for 2 cm and was irregular in shape (Figs. 8.20a and 8.20b). No artifacts were recovered from the feature itself. However, artifacts associated with the feature were found outside the hearth or in the fill above. Artifacts consisted of five ceramic pieces, two flaked-stone artifacts, and one abrading stone. Charcoal and flotation samples were collected.

Feature 13, Pit: Feature 13 was a small pit on the eastern side of US 54, across from the larger activity area. During testing, subsurface artifacts were recovered, but no features were found. A fiber-optic cable and a water-control berm were present, and most of the artifacts were on these disturbances. The berm was mostly created from cleaning of culverts and the piling of soil to control water flow. During excavation, the berm was removed to 10 cm below the original surface, where burned, oxidized soil was exposed (Figs. 8.21a–8.21d). A small, oval-shaped pit—25 cm north–south by 30 cm east–west and 27 cm deep—was revealed. The pit had been dug into the natural, sandy clay; fill consisted of very silty clay with gravel and charcoal flecks. The presence of oxidization on the sides of the pit suggests that this feature was thermal. Three ceramics were recovered outside the pit. Charcoal, pollen, and flotation samples were collected from the fill. Excavations around the pit did not produce any other cultural manifestations. Nearby, other units were dug 40 cm deep and were sterile.

Feature 14, Posthole: This small, deep posthole, 12 cm diameter and 48 cm deep, was located 2 m east of Feature 10 and 3 m south of Feature 23 (Fig. 8.22). The fill of the pit was silty, sandy clay with charcoal flecking. This posthole may have been associated with Feature 10.

Figure 8.7. LA 120973, Feature 3, pit, view north.

Table 8.1. LA 120973, Feature 11, posthole measurements.

Feature	Diameter (cm)	Depth (cm)
11a	17.0	37.0
11b	15.0	43.0
11c	13.0	41.0
11d	16.0	42.0
11e	15.0	40.0

Feature 15, Small FCR Concentration: Feature 15 was between Features 10 and 19. It was a small fire-cracked rock concentration measuring 30 cm north–south by 25 cm east–west (Fig. 8.23). The soil around it was charcoal-stained with charcoal flecking. This may have been a hearth, since all that was left was fire-cracked rock and carbon-stained sediment. No artifacts were found.

Feature 16, Pithouse: This pithouse was found below Feature 12. The feature was probably square in shape, but due to rodent disturbances, the walls were irregularly shaped (Figs. 8.24a and 8.24b). The

Figure 8.8. LA 120973, Feature 5, hearth, view west.

Figure 8.9. LA 120973, Feature 6, view west.

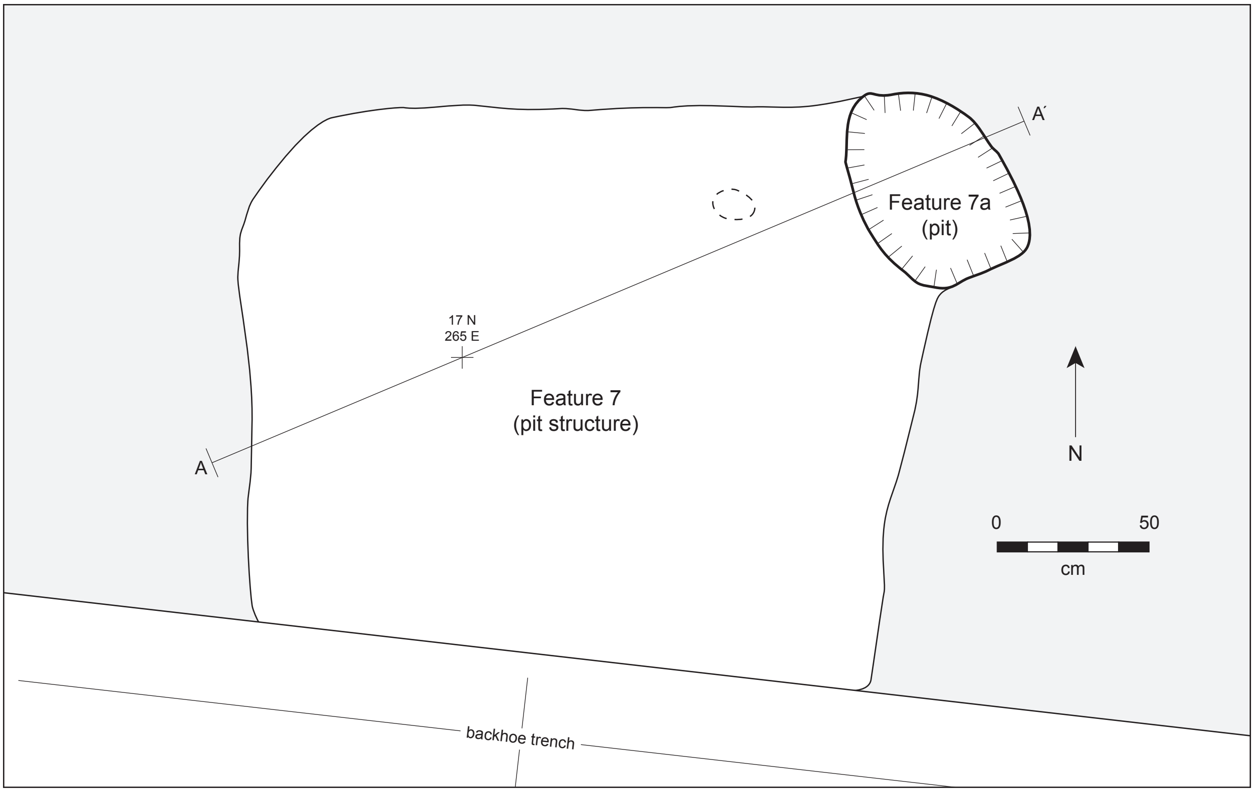


Figure 8.10. LA 120973, Feature 7 and 7a, pithouse, floor one, plan.

pithouse measured 1.76 m north–south by 3.32 m east–west and 26 cm deep. Fill consisted of sandy clay with pea-size gravel, charcoal, and ash scattered lightly throughout the fill.

Seven features were found on the floor. One was a large storage pit (A) in the southeastern corner of the pithouse. The pit was 1.16 m in diameter and 20 cm deep. Pit fill was dry, compact, very fine, sandy clay with charcoal, rootlets, and heavy rodent disturbances. A small piece of yellow ochre was the only artifact. Charcoal, pollen, and flotation samples were collected.

Another small pit (G) was found in the center of the structure. Possibly a hearth, the pit measured 26 cm in diameter and 16 cm deep. When exposed, the hearth exhibited a charcoal lens with ash; fill was silty, sandy clay with charcoal and ash. No artifacts were recovered. Charcoal and flotation samples were collected.

Five postholes surrounded the large pit and the hearth (Table 8.2). The fill of each posthole was identical and consisted of fine, sandy clay with charcoal flecking and very little ash. No artifacts were recovered; charcoal, pollen, and flotation samples were collected. It is believed by some that Feature 16 represented a configuration of the constellation of Orion's Belt.

Table 8.2. LA 120973, Feature 16, posthole measurements.

Feature	Diameter (cm)	Depth (cm)
16b	7.0	10.0
16c	7.0	8.0
16d	7.0	16.0
16e	8.0	17.0
16f	6.0 by 9.0	15.0

Feature 17, Large Storage Pit with Adobe Platform: Feature 17 was the most unusual feature at the site due to the outer platform of adobe that encircled it. Inside the pit was a pedestal of clay, possibly used for threshing (Figs. 8.25a and 8.25b). Feature 17 was dug into natural, compact soil, and the walls and bottom showed no signs of remodeling. The pit opening was circular and slightly bell-shaped; it measured 1.20 m north–south by 1.0 m east–west and was 38 cm deep.

Figure 8.11. LA 120973, Feature 7 and Feature 7a, pithouse and storage pit.

The platform ranged from 16–22 cm wide and was 8–16 cm high. The matrix of the platform was compact clay with some sand and embedded seeds. The pedestal of clay was made of solid, natural clay from the area and was purposely placed at the bottom of the pit. Fill consisted of clay, some sand with charcoal flecking, minute amounts of ash, and small clumps of oxidized soil suggesting the feature had been burned. There was no evidence of burning on the floor or walls. Seeds were present in the fill and were visible to the naked eye during excavation.

Few artifacts were recovered; however, five ceramic pieces were found in the upper 10–20 cm of fill. Charcoal, pollen, and macrobotanical samples were collected. A pollen sample was collected from the bottom of the pit.

The pit may have been used for seed processing instead of storage; this is suggested by the clay pedestal in the center of the pit. The platform contained embedded seeds, suggesting that they got there through either threshing or spillage.

Feature 19, Collared, Bell-Shaped Pit: This pit was dug into the natural clay. The floor and walls were very compact clay. No remodeling was noted (Figs. 8.26a and 8.26b). The feature measured 1 m north–south by 1.20 m east–west and 50 cm deep. The pit was D-shaped and belled out about 30–35 cm along the southern half; it was flat across the northern edge. Fill was semi-compact clay with a little sand, charcoal flecking, rootlets, and rodent activity. In the rodent-disturbed portion, the soil was soft and contained more sand.

Artifacts were mostly from pit fill, with the exception of one ceramic found in the rodent disturbance. Nine artifacts were recovered from the feature fill—one flaked-stone artifact and eight ceramics. There was not enough charcoal to collect a sample for ^{14}C dating. Pollen and flotation samples were collected.

Feature 20, Pit Filled with Trash: Feature 20 was oval in shape and was southwest of Feature 16. The pit was dug into natural clay and showed no signs of remodeling. Rodent activity had destroyed portions of the walls and floor. The pit was 1.40 m north–south by 1.12 m east–west and was 55 cm deep (Figs. 8.27a and 8.27b). Fill was sandy clay, with a charcoal-and-ash lens and artifacts throughout. Oxidized soil was present, suggesting the pit had been burned.

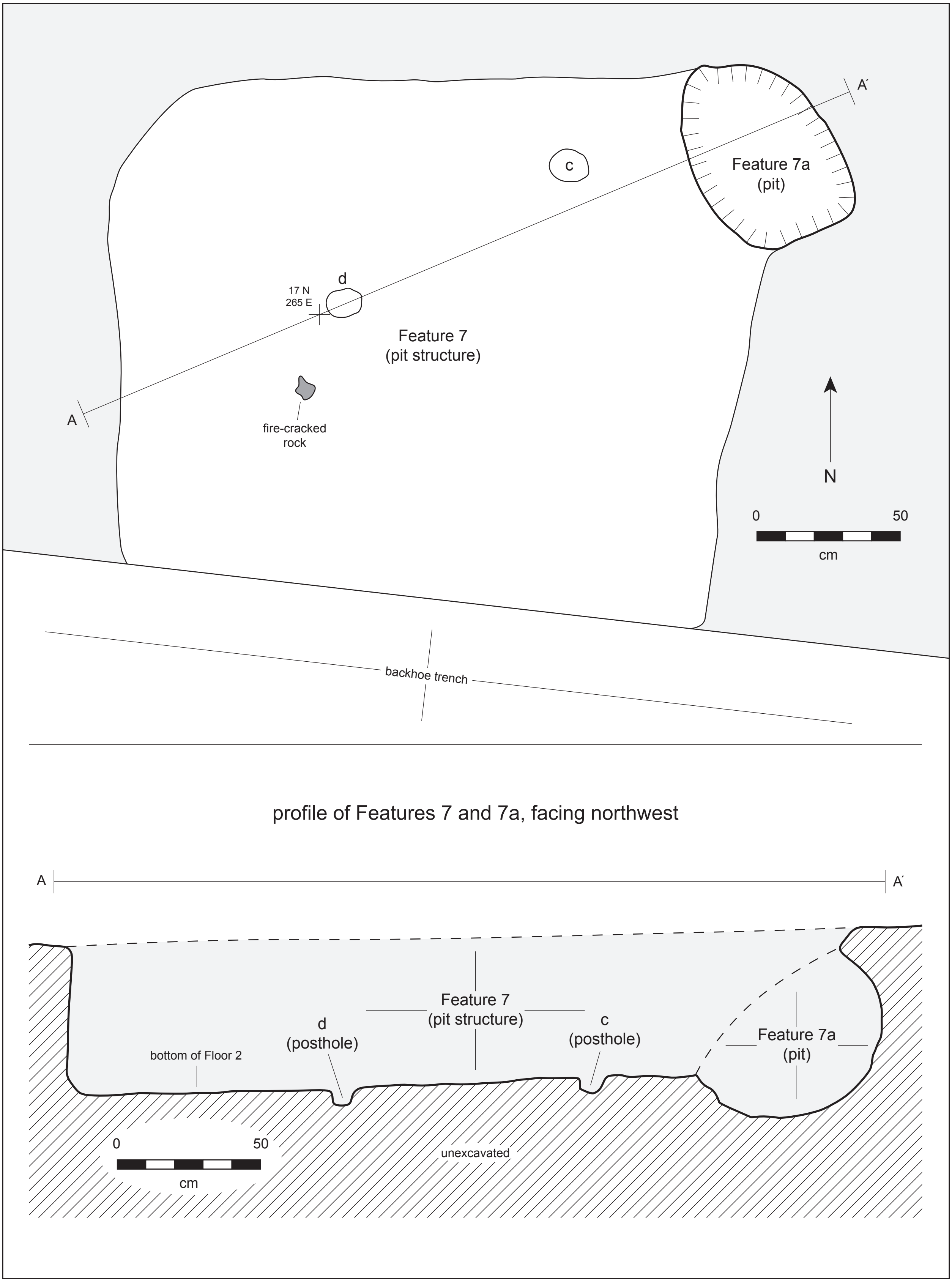


Figure 8.12. LA 120973, Feature 7 and 7a, floor two, plan view and profile.

Figure 8.13. LA 120973, Feature 8, pit, view east.

Figure 8.14. LA 120973, Feature 9, soil profile, possible posthole.

Figure 8.15a. LA 120973, Feature 10, pit.

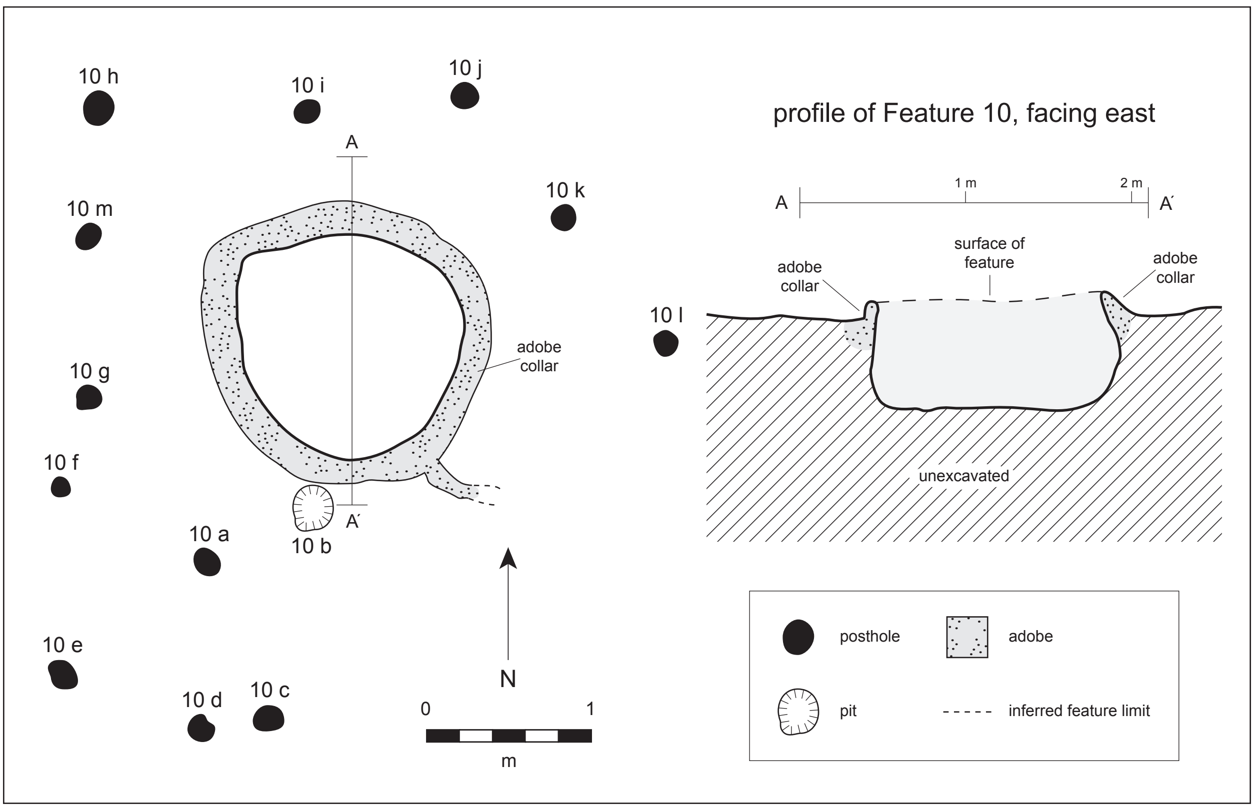


Figure 8.15b. LA 120973, Feature 10, pit, profile.

Figure 8.16. LA 120973, Feature 11, pithouse, floor one.

In all, 385 artifacts were recovered and included flaked-stone artifacts (n = 63), ceramics (n = 215), ground stone (n = 2), fauna (n = 100), shell (n = 3), a turquoise bead (n = 1), and red ochre (n = 1). Most of the artifacts were recovered from the charcoal-and-ash lens.

It is possible this pit was abandoned and used as a trash receptacle. The oxidized soil and the oxidization on the pit walls suggest burning had occurred. Artifacts did not exhibit any signs of burning, indicating that the pit was likely burned prior to trash deposition. Charcoal and flotation samples were collected.

Feature 21, Possible Clay Mixing Pit: The function of this pit is unknown; however, the interior of the pit consisted of clay globs that seemed to be made of clay mixed with water (Fig. 8.28). It is possible that the adobe used for the collars around the storage pits was prepared here. The Rio Bonito water line had cut into this feature and eliminated the western portion of the pit; the partial pit measured 1.4 m north–south by 1.35 m east–west and was 44 cm deep. No artifacts were recovered.

Feature 23, Small Pit: Feature 23 was 2 m east

Figure 8.17. LA 120973, Pithouse 11, partial cloudblower.

Figure 8.18. LA 120973, Pithouse 11, partial cloud blower.

of Feature 19. The pit was 65 cm north–south by 74 cm east–west and was 43 cm deep (Figs. 8.29 and 8.30). The pit, probably used for storage, was dug into the natural soil and exhibited no signs of remodeling. Fill consisted of sandy, loamy clay with charcoal flecking and rodent disturbances. Rodents had removed a portion of the northern wall and a quarter section of the southwestern wall, including the floor in both sections. Fifteen artifacts were recovered from fill; this included five flaked-stone artifacts, nine ceramics, and one small, red ochre nodule. Charcoal, pollen, and flotation samples were collected.

Feature 24: Large Storage Pit: This large pit had rodent activity throughout. Both the bottom of the pit and the pit walls were heavily disturbed. The pit measured 1.80 m north–south by 1.36 m east–west and was 44 cm deep (Figs. 8.31a and 8.31b). Fill consisted of silty, sandy clay with charcoal and ash. The bottom and walls of the pit were of natural compact clay. No evidence of remodeling or burning was present, even though both charcoal and ash were found. Rodents had removed a large section of the wall along the northwestern edge of the pit. Two lithic artifacts were recovered, along with charcoal and flotation samples.

Eleven postholes (A–K) were associated with the feature and were arranged around the outer edge of the pit (Table 8.3). Posthole fill was identical and consisted of a sandy clay loam with no artifacts. Posthole walls were of compact natural clay and showed no evidence of remodeling.

Feature 25, Bell-Shaped Storage Pit: This feature was west of Feature 24. No postholes were associated with it. The pit was D-shaped but belled out below the surface and had been dug into natural clay (Figs. 8.32a and 8.32b). This pit had a 6 cm wide adobe collar, and the floor and walls were built into solid clay. On the northern side, the wall was vertical. The pit measured 72 cm north–south by 70 cm east–west and was 58 cm deep. Fill consisted of semi-compact, sandy clay with charcoal flecking. Gray clay clumps were present in the fill about 10 cm above the bottom of the pit.

The adobe collar was made of very hard, compact clay placed around the pit opening and extending about 6 cm around it. Most of the collar was removed during excavation. At the time, no

Figure 8.19a. LA 120973, Feature 11, pithouse, floor two.

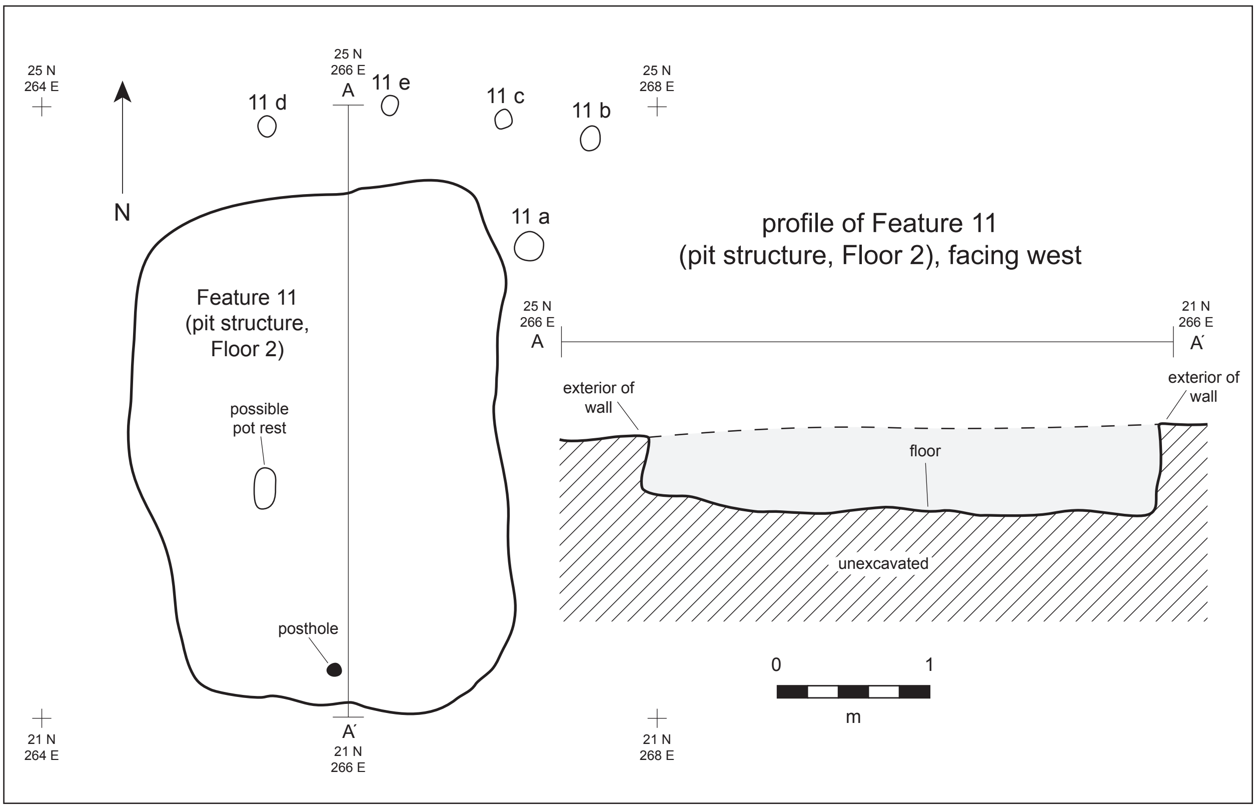


Figure 8.19b. LA 120973, Feature 11, pithouse, floor two, plan and profile.

Figure 8.20a. LA 120973, Feature 12, hearth.

visible differences between the frozen ground and the collar were evident, and the collar was not apparent until the ground began to thaw and the soil became softer; the clay remained hard and compact. Evidence of the collar was visible on the outside surface.

No artifacts were recovered, but a flotation sample was collected. There was not enough charcoal for a ^{14}C sample.

Feature 26, Adobe-Collared Storage Pit: Feature 26 was the only storage pit with an adobe collar and adobe-collared postholes (Figs. 8.33a and 8.33b). The circular feature measured 1.05 m north–south by 1.02 m east–west and was 76 cm deep. The adobe collar was 14–33 cm wide at a height of 12–24 cm. Adobe collars around the postholes were 8 cm high.

The pit was dug into natural clay. Fill consisted of light, silty clay with charcoal and ash. Three stratigraphic breaks consisted of silty clay, an ash-and-charcoal lens, and a clay lens (Figs. 8.34 and 8.35). Artifacts were recovered from the area between the two clay lenses and the ash-and-charcoal lens. No remodeling was noted; however, rodent activity was heavy. Two ceramics and one piece of red ochre were recovered from the pit.

Table 8.3. LA 120973, Feature 24, posthole measurements.

Feature	Length/Width (cm)	Depth (cm)
24A	14.0 by 15.0	41.0
24B	14.0 by 15.0	41.0
24C	14.0 by 15.0	40.0
24D	14.0 by 15.0	33.0
24E	14.0 by 15.0	48.0
24F	14.0 by 15.0	41.0
24G	14.0 by 15.0	44.0
24H	14.0 by 15.0	42.0
24I	14.0 by 15.0	45.0
24J	18.0 by 19.0	45.0
24K	17.0 by 18.0	24.0

Six exterior postholes in the surrounding natural clay were excavated (Table 8.4). Three had adobe collars. The function of the collars around the postholes may have been to support posts. When the collar was removed, the opening increased by 2–3 cm. Fill from the postholes was identical to that in the pit and consisted of compact, silty clay with minute charcoal flecks, caliche, and pea gravel.

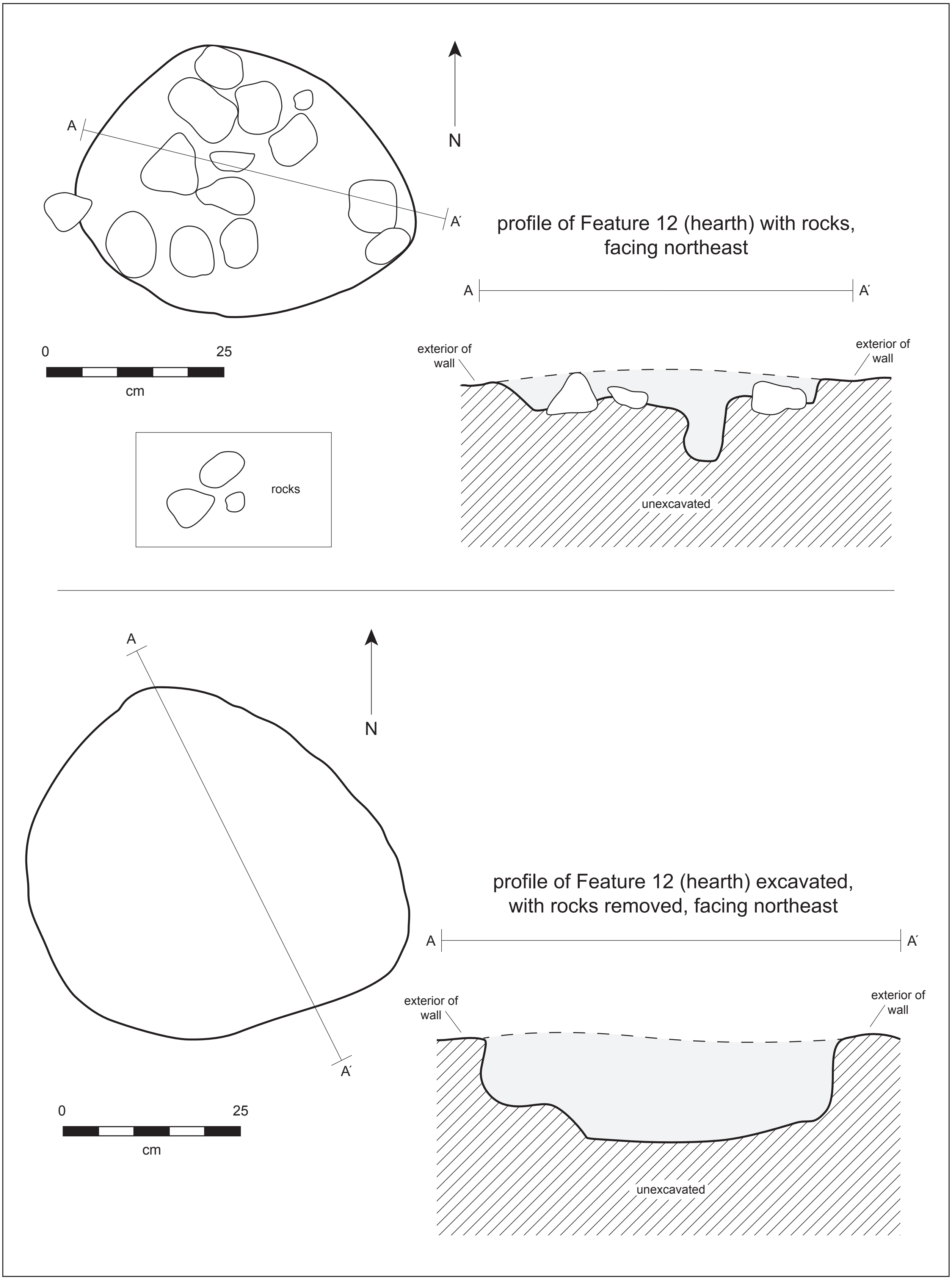


Figure 8.20b. LA 120973, Feature 12, hearth, profile.

Figure 8.21a. LA 120973, Feature 13, pit, exposed during blading.

Figure 8.21b. LA 120973, Feature 13, pit, excavated.

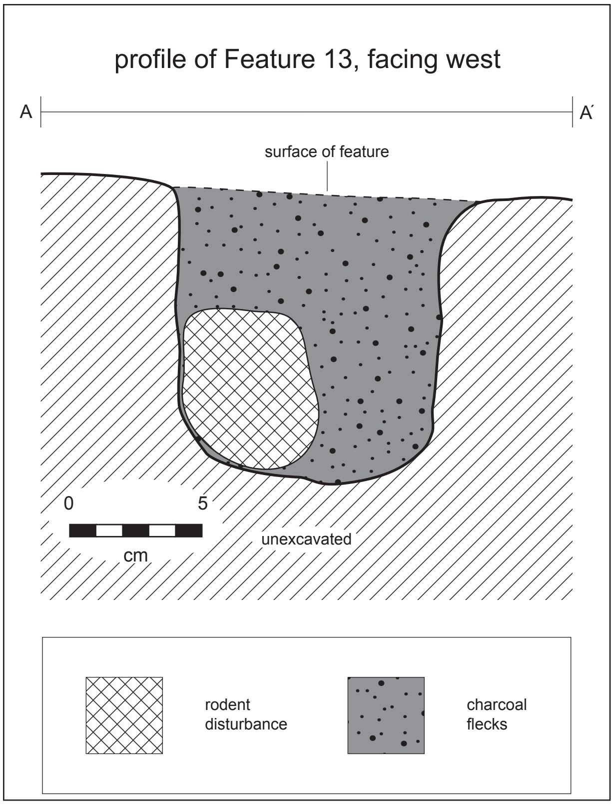


Figure 8.21c. LA 120973, Feature 13, pit, profile. view west.

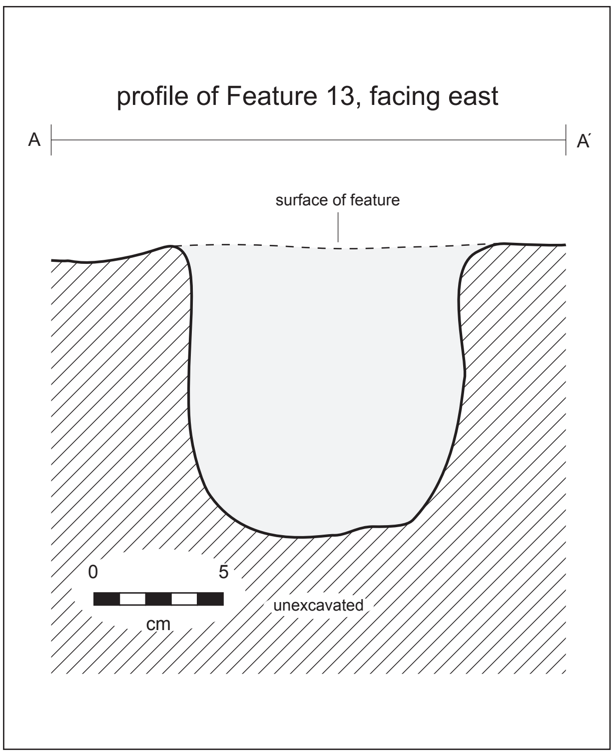


Figure 8.21d. LA 120973, Feature 13, pit, profile, view east.

Feature 27, Pit Structure: The pit structure was immediately west of Feature 11. Square in shape, the feature was dug into natural soil and measured 3.02 m north–south by 3.28 m east–west and 70 cm deep (Figs. 8.36 and 8.37). Fill consisted of loose silty, sandy loam with sparse charcoal flecking, except for the western side, where the backhoe trench for the water line was present. Trenching had removed most of the western wall but did not touch the floor (Fig. 8.38), where there was an upturn to the wall. The trench fill was compact, silty clay with modern trash—white plastic and clear glass—present. There was rodent activity in the walls and floor, which were composed of natural sterile clay and showed no signs of remodeling. Heavy rodent activity was present along the northern wall, near Features A and B. To the north, along the pit edges, was a 40 cm wide adobe collar. The collar continued around to the northeast and stopped above Feature G.

Thirteen features were present on the floor of the structure (Table 8.5). The compact, clay floor was level in areas where rodent activity was not present. Excavated features were found mostly along the edges and consisted of postholes, storage pits, and a possible mealing bin. One feature, Feature K, was a niche in the northern wall measuring 26 by 23 by 11 cm. Fill consisted of silty, clay soil with layers of fine, silty, sandy loam and charcoal flecking. No artifacts were recovered.

The fill of each posthole was identical and consisted of sandy, clay loam with minute charcoal flecks. No artifacts were recovered from the postholes. Postholes E and F may have been ladder supports. These were smaller in diameter and shallow, while the other postholes were larger and deeper.

Pit features may have been used for storage; however, Feature A and Feature B were side by side in the northeastern corner and may have been used together as a mealing bin. These two pits were oval in shape with a raised adobe collar around the two features and a posthole at the southeast edge of the adobe collar. The two pits were dug below the floor into the natural clay. Fill from Features A and B was sandy, clay loam with charcoal flecking. Rodent activity was heavy throughout. Burrows were found going back and forth between the two pits.

The pit structure did not produce many artifacts. Five brown ware ceramics were recovered from the upper fill. This suggested that the structure

Figure 8.22. LA 120973, Feature 14, posthole, view north.

Figure 8.23. LA 120973, Feature 15, small fire-cracked rock concentration, view north.

Figure 8.24a. LA 120973, Feature 16, pithouse.

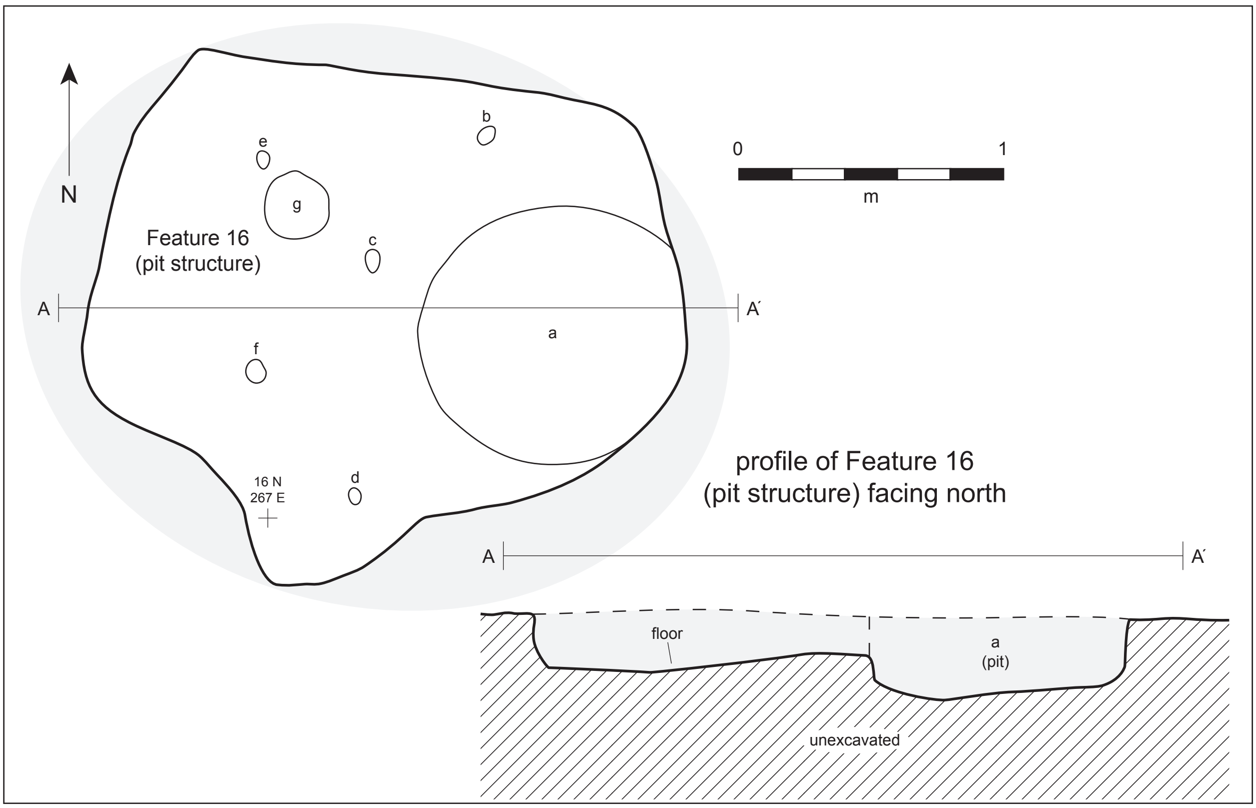


Figure 8.24b. LA 120973, Feature 16, pithouse, profile.

Figure 8.25a. LA 120973, Feature 17 pit.

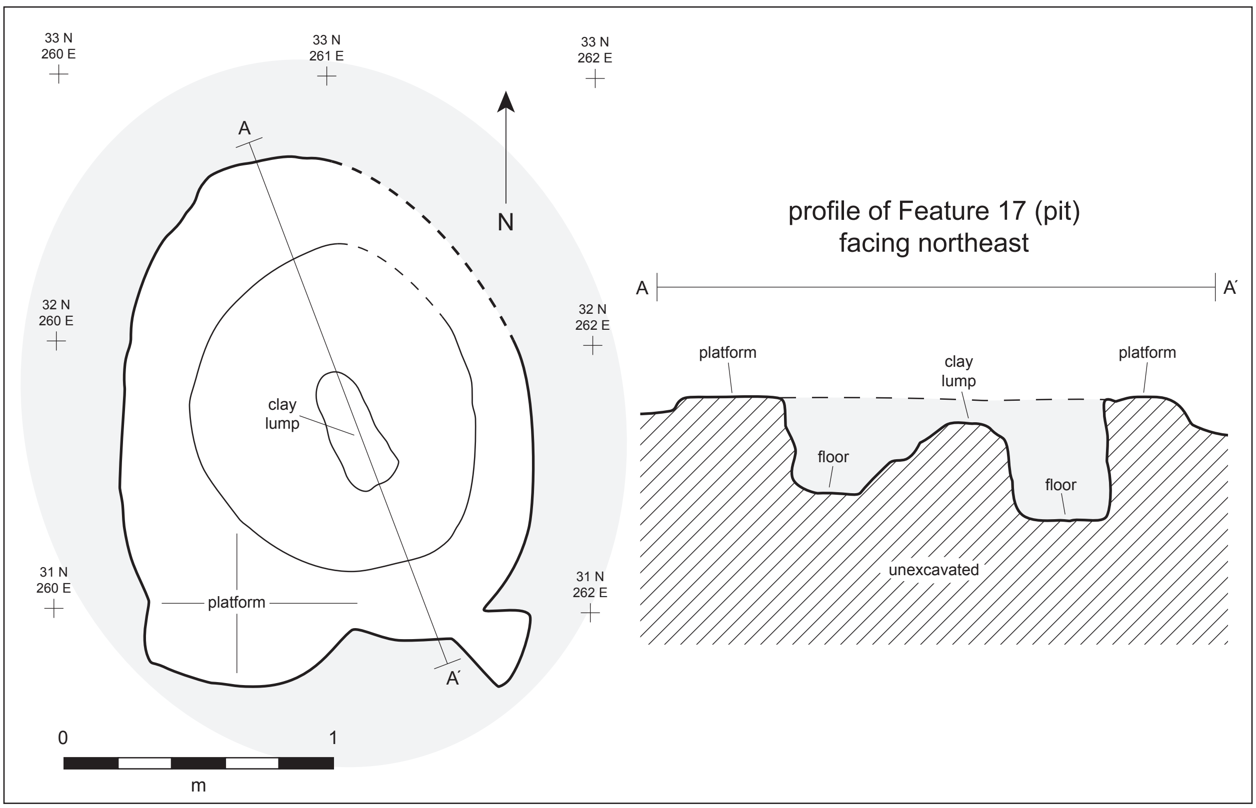


Figure 8.25b. LA 120973, Feature 17 pit, profile.

Figure 8.26a. LA 120973, Feature 19, pit.

had been cleaned out after it was abandoned or that many activities had been performed outside.

Macrobotanical samples collected from the feature revealed some juniper wood had been present in the feature and had possibly been used in the construction of the pit house. The absence of a center hearth in Feature 27 suggests daily activities were performed outside. No extramural features were found.

Feature 29, Storage Pit: Feature 29 was south of the main concentration of features, between Feature 20 and Feature 32. The pit was dug into natural clay soils and was found during the blading of the area by mechanical means. After the area was hand-stripped, the outline of the pit became distinct. During excavation, it was found that the surface around the pit was composed of very compact clay that may have been an adobe collar removed by the blading. The shape of the pit was irregular and measured 1.09 m north–south by 0.91 m east–west and 61 cm deep.

Fill was sandy clay with clay nodules, charcoal, and fine sand (Figs. 8.39a and 8.39b). The walls and floor were made of the natural clay and showed no evidence of remodeling. Rodent activity was heavy throughout. The floor had rodent burrows around the wall edges. The walls also had rodent burrows, although these were not as heavy as those in the floor. With all the rodent activity, it was hard to find the floor; however, just above the floor was a layer of fine yellow sand 5–6 cm thick.

No artifacts were recovered from the fill; however, a drill was recovered from the stripping above. A 12 sq m area northeast of the pit was stripped and several units taken down 40–80 cm.

Table 8.4. LA 120973, Feature 26, posthole measurements.

Feature	Length/Width (cm)	Depth (cm)	Collar
26A	15.0 by 16.0	79.0	no
26B	13.0 by 12.0	42.0	no
26C	18.0 by 15.0	35.0	yes
26D	10.0 by 18.0	17.0	yes
26E	15.0 by 12.0	31.0	no
26F	16.0 by 13.0	34.0	yes

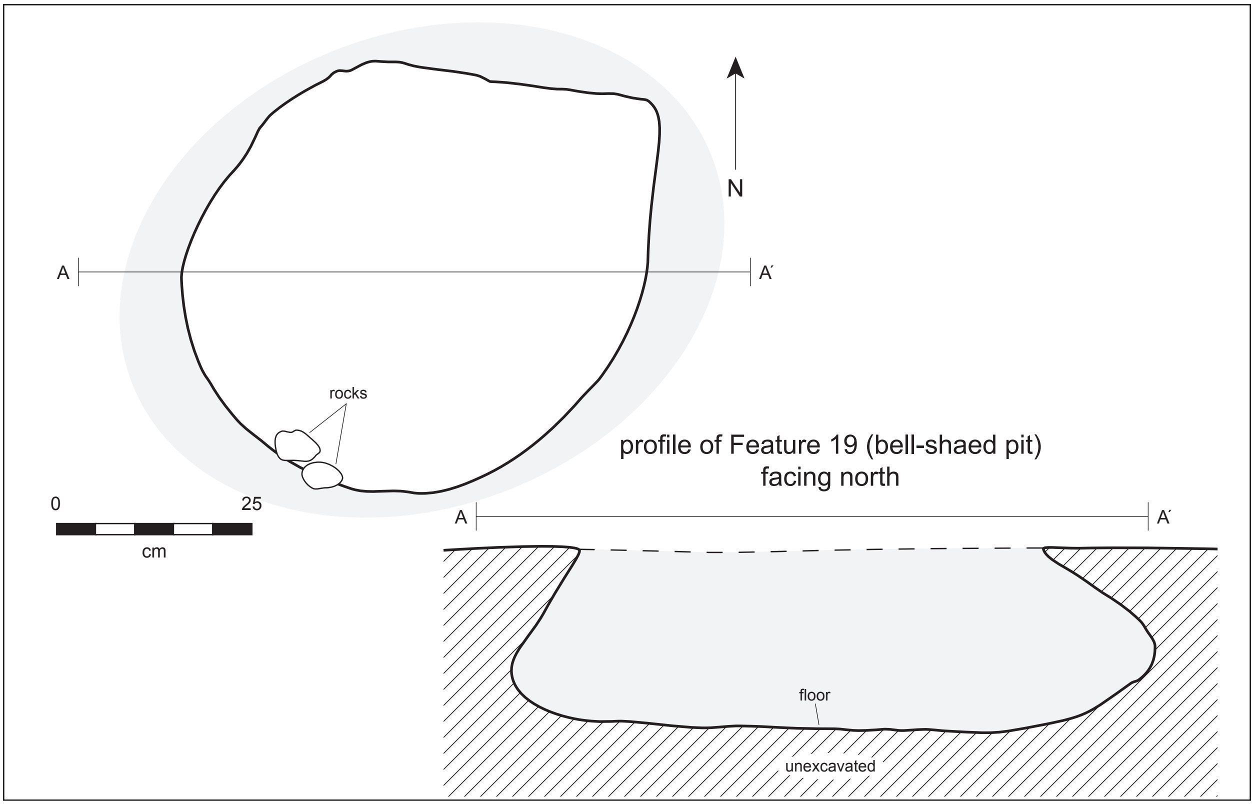


Figure 8.26b. LA 120973, Feature 19, pit, profile.

Table 8.5. LA 120973, Feature 27, floor feature measurements.

Feature	Feature Type	Measurements (cm)	Depth (cm)
27A	pit	48.0 N–S by 47.0 E–W	9.0
27B	pit	38.0 N–S by 53.0 E–W	9.0
27C	pit	64.0 N–S by 82.0 E–W	29.0
27D	posthole	14.0 N–S by 18.0 E–W	18.0
27E	possible ladder support	5.0 diameter	8.0
27F	possible ladder support	5.0 diameter	4.0
27G	pit	63.0 N–S by 37.0 E–W	14.0
27H	posthole	11.0 diameter	16.0
27I	posthole	14.0 N–S by 13.0 E–W	15.0
27J	posthole	15.0 diameter	12.0
27K	wall niche	26.0 by 23.0	11.0
27L	posthole	19.0 diameter	19.0
27M	posthole	20.0 N–S by 12.0 E–W	10.0

Figure 8.27a. LA 120973, Feature 20, profile, view east.

Figure 8.27b. LA 120973, Feature 20, profile, view east.

Although charcoal was present, the units contained no artifacts. Rodent activity—which could have been the reason for the presence of charcoal in the units—was heavy. Blading west of the feature did not reveal any other features. No artifacts were revealed during hand excavations.

Feature 30, Pit: This was a small pit between Feature 2 and Feature 31. Feature 30 was 28 cm north–south by 30 cm east–west and 33 cm deep (Fig. 8.40). Fill was oxidized soil with no charcoal or artifacts. The pit was removed during excavation of the unit north of the feature. Feature 30 was not noted until the unit had been open for several days. The soil was compact and red in areas. After heavy rainfall, the soil became very soft and the outline of the pit became visible.

Feature 31: Bell-Shaped Pit: This small, bell-shaped pit was 62 cm north–south by 60 cm east–west and 68 cm deep. The pit, dug into natural clay, extended 16 cm into the lower interior forming the bell of the pit (Figs. 8.41a and 8.41b). Fill consisted of silty, sandy clay with charcoal and minute ash inclusions. The charcoal was fairly large and was collected for a ^{14}C sample. There was no evidence of remodeling. A layer of fine sand, 1 cm thick, was found above the floor. Collected artifacts consisted of nine Jornada Brown ceramics, three of which were found on the surface; the others were found in the fill.

Feature 32 and Feature 32G, Storage Pit and Small Storage Pit: Located at the southernmost portion of the site was Feature 32, a small activity area with a large storage pit; Feature 32G, a smaller pit to the south; and seven postholes (Figs. 8.42a and 8.42b). Feature 32 was circular in shape and belled slightly; this gave it a bowl-shaped profile. Feature 32 measured 1.3 m north–south by 1.0 m east–west and 61 cm deep. Fill consisted of a semi-compact, clayish loam, 20 cm thick, that turned into loose, silty, sandy clay with some charcoal flecking and pea gravel. Just above the bottom of the feature was fine, yellowish sand. Rodent disturbances were present along the southern edge. The feature was dug into natural clay with the walls and floor being identical. There was no evidence of remodeling. No artifacts were found.

Immediately south was a D-shaped pit, Feature 32G, which measured 63 cm north–south by 47 cm east–west and 33 cm deep. Fill was identical to Feature 32, and no artifacts were present. There was no evidence of rodent activity.

Seven postholes were present around the pit—three large and four small (Table 8.6). One posthole was present in Feature 32G. Posthole fill was identical and consisted of compact clay for the first 5 cm; below, the soil became a dark, loose, fine, silty clay, 10 cm thick. The fill changed to lighter, finer sand just above the bottom of the posthole. No artifacts were associated with these seven features, and charcoal was not present. The sides and bottoms of the postholes were natural clay. There was no evidence of remodeling. Rodent activity was absent in all but one posthole (H), which had a large burrow at the northern end.

Figure 8.28. LA 120973, Feature 21, view northwest.

Features 34, 35, and 36, Postholes: These features were 2.5 m east of Feature 32. The whole area could have been used for the processing of acquired foods or other resources. Weahkee (personal communication, 2009) mentioned that, at modern settlements, hides are processed in areas far away from everyday activities. This may be the reason why these features are so far away from the main activity area to the north.

The three postholes were set in a triangular shape. Their functions are unknown (Fig. 8.43), al-

Figure 8.29. LA 120973, Feature 23, view south.

Figure 8.30. LA 120973, Feature 23, fill profile, view north.

Figure 8.31a. LA 120973, Feature 24, pit.

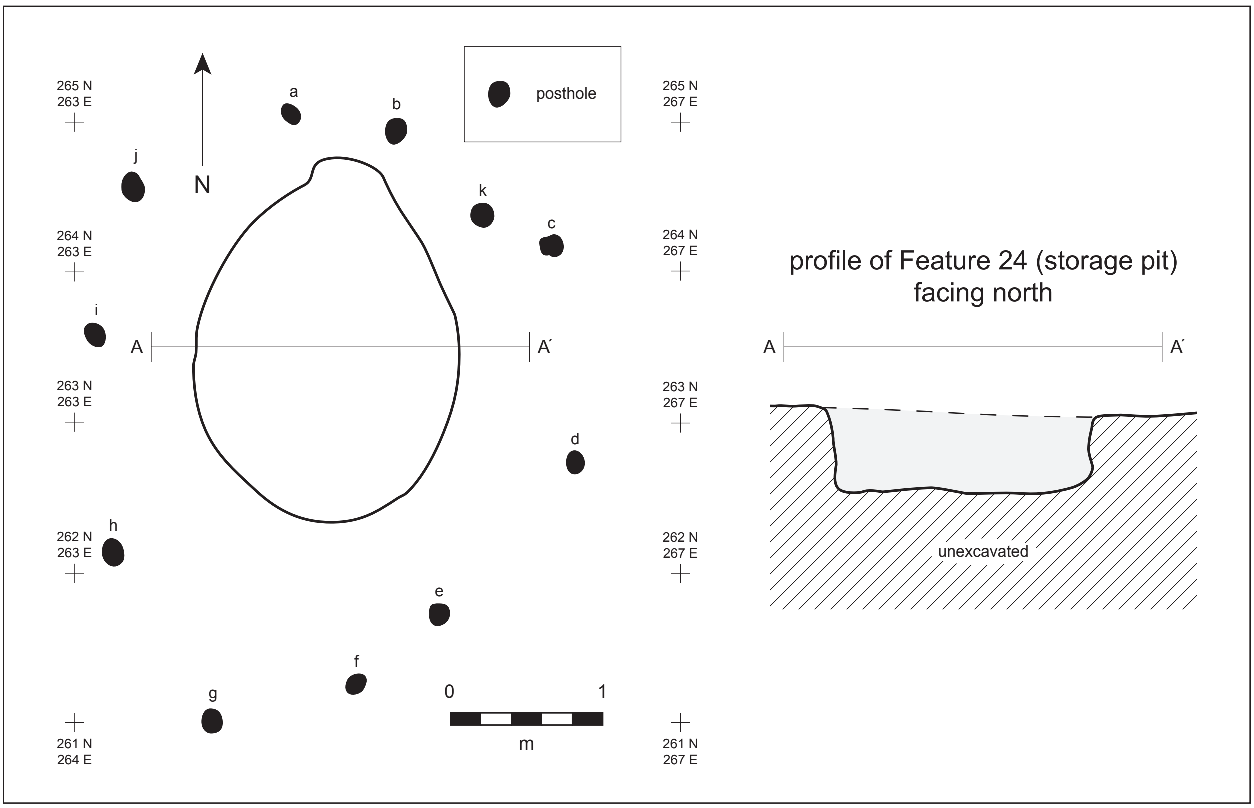


Figure 8.31b. LA 120973, Feature 24, pit, profile.

Figure 8.32a. LA 120973, Feature 25, bell-shaped pit.

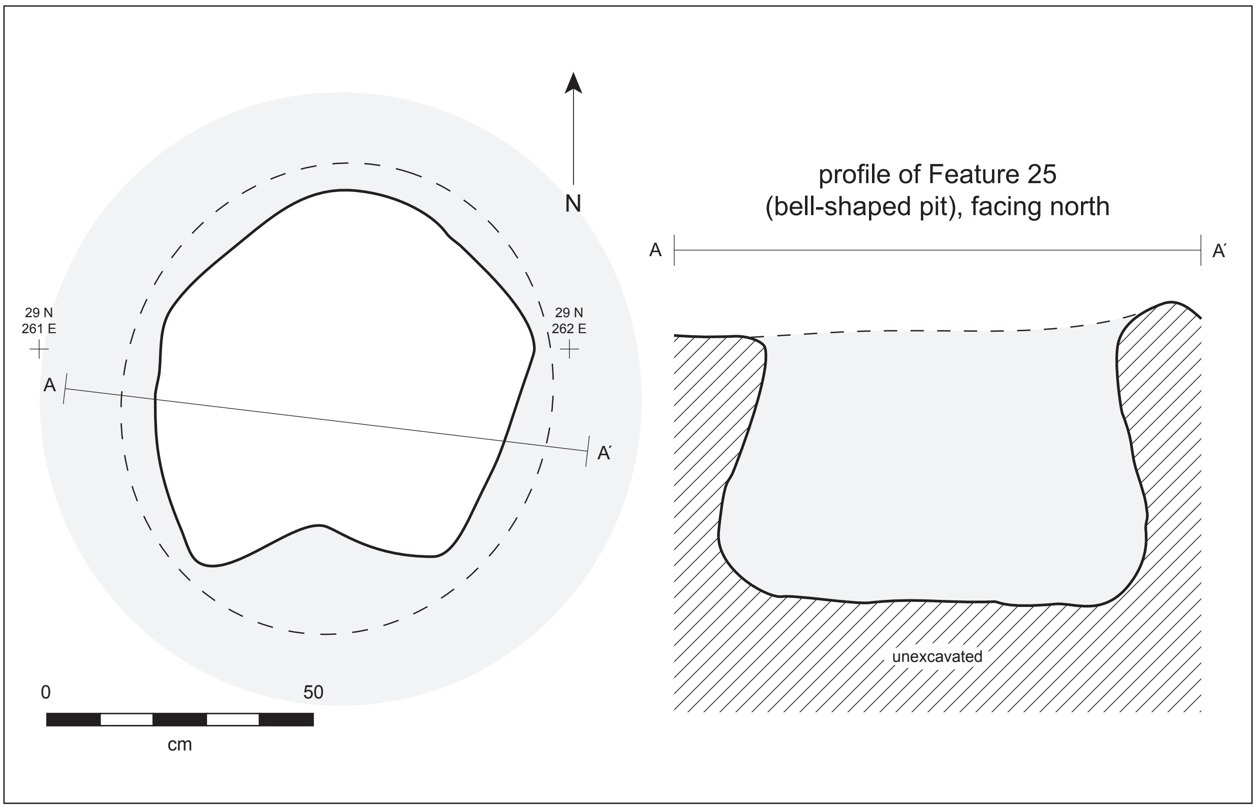


Figure 8.32b. LA 120973, Feature 25, bell-shaped pit, profile.

Figure 8.33a. LA 120973, Feature 26, pit.

though they may have served as drying racks for jerky. Charcoal-stained soil was present throughout the bladed surface, but no hearths were found. The postholes are all close to the same diameter with depths of 30–35 cm (Table 8.7).

Fill consisted of loose, sandy clay with minute charcoal flecking and pea gravel. The sides and the bottoms of the postholes were compact natural clay. No artifacts were recovered.

Artifacts

Some 3,485 artifacts were recovered from LA 120973 (Table 8.8). Of these, 69.5 percent were ceramics, including: Jornada Brown Ware (86.9 percent); El Paso Brown Ware (5.5 percent); Mogollon Brown Ware (5.7 percent); Cibola White Ware, probably Red Mesa Black-on-white (1.9 percent); and Mimbres White Ware (1.1 percent). Mogollon Brown, Cibola White, and Mimbres White were found in all areas except for the single pit on the eastern side of the highway. Ceramic dates for these nonlocal sherds coincide with calibrated radiocarbon dates for the site between AD 890 and AD 1000.

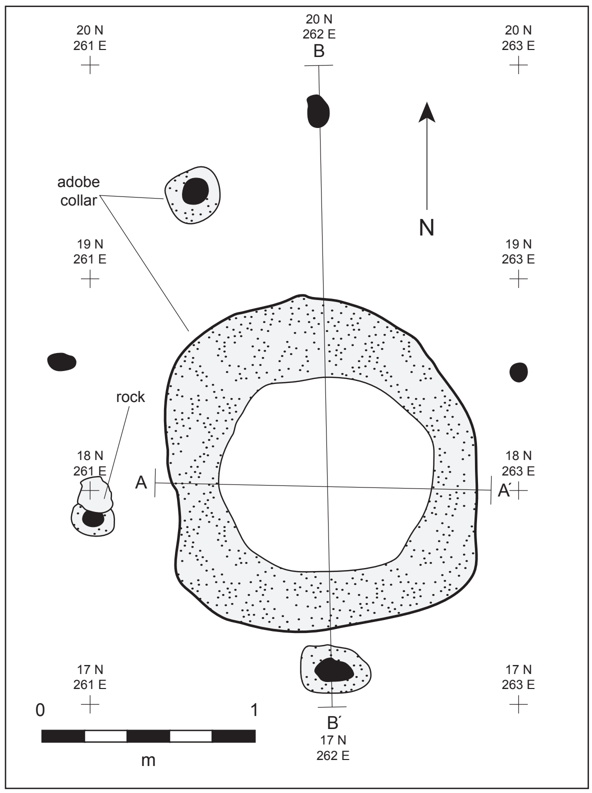


Figure 8.33b. LA 120973, Feature 26, pit, profile.

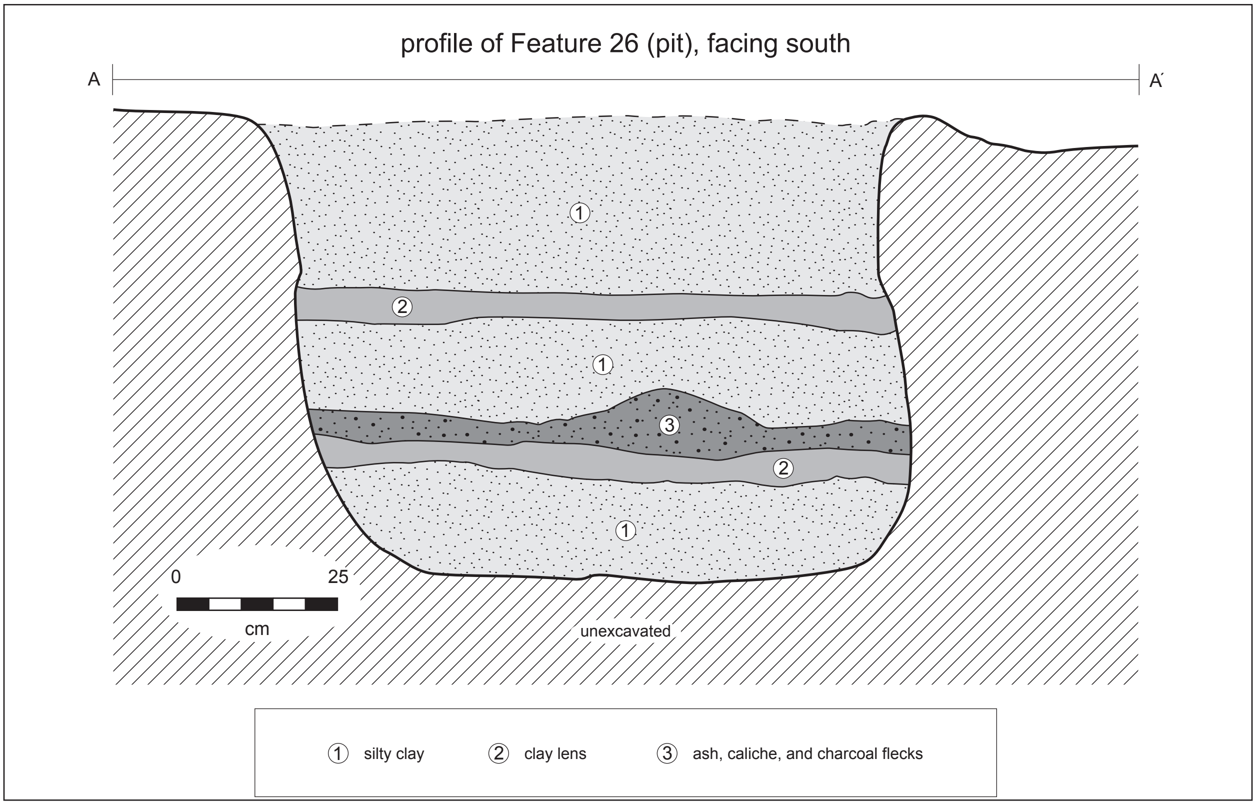


Figure 8.34 LA 120973, Feature 26, south wall, soil profile.

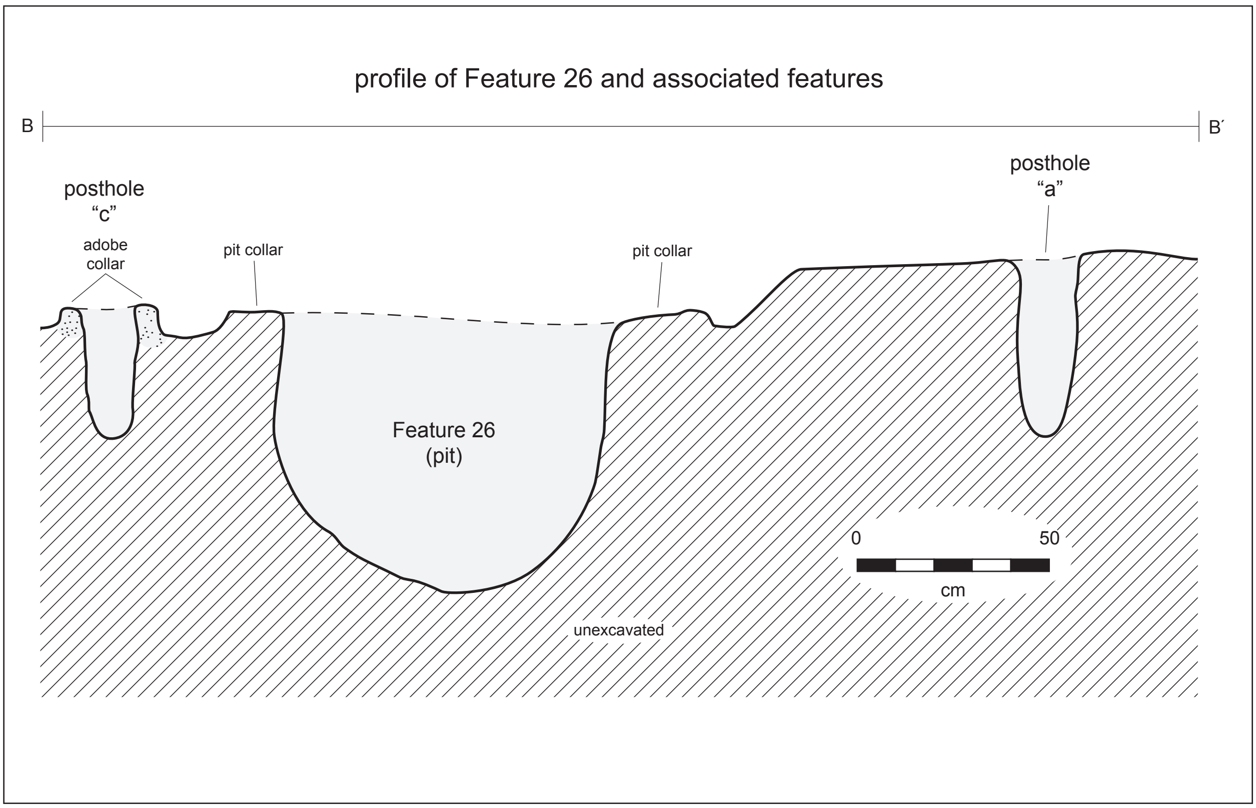


Figure 8.35. LA 120973, Feature 26, feature profile.

Most flaked-stone material at the site was chert (66.6 percent) followed by andesite (12.5 percent). Only 10 formal tools or utilized debitage were recovered, with most found in the northern half of the site or near Feature 16, to the south. Three unidentifiable projectile point fragments were found near or inside Features 1, 11, and 24.

Forty-one ground stone pieces were recovered from LA 120973. These included 16 handstones, nine metates, five polishing stones, an abrader, a paint stone, and nine miscellaneous pieces. Most are handstones or, more specifically, one-hand manos (39.0 percent). There were three complete metates including a trough metate with one end open and two slab metates. The trough metate was found on the floor of Feature 11 while the others were found in storage pits.

Eleven pieces of shell were found at the site: nine were from land snails, one was a freshwater bivalve, and another was an abalone shell. Land snails may have been natural to the soil; however, the bivalve likely came from the Rio Grande and the abalone from the Sea of Cortez or the West Coast. These may have been used as incomplete ornaments. A turquoise bead was found in Pit 20 at the southern end of the site. Two stone balls of rhyolite and hematitic sandstone were found in Features 6 and 11. Twelve pieces of red and yellow ochre were recovered from LA 120973, mostly from storage pits.

This site contained more than three times the faunal bone than LA 120972. Most was from unidentified small-mammal and rabbit species (52.9 percent). Medium-to-large mammals, including fox, pronghorn, and unidentified artiodactyl accounted for 33.1 percent of the faunal assemblage. There were 22.8 percent more large-body forms than at LA 120972. Most were found in Features 10 and 11.

Table 8.6. LA 120973, Extramural posthole measurements.

Postholes	Measurements (cm)	Depth (cm)
Posthole A	10.0 N–S by 11.0 E–W	33.0
Posthole B	14.0 diameter	36.0
Posthole C	23.0 N–S by 25.0 E–W	24.0
Posthole D	8.0 diameter	40.0
Posthole E in Feature 32g	13.0 diameter	25.0
Posthole F	9.0 diameter	12.0
Posthole H	24.0 diameter	22.0

Table 8.7. LA 120973, Features 34, 35, and 36, posthole measurements.

Feature No.	Type	Diameter (cm)	Depth (cm)
34	posthole	22.0	30.0
35	posthole	20.0	30.0
36	posthole	20.0	35.0

Table 8.8. LA 120973, artifacts.

Artifact Type	Count	Col. %
Ceramic	2421	69.5%
Chipped stone	674	19.3%
Ground stone	41	1.2%
Shell	11	0.3%
Ocher/ornament	15	0.4%
Fauna	323	9.3%
Total	**3485**	**100.0%**

Ancillary Studies

Twenty-two sediment samples and ground stone pollen washes were submitted for pollen analysis. Sediment samples indicated a prehistoric, weedy, grassland environment dominated by cheno-ams, grasses, and ephedra, with some ponderosa pine and *Pinus edulis*, probably from surrounding foothills and mountains. The Feature 30 pit contained high levels of cheno-ams, which suggested storage of vegetal types. Feature 11, where the trough metate and mealing bin were found, contained maize pollen. Most of the pollen from the ground stone washes was non-economic, but almost all contained starch granules, presumably from maize. Three had maize pollen.

Forty-four macrobotanical samples from this site indicated several features had a diverse array of economic plants including amaranth and mesquite seeds, piñon nutshells, grass stems, maize cupules, and squash rinds. Charred mesquite seeds suggested that the seeds had been discarded after the pods were ground into meal (Chapter 16). The presence of piñon nutshells was unusual in that the closest piñon trees today are more than 1.6 km (6 mi) to the east. Maize and squash parts were prevalent at the site. Burned grass rhizomes and stems included dropseed grasses, goosefoot seeds, four-wing saltbush fruit, and globe-

Figure 8.36. LA 120973, Feature 27, view north.

Figure 8.37. LA 120973, Feature 27, view south.

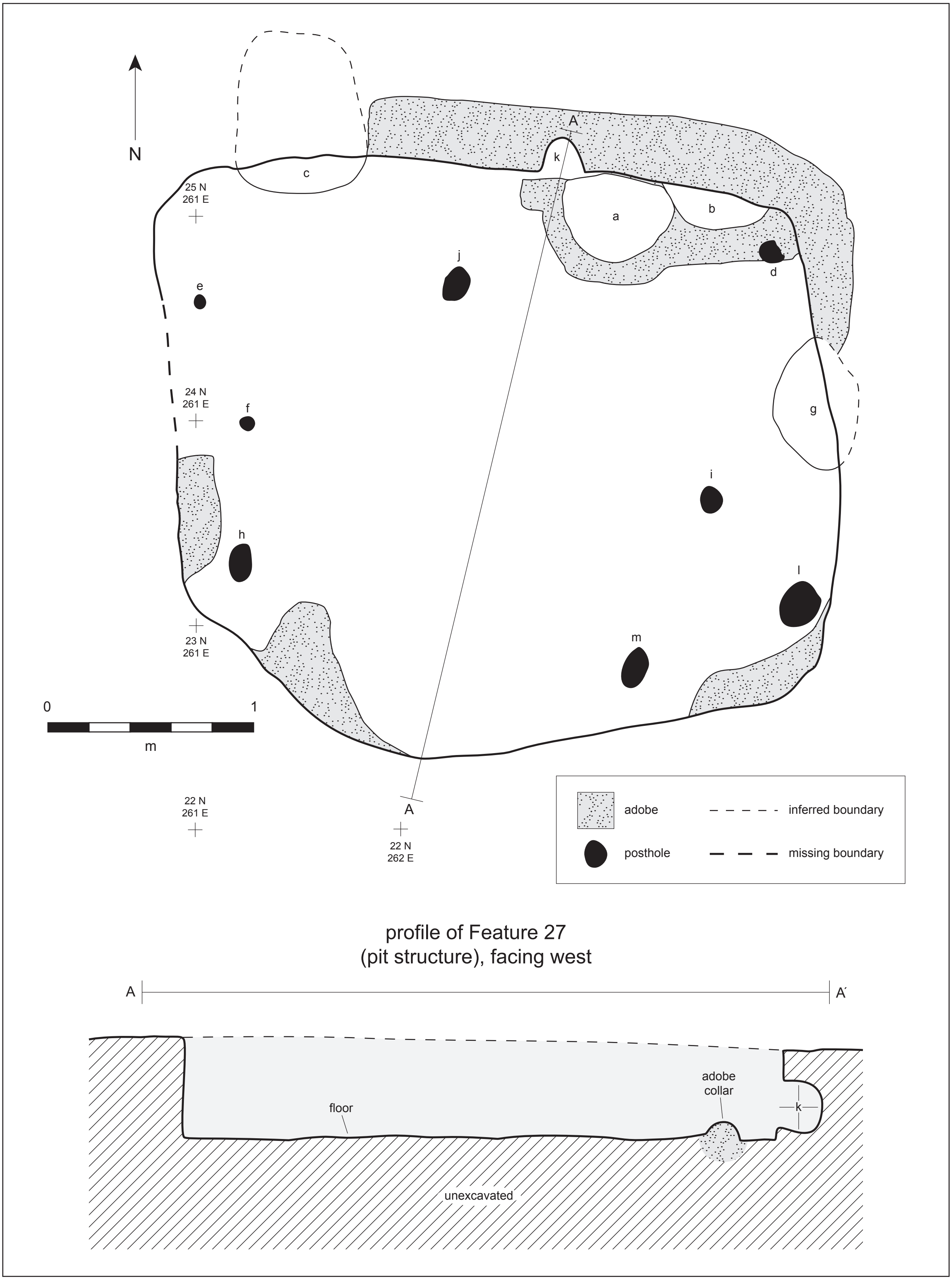


Figure 8.38. LA 120973, Feature 27, plan view and profile.

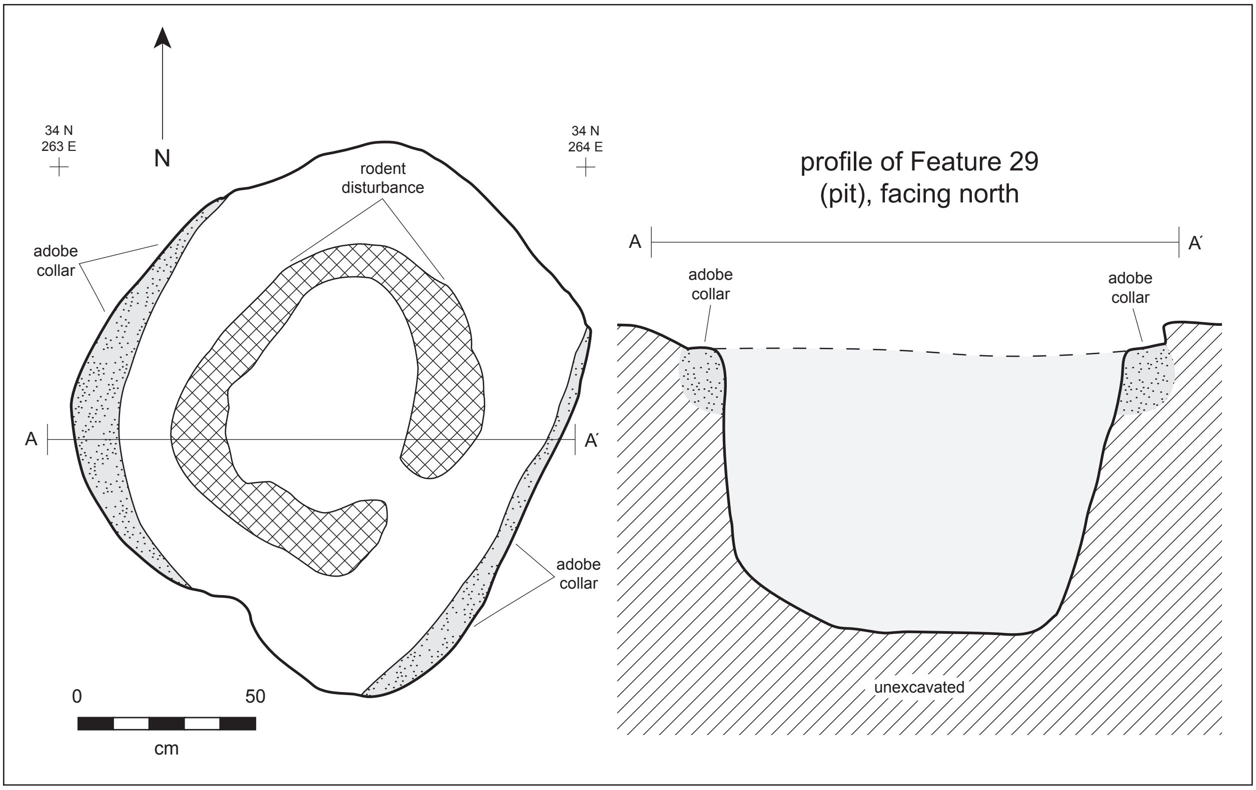


Figure 8.39a. LA 120973, Feature 29, pit, plan view and profile.

Figure 8.39b. LA 120973, Feature 29, pit.

mallow seeds. Other seeds included banana yucca and prickly pear.

Twenty-six wood samples were four-wing saltbush, followed by cholla cactus and mesquite. Pine and juniper were also present, with piñon, four-wing saltbush, and juniper recovered from several post-holes. The site appeared to have been a seasonal camp, where piñon nuts and conifer wood had been brought from the mountains, maize and squash were cultivated, and mesquite pods, dropseed grasses, cactus, and banana yucca seeds were gathered.

Dating of the Site

Twenty-three radiocarbon dates were obtained from LA 120973. All were calibrated dates derived by accelerator mass spectrometry (AMS) analysis. Fig. 8.44 presents the resultant dates with 1- and 2-sigma calibrations for the site. These were retrieved from all features that contained sufficient charcoal for testing; however, in several cases, burned maize kernels were also selected for dating.

Fourteen out of twenty-three (60.9 percent) of the site's features (including pits, pithouses, post-

Figure 8.40. LA 120973, Feature 30, view east.

holes, and a hearth) were dated between AD 870 and 890, with minor, subsequent use between AD 980 and 1020. One isolated pit had an early historic date between 1670 and 1780. Features with similar dates were not necessarily in proximity to one another.

Dates were secured from features in three of the four pithouses at the site—Features 7, 11, 16, and 27. Feature 7 produced three dates, two from the fill and one from a pit in the floor; these three dates were AD 880, AD 880, and AD 980, respectively. Feature 11 produced two dates of AD 870 and AD 1020.

Feature 13, another pit, was isolated on the eastern side of the highway and produced two historic dates of 1670 and 1780. This may represent Apachean use of the area, as Mescalero Apache were in the Tularosa Basin at the time. None of the artifacts were identified as possible Apachean. However, three radiocarbon dates ranging from 170 BC–AD 570 might have indicated a Late Archaic utilization of the site area, but the fact that the three did not overlap temporally might have resulted from the use of old wood by later site occupants.

A single hearth on the site, Feature 5, yielded a radiocarbon date of AD 770. No other feature fell within

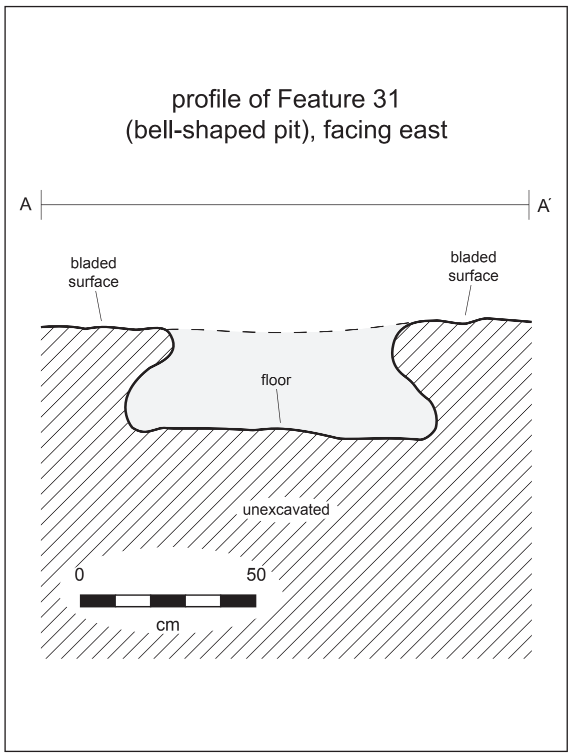


Figure 8.41a. LA 120973, Feature 31, bell-shaped pit, profile.

Figure 8.41b. LA 120973, Feature 31, bell-shaped pit.

Figure 8.42a. LA 120973, Feature 32, storage pits and postholes.

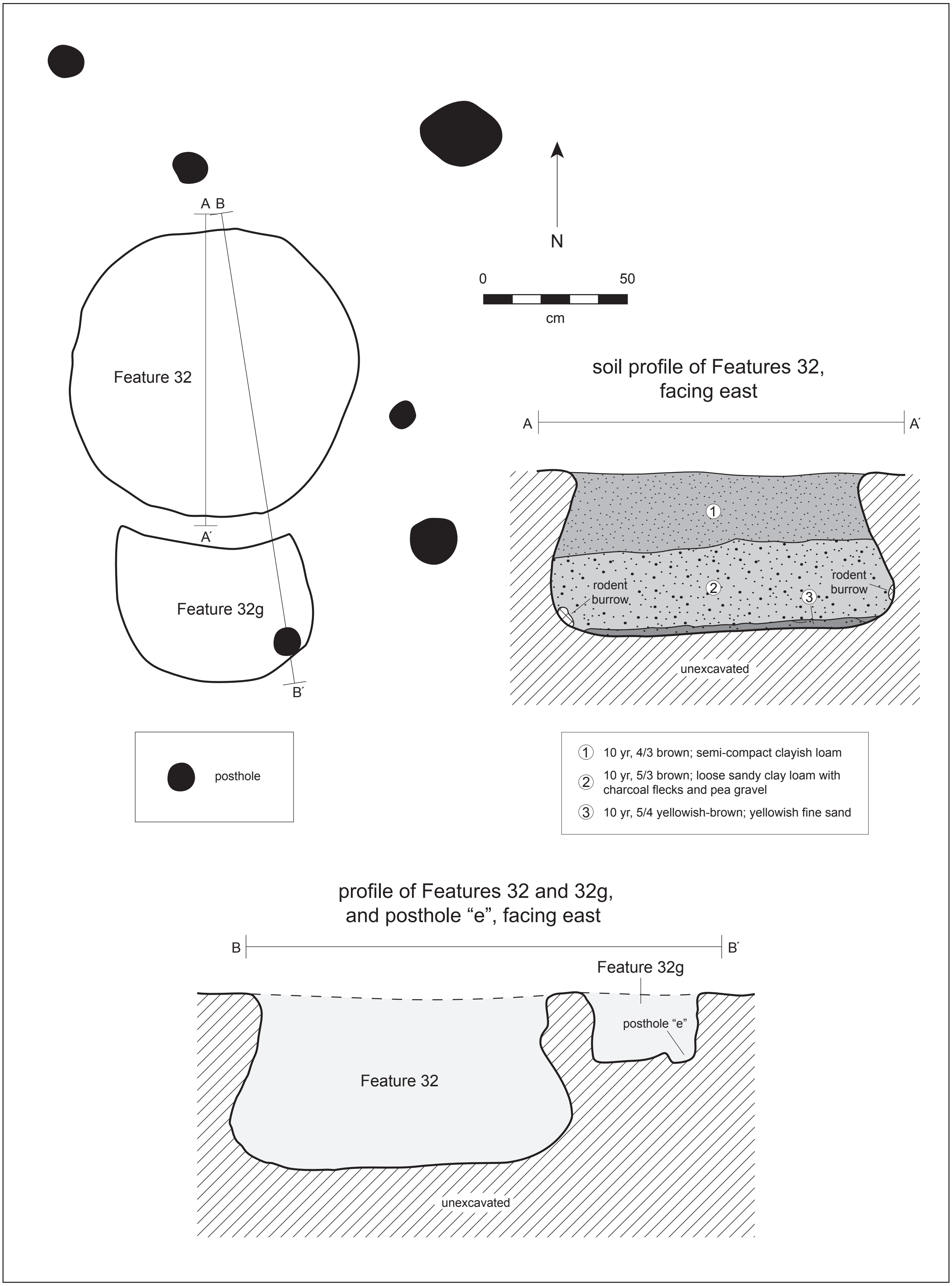


Figure 8.42b. LA 120973, Feature 32, storage pits and postholes, plan and profiles.

Figure 8.43. LA 120973, Features 34, 35, and 36, postholes.

this time period; it is possible that this was a campsite belonging to earlier Jornada Mogollon people.

One posthole, Feature 6E, associated with the Feature 6 pit, produced a date of AD 890, identical to the date obtained from the interior of the pit. The other Feature 6 date appeared aberrant. Only two of the collared structures were datable—Pit 10 and Pithouse 11—and yielded similar dates of AD 880 and 900, respectively, suggesting a time period when the remaining collared units were in use.

Summary

Carrizozo Flats, LA 120973, was a unique site with no comparison within the northern Tularosa Basin. Its location was on the open floodplains, with Willow Draw the only source of water. Remains at the site represented, at the very least, a seasonal occupation, with the growing and harvesting of domesticated maize and squash and the gathering of numerous wild plants. Great effort was put into the collaring of pithouses and pits here; this unique architectural embellishment is found nowhere else in the region.

The primary occupation of the site dated to ca. AD 880; however, there was evidence of earlier and later Jornada Mogollon people utilizing the site area and even of historic use of the locale. Ceramics found at the site were somewhat unique to the area; the assemblage included Mimbres Black-on-white and Red Mesa Black-on-white. Both indicate trade with groups to the west or, less likely, of immigration of peoples from the Rio Grande or Mimbres area.

Astronomical Observations at LA 120973

Mary Weahkee

I believe Feature 16 at LA 120973, the Carrizozo Flats site, is a manmade terrestrial representation of a celestial occurrence. This observation comes from a Native American perspective and is based on origin and other stories passed down among Pueblo and Comanche groups.

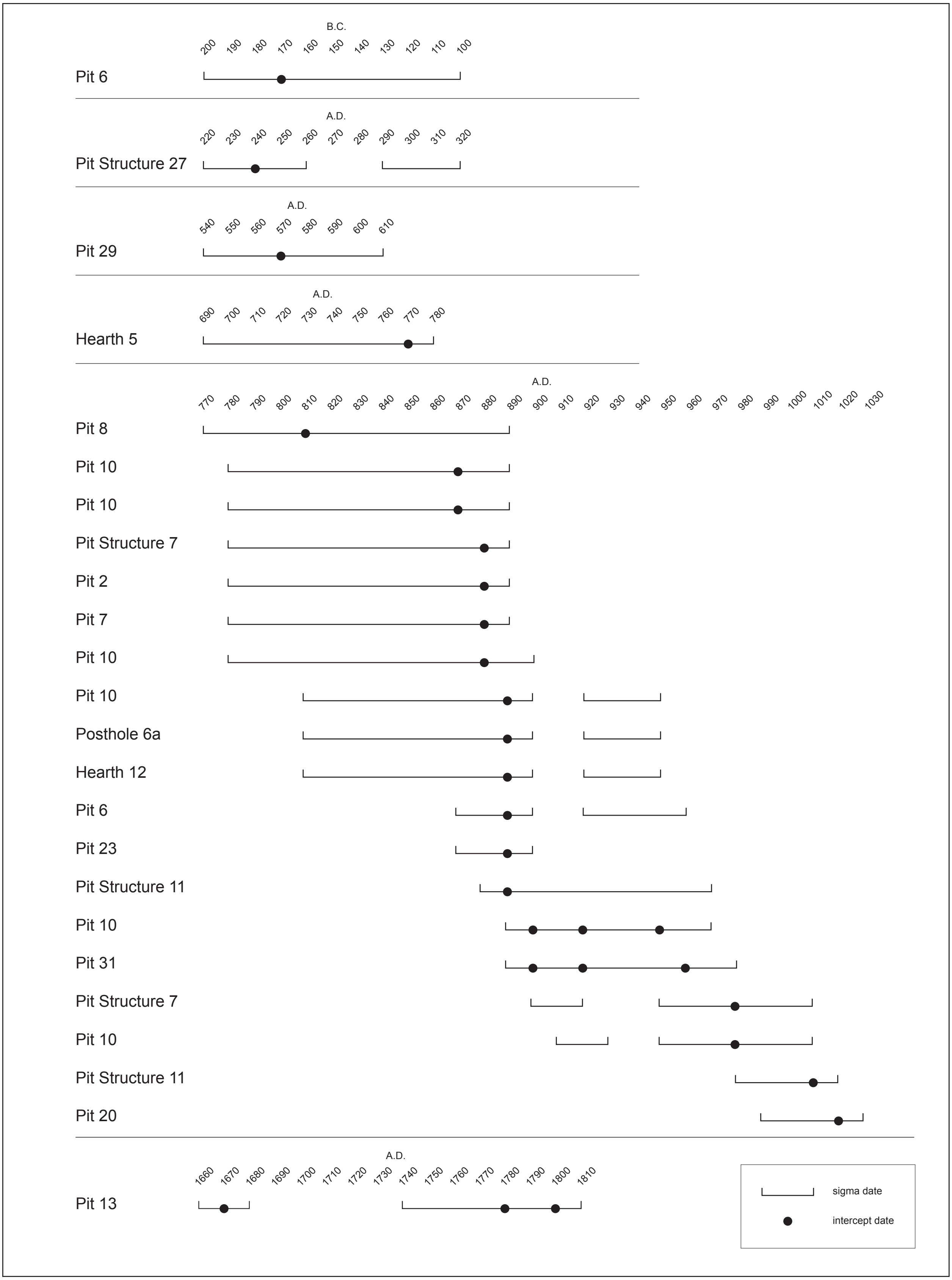


Figure 8.44. LA 120973, radiocarbon dates.

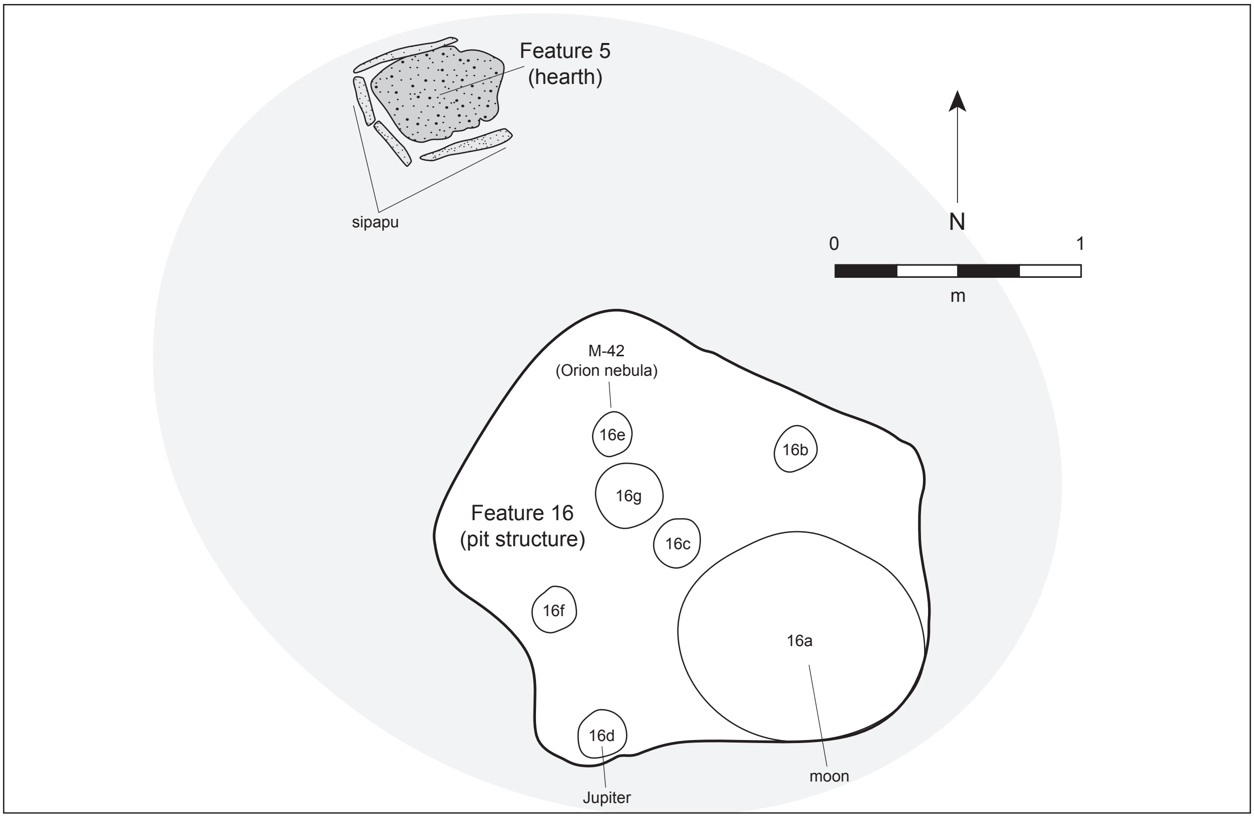


Figure 8.45. Representation of Orion's Belt at LA 120973.

As I walked across Carrizozo Flats between 7:15 and 7:30 a.m. on a late fall day, I noticed a particular set of postholes in Grid 121N/266E. The sun was rising directly above the Willow Draw escarpment, and the alignment on the ground was very familiar to me (Fig. 8.45), yet it seemed most unusual.

It was one of my favorite star constellations: Orion's Belt. I had spent most of the winter camping in the Valley of Fires Park outside Carrizozo, and the constellation had always been at close view and very large. I often notice subtle changes in my surroundings when stars align.

Orion's Belt is the first constellation visible on the eastern horizon, and it always reminds me of my Comanche grandmother who used to tell me stories of the origin of our people. Often, she pointed to a blue star in the eastern sky and reminded me that the People (Numunuu) would come to take those of us who still remember the ancestors.

As a child, having spent time with my elders, I was taught to rely on the stars, or *agoyo*, to determine directions, times of day, when to farm, and when to dance. The sun, called *Tan-sido*, and its movements are looked to for prayers, meditation, and even battle movements. The moon, or *Poh*, conveys crop seasons; the activity of animals, such as deer and elk; bird migrations; and, of course, weather patterns. The moon can also predict rain, tell when to cut the hair of newborn babies, or show when the kachinas will arrive to bless the villages and the people.

When I looked down at Orion's Belt carved into the ground at Carrizozo Flats, I was surprised also to see the full moon and the planet Jupiter. To further my excitement, I was able to locate, about 2 m (6.5 ft) to the southwest at Feature 5, a *sipapu*, or belly button, of the earth. These holes are often placed in a special location in a village or place of prayer.

This sipapu contained a large stone at the base and was carefully lined with flat rocks. What made this particular feature unusual was that it contained an unknown white powder, which later proved to be ash.

The white substance in this small pit indicated that it was a place to leave offerings during ceremonies. There is a pithouse structure to the north that resembles a ceremonial kiva. The large stone inside the sipapu is often called a mother, or *gia*, in my Pueblo language. Offerings of ground cornmeal and turquoise are sometimes placed in these niches in the ground. These sipapu areas connect my Pueblo people to the earth. Before any dance begins, we give cornmeal offerings to our Mother. Each participant is required to give an offering and leave a positive prayer.

The alignment of the moon and Jupiter is often referred to as the fall equinox, which occurred during the time of my presence at 8:30 p.m. on September 16, 2010; the alignment at Carrizozo Flats occurred at 9:07 p.m. on September 18 of the same year.

This alignment and what was found on the ground matched up perfectly and might symbolize the end of the harvest season. I believe Orion's Belt was used as a symbol for the conclusion of the harvest because of the time during which it appears in the eastern sky.

Orion's Belt also was considered a place of origin by the Uto-Aztecan. The image of Star M-42 in the Orion constellation was carved in the earth at Carrizozo Flats and contained four small pieces of chipped stone. Whether these small pieces of stone were intentionally placed in this posthole or not, the presence of these stones could lead one to conclude that this site may have possible Uto-Aztecan roots. The chipped stone should be considered angular debris; no signs of utilization were found.

9 ⩡ LA 130331

Richard Montoya

LA 130331, a Late Archaic hearth site, was situated on BLM Roswell Field Office land on the eastern right-of-way of US 54. This site was in a desert landscape with low vegetation including mesquite, yucca, cactus, and grass-covered dunes (Fig. 9.1). LA 130331 was at an elevation of 1,417 m (4,650 ft), with the Godfrey Hills to the east and White Sands Missile Range to the west. There are 17 similar sites within 16 km (10 mi) of LA 130331.

LA 81605 and LA 81604 are 5.6 km (3.5 mi) northeast of the site at the bottom of the Godfrey Hills and in New Well Draw. These two sites contained fire-cracked rock and lithic debitage. Within a 10 km (6 mi) radius to the northeast are LA 55850, LA 55851, LA 55853, LA 55854, and LA 55855. These sites all contained fire-cracked rock, hearths, and lithic debitage.

To the east, at 4 km (2.5 mi), are LA 81602 and LA 81603, which also contained fire-cracked rock and lithic debitage. Two miles, or 3.2 km, south of the site, on the west side of US 54, are LA 135409, LA 135407, and LA 135414. All three sites contained fire-cracked rock and lithic debitage as well.

About 13 km (8 mi) southwest, at the White Sands Missile Range, are LA 104842 and LA 13530, which also contained hearths and lithic debitage. Lastly, 16 km (10 mi) north and northwest of the site—also on White Sands Missile Range land—are LA 104841, LA 104840, and LA 120977. Along with some formal tools, these sites contained hearths and lithic debitage. LA 130331 was one of the few sites yet to be dated.

LA 130331 was recorded on an earlier survey by Michalik (2000), with no features identified in the right-of-way. However, upon re-examination by the OAS, an eroded hearth was noted within a cut bank next to the roadway. The site was subsequently tested (Oakes 2009) and included in the data recovery plan for the project. Based on excavation data, site size within the right-of-way was determined to be 20 m (66 ft) north–south by 27 m (89 ft) east–west and extended outside of the right-of-way to the east for another 25 m, or 82 ft (Fig. 9.2).

Ninety-eight excavation grids were placed within the right-of-way on a north–south axis in an 85 sq km, or 33 sq mi area. Test pits were excavated to a maximum depth of 50 cm, with an average depth of 35 cm. The total volume of soil removed from the site was 17.1 cu m. Overall fill excavated from the test pits consisted of loose eolian sand and had an average thickness of 15 cm. Thereafter, fill became more compacted; no further cultural material was found.

The excavated grids revealed two hearths, both visible on the surface; 16 lithic artifacts, one of which was a scraper; two bone fragments; a piece of ground stone; and a fire-cracked rock concentration. Two more fire-cracked rock concentrations were noted directly east of the right-of-way fence, and although a line of 1 by 1 m units was excavated at the western edge of the site, along the dunes near the hearths, nothing was located on the hardpan surface beneath.

Feature Descriptions

Feature 1, Hearth: Feature 1 at LA 130331 consisted of a basin-shaped hearth excavated into the native, sterile soil of the site. It measured 60 by 58 by 44 cm (Figs. 9.3 and 9.4). Fill consisted of charcoal stained, fine grained, silty loam with a few pieces of fire-cracked rock about 1–3 cm in diameter and some charcoal flecks. The bottom of the feature contained some ash, about 9 cm thick, and root intrusions. A 10 cm deep rodent hole was found at the bottom of the hearth. No artifacts were recovered from this feature. Based on radiocarbon dates of 1430 and 1400 BC, the hearth appeared to have been used for cooking or warmth during the Late Archaic period.

Feature 2, Hearth: Feature 2 consisted of another basin-shaped hearth excavated into the native, sterile soil of the site. It measured 70 by 58 by 38 cm, with pieces of vesicular basalt intentionally placed at the base of the hearth (Figs. 9.5 and 9.6).

There were three different types of fill in the feature. The upper fill consisted of a dark, yel-

Figure 9.1. LA 130331, sand dune, view north.

lowish-brown, charcoal-stained, silty loam with a maximum thickness of 22 cm. Lower fill consisted of a dark, grayish-brown, charcoal-stained, silty loam with a high amount of charcoal and a maximum thickness of 12 cm.

There was a black, silty loam deposit between the upper and lower deposits, which measured 4 cm thick and 12 cm in diameter. The base of the feature contained seven pieces of fire-cracked vesicular basalt ranging from 10–18 cm in diameter. No artifacts were recovered with this feature.

Artifacts

Sixteen lithic artifacts were recovered from LA 130331, but none were associated with the hearths. These included ten flakes, five pieces of angular debris, and one side scraper. One piece of ground stone was also recovered. Two bone fragments were found, including a portion of a cottontail ilium and a medium-sized mammal acetabulum. Also, a utilized quartzite pebble, with parallel striations on one side, was recovered.

Ancillary Studies

Three macrobotanical samples were identified from the two hearths at the site. Both contained mesquite wood, readily available nearby. Feature 1 also contained yucca stems, known to be edible. Other plants found in the hearth included goosefoot, dropseed grasses, asters, four-wing saltbush, yucca, and hidden flower; these also are present in the environment today. Hearth 2 did not reveal yucca, four-wing saltbush, or asters. However, it did contain mustard, purslane, and spurge. Wood from this hearth included creosote bush, saltbush, and mesquite.

Dating of the Site

Calibrated AMS radiocarbon dates for LA 130331 indicated an Early to Late Archaic utilization of the two hearths (Figs. 9.7). Three of the four dates for the hearths suggested repeated use every 10–20 years with intercept dates between 1430 and 1400 BC. Hearth 2 saw subsequent use around 1300 BC, 100

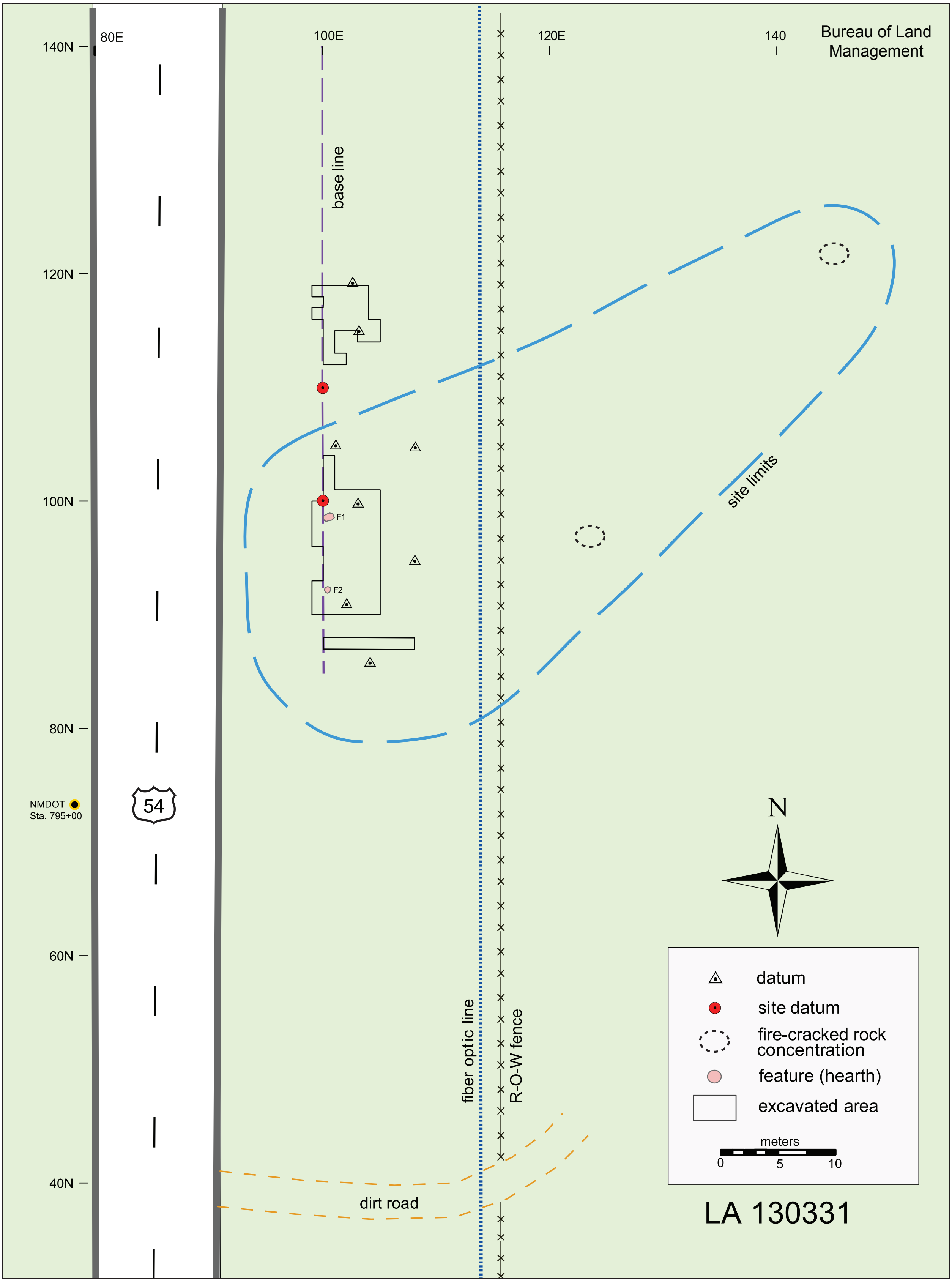


Figure 9.2. LA 130331, site plan.

Figure 9.3. LA 130331, Feature 1, hearth, view west.

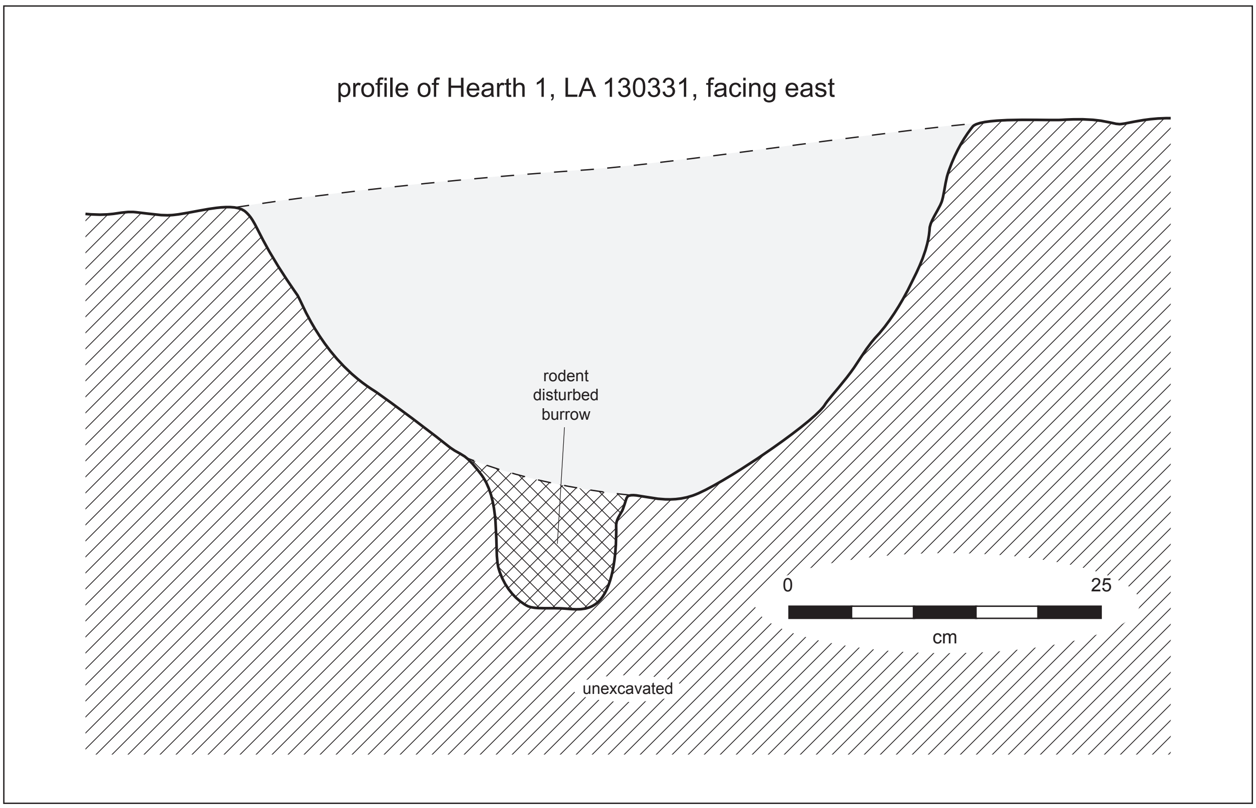


Figure 9.4. LA 130331, Hearth 1, profile, view east.

Figure 9.5. LA 130331, Hearth 2, view east.

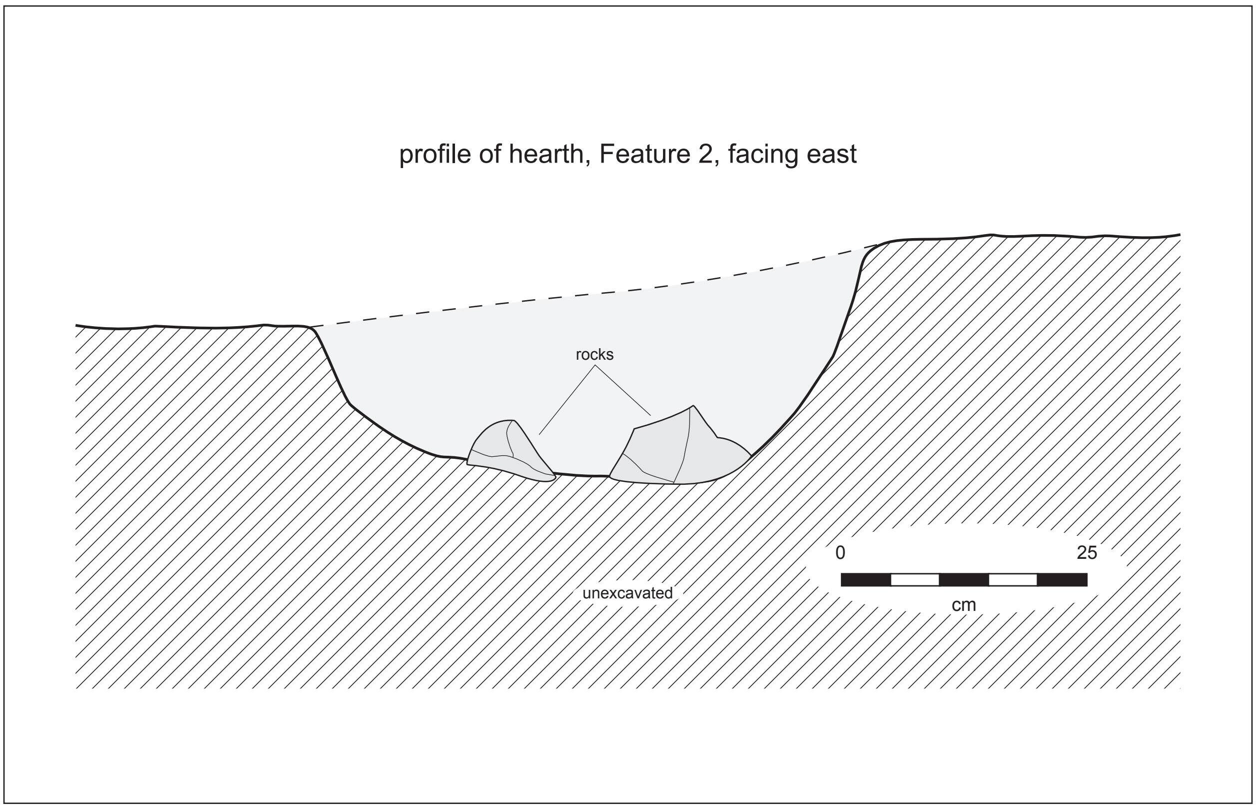
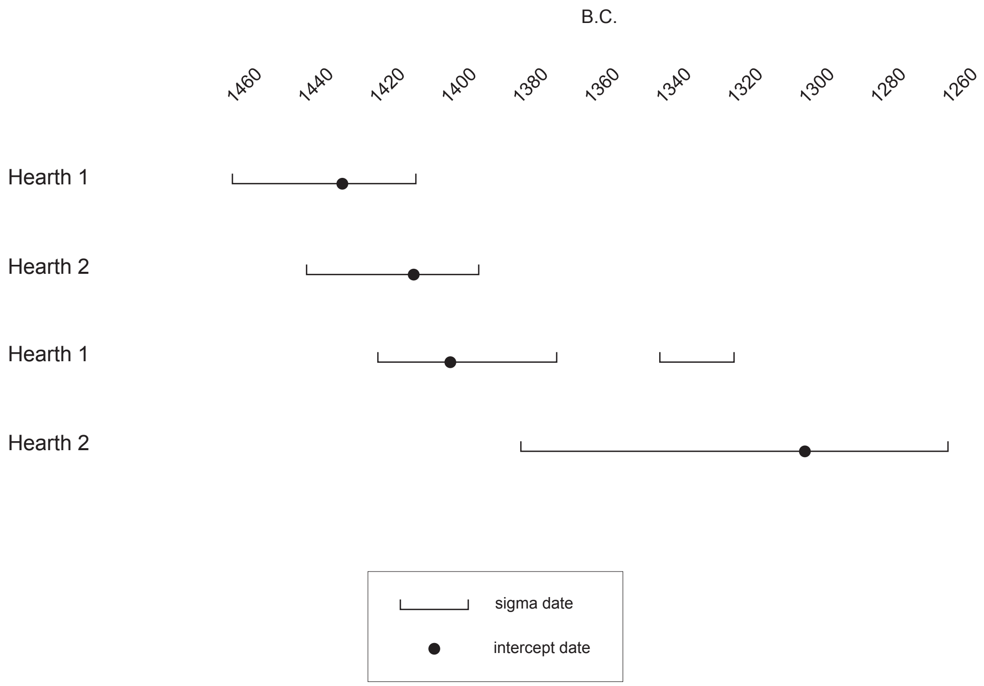


Figure 9.6. LA 130331, Feature 2, hearth, profile, view east.



Beta No.	Feature	Conventional C-14 age BP	Intercept	Calibrated 1-sigma	Calibrated 2-sigma
285534	1 - hearth (west half)	3100 +/- 40	B.C. 1400	B.C. 1420-1370 B.C. 1340-1320	B.C. 1440-1280
285533	1 - hearth (east half)	3160 +/- 40	B.C. 1430	B.C. 1460-1410	B.C. 1500-1380
285535	2 - hearth	3130 +/- 40	B.C. 1410	B.C. 1440-1390	B.C. 1490-1360 B.C. 1350-1310
285536	2 - hearth	3030 +/- 40	B.C. 1300	B.C. 1380-1330 B.C. 1330-1260	B.C. 1400-1190 B.C. 1140-1140

Figure 9.7. LA 130331, radiocarbon dates.

years later. The charcoal used in Hearth 1 was mesquite. Mesquite, creosote bush, and cholla cactus were used in Hearth 2. All were available nearby.

Summary

Only a small portion of LA 130331 was investigated, since the majority of the site was outside of the right-of-way. The presence of only two hearths, along with the lack of other associated structures, indicated that this was probably a short-term campsite in early 1400 BC and again in 1300 BC.

Diagnostic artifacts were lacking. The fragment of ground stone suggested that vegetal processing occurred at the site. Hunting activities were also likely; two faunal portions were recovered. The site, though small, was significant because hearth material produced two Late Archaic dates for the region, dates that aided in the understanding of the early utilization of the northern Tularosa Basin.

10 ⊻ Ceramics Analysis

C. Dean Wilson

An analysis was conducted on prehistoric pottery recovered during the Carrizozo project from two sites along US 54 near Oscura in Lincoln County, NM. Investigations conducted during the recovery phase resulted in the examination of 1,183 sherds from LA 120972 and 2,010 sherds from LA 120973 (Tables 10.1 and 10.2). Pottery previously recovered during the testing phase resulted in the analysis of 221 additional sherds from LA 120972 and 411 sherds from LA 120973 (Oakes et al. 2009).

In order to compare trends noted in this study to those documented during previous investigations in the region, analysis strategies and categories similar to those previously noted were used (Jelinek 1967; Kelley 1984; Levine 1997; Runyon and Hedrick 1987; Wilson 1996, 2000, 2003, 2004; Wiseman 1996, 2000, 2002, 2004).

Descriptive Attributes

The recording of ceramic types and descriptive-attribute categories allowed for the determination of the potential time of occupation of these sites and an examination of patterns and trends. Ceramic attributes recorded during this study included temper categories, pigment type, surface manipulation style, slip type, and vessel form.

Temper Categories

Temper categories were determined through examination of freshly broken, sherd cross-sections with a binocular microscope. While a large number of temper categories were recognized during this study, the majority of sherds were tempered using some form of crushed, igneous rock indicative of production in the Jornada Mogollon region (Wiseman 2001, 2002).

Cases in which temper particles were visible but could not be assigned to a known category were placed in an indeterminate category. Pastes too vitrified to determine associated tempering materials were placed in a vitrified category.

While some variability was noted in tempers, most of the project's brown ware exhibited characteristics that resulted in its assignment to a single category. The most common temper group consisted of light-colored temper fragments referred to here as Jornada leucocratic rock. Items in this category contained whitish, angular grains that were similar in size and were usually visible against the brown paste, even without microscopic examination.

While most project fragments were white, they sometimes ranged in color from buff to light gray and appeared to represent feldspar and some quartz. Smaller black particles were often present in these fragments; the particles were mostly round and usually occurred outside the lighter grains. In rare cases, these fragments appeared in large white particles.

Larger grains were glossy and opaque, although some were crystalline or sugary looking in structure. Temper was represented by crushed granite or monzonites commonly used in the Jornada Mogollon region. A few examples of this temper, with mica, were noted in this project.

Another temper was reflected in larger fragments and included feldspar with hornblende, other dark fragments, and the occasional large, quartz fragment. This temper was common in brown ware produced in the El Paso area and appeared to reflect utilization of crushed granite from the Franklin Mountains. It is possible that some of the examples assigned to this temper also represented the use of crushed igneous rock from the Sierra Blanca region.

It should be noted that determination of basic temper groups common in Jornada Brown Ware is often difficult. Differences in temper categories are usually gradational and depend on slight differences in size, color, and composition. Despite considerable overlap between these categories, trends remain statistically important, and trends con-

Table 10.1. LA 120972, ceramics, by type and ware.

	Testing Phase		Recovery Phase		Total	
Ceramic Type	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Jornada Brown Ware						
Jornada Brown rim	11	5.0%	95	8.0%	**106**	**7.5%**
Jornada Brown body	153	69.2%	1049	88.7%	**1202**	**85.6%**
Jornada Brushed	–	–	12	1.0%	**12**	**0.9%**
Three Rivers Red Ware						
Jornada Slipped Red	2	0.9%	1	0.1%	**3**	**0.2%**
El Paso Brown Ware						
El Paso Brown rim	2	0.9%	–	–	**2**	**0.1%**
El Paso Brown body	47	21.3%	5	0.4%	**52**	**3.7%**
Mogollon Brown Ware						
Alma Plain rim	1	0.5%	–	–	**1**	**0.1%**
Reserve Plain Corrugated	1	0.5%	–	–	**1**	**0.1%**
Reserve Smudged	3	1.4%	–	–	**3**	**0.2%**
Cibola White Ware						
Mineral painted, undifferentiated	1	0.5%	5	0.4%	**6**	**0.4%**
Unpainted polished white ware	–	–	9	0.8%	**9**	**0.6%**
Red Mesa-style Black-on-white	–	–	7	0.6%	**7**	**0.5%**
Total	**221**	**100.0%**	**1183**	**100.0%**	**1404**	**100.0%**

cerning such distribution, particularly between ceramic types and sites, often prove insightful.

Sand refers to the rounded or sub-rounded, white to translucent, well sorted, medium to coarse quartz grains apparent in some fragments. Small angular fragments sometimes hold these grains; this indicates use of sand weathered from sandstone outcrops. Tempers derived from crushed sandstone are similar, but rounded sand grains might contain a matrix that holds them together.

Some sand tempers associated with crushed potsherds were recorded as sherd and sand. A few sherds with more rounded particles—reflecting shale inclusions along with sand—were assigned to the shale and sand category.

Another category used during this study was sand and Mogollon volcanic rock. This category consists of fine, shiny, white to gray quartz and tuff particles; these are often rounded and reflect the use of weathered volcanic/clastic rocks. Inclusions are similar to particles used in self-tempered clays during the production of Mogollon Brown Ware and Mimbres White Ware types in the Mogollon Highlands, the Southwest, and south-central New Mexico (Wilson 1999).

In some cases, similar temper styles were assigned to the fine tuff and sand category.

Pigment Type

Presence, type, and color of paint pigments were also recorded. Sherds showing no evidence of painted decoration were placed in the none category. Sherds from which a type of pigment could not be determined were designated indeterminate.

Matte mineral paint refers to the use of ground minerals—like iron oxides—as pigments. These decorations are applied as powdered compounds, usually along with an organic binder. Mineral pigment is often present as a distinct physical layer and rests on the vessel surface. Such pigments are usually thick enough to exhibit visible reliefs when viewed through a binocular microscope. Mineral pigments usually obscure surface polish and other irregularities, and the firing atmospheres to which mineral pigments were exposed often affects the final color of the piece.

Mineral pigment categories identified during in this study included mineral black, mineral red, and mineral brown. Sherds containing mineral paint in

Table 10.2. LA 120973, ceramics, by type and ware.

Ceramic Type	Testing Phase Count	Col. %	Recovery Phase Count	Col. %	Total Count	Col. %
Jornada Brown Ware						
Jornada Brown rim	22	5.4%	82	4.1%	**104**	**4.3%**
Jornada Brown body	304	74.0%	1694	84.3%	**1999**	**82.6%**
Three Rivers Red Ware						
Jornada Slipped Red	8	1.9%	123	6.1%	**131**	**5.4%**
Jornada Red-on-brown (Mogollon like)	1	0.2%	18	0.9%	**19**	**0.8%**
El Paso Brown Ware						
El Paso Brown rim	1	0.2%	1	0.0%	**2**	**0.1%**
El Paso Brown body	61	14.8%	57	2.8%	**118**	**4.9%**
Mimbres White Ware						
Mimbres White Ware, unpainted	1	0.2%	5	0.2%	**6**	**0.2%**
Early Mimbres Black-on-white	5	1.2%	17	0.8%	**22**	**0.9%**
Cibola White Ware						
Unpainted, polished white ware	3	0.7%	2	0.1%	**5**	**0.2%**
Mineral paint, undifferentiated	3	0.7%	6	0.3%	**9**	**0.4%**
Red Mesa-style Black-on-white	2	0.5%	5	0.2%	**7**	**0.3%**
Total	**411**	**100.0%**	**2010**	**100.0%**	**2421**	**100.0%**

a combination of colors were assigned to mineral black or mineral red categories.

Surface Manipulation Style

Attributes related to surface manipulation styles reflect the presence and types of surface texture, polish, and slip treatments.

Surface manipulation categories were recorded for both interior and exterior vessel surfaces. Surfaces that were too heavily worn to determine original surface treatments were classified as surface missing.

Plain unpolished refers to surfaces where coil junctures are completely smoothed but the surfaces are unpolished. Plain polished surfaces are intentionally polished after smoothing. Polishing implies the intentional smoothing of the surface with a polishing stone in order to produce a compact and lustrous appearance. Plain striated refers to the presence of a series of long, shallow, parallel grooves.

Slip Type

A few sherds exhibited distinct slipped surfaces that had been polished over.

Slips represent the intentional applications of distinct clay, pigment, or organic deposits over an entire vessel surface. Surfaces to which a high-iron slip clay has been applied to create a red ware finish are assigned to a polished red slip or unpolished red slip category. Surfaces to which a low-iron slip is applied, as represented in some white ware, are typically classified as polished white slipped.

Vessel Form

Sherd-based vessel form categories reflect the shape and portion of the vessel from which a sherd has been derived. Categories used here are based on rim shape and the presence and location of polish and painted decorations.

While it is often easy to identify the basic form of body sherds—bowl versus jar, for instance—from many Southwestern regions by the presence and location of polishing, such distinctions are not as easy for Mogollon Brown Ware types including those defined for the Jornada tradition.

This is because Jornada Brown Ware vessels commonly exhibit polish on both surfaces; polish on just one surface; or polish on neither surface.

During the present study, most of the plain brown ware sherds examined were assigned to descriptive categories representing a combination of surface treatments. Sherds with surfaces upon which treatment could not be determined were placed in an indeterminate or indeterminate rim category. Body sherds not exhibiting polished treatments on either surface were classified as unpolished body. Body sherds exhibiting polishing on both sides were assigned to a polished body category. Other body sherds were assigned to a category based on the presence of distinct polish on one surface and included exterior polished body and interior polished body.

In most cases, the bowl body category is limited to body sherds from decorated vessels with heavier polish, slip, or painted decorations on the interior surface. Bowl rim refers to sherds exhibiting an inward rim curvature characteristic of bowls, regardless of associated surface manipulations or treatments.

Jar body is mainly limited to decorated sherds exhibiting higher polished, slipped, or painted decoration on the exterior surface. Jar neck sherds are identified by the presence of distinct curves associated with the neck area.

Jar rim sherds from this project exhibited the distinct curves of a jar neck along with a relatively wide rim diameter. Such vessels commonly show signs of wear and sooting, indicative of cooking or boiling over a fire.

Seed jar rim refers to spherical shaped vessels with rim openings near the top. Rim sherds with an outward slope from the rim are classified as seed jars; rims are characterized by constriction but exhibit no curvature indicative of a distinct neck.

Cloudblower refers to sherds derived from conical-shaped pipes.

Post-Firing Modifications

Evidence of the intentional modification of vessels or sherds for repair or subsequent use was also noted. Most project sherds did not display evidence of modification and were recorded as none.

Modification categories recognized during the Carrizozo project analysis included drill hole complete, drill hole incomplete, punched hole, beveled edge, interior surface partially worked, shaped all sides, indeterminate shape with drill hole, interior worn from cooking, abraded surface exterior, sooted interior-exterior, sooted interior, sooted exterior, exterior partially exfoliated, erosion, and sooted exterior.

Ceramic Types

Ceramic types, as used here, refer to categories used to document and relay information about the distribution of pottery using a combination of traits of temporal, spatial, and functional significance.

Types recognized during the present study were lumped into one group, reflecting both regional traditions and wares.

Recognized ceramic groups included: Jornada Brown Ware; Three Rivers Red Ware; El Paso Brown Ware; Mogollon Brown Ware; Mimbres White Ware; and Cibola White Ware.

Characteristics of these groups, as well as types recognized for each, are described below. Descriptions are followed by a discussion of trends indicated by the characteristics and distribution of types and attributes.

Jornada Regional Pottery

Plain brown ware types were by far the most common pottery investigated at the Carrizozo project sites.

Plain brown ware pottery from various areas of the Jornada region has long been divided into different types based on combinations of attributes thought to be of geographic significance. The division of pottery into various brown ware types as defined for different traditions is based on observed differences in surface color, polish, and temper noted for plain brown wares from different areas of the Jornada Mogollon region (Jelinek 1967; Jennings 1940; Lehmer 1948; Whalen 1994b; Wiseman 1996).

Analysis of project pottery indicated an overlap in characteristics of brown ware common throughout the Jornada Mogollon (Wiseman 2001).

Visual and petrographic examinations have indicated differences in the pastes and manipulation of brown ware pottery that dominated ceramic assemblages at sites in the southern riverine and northern mountainous areas of the Jornada Mogollon.

Some analysts have lumped plain brown ware sherds—previously assigned to specific regional types such as El Paso Brown, Jornada Brown, or South Pecos Brown—into a single plain brown ware category and have documented numerous variations in pottery from different areas through the distribution of pastes and technological attributes (Hill 1996; Whalen 1994a).

Other researchers have noted the usefulness of subdividing brown ware from sites throughout the Jornada Mogollon region while also recognizing the difficulties of identification and documentation of such distributions (Wiseman 2001).

During this study, plain brown ware sherds were designated as modified versions of various brown ware types defined for this region (Jelinek 1967; Kelley 1984; Runyan and Hedrick 1987; Wiseman 2001).

Problems in the recognition of different plain brown ware types may sometimes result from the range of characteristics noted for various brown ware types. For example, some sherds contain a temper class commonly used to define one type and a surface manipulation frequently used to define another (Wiseman 2001).

Still, the use of such categories has allowed for the monitoring of variability within assemblages that are of spatial or temporal significance. Relaying this type of information through such categories is less cumbersome than continual references to combinations of categories.

The major brown ware division used during this study make clear the separation between Jornada Brown Ware and El Paso Brown Ware types.

Jornada Brown Ware

Jornada Brown Ware, as defined here, was first described by Jennings (1940) during the excavation of sites along the Peñasco River. Jennings (1940) referred to the dominant pottery recovered from these sites as Common or Unnamed Brown, which was distinguished from the El Paso type by rim form and surface polish. This seems to refer to forms common in assemblages dating prior to the introduction of El Paso Polychrome. Mera (1943) proposed that the name Jornada Brown be used to describe similar pottery.

Mera (1943) believed that Jornada Brown was derived from Alma Plain produced in the Mimbres or Mogollon regions to the west (Haury 1936). Mera assigned categories delineating forms potentially associated with this sequence and, very briefly, defined a form described as Coarsened Alma (Kelley and Peckham 1962; Peckham 1976). This category refers to forms in transition between Alma Plain from the Mogollon region and Jornada Brown that dominated later sites in the Northern Jornada region.

Brief descriptions given by Mera (1943) distinguish Alma Plain of the Mogollon region by pastes that have been heavily tempered with heterogeneous material. The distinction between the form of Alma Brown in the Mogollon region and the coarsened form produced in early sites in southeastern New Mexico reflects the difference between finer inclusions associated with self-tempered clays and fine volcanic sandstone in the Mogollon Highlands and larger particles derived from porphyries outcrops in highland areas east of the Rio Grande.

While Mera (1943) felt there were differences between earlier transitional pottery and later forms, which he suggested could be referred to as Jornada Brown (Jennings 1940). His description was so broad as to make impossible the differentiation of this from the coarsened form of Alma.

Thus, while the coarsened form of Alma is subsumed here under Jornada Brown, it should be noted that a continuum is represented; surface characteristics of pottery assigned to Jornada Brown and Alma Plain are sometimes indistinguishable (Wiseman 2001).

As used here, Jornada Brown refers to the long sequence of brown ware pottery produced in the northern regions of the Jornada branch (Kelley 1984; Wiseman 2001). Surfaces tend to be smoothed and polished, and temper grains are seldom visible through the surface. Tool marks and polishing streaks are often visible. Vessel walls are fairly thick, ranging from 6–8 mm. Later forms have thicker walls and may reflect an increase in vessel size during later periods.

When re-fired in a controlled, oxidizing atmosphere, pastes consistently fire to shades of red; this reflects the use of high-iron clays. Pastes are often dark, and a distinct carbon core is sometimes present. The range of surface colors tends to be very wide and includes dark gray, gray, tan, brown, yellowish-red, and red. Significant color differences often occur on a single vessel, and firing clouds are common. These characteristics indicated a poorly controlled atmosphere that results in variable amounts of oxidation during the final stages of firing.

Temper fragments are variable in size; those in later forms are fairly small and crystalline in structure.

Most Jornada Brown Ware sherds examined during this study were tempered with similar-sized feldspar. These sherds were placed in a variety of vessel-form classes.

Jornada Brown from earlier components appeared to represent a range of forms that may have been dominated by bowls, while those from later—post-AD 1100—were mostly represented by necked jars.

The majority of sherds examined during this study exhibited these characteristics. Sherds were assigned to either a Jornada Brown rim (Fig. 10.1) or a Jornada Brown body (Fig. 10.2) category.

Distinct striations were noted on the exterior surfaces of a small number of sherds from LA 120972. These treatments likely resulted from the brushing of the vessels with either corn cobs or corn husks during the final stage of construction. Sherds exhibiting this treatment were assigned to the Jornada brushed category (Fig. 10.3).

These characteristics are similar to those noted in pottery from the Texas Plains area, which was presumably produced by Caddoan groups to the east, although it appeared to be too early to have been derived from these types (Suhm and Jelks 1962).

It is likely that the presence of distinct striations may have simply reflected the variation of a widespread Jornada Mogollon technology and foreshadowed treatments used later in forms produced in the Northern Jornada region—particularly Chupadero Black-on-white (Kelley 1984; Farwell et al. 1992; Mera 1931; Hayes et al. 1981; Vivian 1964; Wiseman 1986).

Three Rivers Red Ware

Pottery displaying a combination of Jornada Brown pastes and red slips, or painted decorations, is categorized as Three Rivers Red Ware (Wimberly and Rogers 1977). Most descriptions here focus on types—such as Three Rivers Red-on-terracotta and Lincoln Black-on-red—that do not appear to have been produced until after the beginning of the twelfth century (Wiseman 2002).

While the development of Three Rivers Red Ware and earlier Mogollon types, such as San Francisco Red and Mogollon Red-on-brown, has long been postulated (Mera 1943), the rarity of detailed descriptions of pottery from early sites in the Jornada Mogollon limits the definition and documentation of the early sequence that led to the development of later Three Rivers Red Ware types.

The identification of locally produced red ware pottery has provided further clues concerning the nature of the timing and transition between earlier Mogollon Red Ware, Red-on-brown forms and, later, Three Rivers Red Ware types. Pottery assigned to this group during this study included sherds derived from both painted and unpainted vessels.

Pottery from the Carrizozo project categorized as Three Rivers Red Ware included three sherds (.2 percent) from LA 120972 and 141 sherds (6.2 percent) from LA 120973. Most of this pottery was unpainted and displayed pastes and tempers similar to those described for Jornada Brown. This pottery was covered with a distinct red slip and was characterized here as Jornada Plain Slipped Red (Figs. 10.4 and 10.5).

The use of a red slip over a brown ware paste appears to have been derived from San Francisco Red, a Mogollon type produced around AD 500 (Anyon et al. 1981). Examples assigned to this type exhibited thin to moderately thick red slips and no painted decoration.

By the late sixth century, red slipped plain wares exhibiting various pastes were produced in most Southwestern regions (Daifuku 1961; LeBlanc 1982; Reed et al. 2000; Wilson 2010). It is possible however, that some of the slipped red sherds could have been derived from painted forms, although many were large enough to indicate that they were indeed derived from unpainted vessels covered with red slip.

Slip ranges from a dark brick red to an orange/red color. Slipped surfaces are smooth and lustrous, as a result of polishing; however, polishing streaks and striations are usually absent. Thickness of slip is variable, with some surfaces completely covered with a relatively thick slip and other portions of the unslipped surface clearly visible. Unslipped portions are tan or brown.

Project pastes and tempers were similar to those described for Jornada Brown pieces recovered from the same sites. Forms were mainly represented by bowls with slipped interiors. While both slipped and unslipped surfaces were polished, polishing on the slipped surface was usually heavier.

The other pottery category assigned to the Three Rivers Red Ware tradition is represented by pottery

Figure 10.1. Jornada Brown Ware, rim sherds.

Figure 10.2. Jornada Brown, body sherd, cloud blower.

displaying simple red decorations over an orange, tan, or brown unslipped surface.

Carrizozo forms exhibiting decorations in red paint over Jornada pastes are illustrated in Fig. 10.5. Painted areas shared an appearance similar to the slip clay in previously described slipped red wares. Surfaces and pastes were similar to those noted in pottery assigned to Jornada Brown Ware types.

While a majority of sherds from sites in the Jornada Mogollon region were assigned to Three Rivers Red-on-terracotta, this type does not appear to have been produced until after AD 1100 (Kelley 1984; Mera 1943; Mera and Stallings 1931). This is much too late for the context represented here.

Styles and other characteristics of Three Rivers Red-on-terracotta are distinct from those noted in the red painted brown wares identified in this study.

Styles and executions here are similar to pottery from the Mogollon region assigned to Mogollon Red-on-brown and San Lorenzo Red-on-brown.

Figure 10.3. Jornada Brown Brushed, sherd.

The earliest version of red painted pottery in the Jornada region was referred to by Mera as Broadline Red-on-terracotta (Mera 1943; Mera and Stallings 1931). Mera noted that the Broadline type most likely developed directly out of Mimbres Red-on-brown, with indications of a gradation into Three Rivers Red-on-terracotta. Mera also noted that examples of this form may have been contemporaneous with Three Rivers Red-on-terracotta (Mera and Stallings 1931).

It has been suggested that Broadline and San Andres Red-on-terracotta do not necessarily reflect the early stage of the Three Rivers Red Ware developmental sequence but are instead a variation on the range of Three Rivers Red-on-terracotta (Wiseman 2001, 2002). It is possible, however, that the Broadline form appeared earlier, after which it continued to be made along with Three Rivers Red-on-terracotta and, even later, with Lincoln Black-on-red. Pottery assigned to San Andres Red-on-terracotta has been identified in assemblages lacking samples of Three Rivers Red-on-terracotta in contexts that appear to date to the eleventh century.

Based on investigations at the Hatchet site, McCluney (1961, 1962) placed pottery with lines between 5 mm and 8 mm wide into San Andres Red-on terracotta category. The similarity of decorations on pottery designated San Andres Red-on-terracotta and Mogollon Red-on-brown, as well as on this pottery, has been interpreted as reflecting an earlier version of this type (McCluney 1961).

Lines are usually executed somewhat crudely and begin just under the rim; the wide lines radiate downward and terminate directly above the bottom of the vessel. A joining of the lines may occur below the rim, producing triangle or diamond shapes. The rim is usually painted red.

Vessel forms are usually deep or shallow bowls, although jars are sometimes represented. Temper is described as larger than on Three Rivers Red-on-terracotta samples (McCluney 1962).

McCluney noted little stratigraphic evidence that indicated this pottery clearly preceded Three Rivers Red-on-terracotta. More recent investigations have indicated the presence of pottery assigned to San Andres Red-on-terracotta at assemblages associated with Mimbres Classic Black-on-white that dated from the eleventh to early twelfth centuries. This indicates at least some pottery assigned to this type predates the appearance of more typical Three Rivers Red-on-terracotta.

El Paso Brown Ware

The major distinction made here in the classification of brown wares reflects attempts to distinguish pottery that may have originated in the Southern Jornada region or El Paso area through the recognition of El Paso Brown. As noted, while such distinctions seem warranted, they are very difficult to make for individual sherds that exhibit combinations of attributes commonly used to distinguish more than one type.

El Paso Brown is often distinguished from Jornada Brown by the absence of a distinct polished surface and by the presence of large temper fragments that include rounded quartz fragments (Miller 1995; Miller and Kenmotsu 2004; Runyon and Hendrick 1987; Whalen 1981; 1994a; Wiseman 2001). Pastes on El Paso Brown sherds tend to be soft. Temper often protrudes through the surface, and scraping marks may occur on interior surfaces. Pastes tend to be dark gray or brown with a dark core; surfaces are often dark gray to chocolate brown in color.

Most Carrizozo project sherds displaying El Paso Brown Ware pastes exhibited plain surfaces without textured or slipped treatments. These sherds were placed into either an El Paso Brown rim or El Paso Brown body category. None of the sherds assigned to this category during the present study exhibited the red slips, painted decorations, or thin vessel walls characteristic of El Paso Polychrome.

Mogollon Brown Ware

A small number of sherds found here featured pastes, tempers, and manipulation indicative of Mogollon Brown Ware produced in the Mogollon Highlands to the west (Haury 1936; Nesbitt 1939; Wilson 1999). Sherds exhibiting polished surfaces similar to those noted as Jornada Brown—but with a volcanic and sand temper similar to that used in the Mogollon Highlands—were assigned to Alma Plain. Other types assigned to this group included Alma Neckbanded and Reserve Smudged.

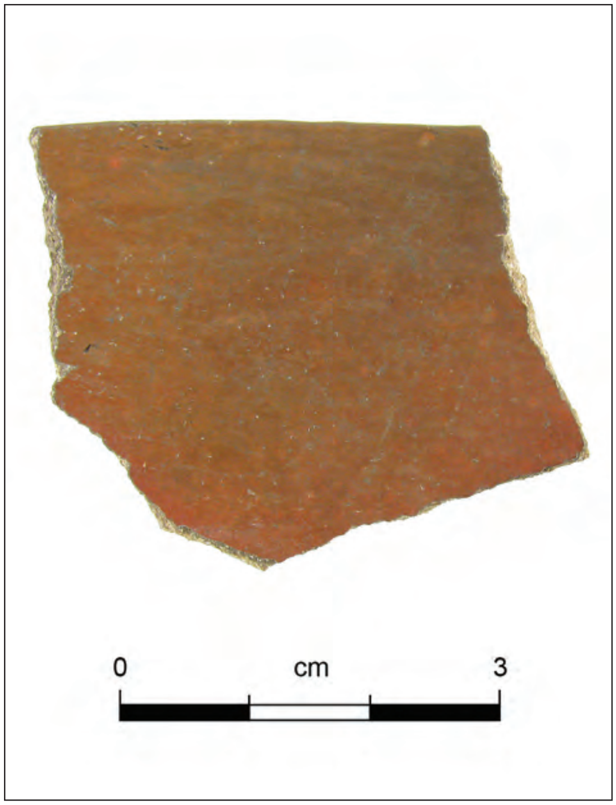


Figure 10.4. Jornada Plain Slipped Red, sherd.

Mimbres White Ware

Mimbres White Ware types refer to white slipped and painted pottery forms produced in the Mimbres region (Brody 1977; Haury 1936; Wilson 1999). Mogollon Painted and Mimbres White Ware types exhibit similar, silty pastes and a volcanic temper also noted for Mogollon Brown Ware types. Painted decorations are executed with iron-based mineral pigments over a white slipped surface that is slightly or moderately polished. These white slips contrast with the gray to brown colors seen in pastes and unslipped surfaces.

Slip tends to be soft and easily weathered, resulting in the common obliteration of painted or slipped surfaces. Surfaces are moderately to lightly polished but are not as lustrous as contemporaneous white ware types from other regions. A long tradition reflecting the gradual development of Mimbres White Ware types from Three Circles Red-on-white to Mimbres Black-on-white has been indicated

Mimbres White Ware types were distinguished by the presence of slip, paint color, and stylistic attri-

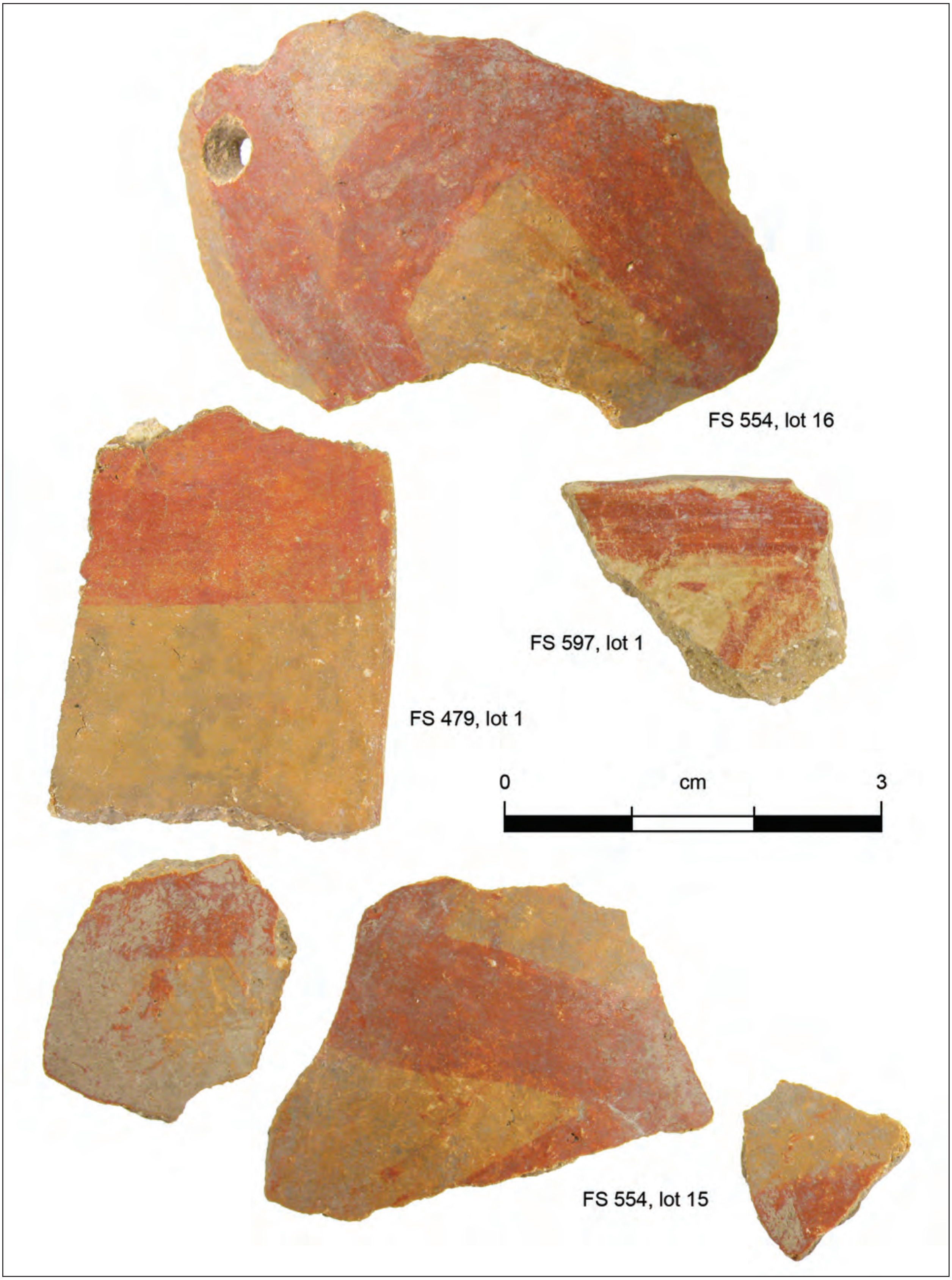


Figure 10.5. Red-paint designs over Jornada Brown Paste.

butes. Given the small number of sherds belonging to this group, Carrizozo sherds included pottery assigned to Mimbres White Ware Unpainted, Early Mimbres Black-on-white, and Undifferentiated categories.

While it is possible some of these sherds originated from Mimbres Classic Black-on-white, most displayed a fairly simple orientation indicative of early types, such as Mimbres Style 1 or Mimbres Style 2. Examples of Early Mimbres White Ware identified during the present study are illustrated in Fig. 10.6.

Cibola White Ware

Other white wares examined during this study exhibited a combination of traits indicative of pottery assigned to the Cibola White Ware tradition.

Types associated with this tradition were produced throughout wide areas of the Cibola region in the Colorado Plateau.

Cibola White Ware types are recognized by the presence of sand, sand and sherd, or sherd tempers; light, low-iron paste; and decorations in mineral paint. Unpainted sherds exhibiting Cibola pastes are designated as unpainted polished white ware. Sherds with similar pastes and indistinct decorations made with mineral paint are assigned to the mineral paint undifferentiated category.

All of the Cibola White Ware sherds found here that could be assigned to specific types were classified as Red Mesa Black-on-white (Fig. 10.7).

Red Mesa Black-on-white refers to white wares that exhibit styles, pastes, and manipulations indicative of pottery produced in the Chaco or Cibola regions during the Early Pueblo II period, or from AD 900–1050 (Gladwin 1945; A. Sullivan 1984; Windes 1977).

Red Mesa Black-on-white was grouped here with pottery that was sometimes described as Kiathulana Black-on-white. Pastes were hard and crumbly, particularly when compared to late Rio Grande types, and were moderate in texture. Pastes were white to light gray in color, with occasional dark cores. Surfaces were usually white; polish and slip were variable. A thin chalky slip was sometimes present, although some examples were unslipped.

A wide range of forms were represented here by a fairly even numbers of bowl and jar forms, including pitchers, seed jars, and gourd dippers. Rims were rounded or tapered and were solidly painted. Decorations were always applied in a mineral pigment red, reddish-brown, or black in color. A number of distinct design motifs occurred together on the same vessel.

Design elements commonly associated with this type include a series of thin parallel lines, wavy or squiggly lines, pendant dots, ticked lines, rickrack lines, scrolls, stepped triangles, and ribbons of squiggly hachure. A quartered or banded layout is often represented, consisting of a series of geometrically opposing sections in which combinations of design elements are repeated. These sections are usually divided by a series of narrow lines.

Trends and Patterns

Trends noted in this study regarding various descriptive attributes and type categories provided the opportunity to examine issues associated with early occupational spans of Chupadera Mesa, in the project area, and elsewhere in the Northern Jornada Mogollon. The dating of contexts from both sites from which ceramics were recovered formed the basis for subsequent examination of various trends and patterns reflected in the production, decoration, geographic distribution, and use of this pottery.

Ceramic Dating

Our current understanding of the timing and nature of changes during the ceramic sequence represented in the Northern Jornada Mogollon region remains surprisingly incomplete; although recent projects have filled some important gaps.

The unique nature of the prehistoric occupations in the southeastern portion of New Mexico and the extreme western portion of Texas was recognized and described in the 1940s (Jennings 1940; Mera 1943; Lehmer 1948).

Lehmer described manifestations in this area in terms of the Jornada Branch of the Mogollon. The Mogollon region had been defined and described only slightly earlier (Haury 1936). This served as an important reference point in understanding distinct pottery and other aspects of materials noted in southeastern New Mexico.

Lehmer (1948) defined three phases for what he termed the northern sequence of the Jornada Mogollon. The earliest of these was the Capitan phase,

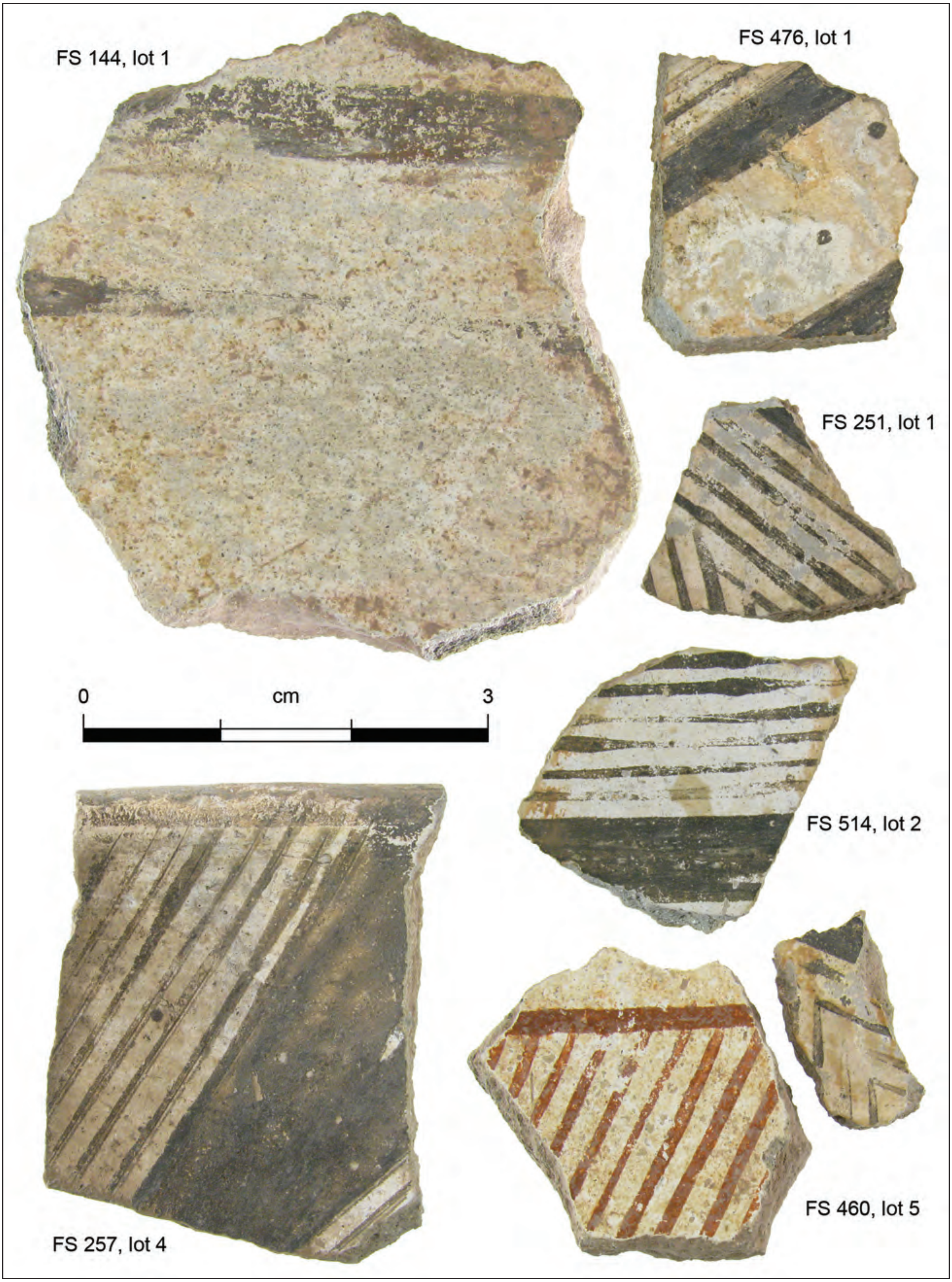


Figure 10.6. Early Mimbres White Ware.

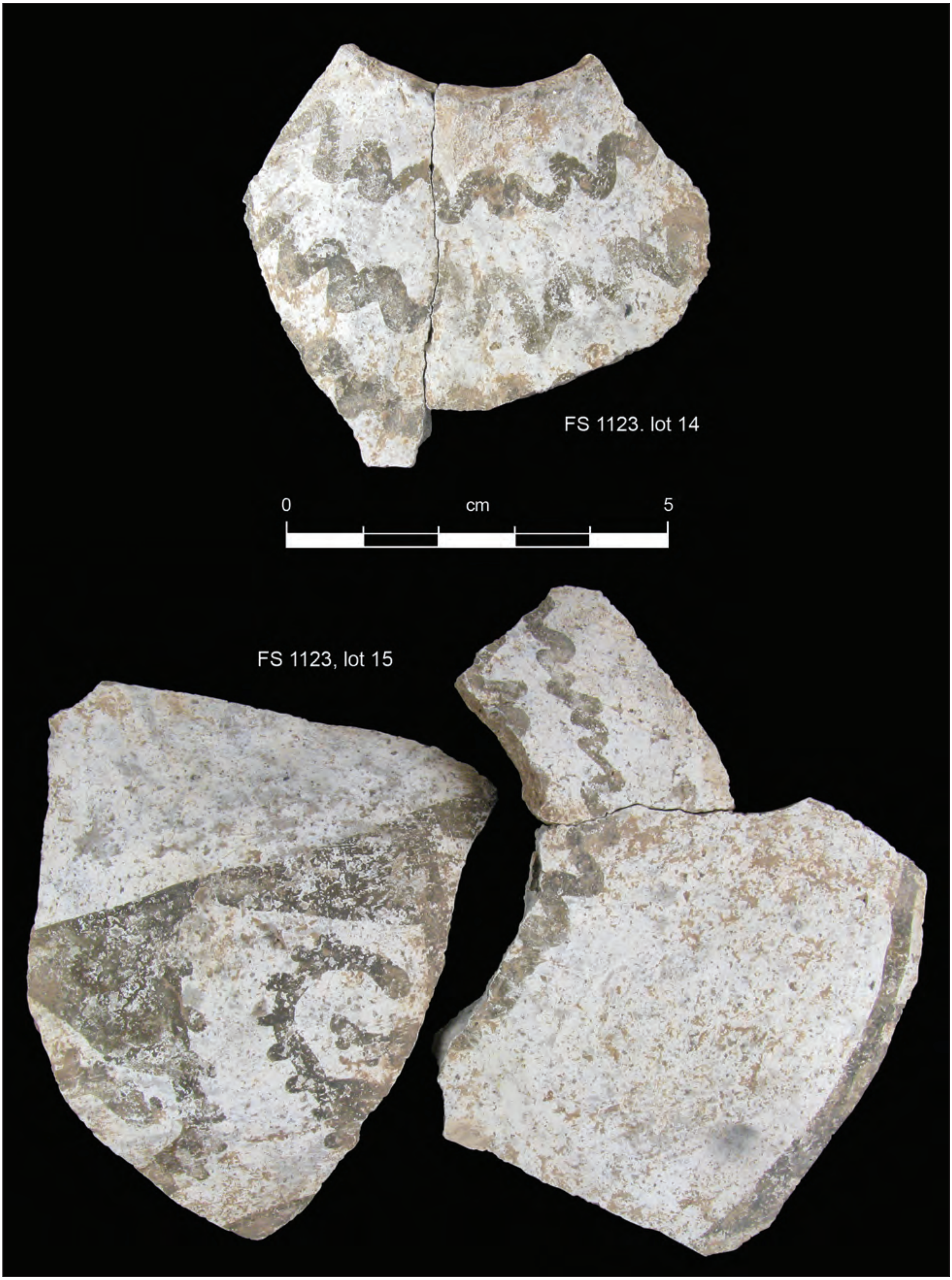


Figure 10.7. Red Mesa Black-on-white, sherds.

which he described as similar and contemporaneous to the Mesilla phase to the south. The Capitan phase was initially assumed to date from about AD 900–1100 (Lehmer 1948).

Jornada Brown was characterized as the dominant pottery type at Capitan phase sites that were, in turn, associated with lower frequencies of Mimbres Black-on-white, Chupadero Black-on-white, and Broadline Red-on-terracotta. This phase was originally defined by investigations by Jennings (1940) at LA 2000 along the Rio Peñasco.

Next in Lehmer's sequence was the Three Rivers phase, which was postulated to date between AD 1100 and 1200. In addition to the continuation of similar Jornada Brown pottery and other types associated with the previous phase, ceramic types of the Three River phase included El Paso Polychrome, Chupadero Black-on-white, and St. Johns Polychrome.

Lehmer's last phase was the San Andres phase, which was described as contemporaneous to the El Paso phase, defined for the Southern Jornada sequence, and assumed to date from AD 1200–1400. Pottery types noted in contexts dating to this phase included Jornada Brown, El Paso Polychrome, Three Rivers Red-on-terracotta, and Lincoln Black-on-red. Other pottery types defined for this phase included Chupadero Black-on-white, Gila Polychrome, Ramos Polychrome, Playas Red Incised, Agua Fria Glaze-on-red Polychrome, Arena Glaze Polychrome, St. Johns Polychrome, and Heshotautla Polychrome (Lehmer 1948).

Based on extensive field work, Kelley (1984) introduced an additional phase system for various areas of the Northern Jornada. Kelley's system has largely replaced the earlier Southern Jornada phase sequence by Lehmer (Farwell et al. 1992; Sebastian and Larralde 1989; Stuart and Gauthier 1981; Wiseman 1985).

For the Sierra Blanca area, Kelley (1984) placed most ceramic-period occupations defined at the time of her study into the Glencoe phase. Kelley then further divided these occupations into the early and late Glencoe phases. While the early date for the Glencoe phase was projected at about AD 1100, the probable existence of earlier occupations was noted and is referred to as an undefined ceramic period (Sebastian and Larralde 1989).

The combination of all known ceramic occupations for the southern Sierra Blanca region into a single phase appears to have been based on the conservative nature of the occupation, as components dating to various spans are usually represented at pithouse sites with ceramic assemblages dominated by similar plain Jornada Brown Ware sherds.

While Kelley (1984) described the Glencoe phase in the Chupadera region as spanning the Early Pueblo III to the Late Pueblo III periods, brief mention was made of a much longer sequence reflected by six foci and based on observations from Toulouse and Stephenson (1960). These foci spanned from early in the ceramic period to Salinas sites occupied during the historic period.

While Mera (1943) did not assign specific periods or dates to ceramic assemblages in southeastern New Mexico, the variations he noted were described in terms of a developmental sequence reflecting both local changes and waves of influences from other areas of the Southwest, including the Mimbres region.

Mera (1943) noted that the earliest pottery produced in this region appeared to have developed directly from Alma Plain. This reflects the earliest Mogollon types and appears to have been first produced in the Mimbres region and elsewhere in the Mogollon Highlands around AD 200 (LeBlanc 1982; Haury 1936; Wilson 1999).

The production of El Paso Brown in the Southern Jornada and El Paso regions is thought to have begun sometime between AD 200 and 400 (Miller 1995; Miller and Kenmotsu 2004; Whalen 1981; 1994a). Mera briefly described a coarse form of Alma Brown as evidence of the transition between earlier forms of Alma Brown and late examples of Jornada Brown (1943).

While most sites noted by Mera as pure Alma sites—displaying no evidence of later intrusive types—were located along the Rio Grande Valley or its western affiliates, Mera did note a few examples scattered along the Sierra Blanca and Sacramento Mountains.

More recent evidence from sites in the Northern Jornada Mogollon region supports the existence of an early occupation made up almost exclusively of plain brown ware. The appearance of early ceramics in this region appears to have taken place slightly later than what has been noted for plain ware types in regions west and south but still reflects an earlier date than is often assumed. Evidence supporting a slightly later starting date for the appearance of brown ware is reflected by the absence of pottery at the Archaic sunset site in the upper Rio Hondo, which appears to have been abandoned between AD 450 and 500 (Wiseman 1996). Other clues indicating a beginning date of about AD 540 in this region were provided by dates at Hondo Valley sites as part of the US 70 project (Campbell and Railey 2006).

Evidence of the early stages of this phase was uncovered during excavations at the Dunlap-Salazar site, which represents a pithouse village found along the Bonito River in Lincoln County, NM (Rocek 1991, 1995).

Radiocarbon dates from these sites indicate the location was occupied between the sixth and tenth centuries (Rocek 1995). Assemblages from these sites were dominated by plain brown pottery, with decorated types mainly limited to proveniences dating after the main occupation of the village. Identified types include Jornada Brown and El Paso Brown. Mineralogical examinations of sherds indicate that these types were probably locally produced, although technology appears to be similar to that noted for El Paso Brown (Howey 2000).

The dating of slightly later components is based on the presence of extremely low frequencies of early, intrusive, decorated types in similar assemblages. Two of the foci for the Chupadera region seem to be defined by the occurrence of decorated types dating to before the production of Chupadero Black-on-white and Three Rivers Red-on-terracotta and appear to predate ages usually assigned to the Glencoe phase (Kelley 1984).

The earliest of the four foci was based on excavations of Gran Quivira Pithouse Village (LA 2579). Findings in both pithouses reportedly yielded a combination of pottery designated as Jornada Brown and Lino and were initially interpreted as signs of a Basketmaker III occupation (Fenenga 1956). However, in 1984, Kelley stated that an Early Pueblo date is more likely.

Of particular importance here is the Claunch focus, which was initially defined entirely on the basis of surface associations (Toulouse and Stephenson 1960). Pottery types associated with this focus included Jornada Brown, Los Lunas Smudged, San Francisco Red, Chupadero Black-on-white, and Indented Corrugated Utility. Some assemblages with similar pottery appear to include Red Mesa, Socorro, Mimbres, and San Marcial Black-on-white as well as Wingate Black-on-red. Toulouse and Stephenson (1960) stated that the Claunch and Arroyo Seco foci were likely contemporaneous occupations.

Sites with similar ceramics were noted by Caperton (1981) during archaeological recovery work at Chupadera Mesa and in the foothills of the Gallinas Mountain. While these sites were not placed into a specific phase or period, the characteristics of pottery types found there indicate occupations similar to those described for the Claunch focus. All pithouse sites were characterized by high frequencies of Jornada Brown Ware along with lower frequencies of decorated types.

Some differences appear to be reflected in assemblages from the northern and southern part of the survey area (Caperton 1981). Decorated types noted in the southern area include Puerco Black-on-white, Socorro Black-on-white, Chupadero Black-on-white, Casas Colorado Black-on-white, Mimbres Bold Face Black-on-white, and San Andres Red-on-terracotta.

Decorated types noted at pithouse sites on mesas to the north include Puerco Black-on-white, Socorro Black-on-white, Chupadero Black-on-white, and Casas Colorado Black-on-white, as well as Red Mesa Black-on-white, Kiathuthlana Black-on-white, and Mimbres Black-on-white. This combination of pottery indicates a long occupation of the sites in the early pithouse group.

Discussions by Mera (1943) provide further clues on the identification and implication of various combinations of ceramic types occurring in early Northern Jornada Mogollon sites. Of particular significance to this study is a discussion of trends associated with the transition from early brown ware sites with few or no decorated ceramics to the very long period during which Chupadero Black-on-white and Three Rivers Red-on-terracotta dominated decorated assemblages in this region.

The occurrence of extremely small amounts of early, decorated pottery types in assemblages dominated by plain brown wares—found in a small number of assemblages in this region—seems to reflect influences from a variety of areas including the Rio Abajo region to the west and the Mimbres region to the southwest (Marshall and Walt 1984).

An initial wave of influence from areas along the Rio Abajo may be reflected by the presence of low frequencies of San Marcial Black-on-white associated with later spans of the San Marcial phase (AD 500–800). This, in turn, appears to have been characterized by locally produced forms of Pueblo I types produced in areas to the west (Marshall and Walt 1984; Mera 1935, 1943).

Slightly later influences are indicated by the occurrence of Red Mesa Black-on-white in assemblages attributed to the Tajo phase (AD 800–1000) of the Rio Abajo (Marshall and Walt 1984). Assemblages indicative of this phase are characterized by low frequencies of white wares assigned to Red Mesa Black-on-white. Pottery assigned to this type appears very similar to examples defined for the Cibola and Chaco regions and also appears to reflect trade ware produced somewhere in this region (Mera 1943).

Brown ware types, which overwhelmingly dominate assemblages in the Rio Abajo region, consist of plain and ribbed pottery sometimes categorized as Pitoche Brown Ware (Marshall and Walt 1984). Red slipped brown, red-on-brown, and smudge brown wares have also been noted in low frequencies in Tajo phase assemblages in the Rio Abajo (Marshall and Walt 1984). The next intrusive black-on-white type described for the sequence in Rio Abajo and the surrounding areas is Socorro Black-on-white. This type is similar to, and may have developed into, Chupadero Black-on-white.

The presence of Mimbres Black-on-white types appears to be a good indicator of occupations in the Jornada region predating the production of Chupadero Black-on-white (Mera 1943). The earliest decorated type produced in the Mimbres region is Mogollon-Red-on-brown, produced in the beginning of the eight century. By the next century, Mogollon-Red-on-brown had been replaced by Mimbres White Ware types. Mimbres Boldface or Style I Black-on-white spans from about AD 750–900. Mimbres Transitional, or Style II Black-on-white, spans from about AD 880–1020 (Schaefer and Brewington 1995).

Assemblages at Carrizozo Project Sites

Pottery assemblages examined at both sites during the Carrizozo project reflected an early but insufficiently researched occupation similar to those previously documented in the Rio Abajo and Chupadera Mesa areas. Assemblages noted for pottery recovered during combined testing and recovery phases are characterized in Tables 10.1 and 10.2; later discussions and the presentation of data will be limited to investigations conducted during the recovery phase.

While the distribution of ceramics in assemblages at the two sites was similar, slight differences were noted, particularly in the occurrence and frequency of different decorated types.

The ceramic assemblage from LA 120972 was dominated by plain brown ware types, with pottery designated as Jornada Brown representing 93.9 percent of the total ceramics found. While most sherds displayed smoothed surfaces, a small number exhibited distinct striations and were assigned to Jornada Brushed. None of the Jornada Brown Ware exhibited painted decoration, although a few pieces (0.2 percent) exhibited red slipped surfaces. Additional brown ware sherds found at the site were assigned to El Paso Brown (3.8 percent) and Mogollon Brown types (0.4 percent). Characteristics noted for the extremely small number of sherds assigned to the Mogollon Brown Ware type seem very similar to those described for the Pitoche Brown Ware type in the Rio Abajo area (Mera 1935; Marshall and Walt 1984). Variation in surface treatments resulted in the assignment of several pieces of Mogollon Brown Ware to three distinct types: Alma Plain; Pitoche Neckbanded; and Reserve Smudged.

White ware sherds identified at LA 120972 were limited to pieces with white paste and sand or sherd tempers. This resulted in the sherds' assignment to Cibola White Ware types; these comprised 1.5 percent of the sherds from this site. All sherds exhibiting distinct designs were classified as Red Mesa Black-on-white.

The ceramic assemblage at LA 120973 was very similar to that at LA 120972, although there was a slightly higher frequency and greater variety of decorated wares. Assemblages were dominated by plain brown ware types, including Jornada Brown (86.9 percent) and El Paso Brown (5.5 percent). Some of the sherds with Jornada Brown pastes (5.4 percent) exhibited red slip on at least one surface and were classified as Jornada Red Slipped. Other examples with similar pastes (0.8 percent) were decorated with red slip or paint and were classified as Early Jornada Red-on brown.

White wares were represented by sherds assigned to two distinct traditions. The most common of these were assigned to Mimbres White Ware types, which comprised 1.1 percent of the total ceramics. While the absence of specific decoration resulted in some of these sherds being assigned to descriptive types, the decorative style present indicated these sherds were derived from early forms such as Mimbres Black-on-white Styles 1 and 2, which preceded Mimbres Classic. Sherds assigned to Cibola White Ware types represented 0.8 percent of the pottery from this site. Those pieces that could be assigned to distinctive types on the basis of design were assigned to Red Mesa Black-on-white, although it is likely that all of the Cibola White Ware sherds noted were derived from vessels of this type.

Similarities including the overwhelming dominance of brown wares and the presence of Red Mesa Black-on-white seemed to indicate occupations that were largely contemporaneous. The main difference in assemblages from these two sites was reflected in the presence of Mimbres White Ware and in a much higher frequency of early forms of slipped or painted brown wares at LA 12973. The combination of types noted at both sites indicated occupations as occurring during the tenth century. Dates derived from charcoal samples from both sites supported the ceramic-based dating assignments. Radiocarbon dates from three samples collected from LA 120972 resulted in mean dates from the late ninth century; another sample dated to the late tenth century. Most radiocarbon samples collected from LA 120973 resulted in dates clustered between AD 879 and 920 or the early AD 1000s.

Other Contemporaneous Sites in the Region

Assemblages for the two sites investigated during the Carrizozo project make up part of a larger cultural manifestation that remains poorly documented and defined. While several, loose, classification frameworks proposed for the Northern Jornada region include sites with a material culture similar to that noted at the two Carrizozo sites (Caperton 1981; Kelley 1984; Lehmer 1948; Toulouse and Stephenson 1960), a specific period, phase, focus, or other unit, defined by a combination of material culture and span of occupation, has not yet been defined. This has made it difficult to group and discuss sites in the area that are both similar and contemporaneous to those examined as part of this project.

As noted, the closest example of a defined complex both contemporaneous and similar to that represented at the two ceramic sites investigated here is the Tajo phase of the Rio Abajo region (Hogan and Winter 1981; Marshall and Walt 1984). The Tajo phase was originally defined in surveys of riparian zones and the surrounding piñon-juniper uplands of the Rio Abajo country to referred to manifestations thought to date between AD 800 and 1000.

Occupations associated with this phase are characterized by an inter-mixing of Mogollon and Anasazi traits. Ceramic assemblages associated with this phase are defined by a mixture of local brown ware and intrusive Red Mesa Black-on-white. Tajo phase sites are described as small, consisting of one to 10 surface units and occasional pit structures (Marshall and Walt 1984).

An example of a Rio Abajo site occupied during this phase is the Fite Ranch site that consists of a pithouse community overlooking San Pedro Wash (Oakes 1986). Of the five pithouses excavated, three were definite habitation structures. In all, 3,724 sherds from this site were analyzed; sherds were dominated by brown wares (95.2 percent) and appear to reflect locally produced varieties of Jornada Brown (Baldwin et al. 1986; Warren 1986). Red slipped examples were classified as Jornada Red. Most white wares were described as Early Chupadero Black-on-white; these were also described as having designs similar to those noted on Red Mesa Black-on-white. Radiocarbon dates indicated that occupation of the site occurred around AD 955.

Characterizations of ceramics from two sites along the base of Chupadera Mesa—Taylor Draw or LA 6565 (Peckham 1976) and LA 71276, just east of Bingham (Levine 1997)—show close similarities between pottery from the two Carrizozo project sites.

Radiocarbon dates from a pithouse at LA 71276 indicated that occupation of this site likely occurred between AD 800 and 1000, while archaeomagnetic dating indicated occupation between AD 930 and 1010 (Levine 1997). The Chupadera Mesa sites were dominated by similar brown wares. The low frequency of white ware was dominated by Red Mesa Black-on-white, with lower frequencies of Mimbres wares derived from earlier forms like Mimbres Boldface. Also present were red slipped and red-on-brown sherds.

The most extensive excavation of a site dating to this time span took place at the Taylor Draw site on a low ridge near the southern end of Chupadera Mesa (Peckham 1976). Investigations at this site resulted in the excavation of 22 slab lined, surface rooms arranged in straight or arched rows, four pithouses, and a kiva (Peckham 1976). Tree-ring dates from Taylor Draw indicated an occupation spanning from the late tenth to early eleventh centuries. Ceramics included Jornada Brown, Red Mesa Black-on-white, early Mogollon White Ware types, and red slipped and early red-on-brown forms. This seems very similar to pottery noted at the sites investigated during the Carrizozo project, as the 25 sites recorded during a survey of Taylor Draw displayed similar combinations of ceramic types (Peckham 1976).

One pithouse excavated at the kite site—also along the base of Chupadera Mesa—included Jornada Brown, Red Mesa Black-on-white, and several different black-on-white types (Rautman 1991). The site was ceramic dated between AD 900 and 1100. One feature yielded a radiocarbon date of approximately AD 979.

It is more difficult to interpret the relationship of the pithouses excavated at the Gran Quivira pithouse village (Fenenga 1956). Pottery from both excavations was poorly described, although Jornada Brown and gray ware pottery were both reported. Pottery from these sites was interpreted as reflecting occupations during the Basketmaker III or Pueblo I periods (Fenenga 1956). It possible this site may have been occupied during the San Marcial period and that occupation took place before those at previously discussed sites.

Evidence of a contemporaneous occupation in the Sierra Blanca region to the east appears to be reflected by a combination of ceramics and dates from LA 30949 on the Mescalero Reservation (Del Bene et al. 1986; Wiseman 2001). The pottery assemblage recovered from a large pithouse was dominated by Jornada Brown but also included Mimbres White Ware (Styles 1 and 2). Other pottery included red ware similar to San Francisco Red, a local bichrome, Reserve Tularosa Black-on-white, Three Rivers Red-on-terracotta, and Chupadero Black-on-white. Tree-ring and radiocarbon dates indicated an occupation between AD 875 and 925 (Del Bene et al. 1986; Wiseman 2001).

Regional Trends and Connections

The analysis of pottery from both ceramic-period sites examined during the Carrizozo project indicated important archaeological manifestations mostly spanning the tenth century. Similar characteristics noted in other assemblages indicated close connections between tenth century sites in the Rio Abajo and those found along Chupadera Mesa and in the Sierra Blanca region. Pottery assemblages from all of these sites appeared to reflect combinations of influences from long occupied cultural areas to the west including Mimbres Mogollon and Cibola Anasazi regions. The pottery also reflected influences from other areas, such as the El Paso region to the south and other local developments, which gave rise to the distinct cultural complexes commonly associated with the Northern Jornada branch of the Mogollon.

Connections with other regions were reflected by the low frequency of pottery exhibiting the distinct combination of traits present in Mimbres Mogollon and Cibola Anasazi ceramic types. This pottery exhibited distinct technological and stylistic attributes as well as a combination of tempers and pastes indicative of the region of production (Tables 10.3 and 10.4).

Most of the pottery examined during the Carrizozo project displayed pastes and tempers indicative of production at Chupadera Mesa and other areas of the Northern Jornada region (Tables 10.3 and 10.4). This pottery exhibited a combination of traits indicated in the transition from earlier ceramics produced in the Mogollon Highlands to later Jornada types. This included plain, polished brown wares with characteristics transitional between Alma Brown and Jornada Brown as well as those with characteristics intermediate between Mogollon Red-on-brown and later Three Rivers Red Ware types.

Both Mera (1943) and Lehmer (1948) noted that the distinct material culture later associated with the Northern Mogollon was influenced by traits from the San Marcial phase of the Rio Abajo region (Marshall and Walt 1984). The importance of the area examined during this study to the transition between developments in different regions is alluded to by Wiseman (1985) who notes similarities between the Claunch focus of the Gran Quivira region and the later Corona and Lincoln phases in the Sierra Blanca region.

Wiseman also suggested that other aspects of material culture associated with later Corona and Lincoln phases in the Northern Jornada were strongly reminiscent of the Claunch and Gran Quivira foci and that manifestations assigned to these phases may have resulted from migrations

Table 10.3. LA 120972, paste distribution, by ware type.

	White ware		Red ware		Brown ware, plain		Total	
Paste	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Indeterminate	1	4.8%	–	–	–	–	**1**	**0.1%**
Sand	1	4.8%	–	–	–	–	**1**	**0.1%**
Sherd and sand	17	81.0%	–	–	–	–	**17**	**1.4%**
Leucocratic igneous, El Paso area	–	–	–	–	5	0.4%	**5**	**0.4%**
Fine Jornada leucocratic igneous	–	–	1	100.0%	1148	98.9%	**1149**	**97.1%**
Oblate shale and sand	1	4.8%	–	–	–	–	**1**	**0.1%**
Jornada-like with mica	–	–	–	–	8	0.7%	**8**	**0.7%**
Vitrified	1	4.8%	–	–	–	–	**1**	**0.1%**
Total	**21**	**100.0%**	**1**	**100.0%**	**1161**	**100.0%**	**1183**	**100.0%**

of groups to the north. Wiseman (1985) felt that the Capitan phase—as defined by Lehmer (1948) for the northern sequence of the Jornada Mogollon—was more connected to the Southern Jornada Mogollon region or El Paso area to the south.

While most components of the Capitan phase were dated later than those discussed in this study, and were also found further south, similarities between the two manifestations warrant mention.

Ceramics from sites in the San Andres Mountains and Tularosa Basin dating to the eleventh century—and reflecting characteristics originally described for the Capitan phase—exhibited similarities to tenth century components to the north (Kemrer 2005, 2007; Laumbach et al. 2002; McCluney 1961, 1962), which also have been described in this study.

One important similarity between these two manifestations is the presence of Mogollon White Ware types. Mimbres Black-on-white pieces from sites described during this study were derived from Bold Face or Transitional Black-on-white (Styles 1 and 2), while those from eleventh century Capitan phase sites to the south were mainly derived from Mimbres Classic Black-on-white (Style 3).

Also of significance was the presence of pottery assigned to San Andres Red-on-terracotta (Kemrer 2005, 2007; Laumbach et al. 2002; McCluney 1961, 1962). This type seemed to represent the transition between red-on-brown forms described in the present study and Three Rivers Red-on-terracotta common at sites across the Jornada region dated to after the thirteenth century. Some of these assemblages may also have contained early forms of Chupadero Black-on-white.

The Capitan phase seems to reflect the geographic extension of a material culture that first developed in the Rio Abajo and Chupadera regions and later extended into areas to the south. This is supported by radiocarbon dates that indicate an occupation at LA 86736, between Carrizozo and Tularosa, from AD 1000–1130 (Laumbach et al. 2002). Ceramics from this site include Jornada Brown, San Andres Brown, Jornada Red Slipped, and Mimbres Classic Black-on-white. Such trends are also supported by investigations of the Cedar Well site on the west slope of the southern San Andres Mountains. Assemblages of ceramic types—from middens yielding dates from the tenth and eleventh centuries—indicate a sequence of change involving various Mimbres White Ware types and early red-on-terracotta types (Kemrer 2005, 2007). Later Chupadero and Three Rivers Red-on-terracotta types were not recovered from these early middens. Further investigations and comparisons are required before the exact nature of this sequence can be understood.

It is likely that the combination of tenth century assemblages in the Rio Abajo and Chupadera regions and the slightly later assemblages to the south attributed to the Capitan phase are part of a related sequence of development.

This sequence reflects a transition between the earliest ceramic phases containing early plain brown wares and later assemblages typically associated with Northern Jornada Mogollon occupations and

Table 10.4. LA 120973, temper distribution, by ware type.

	White ware		Red ware		Brown ware, plain		Total	
Temper	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Sand	3	8.6%	–	–	–	–	**3**	**0.1%**
Sherd and sand	5	14.3%	–	–	–	–	**5**	**0.2%**
Leucocratic igneous, El Paso area	–	–	–	–	58	3.2%	**58**	**2.9%**
Fine Jornada leucocratic igneous	–	–	141	100.0%	1776	96.8%	**1917**	**95.4%**
Mogollon volcanics	21	60.0%	–	–	–	–	**21**	**1.0%**
Sand and Mogollon volcanics	1	2.9%	–	–	–	–	**1**	**0.0%**
Oblate shale and sand	5	14.3%	–	–	–	–	**5**	**0.2%**
Total	**35**	**100.0%**	**141**	**100.0%**	**1834**	**100.0%**	**2010**	**100.0%**

commonly identified by the presence of Chupadero Black-on-white and Three Rivers Red-on-terracotta.

Trends in Vessel Use and Function

Surface characteristic and vessel form categories noted during this study may provide clues about the importance and nature of activities in which pottery vessels were used. Such information could be used to address various research questions, including those related to changing subsistence practices and strategies.

Functional trends were documented through the recording of basic ware categories and ceramic groups, as well as through categories that reflected the shape and portion of the vessel from which the sherd was derived. The probable shape and form of vessels from which sherds were derived was determined by rim shape, the presence and location of polishing and painted decorations, and other traits commonly indicative of intended use. Rim sherds provided specific information about the shape of the original vessel; the curvature of rim sherds and vessels provided clues about the overall size of an object.

The dominance of expediently built, undecorated brown wares found in some early ceramic assemblages may reflect the use of ceramics designed to supplement a mobile hunter-gatherer adaptation in which pottery vessels were characterized as ceramic containers that evened out spatial and temporal resource variation (Mills 1989). Prior to the introduction of agriculture and ceramics, most groups dealt with resource heterogeneity with both mobility and storage. Pottery provided technological alternatives to full scale mobility (Mills 1989).

One model for understanding changes in the form and technology of pottery involves the distinction between maintainable and reliable technological systems (Mills 1989). Maintainable systems sacrifice durability for other attributes like portability, while more reliable systems provide for increased durability. The expected characteristics of ceramic vessels reflecting maintainable systems include simple and easily transferred manufacturing and repairing techniques, a lack of backup systems, portability, and use in a limited range of tasks. Containers associated with reliable production systems are abundant and sturdy, with specialized forms being more resistant to failure during specific tasks. Items associated with reliable systems require specialized manufacturing and firing techniques that are more time consuming.

Examples of highly maintainable systems are represented by the earliest ceramic assemblages apparent in most Southwest regions where ceramics are exclusively represented by brown ware forms largely made with local alluvial clays (Crown and Wills 1996; LeBlanc 1982; Reed et al. 2000; Stark 1995; Wilson and Blinman 1993; Wilson et al. 1996). Mills (1989) notes that widespread trends regarding the gradual shift from maintainable to reliable production systems are reflected in ceramics associated with various periods of the Anasazi.

Such changes include increased differentiation of wares—gray versus white—as well as an increase in decorated wares through time, from the Basketmaker III to Pueblo III periods (Wilson and Blinman 1995). For example, in many Anasazi regions, decorated white ware in a range of forms represented 5 percent of the total ceramics created during the Basketmaker III period; more than 10 percent created during the Pueblo I; more than a third created during the Pueblo II; and almost half of that found in Pueblo III assemblages.

The lack of such dramatic changes—as well as the dominance of similar brown wares during the same temporal span in the Jornada Mogollon region—may reflect a continuation of more mobile patterns resulting in the lesser need for reliable containers. In contrast, the transition from overall brown wares to increasingly specialized and decorated forms may reflect the emergence of a slightly more reliable production system.

Assemblages examined in this study reflect the highly conservative nature of ceramic technology in the Jornada Mogollon region. The majority of pottery from both sites is represented as plain brown ware (Table 10.5). For example, 98.1 percent of the pottery at LA 120972 was brown ware. Brown ware comprised 91.3 percent of the total pottery found at LA 120973. The lower frequency of brown ware at LA 120973 was reflected by a higher frequency of sherds displaying red slip or red decoration on at least one surface; these sherds represented 6.5 percent of the findings from this site and only 0.2 percent at site LA 120973. The frequency of sherds assigned to white ware categories was low at both sites—1.8 percent at LA 120972 and 1.7 percent at LA 120973.

Table 10.5. Ware distribution, by site.

	LA 120972		LA 120973	
Ware	**Count**	**Col. %**	**Count**	**Col. %**
White	21	1.8%	35	1.7%
Red	1	0.1%	141	7.0%
Brown	1161	98.1%	1834	91.2%
Total	**1183**	**100.0%**	**2010**	**100.0%**

Vessel forms at these two sites indicated similar, but not identical, functional patterns (Tables 10.6 and 10.7). Plain brown wares from both sites were represented by a combination of bowls and jars—bowl rims outnumber jar rims about two to one. The occurrence of bowls was even higher in samples from LA 120973, where the majority of sherds found represented bowls. While most white ware sherds from LA 120972 appeared to have come from jars, the majority of white ware sherds from LA 120973 were from bowls. This indicates the dominance of Red Mesa Black-on-white jars at LA 120972 and the prevalence of early Mimbres White Ware bowls at LA 120973.

Table 10.6. LA 120972, vessel form distribution, by ware type.

	White ware		Red ware		Brown ware, plain		Total	
Vessel	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Indeterminate	1	4.8%	–	–	–	–	**1**	**0.1%**
Bowl rim	–	–	–	–	68	5.9%	**68**	**5.7%**
Bowl body	2	9.5%	1	100.0%	–	–	**3**	**0.3%**
Jar neck	2	9.5%	–	–	69	5.9%	**71**	**6.0%**
Jar rim	3	14.3%	–	–	27	2.3%	**30**	**2.5%**
Jar body	13	61.9%	–	–	2	0.2%	**15**	**1.3%**
Body sherd, polished interior/exterior	–	–	–	–	514	44.3%	**514**	**43.4%**
Body sherd, unpolished	–	–	–	–	158	13.6%	**158**	**13.4%**
Body sherd unpolished interior/polished exterior	–	–	–	–	251	21.6%	**251**	**21.2%**
Body sherd, polished interior/unpolished exterior	–	–	–	–	72	6.2%	**72**	**6.1%**
Total	**21**	**100.0%**	**1**	**100.0%**	**1161**	**100.0%**	**1183**	**100.0%**

Table 10.7. LA 120973, vessel form distribution, by ware type.

	White ware		Red ware		Brown ware, plain		Total	
Vessel	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Indeterminate	–	–	–	–	1	0.1%	**1**	**0.0%**
Bowl rim	5	14.3%	32	22.7%	40	2.2%	**77**	**3.8%**
Bowl body	27	77.1%	98	69.5%	–	–	**125**	**6.2%**
Jar neck	–	–	4	2.8%	140	7.6%	**144**	**7.2%**
Jar rim	1	2.9%	2	1.4%	25	1.4%	**28**	**1.4%**
Jar body	1	2.9%	5	3.5%	50	2.7%	**56**	**2.8%**
Cloud blower	1	2.9%	–	–	3	0.2%	**4**	**0.2%**
Seed jar rim	–	–	–	–	2	0.1%	**2**	**0.1%**
Body sherd, polished interior/exterior	–	–	–	–	1111	60.6%	**1111**	**55.3%**
Body sherd, unpolished	–	–	–	–	44	2.4%	**44**	**2.2%**
Body sherd, unpolished interior/polished exterior	–	–	–	–	309	16.8%	**309**	**15.4%**
Body sherd, polished interior/unpolished exterior	–	–	–	–	93	5.1%	**93**	**4.6%**
Indeterminate rim	–	–	–	–	16	0.9%	**16**	**0.8%**
Total	**35**	**100.0%**	**141**	**100.0%**	**1834**	**100.0%**	**2010**	**100.0%**

11 ⸸ Chipped Stone Analysis

Karen Wening

A total of 915 chipped stone artifacts were recovered from LA 114462, LA 130331, LA 120972, and LA 120973 (Table 11.1). The majority of the assemblage was recovered from prehistoric sites LA 120972 (n = 221) and LA 120973 (n = 674), both Capitan-phase sites. Small assemblages were recovered from LA 130331 (n = 15), which appeared to have been an Archaic campsite, and from LA 114462 (n = 5), the site of the historic Oscura Siding LA 114462.

Project sites represented a broad span of time, from Archaic to early Formative to Historic. In addition to this broad temporal range there also were considerable variations in the size of chipped stone assemblages between sites.

The people who occupied Formative sites LA 120972 and LA 120973 in the past appear to have employed nearly identical chipped stone technology, material selection, and tool use. An expedient core-reduction strategy was used at both sites, and while local materials dominated both areas, a significant percentage of chert appeared to have been derived from stone-tool sources throughout the Tularosa Basin.

Material Types

In his study of lithic-type distribution in the southern Tularosa Basin, Carmichael noted that stone-tool sources are overwhelmingly local (1986:183). Church et al. arrived at a similar conclusion in the Jornada Mogollon area, stating that "the overwhelming consensus" of regional lithic-sourcing studies was that locally available materials prevail in the area (Church et al. 1996:28). Church et al. also noted that the definition of the word "local" can vary.

The Carrizozo lithic-material assemblage reflected this pattern as well. A wide variety of material types and qualities were represented in the chipped stone assemblage, most of which appeared to be from local sources (Table 11.1). This conclusion was partially based on the predominance of waterworn cortex, which indicated that tool-stone materials had been re-deposited by water and were not likely to have been collected from their original source. It is important to note that rocks are virtually absent in the basin area around LA 120972 and LA 120973, so travel to stone sources would have been required.

Church et al. (1996) identified predominant Jornada Mogollon materials as limestone, rhyolite, quartzite, chert (four types), basalt, obsidian, jasper (three types), silicified shale, and welded tuff. While most of these materials are represented in the project assemblage, only chert and rhyolite comprised significant percentages.

Chert comprised the majority (n = 535/915; 58 percent) of materials in the project area. Eleven types of chert were observed. Gray and brown chert accounted for nearly half of all material types (47 percent) present. Project cherts varies considerably in quality and range, from very fine grained materials with excellent conchoidal fractures to coarser grained types riddled with internal flaws. Nearly half of all cherts (n = 245/535; 47 percent) display fractures, or vugs that could have adversely affected fracture quality. Igneous rocks, consisting mainly of andesite and granodiorite, account for more than a third (n = 363/915; 37 percent). Quartzite, limestone, sandstone, and obsidian were present in very low frequencies. Sandstone flakes are likely the result of ground stone-tool manufacture, as sandstone seemed to have been most frequently chosen, after rhyolite, for tools in the southern Tularosa Basin (Carmichael 1986:165). Sandstone was also used in the project's ground stone tools.

Local Materials

Sedimentary: Chert (n = 449)

Gray chert (n = 290): Gray chert appeared to be locally available and highly abundant. Project gray chert may have been derived from the several outcrop formations in the Sacramento Mountains. It

Table 11.1. *Chipped stone distribution, by site, material type, category, and source.*

Material Category	Material Type	LA 114462	LA 120972	LA 120973	LA 130331	Category Subtotal	Total
Local							
Sedimentary chert	gray chert	2	24	261	3	449	**290**
	brown chert	–	23	116	4		**143**
	Magadi-type chert	–	1	14	1		**16**
Igneous and metamorphic	andesite	–	53	84	–	361	**137**
	basalt	1	17	17	5		**40**
	granodiorite	–	37	46	–		**83**
	gabbro, black and white	–	–	5	–		**5**
	granite	–	21	6	1		**28**
	red rhyolite	–	8	9	–		**17**
	gray rhyolite	–	5	24	–		**29**
	igneous, unidentified	–	–	1	–		**1**
	quartzite, tan, brown	–	1	16	–		**17**
	quartzite, purple	–	2	2	–		**4**
Other sedimentary	limestone	2	1	5	–	17	**8**
	sandstone	–	–	9	–		**9**
Tularosa Basin							
Sedimentary chert	white chert	–	23	17	–	86	**40**
	San Andres chert	–	–	9	1		**10**
	pink chert	–	–	6	–		**6**
	light pink to orange chert	–	3	6	–		**9**
	dark pink chert	–	–	13	–		**13**
	red chert	–	1	4	–		**5**
	red mottled chert	–	–	2	–		**2**
	yellow brown chert	–	–	1	–		**1**
Exotic							
Igneous	obsidian	–	1	–	–	2	**1**
	Polvadera Peak obsidian	–	–	1	–		**1**
Total		**5**	**221**	**674**	**15**		**915**

is similar to Magadi-type chert, which outcrops in the Carrizozo area less than 16 km (10 mi) north of the project area.

Gray cherts from the project assemblage displayed an identical color range, with the addition of yellowish brown and yellowish gray.

In addition to this Carrizozo source, gray chert outcrops can be found in several formations in the Sacramento Mountains. Gray cherts of the El Paso formation outcrop in nodules and seams rarely more than 5–8 cm thick (Pray 1961:31).

Light gray chert nodules occur in the Valmont formation (Pray 1961:45; Church et al. 1996:19). Banks noted that chert sources abound in the Tularosa Valley and the bordering mountains (1990:81). High-quality gray cherts from the Carrizozo assemblage may have originated from La Tuna or Lake Valley formations in the southern Sacramento Mountains (Church et al. 1996:65).

Chert found in the Jarilla Mountains ranges in color from greenish beige to medium blue or dark blue to gray to black, with gray colors grading to reddish purple (Banks 1990:82). Carmichael referred to a light gray chert that outcrops in the Lake Valley formation (1986:162). Pray also described large, abundant, light colored chert nodules in this formation, though specific color was not listed (Pray 1961:63). Gray chert is also described as "abundant" in the Fusselman formation (Pray 1961:47).

The range in color and quality of project gray cherts was typical of those in the mountain ranges surrounding the Tularosa Basin (Wiseman, personal communication, 2011). Whether gray chert was obtained from the Carrizozo area, Willow Draw, or various mountain outcrops, it appeared to have been an abundant and readily available material.

Brown chert (n = 143, 35; 27 percent) was the next, most common chert type after gray. Similar to gray chert, brown chert is primarily fine grained. Flaws are less frequent, occurring in just over one-third (n = 53/143; 37 percent) of the samples. Considerable overlap in the gray and brown project cherts suggests these may have had the same source or could represent a single type. Sources for brown chert are rarely encountered in literature. The brown chert source recorded most often for the Jornada Mogollon is Rancheria chert.

The gray-to-brown color range is characteristic of Rancheria chert, which outcrops in the Jarilla and Organ mountains to the south. Fracture quality of Rancheria chert is uniformly referred to as moderate to poor (Railey 2002:581; Banks 1990:8; Pray 1961:67). Brown, yellow brown, light brown, black, and dark gray occur within this type, with the full range of colors sometimes present in a single piece (Carmichael 1986:167; Pray 1961:67). Gray and brown banding is also characteristic of type.

Carmichael noted that Rancheria chert is widely distributed in the southern Tularosa Basin (1986:170). Since the Jarilla-Organ mountains source for Rancheria chert is closer to Carmichael's study area than to the project area, such a wide dispersion might not extend as far as the northern Tularosa Basin.

Another possible source of brown chert is the Fusselman formation in the Sacramento Mountains. This chert is gray to grayish brown and often weathers to a yellowish brown (Pray 1961:47). Most Fusselman formation outcrops can be found at less accessible, higher elevations south of the project area.

Magadi-type chert (n = 16) is dense and ranges in color from light gray to dark gray to black to greenish or reddish brown (Moore 1996:70–71).

Igneous and Metamorphic (n = 361)

This category comprised more than one-third of the chipped stone assemblage and includes andesite, basalt, red and gray rhyolite, gabbro, granodiorite, granite, and various unidentified igneous materials (Table 11.1). These materials outcrop in the sills and dikes of the Sierra Blanca Complex, which consist of four formations—Walker Andesite Breccia, Nogal Peak Trachyte, Church Mountain Latite, and Godfrey Hills Trachyte—with Walker Andesite Breccia comprising the majority of eruptive rocks (Thompson 1972).

Igneous materials occur at higher elevations in the Sacramento Mountains, but are locally available as pebbles (Kelley 1984:2). Rhyolite outcrops in the Sacramento Mountains but is found only in small plugs and dikes at Cone Peak (Church et al. 1996:101). Rhyolite cobbles have been noted at Willow Draw during fieldwork.

The majority of igneous rocks are medium grained (n = 195/340; 57 percent), with 40 percent fine grained and 2 percent coarse grained. Church et al. (1996:97,111) categorized these materials as non-glassy volcanic, generally coarse grained, and more difficult to work with than cryptocrystalline cherts; however, they were commonly used in both chipped stone and ground stone-tool manufacture.

Findings at LA 120972 and LA 120973 reflect this trend. Many of the materials in this category were used for ground stone tools. Flakes of these materials might have been debitage resulting from ground stone-tool production.

Andesite and Basalt (n = 177): Among project sites, black aphanitic andesite and basalt were the most frequently used chipped stone materials after chert. Most andesite was fine grained (n = 74); though medium grained was almost equally represented (n = 63). This material typically displays good conchoidal fractures and few internal faults.

Rhyolite (n = 46): This material is abundant throughout the Tularosa Basin as both a primary and secondary source. The use of rhyolite as a toolstone material increased in popularity during the Formative period (Carmichael 1986).

Gray and red rhyolite types comprised most of the assemblage, ranging from aphanitic to porphyritic. All project rhyolite appear to have originated from outcrops in the Sacramento Mountains (Railey 2002:583), and remains abundant at nearby Willow Draw.

Two distinctive rhyolite types from the Jornada Mogollon—Soledad, from the Organ Mountains, and Thunderbird, from the Franklin Mountains—were not encountered. These material types are poorly suited to chipped stone-tool manufacture (Church et al. 1996:101).

Kelley described rhyolite as somewhat unworkable and better suited for ground stone-tool manufacture (1984:2).

Granodiorite, Gabbro, and Granite (n = 116):

Debitage of these coarser grained materials may have been the result of ground stone-tool manufacture, as was noted for some regional projects (Carmichael 1986:165; Kelley 1984:2; Railey 2002:581; Zamora and Oakes 2000:Table 86). It is important to note that all debitage comprised of this material was unmodified and unworn. This may have provided further evidence of its relationship to ground stone-tool production. The cortex was exclusively waterworn, suggesting it had been retrieved in cobble form from Willow Draw.

Quartzite (n = 21): Quartzite was infrequent in the chipped stone assemblage and may have been used for both chipped stone and ground stone tools. Quartzite comprised a higher percentage of the ground stone assemblage than chipped stone (18 percent to 2 percent, respectively). As quartzite ground stone tools commonly displayed scars resulting from shaping and hammerstone use, this material may have rarely been used for chipped stone tools.

Tan, brown, dark brown, black, and purple comprised the color range across both assemblages; quartzite was exclusively medium-to-coarse grained, suggesting it may have been better suited to ground stone-tool use.

Quartzite occurs in several formations in the higher elevations of the Sierra Blanca (Kelley 1984:2), in the Sacramento Mountains (Church et al. 1996:78), in alluvial deposits of the Rio Grande (Railey 2002:583), and in the Franklin and Organ mountains (Carmichael 1986:166). The presence of unmodified quartzite pebbles in the ground stone assemblage suggested that this material was acquired from a secondary source, possibly Willow Draw.

Sedimentary: Other (n = 17)

Limestone (n = 8) is perhaps one of the most common rocks in the Sacramento Mountains. The waterworn cortex predominated on this material as well, indicating a local, secondary source. Limestone outcrops in numerous formations of the Sacramento Mountains, including the San Andres, Yeso, Holder, Gobbler, Rancheria, and Lake Valley (Pray 1961:12). San Andres limestone id usually more than 305 m thick and occurs on most escarpment areas of the Sacramento Mountains (Pray 1961:114).

Sandstone (n = 9) also occurs in several outcrops of the Sacramento Mountains, including Bliss Sandstone, the El Paso formation, and the Oñate formation (Pray 1961:27, 30, 50). Flakes of this material most likely resulted from ground stone-tool production.

Tularosa Basin Materials

This category covers a range of stone-tool sources from local to exotic that will be addressed further in the summary discussion. Most of these materials outcrop at higher mountain elevations surrounding the Tularosa Basin. They also may be obtained from drainages sourced at higher elevations; secondary sources such as these were not encountered in literature possibly because the distance to these sources from the project area ranged from 16–32 km (10–20 mi).

The Tularosa Basin category consisted entirely of chert. Together, these types represented less than 10 percent of the project's chipped stone assemblage. The presence of this type of material may be a potential indicator of trade or travel within the periphery of the Tularosa Basin and in the higher elevations of the bordering foothills.

Sedimentary: Chert (n = 86)

Multiple sources are possible for most cherts in this color range, most of which were found a considerable distance from the project area. While numerous chert outcrops were noted in the mountains bordering the Tularosa Basin, color is not often mentioned.

One exception was Ziegler's 2009 study of the Bonney Canyon member in the San Andres formation, in which a variety of chert colors were documented. Ziegler's study focused on four quadrangles in the southeastern Sacramento Mountains, about 32–48 km (20–30 mi) from the project area. Ziegler reported the occurrence of abundant medium to large chert nodules, ranging in color from white to yellow to orange, red, and dark purple (2009). The distinctive, banded San Andres chert also occurs in the Bonney Canyon Member.

If these chert types consistently occur in various outcrops of the San Andres formation, their range of availability may have decreased to about 16 km (10 mi) northeast and west of the project area. Whalen (1994b:92) noted that stone, after eroding downslope from mountain sources, could have been exploited from piedmont zones; this included chert materials from the Bonney Canyon Member.

San Andres Chert (n = 10): Also referred to as Fingerprint chert, this distinct, high quality, gray-banded material is found in the San Andres formation (Church et al. 1996:70; Ziegler 2009). This formation outcrops about 16 km (10 mi) north of the project area in the Sacramento Mountains and about 16 km (10 mi) west in the San Andres Mountains.

More distant and extensive outcrops of the San Andres formation occur in the Sacramento Mountains, about 32–48 km (20–30 mi) southeast of the project area and in the Zuni Mountains (Kilby and Cunningham 2002). Extensive outcrops of this material also can be found in the vicinity of the Two Rivers Dam west of Roswell, NM.

Cortex was notably absent on nearly every artifact of this type. Only one flake displayed the waterworn cortex indicative of a secondary source. The remaining nine pieces indicated a similar or contrasting source.

Red and Red-Mottled Cherts (n = 7): The occurrence of red chert, or jasper, may be another indication of travel or trade. No local sources of red chert are encountered in literature. The nearest source for this material appears to be the Jarilla Mountains to the south (Church et al. 1996:105).

Red cherts are also described as constituents of the Bonney Canyon Member of the San Andres formation (Ziegler 2009). More distant outcrops of red chert occur at Antelope Mesa and Eagle Mountain, south of the project area (Kurota and Chapman 2010).

White, Pink, Dark Pink, Yellow Brown, and Light Pink to Orange Chert (n = 69): As with red chert, no local source was indicated for cherts in the pink to orange color range. The nearest source may be the Bonney Canyon Member of the San Andres formation, described above (Ziegler 2009). A much more distant source for this chert may be Narbona Pass, also known as Washington Pass.

The color range displayed by project chert was nearly identical to this Chuska Mountain material (Banks 1990:63). Banks stressed that these western New Mexico material sources do not occur in Rio Grande gravels (1990:65). The single, yellow brown chert may be jasper from the Jarilla Mountains in the southern Tularosa Basin (Banks 1990:82).

The color range specified for the far more distant Narbona Pass was similar to those found among project sites and also included white. The considerable distance to this source decreases, but did not preclude, the likelihood of its use.

For the lighter pink and white colors, Narbona Pass appears a more likely source than the Jarilla Mountains, as only brown, yellow, and red shades have been noted in that area. Travel to the Jarilla Mountain area within the Tularosa Basin would have been plausible for site occupants, particularly if the two large sites represented cool season residential sites.

Approximately three-quarters (n = 53/73; 73 percent) of the two preceding chert groups were non-cortical debitage, which could also indicate a non-local source for these materials. Site occupants may have retrieved chert from mountain outcrops or from nearby Willow Draw, which has its source high in the Sacramento Mountains both east and north of the project area.

Cortex, where observed, was almost exclusively waterworn, suggesting site occupants retrieved this material from nearby Willow Draw. Willow Draw cuts through a variety of outcrops from its high-elevation source down to the basin floor, providing the opportunity for multiple material types to be transported to the site.

Exotic Materials

Obsidian (n = 2)

Polvadera Peak Obsidian (n = 1): Of the two obsidian artifacts found, one was sourced, through macroscopic observation, to Polvadera Peak in the Jemez Mountains in north-central New Mexico. No cortex was present, but the small size and singular occurrence suggested it may have had a secondary source in Rio Grande river gravels as an Apache tear.

Obsidian (n = 1): The second obsidian artifact was clear gray and also indicated a possible Jemez Mountain source. However, this flake was also devoid of cortex, reducing the likelihood of a secondary source.

Analysis Methods

OAS standard analysis was used for the chipped stone assemblage (OAS 1994). The technological and scientific explanation for each attribute was based on methods used for the Santa Teresa chipped stone assemblage (Moore 1996:114–118).

Eleven universal attributes were applied to all debitage and tools. Five of these were material characteristics—used to recognize a number of material traits, including: lithic type; color; banding; and inclusions. Each unique combination of traits constituted a single material type. Material quality referred to grain size and flaws; grain size ranged from glassy to coarse—glassy was applied only to obsidian, while the majority of cherts were fine grained. Rhyolite, andesite, quartzite, gabbro, granite, and basalt ranged from medium to coarse grained. Quality identified the suitability of the material for reduction. Material color, banding, and inclusion were noted to help identify stone-tool sources as closely as possible; quality and color were both subjective attributes.

Other universal analysis attributes were artifact morphology and function, cortex percentage and type, portion, dimension, and weight. Artifact morphology types were composed primarily of core-flakes, angular debris, and cores. Flakes were separated from angular debris by the presence of a striking platform, bulb of percussion, and termination; flakes were additionally analyzed to determine platform type, platform lipping, dorsal scarring, and distal termination. Moore described the technological basis for these attributes (1996:116–117).

Crabtree (1972) noted that "platform type is an indicator of reduction technology and stage." Any modification was noted, as were missing and collapsed platforms. Platform lipping was usually indicative of soft hammer reduction and could also be an indication of later reduction stages. Analysis of dorsal scarring was based on whether flake scars originating on the dorsal side of a flake were present. These sometimes opposing scars were often evidence of removal from a biface. This type of distal termination made it possible to determine whether removal had been successful or ended prematurely; distal termination also provided data on manufacturing versus post-removal breakage.

Cortex was recorded in 10 percent increments. For example, a flake with 6 percent cortex would have been categorized as 10 percent; a flake with 11 percent would have been recorded as 20 percent. For flakes, the cortical percentage applied to the combined dorsal surface; for angular debris, the entire surface area was used. Cortex type, whether found on the platform or on the dorsal side, was categorized as either waterworn or non-waterworn; this was essential in identifying material sources as primary or secondary. Portion referred to the artifact portion being examined. Angular debris was always coded as whole; flakes were separated into proximal, distal, lateral, and medial fragments.

As Moore noted, flakes were categorized into primary, secondary, or tertiary reduction stages based on cortex percentage (Moore 1996; CNMA in prep.). Primary flakes were those with at least 50 percent of their dorsal surfaces covered with cortex; secondary flakes were those with less than 50 percent of dorsal cortex, and tertiary flakes exhibited no dorsal cortex. Noting problems with these definitions, Moore used flake categories to inform on reduction strategy and the condition of nuclei when arriving at a site.

OAS standard analysis employed a polythetic set adapted from Acklen (1983) to identify biface manufacturing flakes. This polythetic framework required artifacts meet 70 percent of specified conditions. These conditions modeled an idealized biface flake and included information on platform morphology, flake shape, and earlier removals (Moore 1996:117).

All artifacts were microscopically examined within a 15X–80X magnification range. Higher magnification was used to identify edge-wear patterns, platform modifications, and material-type inclusions. Utilized and modified edge angles were measured with a goniometer. Dimensions were taken using a digital sliding caliper. All analysis data were entered into a computerized database using the Statistical Package for the Social Sciences program. All statistics, tables, and scatterplots were generated from this database.

Analysis Results

Ceramics from Formative period sites in the project area were related somewhat to a Capitan phase association. The first phase of the northern Jornada sequence, the Capitan phase was dated from AD 900–1100 and was followed by the Three Rivers and San Andres phases. The southern Jornada sequence was comprised of the Mesilla, Doña Ana and El Paso phases. The Mesilla phase, AD 200–1100, was divided between early and late at approximately AD 700 (Whalen 1981).

Opinions varied as to the applicability of each sequence to the Jornada region. Similarities between the northern and southern Jornada led some to propose the use of one sequence for the entire region. Noting the identical hallmarks and dates of the two phase sequences, Wiseman proposed use of the southern sequence for the entire region by dividing the Mesilla into early and late phases based on Whalen's study (1981b). Hogan, in examining ceramic types of the two Jornada sequences, stated that the northern version was the most applicable to southeastern New Mexico (2006:4–12). Levine noted that the boundaries for the Capitan phase were unclear and that few descriptions were available (Levine 1991:5).

LeBlanc and Whalen noted that Jornada del Muerto settlement patterns were similar to those in the Tularosa Basin and Hueco Bolson (1980:334). They specifically noted the contemporaneous beginnings of pithouse villages in the northern and southern Jornada (1980:319). The two largest project sites, LA 120972 and LA 120973, dated to the late ninth and early tenth centuries, the same as the early Capitan or the contemporaneous late Mesilla phase. Because late Mesilla site data were in greater supply in literature than were Capitan phase data, Mesilla data will be used here for comparative purposes.

The Mesilla phase marked the beginning of significant changes in chipped stone assemblages, which continued into the later Formative period (Carmichael 1986; Condon et al. 2010:263–266; Whalen 1994b:92–93). The preceding Archaic period was characterized by a curated technology focused on biface tool production. In contrast, Mesilla-phase chipped stone assemblages were the result of a dominant, expedient core-reduction technology. The diminishing importance of biface tool manufacture in the Mesilla phase was considered characteristic of the Jornada Mogollon (Railey 2002:27). High quality stone was the favored material in the Archaic, shifting to coarser grained, lower quality materials in the Mesilla. Chipped stone assemblages comprised an overwhelming majority of the project's Formative period sites and reflected the above changes in technology and material use.

Approaches to Reduction Strategy

A number of approaches have been devised to determine lithic-reduction strategy. Sullivan and Rozen (1985:755) provided a comprehensive review and critique of numerous methods, concluding that "technological origins of debitage cannot, in most cases, be reliably inferred from key attributes observed on individual specimens, and that the manufacture of chipped stone artifacts is more realistically viewed as a continuum rather than as a set of distinct technological events."

Sullivan and Rozen challenged definitions of non-tool and tool debitage categories (1985:755–758). Citing numerous studies, they noted that cortex percentages can be influenced by factors including raw material type and availability, core size, reduction intensity, and regional procurement strategies. Tool debitage categories that employed combinations of selected flake attributes were equally problematic in that they suffered from inconsistent application, contrasting variables, and technological assumptions.

To address these issues, Sullivan and Rozen offered an alternative approach based on relative percentages of four debitage categories: whole flakes; broken flakes (proximal ends); flake fragments; and angular debris. Percentages of cores were also included. Together, they observed that core-reduction assemblages had high percentages of whole flakes and cores and low percentages of broken and fragmentary flakes.

In contrast, tool-manufacturing assemblages had high percentages of broken and fragmentary flakes and low percentages of cores and whole flakes as revealed in the Tuscon Electric Power project, or TEP (Sullivan and Rozen 1985:762). Tool-manufacturing debitage yielded higher percentages of lipping and platform faceting than core-reduction debitage (Sullivan and Rozen 1985:764). Late Paleoindian and Archaic sites in the TEP project were characterized by soft hammer biface manufacture; early Archaic sites, in contrast, yielded a combination of hard hammer, core-and-tool manufacture debitage, with less soft hammer biface reduction than Late Archaic sites (Sullivan and Rosen 1985:767).

Moore observed that most southwestern cultures likely used a combination of curated and expedient reduction strategies (1996:235), noting that use of only one strategy was rare.

Curated strategies involved the use of both local and exotic materials and are often associated with mobility. Large bifacial preforms were produced from high quality materials curated for future tool manufacture. In contrast, expedient reduction strategies used mostly local materials. Cores were expediently reduced to produce flakes used in unmodified form.

Similar to Sullivan and Rozen, Moore also identified problems with traditional debitage definitions, noting that non-cortical debitage was not always an indication of tool manufacture but was useful in determining reduction strategy and the condition of nuclei transported to the site (CNMA in prep.). Moore examined a variety of statistics and ratios to determine the dominant reduction strategy for the Santa Teresa (Moore 1996:246–262) and CNMA projects.

Santa Teresa, a Mesilla phase site, and the Mockingbird Site, a late Mesilla/early Doña Ana phase site, most often exhibited expedient core reduction (Moore 1996:271). The CNMA assemblage, in contrast, indicated use of both expedient and efficient strategies, part of most Archaic analytic groups.

At the Late Archaic component of LA 65006, near San Ildefonso Pueblo, both strategies were used, but not in combination; efficient reduction was employed for exotic materials, and expedient reduction was used for local materials (Moore 1993:82–90).

These previously mentioned reports supplied base line data for reduction strategy indicators from both Archaic and Formative period sites and are used here for comparative purposes. Many reduction-strategy indicators are employed here as well.

Analysis of an assemblage using multiple methods resulted in useful comparisons. The OLE project (Acklen 1993:454–455) compared the results of two methods, one of which employed flake condition (Sullivan and Rozen 1985) and the other, flake size (Patterson 1990). Acklen concluded that the two approaches complemented one another but said that Patterson's flake-size approach was most useful in identifying core reduction on sites initially classified as tool-manufacture areas (Acklen 1993:454–455).

Few differences were observed in reduction strategies between Archaic and Anasazi sites from the OLE project, possibly because Anasazi assemblages could not be isolated (Acklen 1993:463). The Carrizozo assemblage was analyzed using the two approaches described.

It should be noted that sites LA 114462 and LA 130331 yielded extremely small assemblages and, as such, could not be significantly analyzed for reduction strategy, as percentages were skewed. The analysis below focuses on LA 120972 and LA 120973, where the majority of chipped stone was recovered (n = 895; 98 percent). The primary goal of chipped stone analysis is to identify material types and sources, to identify the dominant reduction strategy used at each site, and to determine specific chipped-stone activity areas.

Reduction Technology: Two Comparative Analyses

Reduction-Strategy Indicators

The first comparative analysis was based on the methods outlined for the Santa Teresa and CNMA projects (Moore 1996; CNMA in prep.). For the Santa Teresa assemblage, Moore listed eight characteristics indicative of reduction-strategy style and provided a technical explanation for each. Moore noted that while none of these traits was sufficient enough to specify reduction strategy, the combined results proved a more reliable indicator (1996:248):

Non-cortical debitage: Lower percentages of non-cortical debitage occurred in expedient strategies as a result of decreased tool manufacture, as compared to curated strategies. Non-cortical debitage resulted from the removal of flakes from extensively reduced cores (Moore 1996; CNMA in prep.). This was likely the case at project sites, as the majority of reduction-strategy indicators suggested a dominant expedient strategy. Both LA 120972 and LA 120973 assemblages represented secondary reduction, with 10 percent or less of all findings showing signs of primary reduction (Table 11.2).

Non-cortical, secondary flake debitage clearly dominated both sites. In addition to the dominant use of an expedient reduction strategy, the high percentage of secondary flakes could have been the result of the reduction of large cobbles from nearby Willow Draw. A different scenario existed at LA 114462 and LA 130331; here, tertiary reduction flakes dominated the sites, indicating the use of a curated strategy focused on tool manufacture.

Biface manufacturing flakes: Very low percentages of biface manufacturing flakes were expected in expedient strategies since fewer tools were being manufactured. Using the polythetic set as defined above, biface-flake percentages varied considerably among project sites (Table 11.3). As Moore noted for the Santa Teresa assemblage (1996:257–258) biface flakes were more accurately identified using the polythetic set, since seven out of 10 attributes were needed to define biface flakes. If biface flake identification was dependent on any single

Table 11.2. Dorsal cortex percentage on flakes, by site.

Cortex %	LA 114462	LA 120972	LA 120973	LA 130331
Primary Reduction				
50.0%–100.0%	0	15	29	1
	–	11.0%	7.0%	10.0%
Secondary Reduction				
1.0%–49.0%	1	23	77	3
	25.0%	16.0%	18.0%	30.0%
Tertiary Reduction				
0.0%	3	103	319	6
	75.0%	73.0%	75.0%	60.0%
Total flakes*	**4**	**141**	**425**	**10**

* Total does not include ground stone flakes, strike-a-light flakes, and pot lids.

Table 11.3. Biface flake frequencies and percentages, by attribute and site.

Attributes	LA 114462	LA 120972	LA 120973	LA 130331
Polythetic set	–	5	41	5
	–	2.2%	6.0%	33.3%
Platform modification	–	3	9	–
	–	1.3%	1.3%	–
Platform lipping	–	18	36	–
	–	–	5.3%	–
Diffuse bulb	2	64	132	2
	40.0%	45.0%	31.0%	20.0%
Waisting	–	1	7	–
	–	1%	2%	–
Ventral curvature	1	1	2	2
	20.0%	1.0%	0.5%	20.0%
Total flakes	**5**	**141**	**425**	**10**

Frequencies and percentages based on various attributes and the polythetic set (after Moore 1996: 258 and CNMA: 16–17, n.d.).

attribute, the amount of biface flakes could have increased significantly. This was clearly demonstrated in the Santa Teresa assemblage that used opposing dorsal scars, platform modification, and platform lipping as single-attribute indicators of bifacial flakes. This was also true for the Carrizozo assemblage where biface flakes identified only by a diffuse bulb increased the percentage by nearly 43 percent over the 2 percent determined when the polythetic set was used.

Moore used three different sets of variable combinations to identify biface flakes for the CNMA assemblage. In his comparative study of biface-flake percentages, Moore posited that assemblages with less than 2 percent indicated expedient core reduction; those between 3.5 and 10 percent represented both expedient and curated strategies typical of ceramic residential occupations; and those over 35 percent were indicative of a curated strategy characteristic of an Archaic residential population (CNMA in prep.). It should be noted, however, that CNMA biface-flake frequencies were derived by the weighting of three additional attributes: diffuse bulb; waisted appearance; and ventral curvature. The assignment of these weights was based on the frequency of their appearance in the assemblage.

Biface-flake percentages for LA 120972 and LA 120973 fell within the ceramic period residential cat-

Table 11.4. Platform type and category, by site; count and column percent.

Platform Type*	LA 114462	LA 120972	LA 120973	LA 130331	Total
Platform Type, Unmodified					
Cortical	–	28	56	2	**86**
Single faceted	–	38	153	3	**194**
Multifaceted	2	43	120	1	**166**
Platform Type, Modified					
Single faceted and abraded	–	–	2	–	**2**
Multifaceted and abraded	–	2	7	–	**9**
Retouched and abraded	–	1	–	–	**1**
Platform Type, Obscured					
Collapsed	–	6	31	3	**40**
Crushed	–	3	10	–	**13**
Absent (snap)	2	22	47	1	**72**
Absent (broken in manufacture)	–	–	1	–	**1**
Total	**4**	**143**	**427**	**10**	**584**
Platform Category, Frequency and Column Percent					
Unmodified	2	109	329	6	–
	50.0%	76.0%	77.0%	60.0%	–
Modified	0	3	9	0	–
	–	2.0%	2.0%	–	–
Obscured	2	31	89	4	–
	50.0%	22.0%	21.0%	40.0%	–
Total	**4**	**143**	**425**	**10**	–
Platform Category, Frequency and Column Percent, Obscured Platforms Dropped					
Unmodified	2	109	329	6	–
	100.0%	97.0%	97.3%	100.0%	–
Modified	0	3	9	–	–
	0.0%	3.0%	3.0%	0.0%	–
Total	**2**	**112**	**338**	**6**	–

*excluding ground stone flakes, strike-a-light flakes, and pot lids

egory, with 2.2 percent and 6.0 percent biface flakes, respectively. If all flakes with modified platforms had been included, biface-flake percentages would have doubled for LA 120972 and increased by about one-third for LA 120973. While these were significant increases, overall biface-flake percentages remained well within the ceramic period residential category. For project sites, this indicated a dominant expedient strategy with a low occurrence of formal tool production.

Modified platforms: Very few modified platforms occurred in expedient strategies due to the decreased need for reduction control. Modified platforms occurred infrequently in expedient reduction. Platform modification may also have been an indicator of reduction stage. This was useful in determining the full extent of tool manufacture, as flakes removed in early stages of biface production might not have complied with polythetic set requirements (Moore 1996; CNMA in prep.). Platform modification was virtually absent at all project sites, indicating very little formal tool manufacture (Table 11.4). Modified platforms comprised only 3 percent of chipped stone assemblages at LA 120972 and LA 120973 and were absent from LA 114462 and LA 130331. The percentage of modified platforms rose only slightly when obscured platforms were dropped.

Unmodified platforms were evenly distributed among cortical, single facet, and multifaceted types at LA 120972, while LA 120973 was dominated by single facet and multifaceted platforms with comparatively few cortical platforms. The high frequency of unmodified platforms at both sites corresponded with the high core-flake to core ratio

Table 11.5. Chipped stone reduction strategy indicators, by site.

Reduction Strategy Indicator and Percentage of Assemblage	LA 114462 Historic	LA 120972 Capitan Phase	LA 120973 Capitan Phase	LA 130331 Archaic
Total site count	**5**	**221**	**674**	**15**
Percent of noncortical debitage*	core	core	core	core
	75.0%	67.0%	74.0%	73.0%
Percent of biface flakes	core	core	core	tool
	0.0%	2.2%	6.0%	33.3%
Percent of modified platforms	core	core	core	core
	0.0%	2.7%	2.6%	0.0%
Ratio of flakes to angular debris	tool	core	core	core
	0.0%	2.2%	1.9%	2.0%
Percent of manufacture breaks	core	core	core	core
	0.0%	77.2%	63.6%	0.0%
Platform lipping	core	expedient with some curated	expedient with some curated	core
	0.0%	13.7%	10.4%	0.0%
Core flake** to core ratio	core	core	core	core
	2.0%	6.3%	13.7%	0.0%
Reduction strategy	core with some tool manufacture	core with some tool manufacture	core with some tool manufacture	core and tool

*Noncortical debitage includes all flakes and angular debris; ground stone flakes, pot lids, and strike-a-light flakes are excluded.

** Core flakes include whole flakes and proximal fragments only.

Note: Reduction strategy is indeterminate based on small site assemblages.

for both sites. The latter traits indicated a predominance of expedient core reduction. Assemblages with 1 to 9 percent modified platforms indicated a small amount of tool manufacture (Moore 1996; CNMA, in prep.).

Of note was the fairly high percentage of obscured, crushed, or collapsed platforms that made up approximately one-fifth of the two large site assemblages. Crushed or collapsed platforms resulted from excessive force used to reduce very hard or highly flawed material, both of which dominated the project assemblage.

Flake to angular debris ratio: High flake to angular debris ratios occurred in curated strategies based on the need for greater reduction control. Expedient strategies requiring less control resulted in a lower flake to angular debris ratio. Poor material quality also increased the amount of angular debris. Three project sites displayed a very low flake to angular debris ratio (Table 11.5). These low ratios were characteristic of expedient core reduction. The flake to angular debris ratio was affected not only by the reduction strategy used but by the range of material types. For the project sites, this ratio may have been affected by the high percentage of flawed materials in the assemblage. Material flaws were recorded to assess their impact on flake removal. More than one-third of the materials at LA 120972 and LA 120973 were flawed. However, material flaws did not always adversely affect fracture quality. Whole flakes could have been removed from flawed material. Since more than half of all flakes were whole, it appeared that material flaws were not a major influence on fracture quality (Table 11.6). Project flake to angular debris ratios were similar to those CNMA assemblages assigned to expedient reduction status (Moore 1996; CNMA in prep.).

Flake Breakage Patterns: Very low percentages of manufacturing breaks occurred in expedient reduction because few thin, fragile flakes were being produced. Moore examined flake breakage patterns in the results of chipped stone-reduction experiments (Moore 1996:247–248; CNMA in prep.). He concluded that fracture patterns differ depending on the type of reduction employed. Flakes struck from tools are far more likely to display manufac-

Table 11.6. Flake portion frequency and percentage, by site.

	LA 114462	LA 120972	LA 120973	LA 130331	Total
Portion Frequency					
Indeterminate fragment	–	1	1	–	**2**
Whole	2	76	241	9	**328**
Proximal	–	6	18	–	**24**
Medial	–	2	6	1	**9**
Distal	1	15	28	–	**44**
Lateral	1	41	131	–	**173**
Total	**4**	**141**	**425**	**10**	**580**
Portion Percentage (Col. %)					
Indeterminate fragment	–	0.7%	0.2%	–	0.3%
Whole	50.0%	53.9%	56.7%	90.0%	56.6%
Proximal	–	4.3%	4.2%	–	4.1%
Medial	–	1.4%	1.4%	10.0%	1.6%
Distal	25.0%	10.6%	6.6%	–	7.6%
Lateral	25.0%	29.1%	30.8%	–	29.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 11.7. Flake material quality, by site.

Material Quality	LA 114462*	LA 120972	LA 120973	LA 130331*	Total
Unflawed materials	2	149	403	4	**558**
Row %	40.0%	67.0%	60.0%	27.0%	
Flawed materials	3	72	271	11	**357**
Row %	60.0%	33.0%	40.0%	73.0%	
Total	**5**	**221**	**674**	**15**	**915**

* No snap or manufacturing fractures for LA 114462 and LA 130331.

turing breaks, while flakes struck from cores primarily display snap fractures.

While other factors influence flake breakage patterns, Moore concluded that fewer flakes are broken in core reduction than in tool production. Moore delineated percentage categories for snap and manufacturing breaks and associated reduction strategies. Snap fractures in more than 60 percent of an assemblage suggest an expedient technology, while assemblages with less than 60 percent are associated with curated strategies.

Assemblages at LA 120972 and LA 120973 displayed a low percentage of snap fractures and a high percentage of manufacturing breaks, indicating a curated reduction strategy (Tables 11.7 and 11.8). The assemblage at LA 120973 had a lower percentage of manufacturing breaks than LA 120972. This is interesting considering that LA 120973 had a higher percentage of biface flakes, which highlights the need for multiple reduction-strategy indicators.

Platform lipping: Lower percentages of platform lipping occur in expedient reduction. Platform lipping is the result of soft hammer percussion used in biface tool manufacture. However, it is only marginally related to strategy, as soft hammer percussion is also used in core reduction. Platform lipping also is an indication of reduction technique. Soft hammer percussion is used in both core reduction and tool manufacture and cannot be used as a sole indicator of tool manufacture. It is, however, more commonly employed in the latter (Moore 1996:245).

This attribute was absent at the smaller sites LA 114462 and LA 130331. It was present, however, in

Table 11.8. Flake breakage patterns, by site.

	LA 120972		LA 120973	
Flake Portion	**Snap Fracture**	**Manufacturing Fracture**	**Snap Fracture**	**Manufacturing Fracture**
Proximal	3	1	13	5
Medial	2	–	5	–
Distal	–	2	–	6
Lateral	–	13	2	24
Total	**5**	**16**	**20**	**35**
Row %	22.8%	76.1%	36.4%	63.6%

Table 11.9. Platform lipping and dorsal scar distribution, by site.

	Platform Lipping			Dorsal Scars		
Site	**Present**	**Not Present**	**Total**	**No Opposing Scars**	**Opposing Scars**	**Total**
LA 114462	0	2	**2**	0	4	**4**
Row %	0%	100%	**100%**	0%	100%	**100%**
LA 120972	17	102	**119**	140	0	**140**
Row %	14%	86%	**100%**	100%	0%	**100%**
LA 120973	36	310	**346**	410	15	**425**
Row %	10%	90%	**100%**	96%	4%	**100%**
LA 130331	0	9	**9**	5	5	**10**
Row %	0%	100%	**100%**	50%	50%	**100%**

low percentages at LA 120972 and LA 120973 (Table 11.9), where approximately one-tenth of the flake assemblage displayed lipping. Interestingly, although the majority of lipping occurred on cryptocrystalline chert materials, a significant percentage occurred on rhyolite and andesite. Andesite and rhyolite were harder, denser materials and may have been less responsive to soft hammer percussion.

Opposing dorsal flake scars: Because this attribute was a rare occurrence even when tool manufacture was taking place, it was considered an unreliable indicator of reduction strategy (Moore, personal communication, 2011). For this reason, this attribute was not used in this report.

Core-flake to core ratio: Increased tool production resulted in a high flake to core ratio in an assemblage. Conversely, a low flake to core ratio occurred in expedient reduction. The core-flake to core ratio was highest in tool manufacture assemblages where large numbers of flakes were produced (Moore 1996; CNMA in prep.). This project reflected the opposite scenario, where low core-flake to core ratios occurred on three sites, indicating the expedient production of flakes for informal tools or tool blanks (Moore 1996; CNMA in prep.). There were, however, some mediating circumstances, such as the size of the tool being produced.

Flake to core ratios were very low for LA 114462, LA 120972, and LA 120973. No cores were recovered from LA 130331 (Table 11.10). The highest ratio was at LA 120973, with 9.3 flakes per core. The low number of flakes relative to cores suggested that a large portion of chipped stone reduction was occurring away from the site or that cores were small or of low quality. As nearby Willow Draw was the likely source of stone, it was possible cores were being reduced there and that expediently produced flakes were brought to the sites at a later time. Low flake-cortex percentages may have offered additional confirmation of this off-site reduction theory. Secondary and tertiary core reduction typically resulted in a majority of non-cortical debitage. This was the case at LA 120972, LA 120973, and LA 130331. Little evidence of primary reduction existed at these sites.

Considerable variations existed for the core-flake

Table 11.10. Chipped stone artifact morphology distribution, by site.

Artifact Morphology	LA 114462	LA 120972	LA 120973	LA 130331	Total
Debitage					
Angular debris	–	63	221	5	**289**
Flakes					
Core flake	4	136	382	5	**527**
Resharpening flake	–	–	1	–	1
Notching flake	–	–	1	–	1
Biface Flakes					
Biface flake	–	4	37	5	**46**
Early stage biface	–	1	3	–	**4**
Middle stage biface	–	–	1	–	**1**
Cores					
Tested cobble	–	2	–	–	**2**
Core	–	–	1	–	**1**
Unidirectional core	1	10	14	–	**25**
Bidirectional core	–	–	2	–	**2**
Multidirectional core	–	2	7	–	**9**
Other					
Pot lid	–	–	2	–	**2**
Strike-a-light flake	–	–	1	–	**1**
Ground stone flake	–	3	1	–	**4**
Total	**5**	**221**	**674**	**15**	**915**

Table 11.11. Biface, biface flake, and core ratios, by site.

	LA 114462	LA 120972	LA 120973	LA 130331
Core flakes*	2	77	223	5
Cores	1	14	24	0
Core flake* to core ratio	2.0	5.5	9.3	no cores
Core flake* to biface flake ratio	no biface flakes	15.4	5.4	1.0
Biface flakes	0	5	41	5
Large bifaces	0	0	0	0
Biface flake to large biface ratio	no large bifaces	–	–	–

*whole flakes and proximal fragments only

to biface flake ratio among project sites (Table 11.11). Interestingly, LA 120973 displayed the highest ratio at 15.4, while LA 120972 had the lowest at 5.4. The difference between the two sites was based almost exclusively on contrasting percentages of biface flakes, as whole and proximal fragment core-flake percentages were virtually identical. This ratio indicated that biface manufacture at LA 120973 exceeded that at LA 120972. While this activity was not high at either site, if this ratio was taken as a sole indicator LA 120973 appeared to have evidence for about three times as much formal tool manufacture as LA 120972.

Cores

Cores were recovered almost exclusively from LA 120972 (n = 14) and LA 120973 (n = 24), with a single core recovered from LA 114462. The majority were

Table 11.12. LA 120972 and LA 120973, core material type distribution, by artifact morphology.

Material Type	Tested Cobble	Core, nfs*	Unidirectional Core	Bidirectional Core	Multidirectional Core	Total
Local						
Gray chert	–	–	5	–	4	**9**
Brown chert	–	–	2	–	1	**3**
Igneous	–	–	1	–	–	**1**
Basalt	–	–	1	1	–	**2**
Granodiorite	–	–	2	–	–	**2**
Red rhyolite	–	–	–	–	1	**1**
Gray rhyolite	–	–	1	–	1	**2**
Andesite	–	–	9	1	1	**11**
Quartzite	–	–	1	–	–	**1**
Purple quartzite	1	–	–	–	–	**1**
Tularosa Basin						
White chert	1	1	2	–	–	4
Dark pink chert	–	–	1	–	–	1
Red chert	–	–	–	–	1	1
Total	**2**	**1**	**25**	**2**	**9**	**39**

* nfs = not further specified

unidirectional (n = 25) or multidirectional (n = 9). Much lower frequencies occurred for tested cobbles (n = 2) and bidirectional cores (n = 2).

One core was unspecified. One quartzite core also was used as a hammerstone. Cores that served both as hammerstones and abraders were analyzed with the ground stone assemblage.

The most striking aspect of the core assemblage was the dominance of hard, dense materials (n = 21/39; 54 percent). Andesite cores appeared most frequently, combined with a variety of other dense materials (Table 11.12).

Core-material type frequencies contrasted with those of the debitage assemblage, which was dominated by gray and brown chert. The predominance of chert debitage may have resulted from a preference for the material's ability to form sharp flakes. Andesite cores, in contrast, may have been flakes intended for use as abraders (see Chapter 12).

Also of note was the singular presence of white, red, and dark pink chert cores thought to be from Tularosa Basin sources some distance from the project area. Two of the four white chert cores, as well as the pink chert, displayed waterworn cortex, indicating these were obtained from local, secondary sources like Willow Draw.

Chipped Stone Tools (n = 17)

Tools comprised a small percentage of the chipped stone artifact assemblage (n = 17/915; 1.8 percent) (Table 11.13). The majority of the tool assemblage was utilized debitage (n = 10). Formal tools were few in number and consisted of a drill, a denticulate, a side scraper, and an end/side scraper.

Tools were made from cryptocrystalline materials only and included gray chert (n = 7); brown chert (n = 4); white chert (n = 2); and pink chert (n = 1). The majority of tools were of gray and brown chert, both locally available materials. The source of the white and pink chert was unknown but may be local, based on the presence of waterworn cortex.

Informal Tools

Utilized Debitage: All utilized debitage was made of cryptocrystalline materials comprised of gray, brown, white, and pink chert. This category consisted of unmodified core-flakes, biface flakes, and angular debris utilized on one edge. Wear was exclusively unidirectional. Edge angles ranged from 40 to 87 degrees, with a mean of 64.2 degrees. The number of steep edge angles and unidirectional

Table 11.13. Chipped stone tool type and material type, by site..

Material Type	Tool Type	LA 120972	LA 120973	LA 130331	Total
Local					
Brown chert	utilized debitage	–	2	–	**2**
	drill	–	1	–	**1**
	side scraper	–	–	1	**1**
Gray chert	utilized debitage	1	4	–	**5**
	denticulate	–	1	–	**1**
	end/side scraper	–	1	–	**1**
Tularosa Basin					
White chert	utilized debitage	2	–	–	**2**
Pink chert	utilized debitage	–	1	–	**1**
Total		**3**	**10**	**1**	**14**

wear indicated a predominance of scraping activity. Informal tools were generally small.

Drill: This large, brown chert, core-flake fragment was rounded on a projection of the termination. It was otherwise unmodified and was not notched for hafting. The drill measured 54 by 32 by 15 mm and was recovered from the surface of Grid 43N/268E at LA 120973 (Fig. 11.1).

Formal Tools

Projectile Points: Three projectile point fragments were recovered from LA 120973. None could be identified as to type. The first (FS 51) was a small point of red chert measuring 8 by 5 by 1 mm, with one edge having two notches (Fig. 11.2). The stem was V-shaped, and the tip was missing likely due to an impact fracture. It was found 9.4 cm below the surface in Grid 25N/267E.

The second projectile point (FS 119) was of gray chert and measured 11 by 6 by 2 mm (Fig. 11.3). It was corner-notched with one tang; the base was missing. These breakages were probably manufacturing errors. There were small serrations along the mid-section of the artifact. It was recovered in Grid 31N/265E about 23 to 30 cm below the surface.

The final projectile point (Fig. 11.4) was of brown chert (FS 16) with only the proximal end present; it measured 9 by 8 by 2 mm. One side of the point was not flaked, indicating an unfinished point. It may have been tossed into a fire after breaking, as there was evidence of heat damage. It was found in Grid 14N/263E about 15 to 30 cm below the surface.

Side Scraper: This brown chert, angular debris had been unimarginally retouched to a 70 degree angle. It was unutilized, measures 38 by 28 by 11 mm, and was recovered from Level 4 of grid 91N/102E at LA 130331 (Fig. 11.5).

Denticulate: This gray chert, core-flake was a partially manufactured denticulate. Three small flakes had been removed from one edge, creating a serrated profile. The remainder of the edge was unmodified. The unutilized edge angle was 55 degrees. The core-flake measured 43 by 30 by 20 mm and was recovered from the fill of Feature 20 at LA 120973 (Fig. 11.6).

End/Side Scraper: This core-flake fragment was unimarginally retouched along two adjacent edges to 67 and 70 degree angles. Both edges were unidirectionally worn. The tool was roughly triangular in form and was complete. It measured 30 by 20 by 11 mm and was recovered from Level 1, Grid Unit 12N/266E at LA 120973 (**Fig. 11.7**).

Summary

Based on debitage reduction-strategy indicators and the tool assemblage, an expedient core-reduction strategy was dominant at both LA 120972 and LA 120973. Very little evidence of formal tool manufacture existed, as tools were dominated by unmodified, utilized debitage. Interestingly, utilization was virtually absent among the few formal tools in the assemblage. Only one of the three formal tools was utilized: the side/end scraper. Viewing the tool assemblage as sole indicator, expedient core-re-

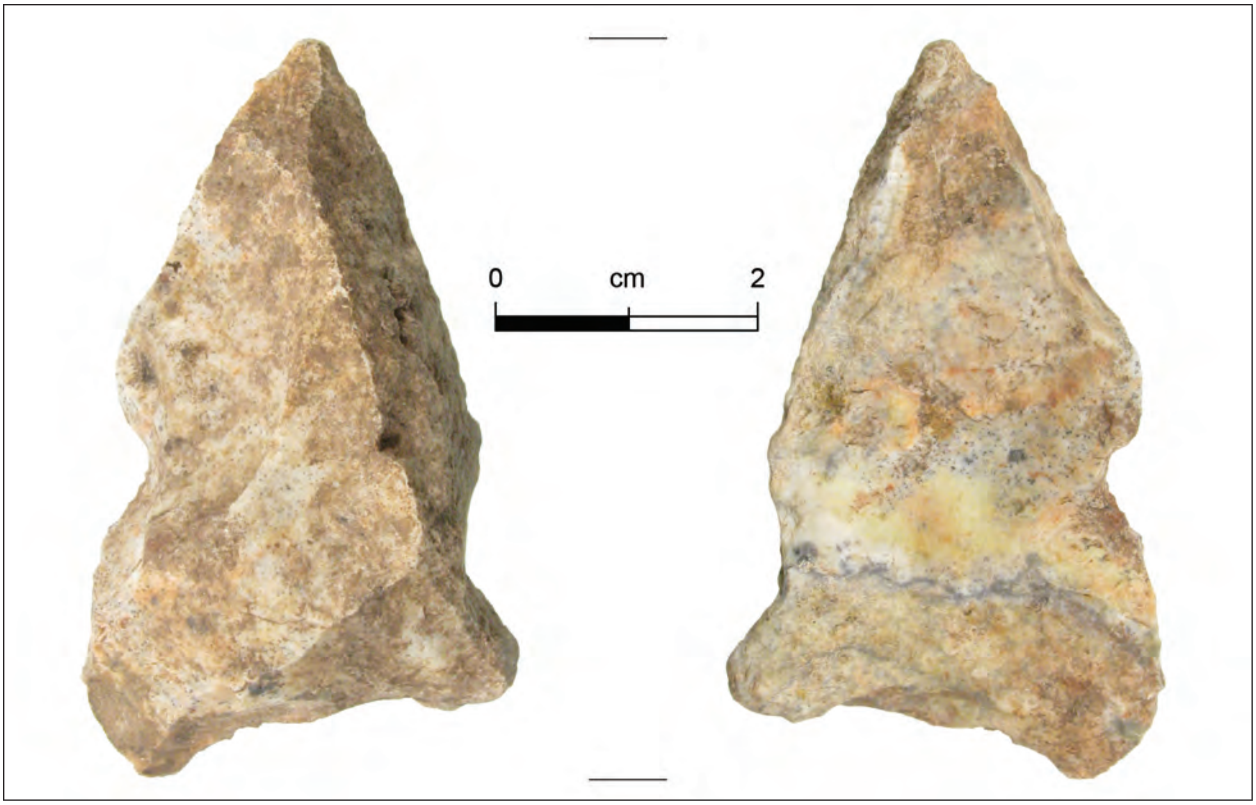


Figure 11.1. LA 120973, drill, brown chert.

Figure 11.2. LA 120973, notched point, red chert.

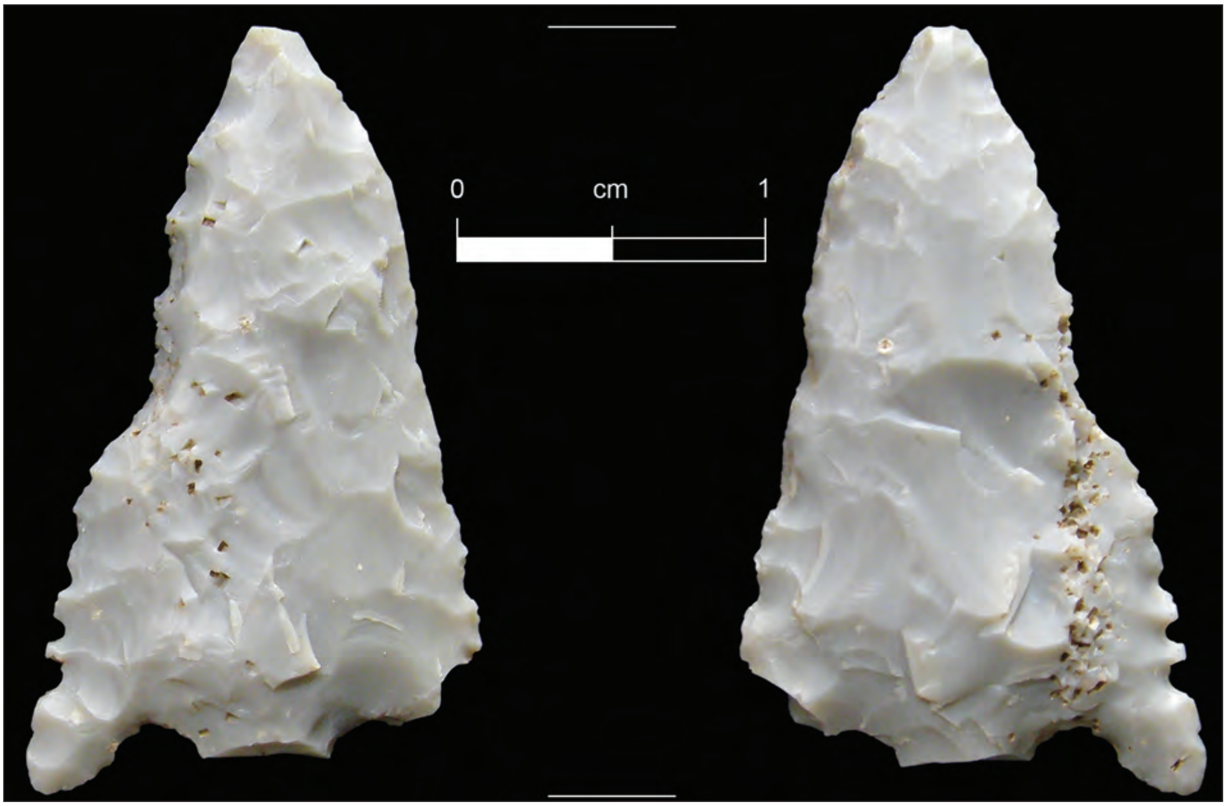


Figure 11.3. LA 120973, corner-notched point, gray chert.

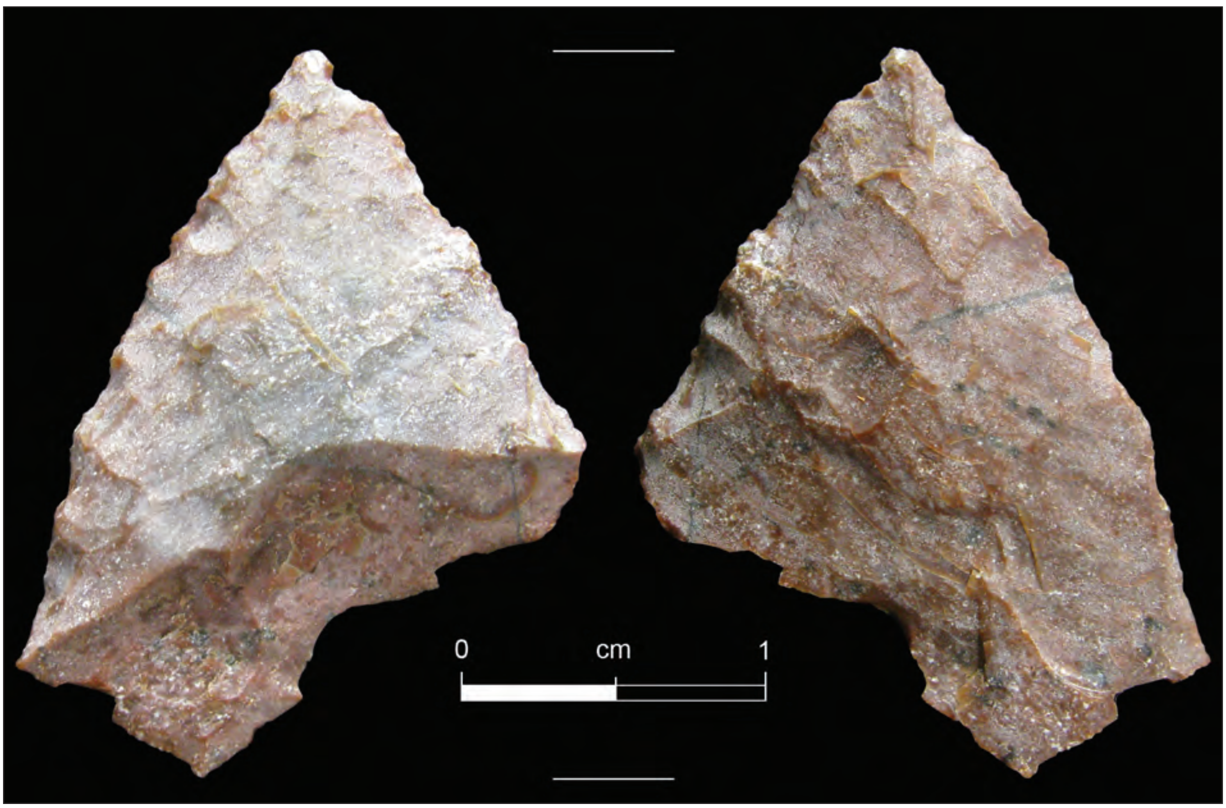


Figure 11.4. LA 120973, partial point, gray chert.

duction strategies appeared to have been the most dominant production technique. Scraping activity clearly dominated, as the mean edge angle for all tools was 64.3 degrees.

Most of the tool assemblage was recovered from LA 120973 (n = 10). The drill, denticulate, end/side scraper, and seven utilized debitage originated from this site. Three utilized debitage tools were found in feature context. Pit Structure 11 and Pits 20 and 21 yielded one utilized debitage tool each.

Of the 10 tools found at LA 120973, six originated in the northern portion of the site where numerous storage pits were located. Only one was found in feature context, in the fill of Storage Pit 21. All tools found in this area, including the drill, were recovered from the top 20 cm of fill. Interestingly, three of the four remaining tools were recovered from the southern end of the site, two from Storage Pit 20 and one from just south of the feature. One utilized debitage tool was recovered from Pit Structure 11.

LA 120972 yielded three utilized debitage tools. None were found in feature fill; however, two were found in extramural areas: one near the Feature 3 pit structure and one near the Feature 1A charcoal pit. All three tools were found in the artifact scatter -hearth area at the extreme north end of LA 120972. Both white chert tools were found there, at considerable distance from one another. LA 130331 yielded a single tool, the brown chert side scraper.

While the chipped stone and tool assemblages were too small to conclusively define the range of activities that might have occurred among the project sites, it was clear that many tasks were performed using expediently produced flakes. In fact, the size of the chipped stone assemblage in general appeared small, given the size and scope of architectural and storage features at the two large sites. Site activities may have focused on tasks less reliant on chipped stone tools. It was also possible that chipped stone reduction and tool use may have occurred off-site, possibly at the Willow Draw source location.

Debitage Condition and Flake Attribute Analysis

The second comparative analysis was based on the method outlined for the Tucson Electric Power (TEP) project (Sullivan and Rozen 1985). The TEP project determined reduction strategy based on debitage condition and relative percentages. To enable comparison with the Carrizozo assemblage, the five flake-portion categories used by OAS were collapsed into the three categories for the TEP project. An additional SPSS attribute was created for TEP debitage conditions.

All proximal and lateral fragments with platform remnants were coded as broken flakes. Medial, distal, and lateral fragments without platform remnants were coded as flake fragments. Flakes with collapsed or crushed platforms were coded as whole for OAS analysis; the TEP project did not specify if these flakes were considered whole.

It should be noted that the TEP project was based on a comparative study of debitage from ceramic and lithic sites, all with substantially larger chipped stone assemblages than the Carrizozo sites. Also, the Carrizozo project did not include Archaic sites of sufficient size with which to compare large ceramic sites, as was done for the TEP project. However, some comparisons were still made between the two projects.

The TEP project restricted its study to locally available chert material in order "to control for technological variability resulting from raw material variation" (Sullivan and Rozen 1985:760–761). To enable comparison with TEP data, all Carrizozo chert materials were combined.

Non-chert materials such as andesite, gabbro, granodiorite, limestone, and rhyolite were not included due to the high variability in fracture quality and grain size and also because non-chert materials were not included in the TEP project.

The results of the Carrizozo project are provided in Tables 11.14 and 11.15. While there was some variation in artifact category percentages between the Carrizozo and TEP assemblages, both LA 120972 and LA 120973 appeared to reflect a dominant use of intensive core-reduction technology similar to TEP Group IB2. There was evidence of unintensive core-reduction technology at the two Carrizozo sites as well.

There were some differences between the two project sites, however. At LA 120972, debitage percentages suggested both unintensive and intensive core reduction was in use, with the latter being the more dominant strategy. Unintensive core reduction was indicated by less debris, fewer retouched pieces, and higher core percentages as compared between LA 120973 and TEP Group IB2.

Table 11.14. Site debitage percentages for chert debitage, cores, and retouched pieces.

	Carrizozo Project Sites				TEP St. Johns and Pitiful Flats* Technological Group			
Artifact Category	**LA 114462**	**LA 120972**	**LA 120973**	**LA 130331**	**IA**	**IBI**	**IB2**	**II**
Whole flakes	50.0%	40.5%	36.3%	0.6%	53.4%	32.9%	30.2%	21.2%
Broken flakes	–	26.6%	21.1%	–	6.7%	13.4%	8.10%	16.8%
Fragmentary flakes	–	16.5%	9.3%	10.0%	16.0%	35.3%	34.70%	51.3%
Debris	–	11.4%	30.0%	20.0%	6.1%	7.9%	23.0%	7.3%
Cores	50.0%	5.1%	2.8%	10.0%	14.7%	2.8%	2.0%	0.6%
Retouched pieces	–	–	0.4%	–	3.1%	7.5%	2.0%	3.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

*adapted from Sullivan and Rozen 1985: Table 2

Table 11.15. Site debitage percentages for chert debitage only.

	Carrizozo Sites				TEP St. Johns and Pitiful Flats**	
Artifact Category	**LA 114462**	**LA 120972**	**LA 120973**	**LA 130331**	**Lithic Sites**	**Ceramic Sites**
Whole flakes	100.0%	42.7%	37.5%	66.7%	18.3% (n = 1036)	24.5% (n = 400)
Broken flakes	–	28.0%	21.8%	–	16.9% (n = 956)	9.8% (n = 161)
Fragmentary flakes	–	17.3%	9.7%	11.1%	57.5% (n = 3260)	42.9% (n = 700)
Debris	–	12.0%	31.0%	22.2%	7.3% (412)	22.8% (n = 372)
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

**adapted from Sullivan and Rozen 1985: Table 5

Whole flake values matched those for intensive core reduction. Interestingly, the TEP assemblage for this technology originated from the "surface of a terrace on which chert cobbles are abundant…and obviously result from unintensive core reduction, i.e., few flakes per core were removed" (Sullivan and Rozen 1985:762). This may have occurred at LA 120972 as well, given its proximity to Willow Draw.

For the most part, LA 120973 reflected the TEP intensive core-reduction strategy values; there were, however, a few exceptions. The high debris, high whole flake, and low broken and fragmentary values were all characteristic of this technology. However, the combined broken and fragmentary flake value was considerably lower compared to LA 120972 and TEP IB2, suggesting unintensive core reduction may have occurred here as well.

The TEP project examined additional variables. Cortex, platform faceting, lipping, and dimensional percentages were tallied for each technological group (Sullivan and Rozen 1985:764). They concluded that additional variables validate technological categories. For example, unintensive, core-reduction debitage consisted primarily of large, thick, cortical flakes; tool manufacturing assemblages were dominated by small, thin, noncortical flakes.

These values were applied to the Carrizozo sites, with less consistent results than those for debitage categories (Tables 11.14 and 11.15). Both sites had thick flakes, yet there were very low percentages of cortical flakes. This may be additional evidence that decortication was occurring in Willow Draw and that reduced materials were brought to the sites where flakes were removed as needed. This may be especially applicable for large cobble source material. Cortical flakes would, therefore, have remained at the source, but sizable flakes could have still been produced from large nuclei transported to the site.

Platform attribute values for both sites were unexpected. LA 120972 and LA 120973 had high percentages of platform faceting and lipping compared with TEP tool-manufacturing assemblages (Table

Figure 11.5. LA 130331, side scraper, brown chert, from angular debris.

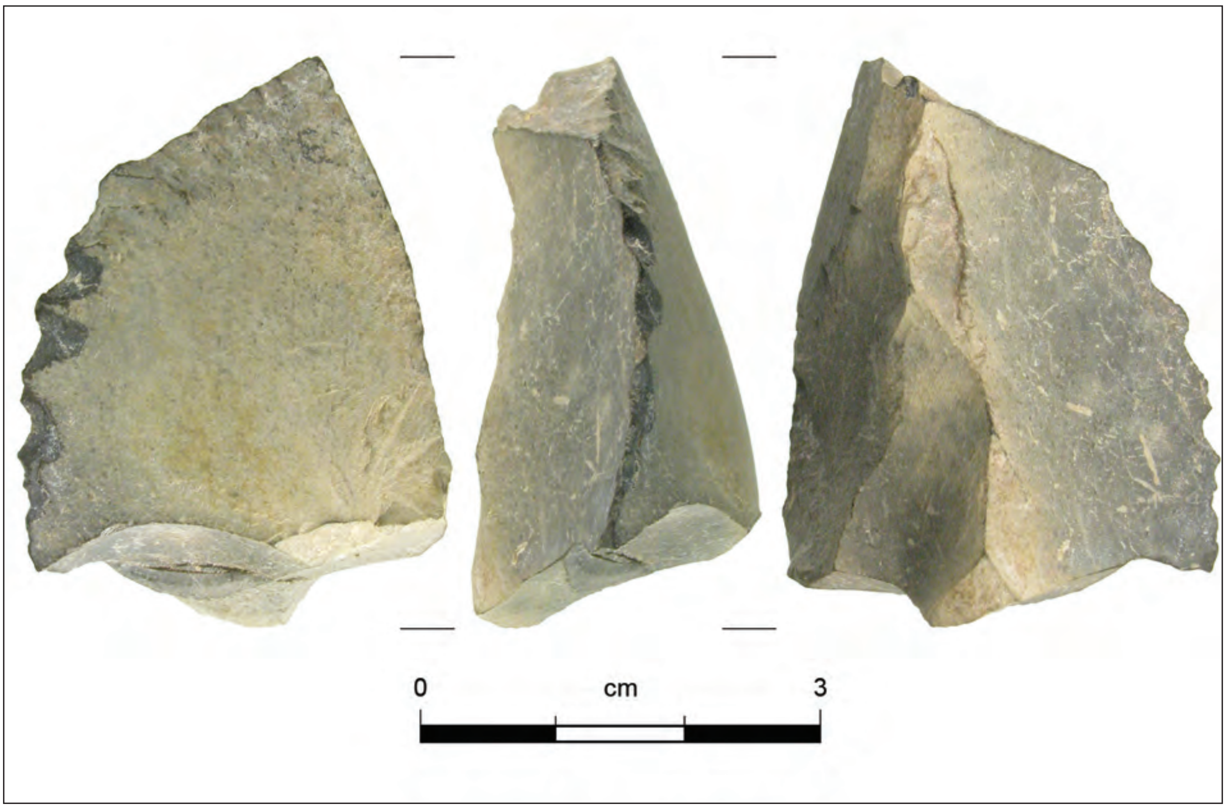


Figure 11.6. LA 120973, denticulate, gray chert.

Figure 11.7. LA 120973, side and end scraper, gray chert.

11.16). Higher percentages of faceted platforms could have resulted from cores being decorticated at Willow Draw and further reduced at the sites.

Lipping resulted from soft hammer percussion used in biface tool manufacture. As there was little evidence of biface tool manufacture in either assemblage, this high lipping value was unexpected. To further examine this attribute, mean size and material distribution are listed in Table 11.17. As expected, most lipping occurred on local gray and brown chert types. Lipped flakes ranged considerably in size, suggesting that soft hammer percussion was used for core reduction as well as for tool manufacture.

Moore noted that hard and soft hammer techniques sometimes overlap, with hard hammer techniques being used in initial biface production and soft hammer techniques used in core reduction (1996:245). However, among whole lipped flakes from project sites, most were non-cortical, suggesting soft hammer percussion was rarely used in decortication (n = 18/24:75 percent, Table 11.18).

To summarize, the majority of debitage attributes for LA 120972 and LA 120973 reflected the use of core-reduction technology. However, both hard and soft hammer techniques were evident. Hard hammer techniques were the most obvious, while soft hammer percussion appeared to have been used only occasionally for both core reduction and tool manufacture.

Site Spatial Distribution

LA 120973: Here, chipped stone artifact distribution was discussed by activity area. The 10 activity areas identified at LA 120973 have been defined both by spatial distribution of artifacts and by the artifacts' relation to each feature (Table 11.19); areas were numbered consecutively from north to south. Chipped stone was recovered from features and extramural areas within each area.

Area 3, the open area around the numerous storage pits, yielded the highest percentage of chipped stone artifacts (n = 251/915; 37 percent).

Table 11.16. Whole chert flake values for Carrizozo and TEP projects.

	Carrizozo Project Sites		TEP St. Johns Project* Core Reduction Technologies			
	LA 120972	LA 120973	Unintensive Core Reduction	Unintensive Core Reduction and Tool Manufacture	Intensive Core Reduction	Tool Manufacture
Artifact Category			IA	IB1	IB2	II
Median flake thickness (mm)	7.5	6.0	8.5	5.1	4.5	3.1
Mean relative thickness (mm)	7.8	8.6	8.4	10.9	10.4	13.1
Cortical flakes (10%+)	23.0%	21.0%	89.9%	44.6%	45.7%	24.0%
Faceted platforms	45.0%	33.0%	8.1%	26.3%	13.1%	39.5%
Lipped platforms	6.0%	13.0%	0.0%	1.6%	6.3%	15.6%
N (all whole chert flakes)	32	167	–	–	–	–

*adapted from Sullivan and Rozen 1985: Table 3

Ground stone artifacts were also clustered in this area (see Chapter 12). Features within Area 3 were Storage Pits 6, 10, 17, 21, 24, and 25.

Perhaps the most interesting find in Area 3 was that the vast majority of chipped stone artifacts (n = 204/251; 81 percent) were found in excavated grid units instead of features (Table 11.20); this suggests activity occurred in the open area between storage pits and that the pits themselves may not have been functionally related to stone chipping activities.

Storage Pit 6, the surrounding postholes, and Feature 10 contained the highest chipped stone frequencies, with 18, 2, and 19 artifacts, respectively; all other features within this concentration yielded small quantities of chipped stone. The majority of chipped stone was recovered in Level 1 and Level 2 grid units and features. Few chipped stone artifacts were found on the surface or in the fill below Level 2.

Area 3 may have served as a chipped stone-reduction area, particularly for gray chert, which made up about half of the material types found (Table 11.21). More than one-third of the exotic materials recovered at this site were found in Area 3; most of these materials were dark pink chert. Four of the seven tools recovered from the site were classified as utilized debitage and were found in this area (Table 11.22).

Area 8 held the second largest concentration of chipped stone (n = 163/674; 24 percent). Located at the southern end of the site, this area included Pit Structure 7, Pit Structure 16, and Storage Pit 20 and contrasted significantly with Area 3 in the distribution of chipped stone. Storage Pit 20 yielded the largest percentage of artifacts recovered from this area (n = 63/163; 38.6 percent), exceeding those found in Area 8 grid units (n = 53/163; 32.5 percent).

The majority of sandstone flakes found here was recovered from Feature 20 fill. While gray and brown cherts were the most numerous, 13 additional material types were recovered from this pit. Such variety, coupled with the occurrence of trash pockets in the pit fill, suggested that this feature served as a refuse area at some point. All chipped stone material was recovered from Level 2; this was particularly interesting considering that maximum pit depth was 55 cm.

Remaining features in Area 8 yielded few chipped stone artifacts. Together, Pit Structures 1, 16, and Fire-Cracked Rock/Ash Concentration 12 contained only about 9 percent of the chipped stone found in the area. Chipped stone was thinly scattered throughout the grid units of Area 8, with a small concentration occurring between Storage Pit 20 and Feature 16.

With the exception of Area 1, all other areas of LA 120973 represented very light, chipped stone concentrations.

Area 1 contained the third largest concentration of chipped stone, representing 12 percent (n = 82) of the total site assemblage. Area 1 encompassed a large portion of the extreme north end of the site. Within this 2,800 sq m area, there was a slightly more concentrated lithic scatter within an area of about 200 m (40N/250E and 60N/260E). Numerous material types were represented here, the majority of which were local.

Area 4 contained less than 10 percent of the as-

Table 11.17. Mean whole chert and obsidian flakes with lipped platforms.

Material Type		Length (mm)	Width (mm)	Thickness (mm)
White chert	Mean	30.0	25.0	8.5
	N*	2	2	2
	SD*	8.5	7.1	4.9
	Minimum	24.0	20.0	5.0
	Maximum	36.0	30.0	12.0
	Range	12.0	10.0	7.0
Carrizozo chert	Mean	18.0	20.0	5.0
	N	2	2	2
	SD	9.9	12.7	2.8
	Minimum	11.0	11.0	3.0
	Maximum	25.0	29.0	7.0
	Range	14.0	18.0	4.0
Pink chert	Mean	9.0	10.0	3.0
	N	1	1	1
Dark pink chert	Mean	24.0	17.0	6.0
	N	1	1	1
Brown chert	Mean	36.3	24.7	7.0
	N	7	7	7
	SD	11.8	6.8	2.6
	Minimum	17.0	14.0	5.0
	Maximum	50.0	33.0	12.0
	Range	33.0	19.0	7.0
Gray chert	Mean	20.0	21.1	6.8
	N	10	10	10
	SD	9.4	10.8	5.3
	Minimum	5.0	6.0	1.0
	Maximum	34.0	41.0	18.0
	Range	29.0	35.0	17.0
Polvadera Peak obsidian	Mean	10.0	14.0	4.0
	N	1	1	1
Total	**Mean**	**24.7**	**21.5**	**6.5**
	N	**24**	**24**	**24**
	SD	**12.5**	**9.0**	**4.0**
	Minimum	**5.0**	**6.0**	**1.0**
	Maximum	**50.0**	**41.0**	**18.0**
	Range	**45.0**	**35.0**	**17.0**

*SD = Standard Deviation; N = count

semblage (n = 66). Pit Structures 11 and 27, and their adjacent grids, were found here. Chipped stone from this area was derived almost exclusively from Level 1 fill from two grid units inside Pit Structure 11 (n = 46/66; 70 percent). This spatial pattern existed across the entire site, with 82 percent of all chipped stone occurring in Levels 1 and 2, in both features and grid units. While all features contained at least a handful of chipped stone artifacts, Storage Pit 20 and Pit Structures 7 and 11, in the central and southern areas of the site, had unusually high frequencies.

The remaining areas yielded small percentages of chipped stone. Area 2, consisting of Storage Pits 19 and 23, contained 42 artifacts; nearly all of them were from Level 1 fill. Area 7 consisted of the open area between Pit Structures 7 and 11, and Storage Pit 8 accounted for only 34 chipped stone artifacts, about 5 percent, all of which occurred in Level 1 fill. Areas 6, 9, and 10 had only single-digit frequencies.

There appeared to be two different patterns of chipped stone distribution at this site. At the north end, chipped stone occurred in open areas between storage pits and rarely within the features themselves. In the central and southern portions of the site, where residential structures were located, the reverse was true. Features contained higher percentages of chipped stone than surrounding grid units. Two patterns became evident: chipped stone was more likely to occur in pit structures than in storage pits and open areas around storage pits tended to have more chipped stone than those near pit structures.

Reduction appeared to have occurred around the storage pits. All of the chipped stone found within the pit structures occurred in fill and may have represented post-occupational deposition. Pit structure floors were completely devoid of chipped stone artifacts.

LA 120972: Chipped stone artifacts were concentrated in three areas of LA 120972 (Table 11.23). Two were found in Component A, at the north end of the site, and one was located at the south end of Component B (Table 11.24). The Component A concentration yielded nearly three-quarters of all chipped stone artifacts from this site (n = 161/221; 73 percent). Artifacts in this area were recovered from three features: Feature 1A, a charcoal pit; Feature 1, the associated activity surface; and Feature 2, a posthole.

A thin scatter was found immediately north of the features. This scatter yielded the majority of chipped stone from Component A, with small frequencies found in Feature 1A and its associated activity surface. The Component A assemblage consisted primarily of unutilized debitage. Three cores, one of which was a core-hammerstone, were found in the 12 m diameter lithic scatter north of the charcoal pit. Two pieces of utilized debitage were also recovered.

The second-largest concentration of chipped stone, less than one-fifth of the assemblage (n = 38/221; 17 percent), was found in Component B. This area, approximately 400 m south of the charcoal pit area, was dominated by the Feature 3 pit structure and other associated architectural features. Artifacts were evenly distributed between pit structure fill and Feature 4 storage pit fill. Interestingly, the majority of chipped stone found in pit structure fill was recovered from Level 2 of grid unit 187S/142E (n = 11/18; 61 percent), with the others originating from adjacent units.

While this may have appeared to be a chipped stone-reduction area, the type and variety of materials indicated otherwise. Tough, coarser grained materials, such as granite, granodiorite, andesite, and rhyolite, dominated. These coarser grained materials occurred in both pit structure fill and associated extramural areas and may have represented byproducts of ground stone-tool manufacture. Cryptocrystalline materials were few and were represented only by white and gray chert.

Table 11.18. Cortex on mean whole lipped flakes.

Dorsal Cortex		Length (mm)	Width (mm)	Thickness (mm)
0	Mean	21.9	20.3	6.1
	N*	18	18	18
	SD*	10.6	8.6	4.1
10	Mean	42.3	31.7	9.0
	N	3	3	3
	SD	11.6	1.2	3.0
20	Mean	25.0	14.0	5.0
	N	1	1	1
	SD	–	–	–
30	Mean	36.0	30.0	12.0
	N	1	1	1
	SD	–	–	–
50	Mean	11.0	11.0	3.0
	N	1	1	1
	SD	–	–	–
Total	**Mean**	**24.7**	**21.5**	**6.5**
	n	**24**	**24**	**24**
	SD	**12.5**	**9.0**	**4.0**

*SD = Standard Deviation; N = count

All remaining chipped stone was recovered from Component A on the east side of US 54. Mechanical surface stripping on the east side of US 54 revealed a light, widely dispersed chipped stone scatter. White chert and andesite (n = 7 and 6, respectively) comprised the majority of chipped stone from the east scatter.

The spatial distribution of chipped stone at LA 120972 revealed few discrete activity areas. Interestingly, cores were almost evenly distributed between the north, south, and east (n = 5, 4, and 4, respectively).

Tools were less evenly distributed. Of the five tools found at the site, three were recovered from the northern portion of the Feature 1A extramural area: two utilized flakes and one core hammerstone. The south area and east lithic scatter yielded one utilized flake each.

One small San Pedro-like projectile point (Fig. 11.8) was found outside the east right-of-way boundary in an extensive artifact scatter. The projectile point was made of gray chert and measured

Table 11.19. LA 120973, chipped stone frequency, by feature, grid unit, and activity area.

	North			Central		South					Total
Grid Unit	**82**	**36**	**204**	**12**	**23**	**5**	**33**	**53**	**5**	**1**	**454**
	Area 1	**Area 2**	**Area 3**	**Area 4**	**Area 5**	**Area 6**	**Area 7**	**Area 8**	**Area 9**	**Area 10**	
Feature No.	**Extreme North End**	**Pits 19, 23, North End Area**	**Pits 6, 10, 17, 24, 25**	**Pit Structures 11 and 27, Surrounding Area**	**Open Area North of Pit Structures 11 and 27**	**Pit Structure 7 and Open Area to West**	**Between Pit Structures 7 and 11, Pit 8**	**Between Structures 1, 7, 16, Pit 20**	**Extreme South End**	**West of Site Proper**	
4	–	–	–	–	–	–	–	1	–	–	**1**
6	–	–	18	–	–	–	–	–	–	–	**18**
7	–	–	–	–	–	–	–	33	–	–	**33**
8	–	–	–	–	–	–	1	–	–	–	**1**
10	–	–	19	–	–	–	–	–	–	–	**19**
11	–	–	–	54	–	–	–	–	–	–	**54**
12	–	–	–	–	–	–	–	2	–	–	**2**
16	–	–	–	–	–	–	–	8	–	–	**8**
16E	–	–	–	–	–	–	–	3	–	–	**3**
19	–	1	–	–	–	–	–	–	–	–	**1**
20	–	–	–	–	–	–	–	63	–	–	**63**
21	–	–	3	–	–	–	–	–	–	–	**3**
17	–	–	5	–	–	–	–	–	–	–	**5**
23	–	5	–	–	–	–	–	–	–	–	**5**
24	–	–	–	–	2	–	–	–	–	–	**2**
6D	–	–	1	–	–	–	–	–	–	–	**1**
6G	–	–	1	–	–	–	–	–	–	–	**1**
Total	**82**	**42**	**251**	**66**	**25**	**5**	**34**	**163**	**5**	**1**	**674**
Grid unit %	100.0%	86.0%	81.0%	18.0%	92.0%	100.0%	97.0%	33.0%	100.0%	100.0%	
Feature %	0.0%	14.0%	19.0%	82.0%	8.0%	0.0%	3.0%	67.0%	0.0%	0.0%	

Table 11.20. LA 120973, chipped stone distribution, by feature, grid unit, and level.

Grid Unit/ Feature	Surface	Level 1	Level 2	Level 3	Level 4	Total	Feature Subtotal	Feature % of Total
Area 1 - Extreme North End								
Grid unit	53	24	5	–	–	**82**	0	0.0%
Area 2, Pits 19 and 23								
Grid unit	4	32	–	–	–	**36**	6	17.0%
Feature 19	–	–	1	–	–	**1**		
Feature 23	–	–	5	–	–	**5**		
Area 3 - Pits 6, 10, 17, 25, and 25								
Grid unit	15	97	90	2	–	**204**	47	19.0%
Feature 6	–	1	4	8	5	**18**		
Feature 10	–	–	19	–	–	**19**		
Feature 21	–	–	3	–	–	**3**		
Feature 17	–	–	5	–	–	**5**		
Feature 6D	–	1	–	–	–	**1**		
Feature 6G	–	–	1	–	–	**1**		
Area 4 - Pit Structures 11 and 27, Surrounding Area								
Grid unit	–	8	4	–	–	**12**	54	82.0%
Feature 11	–	46	8	–	–	**54**		
Area 5 - Open Area North of Pit Structures 11 and 27								
Grid unit	1	15	6	1	–	**23**	2	8.0%
Feature 24	–	–	2	–	–	**2**		
Area 6 - Pit Structure 7 and Open Area to West								
Grid unit	–	5	–	–	–	**5**	0	0.0%
Area 7 - Between Pit Structures 7 and 11, and Pit 8								
Grid unit	2	27	2	2	–	**33**	1	3.0%
Feature 8	–	–	1	–	–	**1**		
Area 8 - Structures 1, 7, 16, Pit 20								
Grid unit	6	29	11	7	–	**53**	109	67.0%
BHT 4	–	–	1	–	–	**1**		
Feature 7	–	–	20	13	–	**33**		
Feature 12	–	2	–	–	–	**2**		
Feature 16	–	6	2	–	–	**8**		
Feature 16E	–	–	3	–	–	**3**		
Feature 20	–	–	63	–	–	**63**		
Area 9 - Extreme South End								
Grid unit	–	4	1	–	–	**5**	0	0.0%
Area 10 - West of Site Proper								
Grid unit	1	–	–	–	–	**1**	0	0.0%
Total level count	**82**	**297**	**257**	**33**	**5**	**674**		
Row %	12.2%	44.1%	38.1%	4.9%	0.7%	100.0%		

2.9 by 2.1 by .2 cm, with a missing tip. This type of point was found extensively throughout the Jornada Mogollon area and suggested an occupation period from about AD 450 to 1450.

The spatial distribution of materials displayed a similar lack of patterning, with a high number of types occurring in all areas of LA 120972. A few low-frequency clusters of granite, granodiorite, white chert, and andesite represented the only possibly discrete areas. Chipped stone tools and materials at this site can be characterized as widely dispersed and intermixed. Perhaps the most distinct spatial distribution of chipped stone occurred in the vertical dimension (Table 11.24 and Table 11.25).

Defined cultural features like the pit structure, the charcoal pit, and associated activity surfaces yielded chipped stone almost exclusively in Level 2 fill. Chipped stone was found in dispersed scatters on the surface. The extramural area surrounding the charcoal pit represented an exception, with artifacts occurring from the surface through Level 3.

LA 130331: The few chipped stone artifacts recovered from this site displayed some spatial patterning. Seven artifacts, including an end scraper and biface flake, occurred within a 1 m radius of Hearth 2. Two basalt debitage artifacts were recovered from hearth fill; most of the remaining chipped stone was scattered within a 10 m radius north of the hearth.

One interesting aspect of the assemblage was the presence of five biface flakes, three of which were found clustered together several meters north of the hearth. Biface flakes were either gray or brown chert.

A wide variety of material types were represented in this small assemblage. Gray, brown, San Andres, and Magadi-type represented cryptocrystalline cherts and basalt; coarse-grained materials were comprised of granite. Most artifacts were recovered from Level 1 and Level 2 fill (n = 7 and 4, respectively) with two found in Level 4.

LA 114462: The five artifacts recovered from this site were widely scattered and were found about 20 to 35 m north of the historic component. The site assemblage consisted of a gray chert, a unidirectional core and four core-flakes. Limestone, basalt, and gray chert materials were represented.

Figure 11.8. LA 120973, San Pedro-like point, gray chert.

Discussion

The predominant use of an expedient core-reduction strategy was indicated at the Carrizozo project sites. This was especially true for the larger sites, LA 120972 and LA 120973. The same strategy appeared to dominate at LA 114462 and LA 130331. The single exception was the high percentage of biface flakes discovered at Archaic period site LA 130331; this number may have been skewed due to low sample size.

Several assemblage characteristics denoted the prevalent use of expedient core reduction. Among these were artifact ratios, including low flake to angular debris ratios and low core-flake to core ratios. Additional indicators included low percentages of manufacturing breaks, platform lipping, modified platforms, biface flakes, and non-cortical debitage. Tools were few in number and most were unretouched, utilized flakes. Formal tools were flakes minimally modified into steep, angled scrapers. Overall, only the barest indication of tool production existed at LA 120972, LA 120973 and LA

Table 11.21. LA 120973, chipped stone material type distribution, by source and activity area.

	North			Central		South					
	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	
Material Type	**Extreme North End**	**Pits 19 and 23**	**Pits 6, 10, 17, 24, and 25**	**Pit Structures 11 and 27, Surrounding Area**	**Open Area North of Pit Structures 11 and 27**	**Pit Structure 7, Open Area to West**	**Between Pit Structures 7 and 11, Pit 8**	**Between Pit Structures 1, 7, 16, Pit 20**	**Extreme South End**	**West of Site Proper**	**Total**
Local											
Gray chert	27	19	116	17	7	2	11	60	1	1	**261**
Brown chert	9	11	40	22	3	–	8	22	1	–	**116**
Magadi-type chert	–	1	7	–	1	–	2	3	–	–	**14**
Igneous, unidentified	–	–	1	–	–	–	–	–	–	–	**1**
Basalt	–	–	6	2	1	–	–	8	–	–	**17**
Gabbro, black and white	–	–	–	1	–	–	–	4	–	–	**5**
Granite	3	–	1	–	–	–	1	1	–	–	**6**
Granodiorite	10	1	14	3	5	1	2	7	3	–	**46**
Red rhyolite	2	–	4	2	–	–	1	–	–	–	**9**
Gray rhyolite	2	–	12	–	2	–	1	7	–	–	**24**
Andesite	15	6	23	12	3	2	5	18	–	–	**84**
Quartzite	4	2	5	2	2	–	–	3	–	–	**18**
Limestone	–	–	2	2	–	–	–	1	–	–	**5**
Sandstone	–	–	–	–	–	–	1	8	–	–	**9**
Total	**72**	**40**	**231**	**63**	**24**	**5**	**32**	**142**	**5**	**1**	**615**
Tularosa Basin											
White chert	6	–	5	1	–	–	–	5	–	–	**17**
San Andres chert	1	–	–	–	–	–	1	7	–	–	**9**
Pink chert	2	–	1	1	–	–	–	2	–	–	**6**
Light pink to orange chert	–	1	1	–	1	–	1	2	–	–	**6**
Dark pink chert	–	–	11	–	–	–	–	2	–	–	**13**
Red chert	1	–	1	1	–	–	–	1	–	–	**4**
Red mottled chert	–	1	–	–	–	–	–	1	–	–	**2**
Yellow brown chert	–	–	1	–	–	–	–	–	–	–	**1**
Total	**10**	**2**	**20**	**3**	**1**	**–**	**2**	**20**	**–**	**–**	**58**
Exotic											
Polvadera Peak obsidian	–	–	–	–	–	–	–	1	–	–	1
Total	**82**	**42**	**251**	**66**	**25**	**6**	**34**	**163**	**4**	**1**	**674**

Table 11.22. LA 120973, chipped stone tool distribution, by area.

	North			Central	South	
	Area 1	Area 2	Area 3	Area 4	Area 8	
Tool Type	Extreme North End	Pits 19 and 23	Pits 6, 10, 17, 24, and 25	Pit Structures 11 and 27, Surrounding Area	Pit Structures 1, 16, Pit 20	Total
Utilized debitage	–	1	4	1	1	**7**
Drill	1	–	–	–	–	**1**
Denticulate	–	–	–	–	1	**1**
End/side scraper	–	–	–	–	1	**1**
Total	**1**	**1**	**4**	**1**	**3**	**10**

Table 11.23. LA 120972, chipped stone artifact function distribution, by provenience area.

	Utilized Debitage	Core/ Hammer-stone	Unutilized Angular	Unutilized Flake	Unutilized Core	Biface (Edge Fragment)	Total
Component A - North Area							
Feature 1A, charcoal pit	–	–	9	25	1	–	**35**
Feature 1, activity surface	–	–	2	5	–	–	**7**
Feature 1, extramural area	–	–	28	64	2	1	**95**
Light scatter north of Feature 1 area	1	1	4	15	2	–	**23**
Total	**1**	**1**	**43**	**109**	**5**	**1**	**160**
Component A - East Area							
Light scatter east of Feature 1 area	1	–	2	13	4	–	**20**
Component A - Isolated Occurrences							
No feature association	–	–	–	2	–	–	**2**
Component B - South Area							
Feature 3, pit structure	–	–	6	11	1	–	**18**
Feature 4, storage pit	–	–	1	–	–	–	**1**
Feature 3, pit structure in extramural area	1	–	8	8	3	–	**20**
Total	**1**	**–**	**15**	**19**	**4**	**–**	**39**
Table Total	**3**	**1**	**60**	**143**	**13**	**1**	**221**

114462. Biface flakes at LA 130331 suggested a single incident of tool manufacturing or maintenance.

Quantities of immediately available materials can be linked with an expedient reduction strategy (Kelly 1988:719). When compared to pre-ceramic sites, Formative period sites typically reflected the use of this strategy combined with low frequencies of formal tools or retouching (Whalen 1994b:93). Here, the two Formative period project sites clearly reflected this pattern.

The use of thermal alteration was low, at 7 percent; it is possible that this was characteristic of the Jornada Mogollon. Chipped stone assemblages from mixed Archaic, Formative, and Pueblo contexts in the Hueco Bolson resulted in the recovery of less than 3 percent of thermally altered artifacts (Whalen 1994b, Schutt 1987).

Whalen suggested that there may have been little use for the practice given the dominant method of expedient reduction technology and the paucity

Table 11.24. LA 120972, chipped stone distribution, by feature and level.

Features	Surface	Level 1	Level 2	Level 3	Level 4	Level 6	Total
Component A North							
Feature 1A, charcoal pit	–	–	35	–	–	–	**35**
Feature 1, activity surface	–	–	7	–	–	–	**7**
Feature 1, extramural area	16	54	20	5	–	–	**95**
Light scatter north of Feature 1 area	18	1	2	1	–	1	**23**
Component A East							
Light scatter east of Feature 1 area	19	1	–	–	–	–	**20**
No feature association	2	–	–	–	–	–	**2**
Component B South							
Feature 3, pit structure	–	–	16	–	2	–	**18**
Feature 4, storage pit in Feature 3 north wall	–	–	1	–	–	–	**1**
Feature 3, pit structure in extramural area	–	5	9	6	–	–	**20**

of biface manufacture (1994b:93). It is interesting to note that 62 percent (n = 41/66) of the thermally altered chipped stone from the project was overexposed, resulting in pot lids and crazing (Tables 11.26 and 11.27). The apparent lack of successful thermal alteration could have explained why the treatment was rarely used.

Mesilla phase chipped stone assemblages contained a variety of material types compared to the later Formative period (Carmichael 1986:185). Chert, rhyolite, basalt, and quartzite were typical constituents of Mesilla phase assemblages. Also characteristic was the increased use of coarser materials (Carmichael 1986:185,186; Oakes 1981:59). While cryptocrystalline materials continued to be employed, coarser stone such as andesite, basalt, limestone, and argillite became increasingly favored (Oakes 1981:59–60).

Carmichael noted that while chert materials, excluding Rancheria, dominated Paleoindian and Archaic assemblages, coarser-grained materials, such as rhyolite, occurred in greater frequency in all Formative period phases. LA 120972 and LA 120973 both reflected and contradicted this statement. The large percentage of coarse-grained igneous rocks at these sites supported a pattern of increased use of these materials at Formative sites; however, the dominance of chert appeared to contradict the pattern, although the project's gray and brown cherts were mostly coarse grained.

Table 11.25. Chipped stone distribution, by level, all features combined.

Level	Frequency	Col. %
Surface	55	24.9%
1	61	27.6%
2	90	40.7%
3	12	5.4%
4	2	0.9%
6	1	0.5%
Total	**221**	**100.0%**

Southern Tularosa Basin alluvial fans had been described as having abundant tool-stone resources; however, workable, high-quality tool stone was not always available, nor was it always evenly distributed (Church et al. 1996:148; Condon et al. 2010:36). While little lithic material of any kind was evident at these sites, a casual examination of Willow Draw indicated a considerable variety of materials. Given the high percentage of lower-quality materials in the assemblage, this variety may not always have resulted in an abundance of workable tool stone. Basin and mountain sources were more distant, thus a lack of stone availability was evident.

Locally available materials dominated chipped stone assemblages at all four sites. Gray and brown cherts seemed to have been exploited most often and comprised nearly half the assemblages at LA

120972 and LA 120973 combined. Tougher, coarser-grained materials, including andesite, rhyolite, granodiorite, and basalt, comprised a significant percentage as well (335/915; 37 percent). It was interesting to note that, at LA 120972 and LA 120973, four local materials–gray chert, brown chert, andesite, and granodiorite–comprised the majority of the assemblage and provided little support for a potentially temporal trend in material selection.

Perhaps the most interesting aspect of these four, dominant-material types is that they were among the most durable materials in the assemblage. While andesite displayed conchoidal fractures of good quality, it was much tougher and denser than chert. Granodiorite was almost exclusively medium grained, was extremely durable, and appeared more suited for ground stone use than other chipped stone tools. Gray and brown cherts were the coarsest cryptocrystalline materials found in the project area, particularly in comparison to white, pink, red, and orange cherts. Gray and brown cherts also were locally available, which may have indicated that these were selected as much for convenience as for character.

The high occurrence of igneous materials, including andesite and granodiorite, may have indi-

Table 11.26. Thermally altered material types, from combined Formative Period sites.

Material Type	Count	Col. %
White chert	4	6.1%
San Andres chert	2	3.0%
Pink chert	2	3.0%
Light pink to orange chert	5	7.6%
Dark pink chert	1	1.5%
Red chert	1	1.5%
Brown chert	18	27.3%
Gray chert	31	47.0%
Red mottled chert	1	1.5%
Gray rhyolite	1	1.5%
Total	**66**	**100.0%**

Table 11.27. Thermal alteration distribution, by site and material type.

Thermal Alteration	LA 114462	LA 120972	LA 120973	LA 130331	Total
Overexposed					
Dorsal pot lids	1	–	–	–	**1**
Pot lids	–	–	3	–	**3**
Crazed	–	5	13	–	**18**
Crazed, dorsal pot lids	–	–	1	–	**1**
Crazed, pot lids	–	–	2	–	**2**
Crazed, dorsal and ventral pot lids	–	–	1	–	**1**
Pot lid	–	–	1	–	**1**
Luster variation and pot lids	–	–	3	–	**3**
Luster variation and crazed	–	–	7	–	**7**
Luster variation and ventral pot lids	–	–	2	–	**2**
Luster variation, crazed, pot lids	–	1	–	–	**1**
Luster variation, crazed, dorsal pot lids	–	–	1	–	**1**
Color change, luster variation, crazed, pot lids	–	1	–	–	**1**
Overexposed subtotal	1	7	34	–	**42**
Overexposed percentage	100.0%	70.0%	61.0%	–	**62.0%**
Normal Exposure					
Luster variation	–	3	14	1	**18**
Luster variation and color change	–	–	1	–	**1**
Lustrous	–	–	7	–	**7**
Normal exposure subtotal	–	3	22	1	**26**
Normal exposure percentage	–	1.4%	3.3%	6.7%	**2.8%**
Total heat treated	**1**	**10**	**56**	**1**	**68**
Total heat treated percentage	**20.0%**	**5.0%**	**8.0%**	**7.0%**	**–**
Total Formative Period site thermal alteration	**–**	**7.0%**	**–**	**–**	**–**
Total assemblage	**5**	**221**	**674**	**15**	**915**

cated a clear preference for more durable materials. Not only durable, these materials were locally available. It was important to note, however, that these materials also were used for ground stone tools, some of which were flaked to shape. These same tools often displayed flake scars resulting from battering and crushing wear. Flakes resulting from such wear resulted in inflated percentages of igneous materials in a chipped stone assemblage.

With the exception of obsidian, cherts from local and Tularosa Basin sources were the most brittle materials found in the assemblage. As with other Formative period sites near US 54 in the southern Tularosa Basin, the seven, least common material types made up less than 2 percent of the assemblage (Van Hoose and Lundquist 2009:613); four of these types were derived from the Tularosa Basin and from local and exotic sources.

As many as eight project-material types may have originated from the Sacramento, San Andres, and Jarilla mountains. While the combined percentage of these types was small, their presence suggested travel to or trade with areas where raw stone and subsistence resources were available. If LA 120972 and LA 120973 were indeed seasonally occupied, these materials could have been obtained when occupants moved to other seasonal locations.

This pattern of raw-stone acquisition seemed to bear some similarity to Condon's theory concerning the transition of chipped stone technology and materials from the Archaic to Formative periods (2010:246). Noting the shift from high to low quality stone and from curated to expedient technology, Condon et al. suggested climatic and environmental changes as underlying causal factors (2010:246) since the shift to a drier climate in the Hueco Bolson and the surrounding area around 950 BC reduced the resource base and forced populations to economize.

As a result, stone was likely acquired during foraging trips and by balancing patchy material sources with known subsistence resources. Condon et al., (2010:264) further suggested that the increased use of coarser-grained materials over time may have been related to a higher dependence on small game, plants, and seeds, as well as a decreased need for sharp-edged cutting tools required for large game (2010:265).

A modified version of this resource-acquisition scenario (Condon et al. 2010) could be applied to Formative sites within the project area. Use of either of these patterns by former residents of LA 120972 and LA 120973 would have signified greater mobility throughout the basin and use of the site areas as seasonal base camps.

12 ⊻ Ground Stone Analysis

Karen Wening

The Carrizozo ground stone assemblage contained a variety of artifacts, including manos, metates, a palette, paint stones, and polishing stones. The assemblage was dominated by handstones that have been divided into four subgroups. Mano subgroups are characterized by small sizes, low abrasion, and wear indicative of heavy use on unrejuvenated surfaces. The assemblage consisted of 80 artifacts including handstones (n = 38); metates (n = 11); polishing stones (n = 9); paint stones (n = 3); a pigment processing stone (n = 1); manuports (n = 7); a shaped stone (n = 1); small cobble abraders (n = 2); and some indeterminate fragments (n = 8).

Methods and Attributes

As stated in the project research design (Oakes et al. 2009:52), the *OAS Standardized Lithic Artifact Analysis* (1994) was employed for the ground stone assemblage. A number of attributes have been added; these will be discussed below.

Artifacts were checked for material type, texture and induration, function, portion, preform morphology, production input, plan view outline, transverse and longitudinal cross-section shape, shaping methods, number of uses, number of wear surfaces/edges, evidence of heating, presence of residues, artifact dimensions, and weight. It should be noted here that the term "function" was used broadly and included handstones and even netherstones (Jenny Adams 2002:98).

Subgroups were defined only after analysis was complete. It was hoped that this approach would reduce the assignment of function based on tool morphology alone and would further enable the incorporation of use-surface attributes.

These attributes added to the standard OAS analysis focused on use-surface morphology, tool manipulation, and companion tools and were based on J. Adams' (2002, 2010) use-wear experiments. Use-surface attributes, including the stroke, or strokes, used to manipulate tools using either horizontal or vertical movement; the degree of desired control; multiple uses; the type of netherstone or handstone companion tool; and the degree of use, have great potential for providing information.

The combination of any of these factors denoted specific processing strategies. Determining the range of processing strategies through use-surface attributes was useful in the analysis of the Carrizozo assemblage, since defining site activities and work areas often provides answers to research design questions regarding site structure, subsistence strategies, and mobility patterns (Oakes et al. 2009:47–500).

In order for processing strategies to be better understood, the use-surface of ground stone tools was analyzed. Utilized surfaces and edges were examined individually for dimension, texture, sharpening, transverse and longitudinal contour shape, and microscopic wear patterns. Macroscopic wear type and wear location provides a great deal of information about artifact function and often aids in the differentiation of artifacts appearing to have identical functions (J. Adams 2010). Edge angle was measured to check for modified or worn edges. Wear and contour attributes provided information about the type of stroke used to manipulate a mano and the type of base companion stone used (J. Adams 2002:100–114).

This helped in the definition of processing strategies and greatly enhanced the identification of multifunctional tools. J. Adams' (2002:45) terminology for mano surface and edges was employed to further define the locations of any apparent cultural modifications.

Analysis Attributes

Material Type: All artifacts are checked for material type, color, and degree of cementation. Any combination of these three characteristics denoted a specific material type.

For instance, red, friable sandstone is a specific material type, as is red-cemented sandstone. Sandstone containing hematite is additionally specified.

Material Texture: Stone material types are defined as fine grained, medium grained, coarse grained, or cryptocrystalline. Grain size is identified with an American/Canadian Stratigraphic card. Large grained refers to particles larger than 710 microns; medium grained to particles between 350 and 710 microns; fine grained to particles 350 microns and smaller. No large grained materials were recovered in this project. Quartzite represented the only conchoidally fractured material found.

Raw Material Form refers to the form of the ground stone source material. Artifacts were recorded as having been manufactured from a rounded cobble; a flattened cobble; a thick slab (10 cm or more); a thin slab (5–10 cm); or a very thin slab (less than 5 cm). Artifacts with manufacturing techniques that completely obscured the raw material form were recorded as indeterminate.

Plan Shape is the outline of the top, or dorsal, view of the artifact. If the artifact is fragmentary, this attribute is considered indeterminate.

Transverse Cross-Section Shape (TXS) defines the outline shape of the mano or metate across the width axis. For some wedge- and truncated wedge-shaped manos in the assemblage, these shapes did not appear to be the result of use, but of intentional shaping. This is discussed in detail in analysis results.

Longitudinal Cross-Section Shape (LXS) defines the outline shape of the mano or metate across the length axis. Both TXS and LXS attributes were added to the standard OAS ground stone analysis, as was Use-Surface Contour below.

Use-Surface Contour attributes are recorded for the transverse (TXC) and longitudinal (LXC) axes for every ground surface. As a result, each use-wear surface has two contour attributes. A mano used on two surfaces has four contour attributes. Transverse Contour, Ventral Surface refers to the width axis contour of the wear surface on the ventral, or working, surface. Longitudinal Contour, Ventral Surface refers to the long axis contour of the ventral, or working, wear surface. Transverse Contour, Dorsal Surface refers to the contour of the width axis on the dorsal, or hand-held, wear surface. Longitudinal Contour, Dorsal Surface refers to the contour of the long axis on the dorsal, or hand-held, surface. The more heavily used surface is designated the ventral surface; the more lightly worn surface is designated as dorsal. This also applies to metates. In the case of equally worn surfaces, a random assignment is made.

Ventral Stroke refers to the motion used to manipulate handstones when the ventral surface is in contact with the netherstone. It also refers to the stroke used on the ventral surface of a metate.

Dorsal Stroke records the manner in which the mano was manipulated while the dorsal surface was in contact with the netherstone. If a metate is bifacial, the less worn use-surface is the dorsal surface. For unifacial metates, this attribute cannot be applied.

Production Input describes the level of manufacturing effort expended on a specific tool. This is defined by the percentage of a tool's surface area that has been shaped. Fully shaped refers to 100 percent of the surface area; mostly modified to 50–99 percent, and slightly modified to less than 50 percent. These definitions are applied subjectively to fragments. If a fragment exhibits a high degree of shaping, the artifact is recorded as mostly modified even though the missing portions are not observed. This is done to obtain the maximum information possible from fragmentary artifacts.

Shaping refers to the methods used to shape a ground stone tool. Grinding, flaking, pecking, and a combination of these methods are recorded. Pecking to shape an artifact is different from pecking to re-sharpen a grinding surface, which is recorded under Wear Surface Rejuvenation. Fragments are analyzed for production input.

Heat Alteration describes the degree of heat to which an artifact has been exposed. Attributes consist of reddened, crazed, fractured, burned, and sooted, as well as combinations of all of these.

Adhesion refers to any foreign substance on the artifact such as caliche or pigment. The amount and location of caliche coverage is included in this attribute, as is pigment type and color.

Function recorded the general tool-type category. Manos were classified as handstones; metates as netherstones. Handstones were identified using J. Adams' definitions for this artifact. The first defined handstones as "all tools held in the hand" (2002:142). The second included all handheld tools not displaying attributes that would define them as manos, abraders, polishing stones, or pestles. These are primarily small stones used to process pigments or mix other substances on lapstones and netherstones (J.

Adams 2002:142). All netherstones, or base stones, were recorded as metates (J. Adams 2002:98). If the tool function is unidentifiable, as with very small fragments, the function is indeterminate. Reworked and reshaped artifacts with multiple functions are coded individually for all identifiable functions. Functions are coded in the reverse order of use, with the most recent function first. In some cases, as with reused or reshaped fragments, the primary function cannot be fully determined because it has been obscured by consequential use.

Number of Functions is the number of identifiable functions of an artifact.

Number of Wear Surfaces is recorded for every ground stone artifact. For metates, if the base is only worked to shape, that surface is not analyzed as a wear surface.

Portion describes the artifact's condition as whole, end fragment, medial fragment, corner fragment, internal fragment, or corners only missing. A flake from a ground stone artifact that retains a small portion of the ground surface is categorized as a ground stone flake. Use-wear surface attributes are analyzed to the furthest extent possible with ground stone flakes.

Wear Surface Rejuvenation is the presence or absence of pecking needed to re-sharpen a grinding surface. This attribute is recorded for all wear surfaces.

Wear Surface Degree describes the extent to which each ground stone surface was used: light; moderate; or heavy. While this is an admittedly subjective attribute, an attempt was made to objectify theses values. Grinding wear that occurs only on the high points of a surface, leaving some areas unused, is classified as light. Here, the boundaries of the use-surface are not well defined; the unmodified raw material texture is still visible after light use. A moderate designation refers to wear extensive enough to grind down the entire use-surface, leaving no unused areas. Moderate wear obscures the original raw material texture. Heavy refers to wear that has completely altered the raw material texture, resulting in striated surfaces. Rough materials such as sandstone are worn smooth and the use-surface contour can become faceted or well delineated. Very fine grained or conchoidally fracturing materials, such as quartzite, become polished and striated from heavy use. If a tool is re-sharpened with pecking and some of the unsharpened use-surface remained, wear degree is assigned based on that data.

Wear Type refers to each individual example of wear observed on each ground surface. J. Adams (1988, 2002, and 2010) repeatedly stressed that tool form does not necessarily determine function, and that artifacts of identical morphology can be functionally distinguished only when wear patterns are carefully examined. Both the type and location of tool wear are essential components of function. Wear-pattern location also indicates the nature of the substance being processed (J. Adams 2010:132).

Wear-Type Values consisted of grinding, striation, pitting, battering, and polishing. Two additional wear attributes, grain melting and grain rounding, were added during the course of analysis. The melting term is borrowed from J. Adams (1988:308) and is used to describe areas ground flush with the surrounding matrix, virtually eliminating all interstices and creating a melting effect. Grain rounding refers to individual grains and interstices. It is important to note here that worn areas were compared to unmodified artifact surfaces in order to eliminate confusion with natural erosion. Striations are additionally examined for location and orientation.

Length in Centimeters is recorded for each artifact. If the original long axis of the artifact cannot be determined, this measurement is recorded as length even if it is not the longest dimension. If the long axis cannot be identified, the longest dimension is recorded. If metate fragments displayed parallel striations on the use-surface, this axis is assumed to be the length.

Width in Centimeters is recorded for each artifact. As with length, if the length and width orientation can be determined, measurements are taken along this axis even if the width is not the second largest dimension.

Thickness in Centimeters is recorded for each artifact.

Weight in Grams is recorded for all artifacts. If fragments can be determined to be part of the same artifact, they are weighed together.

Material Sources and Descriptions

Volcanic and Igneous Materials: The Carrizozo ground stone assemblage consisted primarily of volcanic materials, with metamorphic, sedimentary, and igneous rocks also present in much smaller fre-

Table 12.1. Miscellaneous ground stone distribution, by material type.

Material Type	Indeterminate Fragment	Polishing Stone	Small Cobble Abrader	Paint Stone	Manuport	Pigment Grinding Stone	Shaped Stone	Total
Granite								
Granite	–	–	–	–	–	–	1	**1**
Grey rhyolite	2	1	1	–	–	–	–	**4**
Brown rhyolite	1	–	–	–	–	–	–	**1**
Black rhyolite	4	2	1	–	–	1	–	**8**
Quartzite								
Black quartzite	–	1	–	–	2	–	–	**3**
Gray quartzite	1	–	–	–	–	–	–	**1**
Tan quartzite	–	1	–	–	–	–	–	**1**
Brown quartzite	–	4	–	–	2	–	–	**6**
Red quartzite with hematite inclusions	–	–	–	–	1	–	–	**1**
Limestone								
Limestone	–	–	–	–	2	–	–	**2**
Compact hematite	–	–	–	3	–	–	–	**3**
Total	**8**	**9**	**2**	**3**	**7**	**1**	**1**	**31**

quencies (Tables 12.1, 12.2, 12.3). In this case, volcanic materials were overwhelmingly represented by rhyolite, which occurs in gray, black, and brown. Rhyolite is exclusively fine grained. Hornblende inclusions are common, particularly in gray rhyolite. While rhyolite is common in the higher elevations of the Sacramento Mountains, occurring in dikes, it was most likely obtained from nearby Willow Draw. Most rhyolite displayed smooth, cortical surfaces that may be the result of alluvial erosion from the Sacramento Mountains descending into Willow Draw.

Andesite, andesite porphyry, and basalt made up the remaining volcanic materials. Andesite is cryptocrystalline and often displays conchoidal fractures. While some material impurities exist, these are rare and do not appear to negatively influence flaking.

Both andesite artifacts found during the Carrizozo project appear to have initially served as chipped stone source material and were later processed into ground stone tools. Andesite porphyry is darker and much coarser grained than the andesite artifacts. Its large grains and evident crystal structure tend to very poor conchoidal fracture, indicating that its use is usually restricted to ground stone tools.

Igneous materials were represented by granite alone. Nearly all granite materials contain hornblende inclusions. All granite is medium grained and the material abrasive. The raw material form is indeterminate.

Volcanic and igneous materials likely originated from the Sierra Blanca igneous complex, as later eruptions contain high amounts of hornblende (Thompson 1972). Hornblende is a component of virtually all rhyolite and occurs in granite and quartzite as well.

Metamorphic Materials: This material class was exclusively represented by quartzite cobbles. A variety of colors were recovered, with brown and black constituting the majority; other colors included gray, tan, and black, all with hornblende inclusions, and red, with hematite inclusions. The base of the Abo formation, in the Sacramento Mountains, is overlain by a quartzite-rich conglomerate (Otte 1959:13).

Sedimentary Materials: Sandstone is usually the most dominant material type in most Southwest ground stone assemblages. In this case, it comprised only 11 percent of the Carrizozo assemblage. Eight sandstone materials were represented here, most of which were fine grained. A variety of colors were also represented, including white, brown,

Table 12.2. Handstone distribution, by material type.

Material Type	Core Tool (low abrasion)	Shaped One Hand (higher abrasion)	Cortical-surfaced Cobbles (low abrasion)	Shaped One Hand (low abrasion)	Indeter-minate Fragments	Total
Igneous and Volcanic						
Granite with hornblende inclusions	–	–	2	–	1	**3**
Grey rhyolite	5	–	9	–	3	**17**
Brown rhyolite	1	1	1	–	–	**3**
Black rhyolite	5	1	–	–	–	**6**
Purple rhyolite	–	–	–	1	–	**1**
Andesite	1	–	–	–	–	**1**
Sandstone						
White sandstone, indurated	–	2	–	–	–	**2**
Yellow brown sandstone, indurated, hematite inclusions	–	1	–	–	–	**1**
White sandstone, indurated, hematite inclusions	–	2	–	–	–	**2**
White sandstone, friable, copper-based inclusions	–	1	–	–	–	**1**
Black quartzite	–	–	1	–	–	**1**
Total	**12**	**8**	**13**	**1**	**4**	**38**

Table 12.3. Metate distribution, by material type.

Material Type	Metate, Trough, One End Open	Metate, Slabs	Metate Fragments	Total
Granite with hornblende inclusions	–	–	1	**1**
Grey rhyolite	1	2	3	**6**
Black rhyolite	–	–	1	**1**
Andesite	–	–	1	**1**
Black sandstone, indurated, with hornblende and hematite inclusions	–	–	1	**1**
Brown sandstone with hornblende inclusions	–	–	1	**1**
Total	**1**	**2**	**8**	**11**

yellow-brown, purple, and black. The majority of these materials contained hornblende or hematite inclusions. One white sandstone material contained green, copper-based inclusions. Most sandstone originates from slab materials; however, several are present in cobble form.

Willow Draw originates in the Sacramento Mountains east of the sites. This broad, deep draw contains an array of tool-stone types. The sandstone rock types in the ground stone assemblage may have originated from either the lower Gobbler formation or the Bug Scuffle member of the Gobbler within the Sacramento Mountains (Benne 1975:iii, 1, 3). It could be more likely that sandstone and limestone were derived from the Bug Scuffle member of the lower Gobbler, as the lower part of the Gobbler formation is mostly covered by talus from the overlying Bug Scuffle member (Benne: 1975:3).

The overwhelming majority of this project's manos and metates reflects Stone's analysis (1994:684) of tool manufacture as related to unrestricted material availability. Where raw material is plentiful, as was the case at the Carrizozo sites, tool size and morphology is dictated by the amount and type of foods being processed. Where tool-stone is restricted, mano and metate use is maximized; this is reflected in increased shaping modification, surface rejuvenation, and reuse of fragments.

There were notable exceptions in the Carrizozo assemblage, however. The large trough metate and the full shaped, one-hand mano reflected the latter situation while virtually every other mano and metate in the assemblage indicated an abundance of raw material. Site sediments at LA 120972 and LA 120973 are virtually devoid of rock material; however, materials become increasingly available as one moves east toward the Sacramento Mountains. They remain abundant in nearby Willow Draw.

Ground Stone Assemblage

The project ground stone assemblage consisted of 80 artifacts with the overwhelming majority originating from LA 120973 (n = 41) and LA 120972 (n = 33). The remaining six artifacts were from LA 114462 and 130331 (n = 4 and n = 2, respectively). Approximately half of the assemblage was fragmentary (n = 43/80; 54 percent).

Handstones (n = 39)

Handstones were recovered from three project sites, with the majority originating from LA 120972 (n = 20) and the remainder coming from LA 120973 (n = 16) and LA 114462 (n = 3). Rhyolite was the predominant material and included gray (n = 17); black (n = 6); brown (n = 3); and purple (n = 1). Sandstone comprised 16 percent of all handstones and included white (n = 5) and yellow-brown with hematite inclusions (n = 1). Granite (n = 3); andesite (n = 1); and black quartzite (n = 1) comprised the remainder. More than half of the assemblage was made up of whole artifacts (n = 21/39; 54 percent). Fragments were represented by end (n = 6); edge (n = 5); internal (n = 3); and surface flake (n = 1) portions. Two handstones were reshaped fragments.

Roughly half of the assemblage displayed attributes that clearly define the half as handstones. These handstones were small, convex- or flat-surfaced stones that had clearly served as the upper stone in processing activity. However, considerable variations existed within this group; several characteristics indicated that functional subgroups existed within the handstone category. Differences in material type, wear patterns, morphology, and use or disuse of cortical and broken surfaces indicated that contrasting processing strategies existed when it came to handstones. Interestingly, a number of attributes were shared, particularly wear patterns.

This mix of shared and contrasting attributes provided some interesting challenges in terms of defining subgroups. To assist in this process, several steps were taken:

1. Each material type was relegated to a broad type category based on abrasion qualities. Variations within each material type, such as color and inclusions, does not affect material texture and abrasion quality; for example, this enables all rhyolite colors to be combined;

2. All observed wear patterns were grouped into a single category after first being recorded individually. The distribution of individual and combined wear patterns among material types and surface morphology is illustrated in Table 12.4. Wear-pattern combinations were tallied by use-surface types (Table 12.5). Cortical surfaces were separated from shaped surfaces. Shaped surfaces on fine grained igneous materials were either large flake scar(s) or convex ends that first served as hammerstones. Shaped surfaces on sandstone artifacts were few in number (n = 3). These occurred on fully formed artifacts shaped by pecking and grinding. The surface shaping was assumed, as it was obscured by use;

3. Artifact morphology was taken into consideration. This is primarily defined by transverse cross-section shape and shaping methods. Most core tools were flaked into subspherical forms. In contrast, most sandstone artifacts were shaped by various combinations of pecking, grinding, and flaking into flattened, tabular forms. A third handstone subgroup was defined by unmodified forms that utilized the cortical surface. There was a small amount of overlap in these characteristics. For example, one tabular sandstone artifact resembled all others in the category, but was not shaped as the others were. Because it was morphologically similar, however, it was included in this group.

These three steps resulted in the definition of

Table 12.4. Distribution of handstone wear patterns, by material type and surface morphology.

	Material Group					
Individual Surface	**Rhyolite**	**Quartzite**	**Basalt**	**Granite**	**Sandstone**	**Total**
Cortical Surfaces - Wear Surface 1, Combined Wear						
Grinding and parallel striations	2	–	–	1	–	**3**
Grinding and random striations	8	2	1	1	–	**12**
Grinding and polish	1	–	–	–	–	**1**
Grinding only	3	–	–	1	–	**4**
Grinding and perpendicular, parallel striations	1	–	–	–	–	**1**
Grinding, random striations and polishing	1	–	–	–	–	**1**
Polish and parallel striations	1	–	–	–	–	**1**
Grinding, parallel, perpendicular striae and polish	1	–	–	–	–	**1**
Grinding, parallel striae, grains melted	1	–	–	–	–	**1**
Grinding, grains melted, polished, random striae	1	–	–	–	–	**1**
Grinding, grains melted, random striae	1	–	–	–	–	**1**
Grains rounded	–	–	–	1	–	**1**
Total	**21**	**2**	**1**	**4**		**28**
Cortical Surfaces - Wear Surface 2, Combined Wear						
Grinding and random striations	–	1	–	1	–	**2**
Grinding only	3	–	–	–	–	**3**
Grinding, random striations and polishing	–	–	–	1	–	**1**
Grinding, grains rounded and polished	3	–	–	–	–	**3**
Grinding, parallel striae, grains melted	2	–	–	–	–	**2**
Grinding, grains melted, random striae	2	–	–	–	–	**2**
Grinding, polish, parallel striae	2	–	–	–	–	**2**
Grinding, some grains melted, rounding, polish	2	–	–	–	–	**2**
Grinding, random striae, rounding, polish	1	–	1	–	–	**2**
Total	**15**	**1**	**1**	**2**		**19**
Cortical Surfaces - Wear Surface 3, Combined Wear						
Grinding, random striations and polishing	4	–	–	–	–	**4**
Grinding, grains rounded and polished	2	–	–	–	–	**2**
Grinding, some grains melted, polish	1	–	–	–	–	**1**
Grinding, parallel striations, rounding and polish	1	–	–	–	–	**1**
Grinding, some grains melted, rounding, polish	2	1	–	–	–	**3**
Grinding, parallel striae, rounding, polish, melting	–	–	1	–	–	**1**
Total	**10**	**1**	**1**			**12**
Total used cortical surfaces, all artifacts						**59**
Shaped Surfaces - Wear Surface 1, Combined Wear						
Grinding and polish	1	–	–	–	–	**1**
Grinding only	–	–	–	–	2	**2**
Grinding, edge flaking and polish	1	–	–	–	–	**1**
Grinding, grains melted	–	–	–	–	1	**1**
Grinding and some grains melted	–	–	–	–	2	**2**
Grinding, grains melted, polished, random striae	1	–	–	–	–	**1**
Grinding, grains melted, random striae	–	–	–	–	1	**1**
Grinding, some grains melted, polish	–	–	–	–	1	**1**
Total	**3**				**7**	**10**
Shaped Surfaces - Wear Surface 2, Combined Wear						
Grinding and random striations	–	–	–	–	1	**1**
Grinding only	1	–	–	–	4	**5**
Random striations	1	–	–	–	–	**1**

Table 12.4 (continued)

	Material Group					
Individual Surface	**Rhyolite**	**Quartzite**	**Basalt**	**Granite**	**Sandstone**	**Total**
Grooving	–	–	–	–	1	**1**
Grinding, grains rounded and polished	1	–	–	–	–	**1**
Total	**3**				**6**	**9**
Shaped Surfaces - Wear Surface 3, Combined Wear						
Grinding, grains rounded and polished	1	–	–	–	–	1
Total	1					**1**
Total, all flake scar and convex end wear surfaces	**7**				**13**	**20**
Total used surfaces	**53**	**4**	**3**	**6**	**13**	**79**

three subgroups described below. However, the wear and surface morphology tally was not broken down into the morphological types, which are also below. It appears that there was considerable functional overlap between these tool groups; this is discussed further in the summary section.

The summary reveals dominant wear characteristics of the handstone category. Most apparent was a clear preference for minimally abrasive surfaces, some of which were derived from natural material qualities and some of which occurred partially through use.

For example, cortical rhyolite surfaces were minimally abrasive in unmodified form. Rhyolite flaked use-surfaces were also minimally abrasive. In contrast, fine grained sandstone was more abrasive; however, half were worn so extensively that the surfaces had become smooth and nearly slick. Surface rejuvenation was nearly absent as it occurred only on sandstone.

Macroscopically, these surfaces appeared smooth and dull and sometimes displayed wear striations. However, under 40X magnification, these surfaces transformed when ground to the point where the grains formed a solid, flat surface, nearly eliminating interstices and material imperfections. Light wear also produced this effect, with grains on the highest points becoming melted through polish and rounding—sometimes referred to as "high point planning".

Grain interstices comprised a minority of the use-surface area. On a significant percentage of tools, interstices were completely eliminated. Where interstices remained, edges were rounded. The grain interstices literally seemed to disappear on many artifacts, except where larger surface pits appeared. These pits also displayed rounded edges.

Surface sheen was prominent on surfaces with melted grains. This polish was particularly obvious where grains had become completely flattened. This sheen also occurred in aforementioned pits and interstices, but only where the surface was worn heavily enough to reduce surface imperfections and grain interstices. Otherwise, polish was restricted to the rounded edges of the interstices.

Sheen was heaviest where the entire surface had become flattened, displaying a bright, polished sheen. It was interesting to note that artifacts worn on three surfaces typically displayed one heavily and one or two lightly or moderately melted surfaces. These lightly worn surfaces may have served as handgrips, with the surface texture resulting from accumulation of hand oils. It should be noted here that these surfaces were compared with unutilized areas.

Fresh chips or gouges incurred during the excavation process, or deep, natural concavities where contact was unlikely to have occurred, were used for comparison with ground surfaces.

In J. Adams' use-wear experiments, she noted that regardless of the material being ground "the stones' surfaces all had at least a few striations and impact fractures from abrasive and fatigue wear mechanisms" (2002:36). J. Adams observed distinctive sheen wear resulting from grinding oily substances. However, in her experiments, this sheen did not occur in grain interstices or vesicles.

J. Adams' observations are noted here to highlight the contrast between project handstones, many of which display sheen within vesicles, and interstices of the use-surfaces. Many handstones also

Table 12.5. Wear pattern combinations, by material group and use surface type.

	Material Group					
	Rhyolite	**Quartzite**	**Basalt**	**Granite**	**Sandstone**	**Total**
Cortical Surfaces - Combined Wear						
Grains rounded	–	–	–	1	–	**1**
Grinding and parallel striations	2	–	–	1	–	**3**
Grinding and perpendicular, parallel striations	1	–	–	–	–	**1**
Grinding and polish	1	–	–	–	–	**1**
Grinding and random striations	8	3	1	2	–	**14**
Grinding only	6	–	–	1	–	**7**
Grinding, grains melted, polished, random striae	1	–	–	–	–	**1**
Grinding, grains melted, random striae	3	–	–	–	–	**3**
Grinding, grains rounded and polished	5	–	–	–	–	**5**
Grinding, parallel striae, grains melted	3	–	–	–	–	**3**
Grinding, parallel striae, rounding, polish, melting	–	–	1	–	–	**1**
Grinding, parallel striations, rounding and polish	1	–	–	–	–	**1**
Grinding, parallel, perpendicular striae and polish	1	–	–	–	–	**1**
Grinding, polish, parallel striae	2	–	–	–	–	**2**
Grinding, random striae, rounding, polish	1	–	1	–	–	**2**
Grinding, random striations and polishing	5	–	–	1	–	**6**
Grinding, some grains melted, polish	1	–	–	–	–	**1**
Grinding, some grains melted, rounding, polish	4	1	–	–	–	**5**
Polish and parallel striations	1	–	–	–	–	**1**
Total combined cortical surface wear	**46**	**4**	**3**	**6**		**59**
Modified Surfaces - Combined Wear						
Grinding and polish	1	–	–	–	–	**1**
Grinding only	1	–	–	–	6	**7**
Grinding and random striations	–	–	–	–	1	**1**
Random striations	1	–	–	–	–	**1**
Grinding, edge flaking and polish	1	–	–	–	–	**1**
Grinding, grains melted	–	–	–	–	1	**1**
Grinding and some grains melted	–	–	–	–	2	**2**
Grinding, grains melted, polished, random striae	1	–	–	–	–	**1**
Grinding, grains melted, random striae	–	–	–	–	1	**1**
Grinding, some grains melted, polish	–	–	–	–	1	**1**
Grooving	–	–	–	–	1	**1**
Grinding, grains rounded and polished	2	–	–	–	–	**2**
Total modified surfaces	**7**				**13**	**20**
Total, all wear surfaces	**53**	**4**	**3**	**6**	**13**	**79**

displayed uniform sheen on uneven surfaces. This combination of heavy grinding and sheen may have resulted from processing materials with substantial oil content and is discussed further below.

Most importantly, however, J. Adams noted that seed and corn grinding experiments resulted in grains being flattened to the point that they were nearly level with the matrix (2002:36). This was perhaps the most significant observation for the project's tools, as this could indicate that these heavily worn tools could have been used to process corn as well as wild seeds.

Both parallel and random striations were often present, visible both macroscopically and microscopically. This type of surface is similar to what J. Adams described as grains melting together. However, J. Adams observed this texture macroscopically, stating that it altered considerably under magnification (1988:308).

Handstone Subgroup 1: One-Hand Core Tool Subgroup, low abrasion (n = 12)—One of the most compelling aspects of this type of wear was that it was present on a variety of morphological forms. Three forms were defined: core tools, sandstone manos, and tabular cortical manos. While some wear patterns occurred throughout all of these forms, some were unique to each type.

The largest and most uniform group of handstones displaying this wear was made up of core tools (Fig. 12.1:FS 1123, FS 237, FS 1004). These tools served initially as cores and finally as smooth-surfaced abraders. Several also had been used as hammerstones between use as cores and abraders.

Core-abrader tools displayed three types of use-surface morphology. The first was a flat or convex, smooth, unmodified, cortical surface. The second use-surface was formed by the removal of large unifacial flakes. This created a rather evenly contoured convex or flat surface that retained numerous low flake scar ridges. The resulting forms were typically subspherical in cross section. The third use-surface consisted of markedly convex ends and edges, which seemed to have formed through hammerstone use, as battering wear underlies grinding wear. This battering wear may have resulted from use in chopping activity for a minority of tools, but the obtuse edge angles of the item appeared more indicative of hammerstone use.

Macroscopically, cortical areas appeared dull, with light polish appearing only on ridges and high points. Macroscopic striations were sometimes visible. Flaked surfaces also displayed a light sheen, with occasional striations, on the ridges. Convex hammerstone use-areas displayed the same dull texture of the cortical areas; striations were rarely present. The cortical facets on most of these tools were generally small and flat. Flaked areas varied in morphology, though the heaviest use occurred on flatter surfaces. Grinding on hammerstone use-areas was generally light, though extensive enough to obliterate the majority of battering wear.

Most core tools that displayed this wear were flaked into sub-spherical forms. Two were more angular, and appeared to have been large core fragments. Wear location indicated that these tools had been held in a variety of positions and manipulated in multiple directions. All measured less than 12 cm in length. Mean dimensions were 8.0 by 6.4 by 5.4 cm (Table 12.6).

Handstone Subgroup 2: Shaped One-Hand Subgroup, higher abrasion (n = 8)—The second and least uniform handstone subgroup was comprised of tools of more abrasive material, which were shaped by pecking and grinding (Fig. 12.1:FS 1 and FS 4). Materials were more abrasive and were primarily comprised of sandstone. Based on similar material texture, functional history, and wear, two fragmentary shaped tools of vesicular rhyolite were included with this group.

All appeared to have first served as one-hand manos that, following breakage, functioned as smooth surface abraders. This was clear due to the predominance of heavy wear characterized by grains worn even with the matrix and by random striations. Polish was present on some artifacts, but was much less prevalent on sandstone artifacts.

The few one-hand, shaped manos displaying this wear were all fragmentary; only one mano was complete but had been refit from two fragments. Interestingly, these fragmentary manos exhibited wear on broken surfaces as well as on primary use-surfaces. Broken-surface wear was light to moderate; primary use-surface wear was heavy and consistently displayed random striations.

Since this evidence represented the secondary use of these manos, it cannot be determined if they were manipulated reciprocally—which would be indicated by parallel striations—or if they were worn differently when in complete condition (i.e., rejuvenated). The basalt artifact displayed an oily sheen and red pigment stains as well. All of these materials were more abrasive than the core tools of rhyolite and andesite but seemed to have become nearly slick-surfaced as a result of extensive use and/or processing of some material that created heavy rounding and polish.

It should be noted here that unique examples did exist within the handstone assemblage. While more abrasive materials—sandstone, granite, and isolated examples of rhyolite and basalt—shared this heavy, grain-flattened wear, several of the samples did not. For example, one sandstone artifact was in the beginning stages of this wear with about half of the grains exhibiting the merged appearance and rounded interstices.

One sandstone fragment that did not appear to have been part of a larger tool displayed significantly different wear. The grains were lightly sheared at the top, interstices were sharp, and numerous grains appeared to have been plucked out during use. Clearly, this artifact differed functionally from other tools of abrasive materials.

Sandstone also differed when it came to more frequent occurrences of grain interstices, though

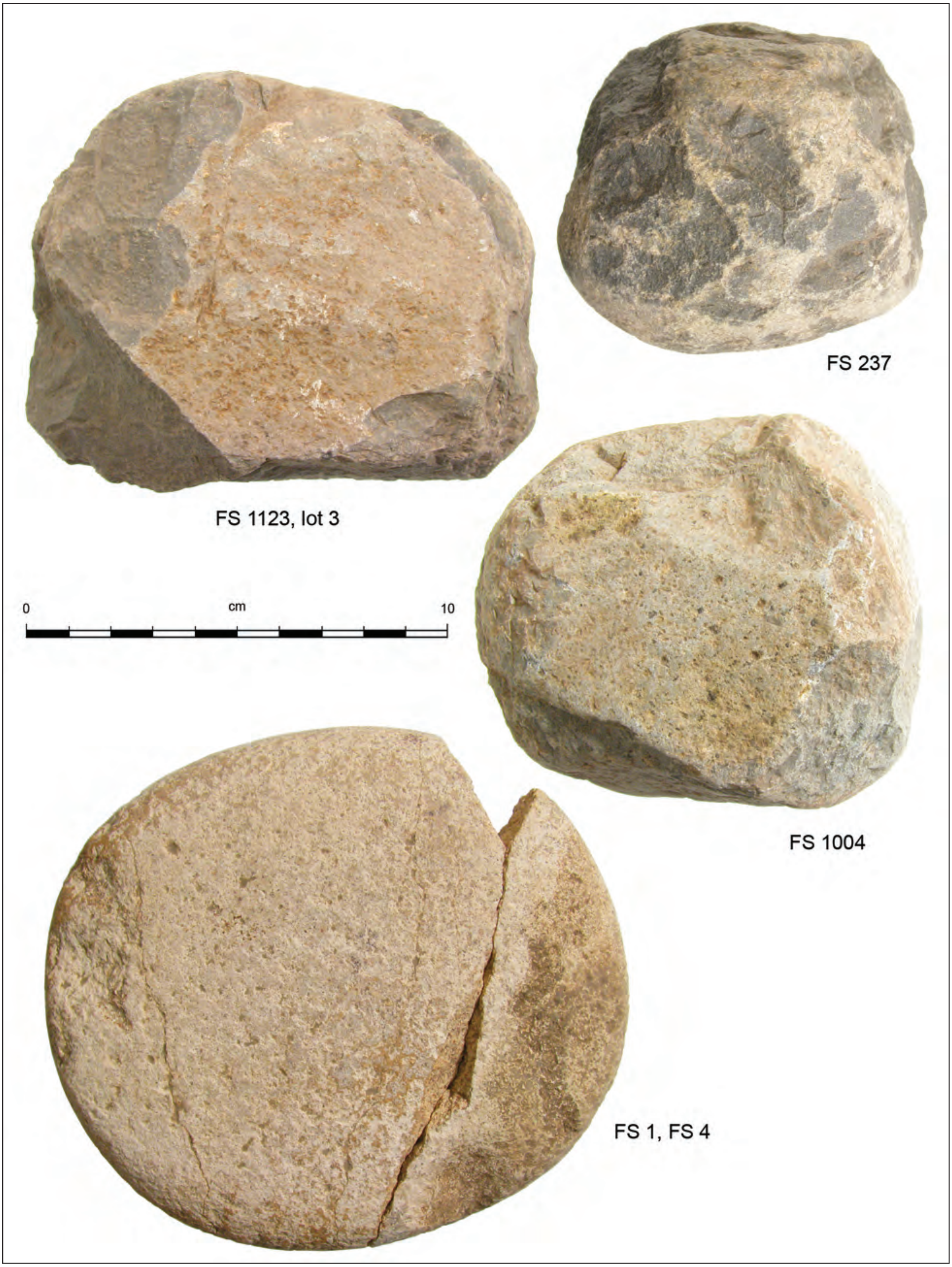


Figure 12.1. One-hand core tools, FS 1123, FS 237, and FS 1004, Handstone Subgroup 1; shaped, one-handed mano, FS 1 and FS 4, Handstone Subgroup 2.

Table 12.6. Mean handstone dimensions for whole tools.

Mano Subgroup Category		Length (cm)	Width (cm)	Thickness (cm)
LA 114462				
Cortical-surfaced cobbles (low abrasion)	Mean	10.2	5.3	2.8
	N*	1	1	1
	SD*	–	–	–
Total	**Mean**	**10.2**	**5.3**	**2.8**
	N	**1**	**1**	**1**
	SD	**–**	**–**	**–**
LA 120972				
Core tool (low abrasion)	Mean	8	6.4	5.4
	N	6	6	6
	SD	1.2	1.3	1.6
	Minimum	6.7	4.8	3.4
	Maximum	10	8.3	8.1
	Range	3.3	3.5	4.7
Shaped one hand (higher abrasion)	Mean	12.4	11.4	4
	N	1	1	1
	SD	–	–	–
	Minimum	12.4	11.4	4
	Maximum	12.4	11.4	4
	Range	0	0	0
Cortical-surfaced cobbles (low abrasion)	Mean	8.88	7.16	4.22
	N	5	5	5
	SD	1.3	1.0	2.5
	Minimum	7.7	6.1	2
	Maximum	10.5	8.7	7.9
	Range	2.8	2.6	5.9
Total	**Mean**	**8.7**	**7.1**	**4.8**
	N	**12**	**12**	**12**
	SD	**1.7**	**1.8**	**2.0**
	Minimum	**6.7**	**4.8**	**2**
	Maximum	**12.4**	**11.4**	**8.1**
	Range	**5.7**	**6.6**	**6.1**
LA 120973				
Core tool (low abrasion)	Mean	8	6.84	5.38
	N	5	5	5
	SD	1.1	1.7	1.8
	Minimum	6.9	4.8	3.5
	Maximum	9.2	9	8
	Range	2.3	4.2	4.5

Table 12.6 (continued)

Mano Subgroup Category		Length (cm)	Width (cm)	Thickness (cm)
Shaped one hand (higher abrasion) (reused fragments = 7, refit whole = 1)	Mean	8.3	7.0	4.0
	N	8	8	8
	SD	2.2	2.2	1.1
	Minimum	5.7	4.3	2.8
	Maximum	12.4	11.4	6.4
	Range	6.7	7.1	3.6
Cortical-surfaced cobbles (low abrasion)	Mean	6	4.3	1.6
	N	1	1	1
	SD	–	–	–
	Minimum	6	4.3	1.6
	Maximum	6	4.3	1.6
	Range	0	0	0
Total	**Mean**	**8.2**	**6.7**	**4.9**
	N	**8**	**8**	**8**
	SD	**1.5**	**1.6**	**2.0**
	Minimum	**6**	**4.3**	**1.6**
	Maximum	**10**	**9**	**8**
	Range	**4**	**4.7**	**6.4**
All Sites				
Core tool (low abrasion)	Mean	8	6.6	5.4
	N	11	11	11
	SD	1.1	1.4	1.6
	Minimum	6.7	4.8	3.4
	Maximum	10	9	8.1
	Range	3.3	4.2	4.7
Shaped one hand (higher abrasion)	Mean	10.7	8.8	5
	N	3	3	3
	SD	1.5	2.2	1.2
	Minimum	9.7	7.4	4
	Maximum	12.4	11.4	6.4
	Range	2.7	4	2.4
Cortical-surfaced cobbles (low abrasion)	Mean	8.7	6.5	3.6
	N	7	7	7
	SD	1.6	1.4	2.3
	Minimum	6	4.3	1.6
	Maximum	10.5	8.7	7.9
	Range	4.5	4.4	6.3
Total	**Mean**	**8.6**	**6.9**	**4.8**
	N	**21**	**21**	**21**
	SD	**1.6**	**1.7**	**1.9**
	Minimum	**6**	**4.3**	**1.6**
	Maximum	**12.4**	**11.4**	**8.1**
	Range	**6.4**	**7.1**	**6.5**

*SD = Standard Deviation; N = count

most still displayed rounded edges. While all site materials were fine to medium grained, and thus more likely to display this type of wear than coarse grained materials, it was remarkable that nearly identical wear was displayed on such a range of materials.

Surface rejuvenation was rare and occurs here only on sandstone. Rejuvenation appeared to have been shallow and executed only in the central area of the ground surface. In the cases of light wear, rounding and polish wear existed on the grain clusters at the high points with only the interstice edges displaying the same wear. Mean dimensions were 10.7 by 8.8 by 3.0 cm.

Handstone Subgroup 3: One-Hand, Cortical-Surfaced Subgroup, low abrasion (n = 13)—These tools were the least abrasive and least worn of the handstone category (Fig. 12.2). They were exclusively fine grained igneous or volcanic materials. Rhyolite (n = 12) and granite (n = 1) cobbles were utilized in unmodified form, with the cortical surface serving as the use-area. Seven were whole; five were fragmentary; and one was a reshaped fragment.

Most tools in this category were flattened, sub-rectangular cobbles with transverse and longitudinal cross-sections of the same shape and had been utilized lightly on cortical surfaces. These artifacts were less heavily worn than the previous subgroups. Most displayed random striations and polish with grain melting and rounding less prevalent than on other handstones. Most were worn on two opposing surfaces (n = 6), though one wear surface was nearly equally represented (n = 5). One tool was worn on three surfaces.

Two artifacts were slightly anomalous to this group in terms of use. One tabular rhyolite fragment was used on a slightly more abrasive surface created by natural material fractures. It was polished and striated on the high points of this surface from use as an abrader but also displayed signs of use on the edges, possibly from a chopping, scoring, or scraping motion. One rhyolite artifact was worn on two adjacent surfaces and appeared to have been used in a planing type of motion employing both surfaces. The edge between the two surfaces was unimarginally flaked and crushed. The subgroup mean for whole artifacts was 8.6 by 6.8 by 4.8 cm.

Handstone Subgroup 4: Shaped One-Hand Subgroup, low abrasion (n = 1)—This artifact was morphologically identical to the Shaped One-Hand high abrasion subgroup, but was manufactured from low abrasion, fine grained, purple rhyolite (Fig. 12.3). It was an end fragment that had been used on the broken surface and on the original artifact surface. Grain melting, striations, and polish were all indicative of heavy wear on the original surface, while the broken surface was moderately used.

Indeterminate Subgroup (n = 4): The remaining tools displaying this wear were very small fragments and use-surface flakes. Three were gray rhyolite; one was granite. One was heavily worn, displaying grain melting, striations, and polish; two displayed lighter wear in the form of grain shearing and grain rounding. None of the wear surfaces were rejuvenated. All fragments measured about 5 cm in length, precluding determination of overall tool morphology.

Handstone Summary and Discussion: The handstone assemblage was dominated by small tools with minimally abrasive surfaces. Some abrasive materials occurred, but these were in the minority. Three dominant subgroups were defined based on use-surface morphology, tool morphology, wear patterns, and differential use of cortical surfaces. Core tools, used initially as raw material for chipped stone, often served a secondary purpose as hammerstones, and finally as grinding or abrading tools. Based on sub-spherical morphology, which was devoid of edges acute enough for such activity, the use of these tools as choppers was unlikely.

In all cases, grinding wear reflected the most recent use of these tools. Only one tool displayed battering wear not overlain by grinding. Both flaked and cortical surfaces were used. Small, cortical-surfaced tools employed flattened, subrectangular cobbles ground on the unmodified cortex. These two subgroups were manufactured from minimally abrasive, fine grained igneous and volcanic materials.

Wear was dominated by striations, polish, and grain melting for both groups, with less heavy wear occurring on flattened cobbles. Shaped, one-hand sandstone manos were almost entirely fragmentary and were frequently used on broken surfaces. While sandstone materials were more abrasive, nearly all had been worn to a smooth, polished finish with little evidence of rejuvenation.

It is important to note that a significant number

Figure 12.2. One-handed, cortical-surfaced handstone, Handstone Subgroup 3.

Figure 12.3. Shaped, one-handed handstone, Handstone Subgroup 4.

of handstones retained red or yellow ochre in the vesicles (n = 6 and n = 1, respectively), most of which were core/abrading tools. The interstices of one nearly complete, flattened cobble contained a thick, unidentified orange substance. One core tool and one sandstone fragment had charcoal adhesions within the interstices. These adhesions were particularly interesting in view of similar substances observed on metates.

A range of wear patterns existed among all handstones, but dominant wear indicated that most surfaces were extensively or intensively worn by the processing of substances with some oil content. This wear appeared to most closely resemble J. Adams' tribochemical wear characterized by the buildup of residue resulting in a flat, polished surface. The most heavily utilized surfaces were ground to a flat, smooth, polished, and striated texture. Lightly worn surfaces displayed clusters of melted, rounded, polished grains, with rounded interstices edges.

The heavy wear-pattern suite was primarily observed on cortical and flaked surfaces of very fine grained rhyolite, basalt, granite, and quartzite. More abrasive materials, such as sandstone, displayed both wear-pattern groups. This heavy wear found on sandstone materials may have represented some secondary use, as all were reused fragments with wear displayed on broken edges. Rejuvenation was virtually absent but was shallowly executed in the center of a few surfaces (n = 3/79 surfaces; 4 percent).

Wear-pattern analysis raised questions concerning processing strategies and handstone function. Only one or two tools in the handstone assemblage indicated processing on even a moderate scale, assuming larger manos were the most efficient tools for processing large amounts (J. Adams 2002:27). Most project tools were small, minimally shaped, and non-abrasive.

Based on these observations, the primary question concerned representation: Did these tools represent every function involving ground stone at the project sites? Both the morphology and wear of most handstones in the assemblage suggested use on softer materials, like the processing of hides or small grained foods. The presence of different types of adhesions on a significant percentage of items indicated mineral processing (Table 12.7). However, most artifacts with adhesions displayed grain melting, wear, or polish and appeared to have been used lightly or to process a material that produced less wear; possible fatty adhesions on one flattened cobble may have indicated hide processing. These adhesions shed light on only a few conclusively identifiable functions (n = 8/39; 21 percent).

The trough metate indicated that large tools were being used, presumably, for flour production. The presence of corn macrobotanical remains was indisputable evidence of cultigens in the diet. The combination of these two factors suggested corn was being ground into flour. Hard linked an increase in mean mano length to an increase in agricultural dependence in the Mogollon (1990) and elsewhere (1986). Mauldin's (1993) ethnographic studies indicated that larger tools were more efficient in that they decreased processing time. J. Adams stated that larger, heavier tools were more efficient than smaller, lighter tools (2002:27). She also theorized that the presence of larger, heavier tools may have been linked with an increased reliance on flour, stressing that this could have involved both gathered and cultivated plants (1999).

Taking these theories into account, and assuming that the Carrizozo ground stone assemblage was representative of all site tasks, one can conclude that flour production did not dominate food processing activities at these sites. It is also possible that flour production occurred elsewhere, possibly in warm season locales.

The majority of ground stone tools recovered from LA 120972 and LA 120973 appeared to be related to processing strategies involving tools with low abrasive qualities. It is highly unlikely that any of these handstones were used to process large quantities of cultigens. This was indicated by the subspherical, flattened cobble or reused fragment morphology; small size; use of cortical surfaces and flaked surfaces; and heavily worn, unrejuvenated surfaces. While larger handstones were not always the most efficient (J. Adams 2002), they were more likely to be used to process cultigens into flour. Yet, they were completely absent from the assemblage.

While overlap clearly existed in the function of mano subgroups, subtle differences existed as well. The subspherical core tools may have been used in heavier processing activities involving crushing and rotary use. The cortical-surfaced tools were the least abrasive. The primary difference between these two groups was weight and overall shape.

Wear indicated that they were worn and ma-

Table 12.7. All sites, handstone adhesions, by wear surface and material.

			Rounded Cobble				Slab, very thin (<5cm)	
Site	**Adhesions**	**Wear Surface 1, Combined Wear**	**Sandstone**	**Rhyolite**	**Basalt**	**Granite**	**Sandstone**	**Total**
LA 114462	Unidentified orange adhesions	grinding only	–	1	–	–	–	**1**
LA 120972	Red pigment	grinding and random striations	–	1	–	–	–	**1**
	Charcoal adhesions	grinding only	–	–	–	–	1	**1**
	Red pigment, oily residue	grinding, grains rounded and polished	–	–	1	–	–	**1**
LA 120973	Red pigment	grinding and parallel striations	–	–	–	1	–	**1**
		grinding and random striations	–	1	–	–	–	**1**
		grinding only	1	–	–	–	–	**1**
		grinding, random striations and polishing	–	1	–	–	–	**1**
	Charcoal adhesions	grinding, grains melted, random striae	–	1	–	–	–	**1**
	Unidentified yellow adhesions	grinding and some grains melted	1	–	–	–	–	**1**
Total			**2**	**5**	**1**	**1**	**1**	**10**

nipulated similarly; however, the added weight of the core tools may have been necessary for heavy rotary movement or for pounding against soft materials like hides. Flattened stones may have provided the additional control needed to grind small seeds and other materials.

It was difficult to determine the function of sandstone artifacts, owing to their fragmentary, reused status; it was also difficult to determine if the function of these artifacts changed after the artifact was broken. Heavy wear displayed on most of these artifacts may have reflected only the most-recent use, as the original function might have required a more abrasive, rejuvenated surface.

The ground stone assemblages were small and fragmentary for sites of this size. Few artifacts, including ground stone, were recovered from feature floors and occupation surfaces. Most handstones represented low manufacturing investment. It is likely that most raw materials had been obtained in cobble form from nearby Willow Draw. These materials could easily have been replaced when broken or exhausted.

Little or no shaping modification occurred with these objects. They were devoid of "comfort features," morphological features such as finger grips designed for user comfort. Such features were usually associated with extensive or intensively used tools (J. Adams 2002:19) and were virtually absent here, with the exception of two one-hand manos.

These factors suggested that items of importance may have been transported from the sites, and that tools left behind may have been less valued, as they were easily reproduced.

J. Adams (2002) suggested that tools with comfort features were more likely to have been used intensively while performing tasks of long duration. Only one ground stone tool appeared to have been used intensively.

If LA 120972 and LA 120973 were vacated, it could be presumed that only the most valued and necessary artifacts were removed, and those that were more expendable and easily produced were left behind. If this was the case, the majority of the assemblage represents only a portion of the ground stone tool kit. If it was not, subsistence strategies must have been dominated by wild resources, with a low reliance on cultigens.

Metates (n = 11)

Three complete and seven fragmentary metates comprised the project assemblage. The majority were recovered from LA 120973 (n = 9), with the remaining two from LA 120972. Metates were primarily manufactured from gray rhyolite (n = 6). Single examples of black rhyolite, andesite, black sandstone, brown sandstone, and granite with hornblende inclusions comprised the remainder of the assemblage.

Of the eight metates analyzed for raw material form, cobbles and slabs were equally represented. Three were complete and eight were small fragments less than 10 cm in length.

Of the three complete metates, one appeared broken and seemed to have been reshaped to be used again as a smaller version of the original. Two of the three complete metates were formed from rhyolite cobbles and were likely found in Willow Draw.

All three complete metates were recovered from LA 120973 with the two rhyolite cobble artifacts that originated from the surface. These three complete artifacts merit individual description. A summary on metate fragments follows.

Trough Metate, One End Open (n = 1): This complete trough metate was open at the proximal end; three-fourths of the ventral surface was made into a trough (Fig. 12.4).

Measuring 55.8 by 33.4 by 9.0 cm, this metate was formed from a gray rhyolite slab into a somewhat irregular, subrectangular shape. The use-surface was concave in both longitudinal and transverse cross-sections, indicating the use of a rocking, reciprocal mano stroke that most likely involved lifting the proximal end of the mano at the distal end of the metate and resulted in a transversely convex mano surface.

Flaking, grinding, and pecking methods were used to shape this artifact, but these methods were differentially employed. The proximal end received the most modification; about half of the proximal end was fully shaped by pecking; the other half was flaked. One lateral edge was flaked and ground. The other lateral edge was largely unmodified, with light grinding of the cortical surface. The distal end was subtriangular, with one side evenly pecked; the other side was unmodified. It was smoothly ground and may have served as a mano shelf.

The trough use-surface appeared to have been well maintained, displaying very evenly applied pecking used to rejuvenate the surface. At the deepest point, the trough measured 3.5 cm. Despite this considerable depth, the lateral edges of the trough were not well defined. They were moderately ground, possibly to protect the user's hands (Wiley et al.1965:456; Horsefall 1983:71–72).

Interestingly, trough width was variable and measured 24 cm at the proximal end and expanded to 28 cm at the distal end. The trough length at the longest axis was 42 cm. However, the use-surface appeared to have been uniformly worn and maintained for the entire length and width, suggesting that a variety of mano lengths may have been employed during use. The use of a variety of manos with a single metate has been observed in a number of ethnographic studies (Horsefall 1983:52). This was often the result of several factors, one of which was convenience. Manos were often chosen in ethnographic contexts because they were close at hand. Manos also have a comparatively shorter use-life, as they are more prone to breakage than metates, necessitating the use of a number of manos during the life of one metate.

Shaping efforts appeared to have been primarily focused on removing and smoothing angular portions of the raw material, without attempting to modify the perimeter to a regular outline. While the morphology of this metate indicated use with a two-hand mano, none were found. The single mano that could have created the wear path on this metate was an unlikely companion, due both to its size and origin at LA 120972. The companion mano of this metate may have been seasonally transported to another site. It it also possible that its location in the floor fill of Pit Structure 11 indicated a ceremonial function that may have, in turn, resulted in the use of different companion handstones.

Small Slab Metate (n = 1): This metate was formed from a minimally modified, gray rhyolite cobble. The cobble had a marked triangular cross section that caused the metate to sit at an angle on one of two facets (Fig. 12.5). This caused the ground surface to tilt to either one side or the other and

Figure 12.4. Trough metate with open end.

would require the metate to be propped up or set into the earth to enable use of the flat, cortical use-surface.

It seems that the manufacturer chose not to expend the effort needed to flatten this surface and increase potential use-area; this suggests that this material was available in quantity. Four flakes had been removed to shape one lateral edge, but otherwise the metate was unshaped.

The use-side of the cobble was irregular in contour, with one large, natural flake creating a large concavity. This area was not utilized. The use-surface occupied a small percentage of the potentially available surface. It was not rejuvenated.

Macroscopic wear seemed moderate; microscopic wear appeared light. The highest grains were slightly rounded and polished. Vesicles and interstices were angular and unpolished. Parallel striations existed in small patches.

These striations were oriented across the width. Macroscopic striations were parallel to the length, suggesting that multiple manipulations were employed. Many vesicles contained a bright yellow substance (Munsell 7.5YR 7/8, reddish yellow) identical to that observed on a handstone from the same site (FS 12). The texture of this substance was granular, indicating that it may be a mineral. The irregular cross-section shape, wear patterns, small ground surface area and lack of modification suggested that this tool was used for tasks of short duration, which required few comfort features. The metate measured 33.0 by 26.6 by 15.5 cm and weighed 16,400 gm.

Cobble Metate (n = 1): This metate was also formed from a large, gray rhyolite cobble. Two very large flakes were removed from the bottom, but it was not clear if this occurred naturally or if it was the result of modification, which would have allowed the tool to sit level.

The potential use-surface was a large, flat cortical area; it was unrejuvenated. The utilized area occupied less than one-quarter of the potential surface area and was very lightly ground. The highest grains were sheared, creating interstices with angular edges. Nearly all interstices and vesicles were filled with sheared material.

Neither polish nor adhesions were present. This metate measured 36.8 by 34.2 by 11.0 cm and weighed 16,000 gm. The potential use-surface was approximately 20 by 30 cm (600 sq cm). The ground area was about 16 by 16 cm (256 sq cm) and occupied 43 percent of the surface.

Metate Fragments (n = 8): These small fragments were primarily interior portions, with use-surfaces and metate bases occupying opposing surfaces. Gray rhyolite (n = 3) was the predominating material among these fragments, with single artifacts of black rhyolite, granite, andesite and brown and black sandstone materials. Five of the fragments represented internal portions; three were edge fragments.

Only two fragments retained portions of cobble cortex; the remaining pieces were too fragmentary to have been analyzed for raw material form. Two were bifacial fragments. One bifacial fragment was heavily used on one surface and moderately used on the opposing surface.

The second bifacial metate fragment was heavily rounded on all edges and appeared to have been used after breakage. These rounded edges posed an interesting conundrum, however. The tabular piece was an edge fragment that appeared to have been broken on both lengthwise edges and across the width of the thinnest section of the metate.

This resulted was 10 potential edges that could have been used. However, only two edges displayed use; the others did not. One used edge formed the edge of the original metate; the other formed the lateral. Edge rounding on the entire artifact was so extensive that it appeared waterworn.

The artifact was 3.6 cm thick at the edge and was extensively worn to a thickness of 1.0 cm. Both surfaces were heavily striated parallel to the length. This piece may have served as a small abrader, which might have been held in two different positions, based on the location of the used edges. It was recovered on the surface just north of the site.

Another metate fragment displayed one concave ground surface with parallel striations. The orientation of the striations was indeterminate. The metate use-surface was used as a platform to remove several flakes. The flaked artifact appeared unfinished.

The two sandstone metate fragments offered intriguing information concerning the preference for abrasion. Both were internal fragments and were used heavily on one surface. Both surfaces were smooth and displayed large areas where grains were flattened, even with the matrix. One fragment appeared to have been rejuvenated at some point, but evidence of this seemed to have been nearly

Figure 12.5. Small slab metate. Blue color at upper right is likely a paint tag inadvertently applied in the course of modern-day road work.

obliterated by grinding. The other showed no signs of rejuvenation.

It is interesting to note that both sandstone materials were fine grained and heavily worn, with little or no rejuvenation. Rhyolite materials were very fine grained and were frequently used on unrejuvenated cortical surfaces. The large trough metate represented a notable exception to the dearth of rejuvenation in the metate assemblage. As with the handstones, a preference for minimally or non-abrasive surfaces was evident.

One bifacial metate fragment was heavily worn on two opposing surfaces. Most of the grains were sheared flat with the surrounding matrix, and the entire surface displayed random striations. The remaining interstices were filled with red ochre.

One complete metate and two fragments displayed adhesions that appeared to be yellow ochre (Munsell 10YR 7/6, yellow). In addition to the slab metate, one sandstone fragment retained yellow ochre in its vesicles.

One fragment had two broken surfaces that were heavily stained with yellow ochre. This seemed unusual because no wear existed on the broken surfaces, and the use-surface had only a few vesicles filled with this substance. The remaining artifacts, however, retained these adhesions on the use-wear surface, indicating that at least one function of some of these metates was ochre processing.

Metate Summary: Most of the project's metates were manufactured from fine or very fine grained, minimally abrasive materials. When sandstone was chosen for metate use, it was fine grained. Unmodified cortical surfaces were frequently used. Signs of rejuvenation were present on three artifacts, one of which appeared to have been regularly maintained. The other two metate fragments displayed signs of rejuvenation that had been nearly obliterated by use.

Metate wear differed from handstone wear. Smooth handstone surfaces, which displayed prominent grain melting and high polish, occurred less often in metates. Instead, most metates displayed sheared grains, rounded interstice edges, striations, and varying degrees of polish. Within the small project assemblage of 10 metates, four displayed red or yellow ochre in the vesicles, indicating the metates were used to process minerals.

While metate wear appeared to be less extensive than mano wear, minimally abrasive surfaces dominated both artifact groups. While differential wear did exist among manos and metates, this contrast did not suggest radically different functions. Similarities between the assemblages trumped the differences; that said, metate surfaces were slightly more abrasive than mano surfaces. Metates also seemed to have been rejuvenated more often than manos (metates: 3/15 surfaces, 20 percent; manos: 3/81 surfaces, 4 percent).

The differential wear between handstones and metates may have been caused by a number of factors. First, the majority of whole handstones were cobble tools with a wide range of wear surface morphologies. These artifacts were small and versatile, and may have been used on a variety of netherstones. They appeared unlikely candidates for single metate companion tools. Second, nearly half of the assemblage was fragmentary. Many of the tools had secondary functions that might not have involved a netherstone.

The light to moderate use of the two, large, rhyolite cobble metates from LA 120973 suggested that some tools were simply in the early stages of wear. Lastly, the higher surface rejuvenation of metates may have indicated that few project manos served as companion tools. This again raised the point that some manos may have been transported from the sites, as addressed in preceding pages and in the assemblage discussion below.

Polishing Stone (n = 9)

Polishing stones were recovered from three sites: LA 120973 (n = 7); LA 120972 (n = 1); and LA 130331 (n = 1). All stones were unmodified round or oval cobbles of quartzite (n = 6) or rhyolite (n = 3). Quartzite colors were tan, black, and brown; rhyolite was gray or black. Most stones were worn on two, opposing, convex surfaces; two showed signs of wear on three surfaces. Three displayed random striations, and one parallel. All displayed polish wear. One polishing stone exhibited red pigment stains on one use-surface. The tan quartzite polishing stone retained a waxy residue on one convex surface. The polishing stones ranged in size, with a mean length of 3.6 cm. Several artifacts, which may have been raw material for polishing stones, were included as manuports below.

Figure 12.6. Natural limestone manuport.

Manuports (n = 7)

The most distinctive manuport was an unusual piece of limestone refit from two fragments (Fig. 12.6) at LA 120972.

Portions of this artifact were recovered from two different proveniences, but the pieces fit together. One surface was markedly convex, and the other heavily eroded by rainwater dissolution that resulted in numerous, small, scalloped concavities.

The most interesting characteristic of these pieces was that, despite originating from the same artifact, each piece was a different color. Munsell colors were 7.5YR 5/2 and 10YR 5/3. This color difference was too marked to owe to differences in provenience.

The reddish piece was recovered in the fill of Pit Structure 3, near the west wall (187S/142E). The other fragment, which appeared more yellowish in color, was found in the floor fill of the same structure, near the north wall (187S/145E). The vesicles of this fragment contained yellow ochre; the reddish fragment did not display pigment. These two refit pieces may have been the medial section of a larger piece; however, because one broken end was lightly ground, this may not have been the case.

The remaining manuports were black, brown, or red quartzite cobbles. All were unmodified, but were categorized as manuports based on the feature provenience of many. One each was recovered from the fill of Feature 6, a square posthole at historic LA 114462, and from the fill of Storage Pit 20 at LA 120973, which also yielded a turquoise pendant. One came from the fill of Feature 1A, a charcoal-filled pit at LA 120972, and another two were found in the fill of Pit Structure 3 at the extreme south end of LA 120972.

The only one of these small, quartzite cobbles not found in feature association was recovered from LA 130331, in Level 2 of 100N/99E. As LA 114462 was a historic site, the cobble may not have had a cultural significance, though it may have served as a lodging stone for a post. Those in a Prehistoric context, however, seemed far more likely to have been related to activities associated with these pit features.

Paint Stone (n = 3)

These three paint stones were comprised of two small pebbles and one angular piece of compact hematite. Both cobbles were from LA 120972; the angular fragment was from LA 120973.

The angular fragment was found in Level 1 of 33N/263E, in the vicinity of Storage Pit 6 and its associated postholes. The angular fragment was trapezoidal in cross section and was ground on each of the five facets. Both ends were ground as well; all seven ground surfaces displayed marked random striations and polish.

The two hematite pebbles were lighter in weight and were more coarsely grained than the previous artifact. The larger of the two pebbles was lightly ground on two convex surfaces. The grains were sheared and nearly every vesicle was filled with ground material. The smaller pebble appears to have been ground twice to test color, as two narrow, abraded strips represented the only wear. Both pebbles were recovered from Feature 1A, the small pit north of LA 120972 proper.

Hematite inclusions were frequently found in the rhyolite and sandstone materials, and indicated that this material was naturally occurring. Also, Feature 1A was dug into a sterile layer of reddish sand that may also have contained hematite.

Small Cobble Abraders (n = 2)

These two artifacts were separated from the handstone category by their small size. Both measured less than 5 cm in diameter; both were unmodified, black or gray rhyolite cobbles ground on cortical surfaces.

One of these artifacts was split in half, lengthwise, during excavation. For this reason, the opposing surface could not be analyzed for wear. Wear on the convex surfaces of both cobbles was light, resulting in shearing of the highest grains. The cortical surfaces of both artifacts were vesicular and were slightly more abrasive than the quartzite polishing stones. They appeared to have differed functionally but could have been used in ceramic vessel polishing as well.

The black rhyolite cobble was from Level 1 of 32N/260E near Storage Pit at LA 120973. The gray cobble was from Level 1 of 247N/99E near Feature 1A at LA 120972.

Pigment Grinding Stone (n = 1)

This naturally tabular, rhyolite fragment retained heavy red pigment stains on one flat, cortical surface. It was ground and randomly striated on the pigmented surface and was subtriangular, with two complete cortical surfaces and one broken edge. The fragment was not shaped.

This artifact could have served as either the handstone or netherstone in pigment processing. Nearly all pigment stains were concentrated at the triangle apex. It was clearly part of a larger piece; however, whole dimensions could not be determined. This grinding stone was recovered in the fill near the southern wall of Pit Structure 11, in 21N/266E. It is 7.7 by 6.6 by 1.9 cm and weighed 109 gm.

Shaped Stone (n = 1)

This naturally tabular, white rhyolite fragment was subrectangular. One end was broken; it was lightly ground on two opposing sides, with the highest grains sheared. A high polish was also present on these sheared grains. The remaining surface area was unmodified. The stone may have been a partially manufactured ornament. It was lightweight, but fairly thick, which lessened the likelihood of an ornamental function. It was recovered from Level 1 of 245N/98E. This grid unit is within close proximity of Feature 1A, the small pit north of LA 120972 proper.

Indeterminate Fragments (n = 8)

Most of the artifacts in this category appeared to be use-surface flakes from larger artifacts. All displayed a single ground surface. Black rhyolite (n = 4); gray rhyolite (n = 2); brown rhyolite (n = 1); and gray quartzite (n = 1) comprised the material types. The brown rhyolite fragment retained red pigment on the use-surface. The mean of all indeterminate fragments was 3.6 cm, with the largest fragment measuring 5.6 cm in length. Nearly all fragments originated from LA 120973 (n = 7), with the remaining artifact from LA 120972. Two black rhyolite fragments from LA 120973 were recovered from the fill of Storage Pit 6.

Site Assemblages

LA 120973 (n = 41)

This site yielded the largest ground stone assemblage in the project (Table 12.8). It consisted primarily of handstones (n = 16) with metates (n = 9), polishing stones (n = 5), and indeterminate fragments (n = 7). Manuports, paint stones, pigment grinding stones, and small cobble abraders were each represented by one artifact. Less than half of the assemblage was complete (n = 18/41; 44 percent).

This site yielded the lowest percentage of whole ground stone artifacts and the highest number of indeterminate fragments. As with most project sites, igneous material types dominated the assemblage, with rhyolite (n = 24) and granite (n = 3). Sandstone (n = 6), quartzite (n = 7), and compact hematite (n = 1) completed the material types.

The LA 120973 assemblage had several unique characteristics. The handstone assemblage, in particular, was noteworthy and differed considerably from the LA 120972 ground stone assemblage. Handstones here were more abrasive and suited to processing foods than those from LA 120972. Every shaped mano that was made of more abrasive sandstone originated from LA 120973.

Five of the 11 core tools were found at LA 120973, with the majority found at LA 120972. The majority of project metates were also found here, including the large, open-ended trough metate. While a low number of abrasion tools were found here, they also comprised the minority.

Of the seven rejuvenated surfaces in the project assemblage, four were on artifacts from this site. The largest mano from the project would have fit well with this assemblage, but it was not recovered here and originated instead from LA 120972.

One distinctive feature of LA 120973 ground stone was the presence of adhesions. Most substances found on used surfaces occurred on artifacts from this site (see Chapter 14). Adhesions consisted of hematite, limonite, and waxy and oil-based residue (Tables 12.9, 12.10, 12.11, 12.12). The most interesting aspect of the adhesions was that they occurred on a variety of artifact types, the majority of which were fragmentary. Most adhesions occurred on handstones, including shaped one-hand manos and cobble abraders used on cortical surfaces. While adhesions were present on a minority of artifacts, they indicated that activities other than food processing had occurred here, possibly to a greater extent than at other project sites.

Within LA 120973, most ground stone artifacts were recovered from grid unit proveniences outside features; however, a small percentage was directly associated with features (n = 12/41; 29 percent). Pit Structure 7 and Storage Pit 6 yielded the highest number of feature ground stone, with three artifacts a piece.

Pit structures yielded five ground stone artifacts. Pit Structure 7 contained three whole artifacts, including two core handstones and a tabular, cortical handstone. The large trough metate was in the floor fill of Pit Structure 11; the pigment grinding stone was also found in the fill. Storage pits contained six artifacts. Storage Pit 8, between Pit Structures 7 and 11, contained a whole, granite handstone. Storage Pit 6, at the north end of the site, yielded three fragments, two indeterminate and one metate. One of the associated postholes, Feature 6F, contained a whole rhyolite core tool. Most of the ground stone artifacts were directly associated with features were whole (n = 8/12; 67 percent). Storage Pit 6 was somewhat anomalous in its completely fragmentary ground

Table 12.8. Ground stone distribution, by artifact type and site.

	LA 114462	LA 120972	LA 120973	LA 130331	Total
Handstones					
Core-abrader	–	5	4	–	**9**
Core-hammerstone-abrader	–	2	1	–	**3**
Abrading stone	–	2	2	–	**4**
Smooth-surfaced abrading stone	2	7	2	–	**11**
Mano fragments	1	5	1	–	**7**
One-hand mano	–	–	6	–	**6**
Total	**3**	**21**	**16**	–	**40**
Metates					
Metate fragments	–	2	6	–	**8**
Metate, trough, one end open	–	–	1	–	**1**
Metate, slab	–	–	2	–	**2**
Total	**–**	**2**	**9**	**–**	11
Miscellaneous Ground Stone					
Small cobble abraders	–	1	1	–	**2**
Polishing stone	–	1	5	1	**7**
Manuport	1	4	1	1	**7**
Paint stone	–	2	1	–	**3**
Pigment grinding stone	–	–	1	–	**1**
Shaped stone	–	1	–	–	**1**
Indeterminate fragments	–	1	7	–	**8**
Total	**1**	**10**	**16**	**2**	**29**
Table Total	**4**	**33**	**41**	**2**	**80**

Table 12.9. LA 120972, ground stone, with ochre adhesions.

	Hematite	Ground Compact Hematite	Yellow Ochre	Total
Feature 1A, charcoal-filled pit east of site	–	1	–	**1**
Pit Structure 3, fill, unit -187S/142E	1	–	–	**1**
Pit Structure 3, floor contact	–	–	1	**1**
Total	**1**	**1**	**1**	**3**

stone assemblage, with all other features, even the posthole, containing whole artifacts.

There were three concentrations of ground stone activity within LA 120973 (Table 12.13). The largest (n = 12/41; 29 percent) was in the area including Pit Structure 7, Storage Pit 8, and the open area south and southwest of these features. The most notable feature of this area was the high concentration of manos (n = 10/16; 63 percent).

The ground stone assemblage from this activity area consisted almost exclusively of handstones, with two indeterminate fragments. There was a mix of handstone types, including core handstones, shaped manos, and tabular cortical abraders. Most handstones from this activity area were whole (n = 6) with only one mano fragment present. Interestingly, there were few metates present, with the nearest one occurring in the area of Pit Structure 11.

The open area between Storage Pits 6, 17, 24, and 25 made up the next largest concentration of ground stone tools (n = 11/41; 27 percent). The assemblage here was much more diverse and was comprised

Table 12.10. LA 120972, ochre distribution, by weight in grams.

	Hematite, Soft	Yellow Ochre	Red and Yellow Ochre Mixed	Total
Feature 1A, charcoal-filled pit	60.1	87.6	–	**147.7**
No association (185S/143E)	–	1.6	–	**1.6**
Total	**60.1**	**89.2**	**–**	**149.3**

Table 12.11. LA 120973, ground stone, with ochre adhesions.

	Hematite, Soft	Hematite and Charcoal Adhesions	Ground Compact Hematite	Yellow Ochre	Oil-based Residue	Waxy	Charcoal Adhesions	Total
Pit Structure 7, Storage Pit 8 and open area to SW	1	–	–	1	–	–	–	**2**
Pit Structure 11, open area between Features 7 and 11	1	1	–	–	–	–	1	**3**
South end of site near Storage Pit 20	1	–	–	–	–	–	–	**1**
Open area between Storage Pits 24, 25, 17, and 6	1	–	–	1	1	–	1	**4**
Extreme north end of site	–	–	–	1	–	1	–	**2**
Total	**4**	**1**	**–**	**3**	**1**	**1**	**2**	**12**

of handstones, netherstones, pigment-processing artifacts, ceramic-processing artifacts, and indeterminate fragments. Five artifacts were whole—a slab metate; a tabular, cortical handstone; a paint stone; a core tool; and a reshaped mano fragment. Four of the nine site metates originated from this area, though only one was whole.

This area also yielded the highest number of artifacts with adhesions (n = 4), though this attribute was otherwise evenly distributed among activity zones (Table 12.13). Hematite, limonite, and oil-based residues were observed on four ground stone tools.

The small concentration of artifacts found between Pit Structures 7 and 11, including those found in Storage Pit 8, denoted the third activity area (n = 6/41; 15 percent). This area was also diverse, and included: handstones; the large, trough metate; and pigment- and ceramic-processing artifacts (Table 12.13). Three artifacts were whole, including: the trough metate; a granite handstone; and a polishing stone. This area also yielded the second highest number of artifacts with adhesions (n = 3), which were comprised of hematite (n = 2) and charcoal (n = 1).

The majority of manos and metates did not occur together at LA 120973, which suggested that these items were not companion tools. Also, since polishing stones were found widely scattered throughout the site, the reason for their presence may have been a natural one. This theory was corroborated by handstone wear, morphology, and multifunctional roles, and possibly by the differential wear patterns found on handstones and netherstones. The high frequency of fragmentary artifacts, many of which appeared to have been reused, also supported this theory. Notable exceptions were the two, small, slab metates formed from rhyolite cobbles, both of which appeared to have been likely companions of the small handstone assemblage.

The site assemblage indicated that grinding activity was not based on large-scale flour production. Indeed, small-scale grinding activity requiring artifacts with low abrasive, easily manipulated tools seemed to have dominated here. The use of cores, core-hammerstones, and broken tool surfaces as grinders suggested that abrasion was accomplished using uneven surfaces. The high percentage of arti-

Table 12.12. LA 120973, ochre distribution, by weight in grams.

	Hematite, Soft	Yellow Ochre	Red and Yellow Ochre Mixed	Total
Open area south of Storage Pit 10 (34N/265E)	–	–	3.3	**3.3**
38N/266E	0.15	0.03	–	**0.18**
East of Storage Pit 10	1.8	–	–	**1.8**
Storage Pit 10	0.1	–	–	**0.1**
Pit Structure 16	0.1	–	–	**0.1**
	–	–	2.9	**2.9**
Storage Pit 20	0.4	0.7	–	**1.1**
Storage Pit 26	1.4	–	–	**1.4**
Feature 32G, small storage pit adjacent to larger Feature 32 storage pit	2.8	–	–	**2.8**
Total	**6.75**	**0.73**	**6.2**	**13.68**

facts displaying adhesions indicated the processing of items other than foodstuffs. This also appeared to be true at LA 120972, where metates were almost completely absent and the handstone assemblage was similar to that at LA120973.

LA 120972 (n = 33)

The second highest, ground stone tool assemblage, which consisted of 33 artifacts, was recovered here. Igneous and volcanic material types dominated. These were comprised of gray rhyolite (n = 14), black rhyolite (n = 2), brown rhyolite (n = 1), white rhyolite (n = 1), andesite (n = 2), basalt (n = 1), and granite (n = 2). Sedimentary materials included white sandstone (n = 3) and limestone (n = 2). Quartzite (n = 3) and compact hematite (n = 2) constituted the remainder of the assemblage.

The most striking detail of the site's tool kit was the overwhelming dominance of handstones (n = 21/33; 64 percent). Less abrasive handstones, including cortical surface abraders and core tools, comprised the majority (n = 15), while two metate fragments, one of which had been reshaped into a small abrader, represented the entire netherstone category.

The manuport category was the second largest and included painted, refit, tabular limestone pieces and two unused quartzite pebbles. Other miscellaneous artifacts included a shaped stone, a paint stone, several polishing stones and other indeterminate fragments. Interestingly, more than half of these artifacts—most of which were handstones—were complete (n = 17/33; 52 percent).

Most of the ground stone artifacts found at the site were associated with features (n = 19/33; 58 percent). Fill from Pit Structure 3 yielded the highest numbers (n = 13), while Charcoal Pit 1A (n = 6) comprised the feature assemblage. As there was considerable distance between these two features, they will be referred to here as LA 120972 South and LA 120972 North.

At LA 120972 South, the majority of ground stone items was recovered from Pit Structure 3 (n = 13/16; 81 percent); many were whole items (n = 7/13; 54 percent). Most of the pit structure assemblage was made up of handstones. Metates were represented by a single rhyolite fragment that had been ground on a cortical surface. Painted, limestone, manuport pieces also were recovered from Pit Structure 3, though these were not within close proximity of the other items.

Most of the ground stone at LA 120972 North was recovered from Charcoal Pit 1A and its immediate surroundings (n = 14/17; 82 percent). This area yielded an assemblage of handstones (n = 8), paint stones (n = 2), a shaped stone (n = 1), a quartzite pebble manuport (n = 1), a polishing stone (n = 1); and a small cobble abrader (n = 1). Three of the handstones were found within a 5 m radius of the pit. This pit also contained significant amounts of bone, ceramics, and lithic artifacts. While this combination suggested a possible trash pit, most of the ground stone was whole, indicating that these tools

Table 12.13. LA 120973, ground stone distribution, by type and activity zone.

Ground Stone Type	Pit Structure 7, Storage Pit 8, and Open Area to SW	Pit Structure 11, Open Area between Fea. 7 and Fea. 11	South End of Site near Storage Pit 20	Open Area between Storage Pits 24, 25, 17, and 6	Vicinity of Storage Pit 6	Near Storage Pits 19 and 23	Extreme South End of Site	Extreme North End of Site	Total
Handstones									
Shaped sandstone one-hand mano	3	1	–	1	–	–	1	–	**6**
Core-abrader	3	–	–	1	–	–	–	–	**4**
Core-hammerstone-abrader	1	–	–	–	–	–	–	–	**1**
Abrading stone	–	1	–	1	–	–	–	–	**2**
Tabular cortical handstones	2	–	–	–	–	–	–	–	**2**
Mano fragments	1	–	–	–	–	–	–	–	**1**
Total	**10**	**2**	**–**	**3**	**–**	**–**	**1**	**–**	**16**
Metates									
Metate fragments	–	–	–	3	–	1	–	2	**6**
Metate, trough, one end open	–	1	–	–	–	–	–	–	**1**
Metate, slab	–	–	1	1	–	–	–	–	**2**
Total	**–**	**1**	**1**	**4**	**–**	**1**	**–**	**2**	**9**
Pigment Processing									
Paint stone	–	–	–	1	–	–	–	–	**1**
Pigment grinding stone	–	1	–	–	–	–	–	–	**1**
Total	**–**	**1**	**–**	**1**	**–**	**–**	**–**	**–**	**2**
Ceramic Processing									
Polishing stone	–	1	1	–	–	–	1	2	**5**
Small cobble abrader	–	–	–	1	–	–	–	–	**1**
Total	**–**	**1**	**1**	**1**	**–**	**–**	**1**	**2**	**6**
Other									
Manuport	–	–	1	–	–	–	–	–	**1**
Indeterminate fragments	2	1	1	2	1	–	–	–	**7**
Total	**2**	**1**	**2**	**2**	**1**	**–**	**–**	**–**	**8**
Table Total	**12**	**6**	**4**	**11**	**1**	**1**	**2**	**4**	**41**

may have been used in activities related to the pit prior to its use as a trash receptacle.

The widely dispersed artifact scatter and hearths found both north and west of the excavated portion of LA 120972, indicated that the site should be extended into this area. Three LA 120972 ground stone artifacts may have come from this area, with two found south of the site proper at 180N/99E and 206N/148E and one found to the far north at 279N/99E.

The predominance of handstones comprised of core tools and cortical-surfaced abraders was interesting in view of the almost total absence of netherstones. It seemed unlikely that netherstones would be transported away from the site. It was possible however, that netherstones were underrepresented in the site assemblage, as the large artifact scatter west of the site remained unexcavated. It was also possible that at least a portion of these handstones were not used in conjunction with netherstones.

Wear-pattern distribution at LA 120972 was similar to that at LA 120973. Both assemblages displayed similar frequencies of grain melting, rounding, and polish indicative of heavy, unrejuvenated surface use. Both site assemblages also displayed a tendency toward random, as opposed to parallel, striations. This could mean that these handstones were used mainly for the grinding of non-food items, but only if this kind of use was more prone to result in random striations.

LA 114462 (n = 4)

This site assemblage was comprised of handstones (n = 3) and a quartzite pebble with a high percentage of hematitic inclusions, which was possibly collected as a manuport (n = 1). The three handstones consisted of cortical-surfaced rhyolite cobbles (n = 2) and an indeterminate fragment. One handstone was whole and heavily worn; the fragmentary handstones were lightly worn. The quartzite pebble displayed no wear.

The three handstones were found in the fill of the Feature 1 root cellar; the quartzite pebble was found in the fill of the Feature 6 posthole. The prehistoric handstones may have been manuports collected by occupants of the historic site either to serve in some function related to the root cellar or as curiosities. They also may have been unearthed during the construction of the root cellar.

LA 130331 (n = 2)

Two quartzite pebbles comprised the entire ground stone assemblage. The brown quartzite artifact was moderately worn and displayed parallel striations on one use-surface and polish wear on the reverse surface. The black quartzite pebble was not used and was analyzed while taking into account its possible role as a manuport. Both quartzite pebbles were recovered from Level 2 of 100N/99E and measured 3.7 by 2.6 by 2.3 cm and 3.7 by 2.6 by 2.6 cm.

Discussion

A late summer–fall occupation of LA 120972 and LA 120973 was indicated by faunal assemblage analysis (see Chapter 15). Faunal analysis results, as well as the sites' location in an alluvial fan basin and the discovery of storage pits containing macrobotanical corn remains, all suggested that these sites were seasonal farming locations.

Based on the ground stone assemblage, these sites did not appear to have been used as cultigen processing locations. Small handstones; cortical surfaces; fine grained, minimally abrasive materials; and heavily worn, randomly striated, unrejuvenated surfaces would all have been inefficient for the processing of large, hard grained materials into flour.

Smooth surfaced, handheld tools were best suited for the processing of smaller-sized foodstuffs, during which less seed loss would occur and manipulative control would be maximized. Based on fat-based residues observed on some project tools, it appeared that foods with high oil contents may have been processed with these tools or that these tools may have been used to soften hides. Evidence showed that these tools were also used to process pigments.

Extending from the lower basin to the alluvial fan and upwards to the mountain foothill areas the site location offered a wide range of exploitable resources. The site encompassed grasslands, piñon and juniper forests, and the foothills of the highlands (Hard 1997:93).

Chihuahuan Desert Scrub included xeric grasses, mesquite, sotol, creosote bush, American tarbush, whitethorn acacia, four-wing saltbush, and Mormon tea (Kirkpatrick et al. 2000:6–8). The semi-desert grassland included yucca, bear grass, agave, littleleaf sumac, and barberry. The Plains grasslands included blue grama, buffalo grass, Indian ricegrass and alkali sacaton. Shrubs included soaptree yucca, cholla cactus, prickly pear cactus, and snakeweed. The foothills and lower mountain zones, which border these grasslands to the east, included several species of oak, squawbush, birchleaf mountain mahogany, ponderosa, desert ceanothus (buckthorn), Apache plume, and concentrations of ocotillo, sotol, yucca, and agave (Carmichael 1990:124).

While this list is far from complete, it points to the wide array of resources available within a 16 km (10 mi) radius of the site. Alluvial fan locations were optimal for the exploitation of multiple, environmental resource zones (Condon et al. 2008:325). Many of these would require processing with ground stone tools.

Carmichael noted that the greatest diversity occurred in the low mountains and foothills, as opposed to basin floors and high mountain areas (1990:124). The project area was located within 8 km (5 mi) of the foothills and offered a significant and diverse range of resources and arable land. Each of these three zones could have been exploited, with portions of the wide expanse of surrounding land free for cultivation. Carmichael further posited that individual basins were unlikely to have contained a full spectrum of subsistence resources, thus necessitating the use of the entire Jornada region.

While cultivated and wild foods appeared to have constituted the majority of these people's diets, the absence of two-hand manos and a dearth of large metates indicated that cultigens were processed elsewhere, possibly at a late fall or winter site. It also was possible that tools used for processing food were transported seasonally or that reliance on cultigens was low and required few tools.

Of interest was Mauldin's observation that corn was processed in various locations within Bolivian villages (1993:320). Corn flour was sometimes ground at permanently occupied sites then transported to agricultural camps; sometimes it was ground at the agricultural camps themselves. Grain was transported to pastoral camps for grinding as well.

Wright discussed the problems that mobile foragers faced when dealing with ground stone tools (1994:246–247). Tools needed to be close to the location where processed foods were consumed. This could have resulted in lightweight portable tools being transported among camps, the caching of heavy tools near resource areas, and the reduction of the foraging area to ease the transport of gathered foods to where they would be consumed. The first two strategies were perhaps most applicable to the project sites. Most tools were small and portable; however, the trough metate found at the project site appeared to have a fixed position in a resource area-seasonal camp location.

The differences in tools used for agriculture and non-agricultural purposes in Bolivia might also apply to the Carrizozo project (Mauldin 1993:320, Fig.1). Manos used to process chile, dried meat, salt, and other items were often far smaller than those used to grind corn; smaller tools were rarely used in agriculture (Mauldin 1993:321).

Mean mano area was 57.4 sq cm for LA 120972 and 51.3 sq cm for LA 120973 (Table 12.14). It was interesting to compare these figures to the mean area range of 25–125 sq cm for the Bolivian non-agricultural manos. Rocek, citing Early Pueblo ethnographic studies, saw the village as the most likely location of corn shelling following the transport of cobs from the fields. (1995:230).

Ground stone assemblages dominated by small handstones of non-vesicular material and basin metates denoted a reliance on small, wild seeds; a predominance of trough or slab metates and two-hand, specialized manos of more abrasive, vesicular materials indicated a focus on large grained cultigens like corn (Stone 1994:683, 684).

In the Hohokam site of Pueblo Grande, use of vesicular basalt was crucial enough to necessitate the importation of the material, as local tool stone was far less abrasive (Stone 1994:685).

The crushing, grinding, and rotating motions required to process and hull small grained foodstuffs resulted in multiple, random striations and crushing wear on the handstone and base stone. The smooth surfaces of quartzite and aphanitic volcanic material helped to prevent seed loss.

In contrast, corn processing required the use of a reciprocal stroke, creating a shearing-and-grinding action resulting in parallel striations. More abrasive materials were needed to produce corn flour, as evidenced by surface rejuvenation (Stone 1994:682–683).

At the La Joya sites along the southern coast of the Gulf of Mexico, abrasive, vesicular basalt tools were preferred over those of a less abrasive, granitic, and quartzitic variety as agricultural dependence intensified (Vanderwarker 2009:22, 33). Tools became increasingly specialized as cultigens dominated the diet; one-hand manos were replaced by two-hand manos, and the use of bifacial metates increased. Granitic material and quartzite were considered inefficient for grinding large scale cultigens and may have been better suited for processing wild seeds, roots, berries, and meat (Hard 1983a).

The absence of vesicular basalt in the assemblage was particularly interesting in view of the unlimited source of this material in the Valley of the Fires, about 9 mi northwest of the project area. Clearly, this material was not preferred.

One-hand manos and gathered-food processing appeared to have been a dominant practice at the Mesilla phase sites of the Fort Bliss project. Authors noted that late Mesilla phase sites shifted from basin to upland alluvial fans for extended periods (Condon et al. 2007:289). While this particular Fort Bliss project was located in the southern Jornada, the geomorphological location of the site's alluvial

Table 12.14. *Mean whole mano area, by subgroup category.*

Subgroup Category	Mean (cm^2)	N*	SD*	Minimum	Maximum	Range
Mean Whole Mano Area, All Sites						
Core tool (low abrasion)	53.9	11	18.1	34.1	83.0	48.9
Shaped one hand (higher abrasion)	77.0	1	–	77.0	77.0	0.0
Cortical-surfaced cobbles (low abrasion)	53.3	8	19.8	20.6	86.1	65.5
Total	**54.8**	**20**	**18.6**	**20.6**	**86.1**	**65.5**
Mean Whole Mano Area, LA 120973						
Core tool (low abrasion)	56.0	5	20.3	34.1	82.8	48.7
Shaped one hand (higher abrasion)	77.0	1	–	77.0	77.0	0.0
Cortical-surfaced cobbles (low abrasion)	26.8	2	8.7	20.6	33.0	12.4
Total	**51.3**	**8**	**23.0**	**20.6**	**82.8**	**62.2**
Mean Whole Mano Area, LA 120972						
Core tool (low abrasion)	52.2	6	17.9	34.1	83.0	48.9
Cortical-surfaced cobbles (low abrasion)	63.7	5	13.6	51.6	86.1	34.5
Total	**57.4**	**11**	**16.4**	**34.1**	**86.1**	**52.1**

*SD = Standard Deviation; N = count

fan was nearly identical to that in the Carrizozo project area. The accessibility to a wide range of resources pertained to both cases as well.

An impressive array of pollen species was recovered from four Mesilla and Doña Ana phase sites (AD 660–780 and AD 1030–1160). Cheno-ams (goosefoot and/or amaranth), cocklebur, pumpkin, sunflower seeds and shells, currants, jojoba, tansy mustard, and yucca were found on a ground stone artifact; this indicated the processing of jojoba beans as well as seeds from the sunflower and mustard families. Other probable botanical matches included mesquite pods, fruits or berries, prickly pear pads, baked and raw agave, *Zea mays* cupules and oil, and, possibly, egg yolk (Condon et al. 2008:282–283, 388).

Formal artifacts like trough metates were conspicuously absent (Condon et al. 2008:404). The Fort Bliss sites were thought to have been seasonally occupied since it was likely that plants identified during pollen analysis were harvested in late summer or fall. (Condon et al. 2007:398).

Another Fort Bliss sample yielded much overlap with the aforementioned species, along with *Cucurbita pepo* and bird blood, leading to the suggestion that wet and dry ingredients were combined with seeds from the mustard family, squash flesh, mesquite pods or meal, bird blood, or meat. It seemed equally probable that at least some of these items were processed separately or in variable combinations. Squash, in particular, appeared to have been a staple during Mesilla and Doña Ana phases, while *zea mays* was far less evident (Condon et al. 2008:389–390, 394).

While locally available rhyolite, granite, and quartzite materials were used at Fort Bliss, they were described as coarse grained, suggesting that they were more abrasive than project ground stone. Similar to Carrizozo, sandstone tools were in the minority. Mano plan view images were similar to shaped one-hand tools; however, the absence of cross-section shapes precluded full comparison.

The angular hammerstones at Fort Bliss resembled Carrizozo core tools; however, since grinding wear was not mentioned, they may have differed functionally (Condon et al. 2007:343, Fig. 10.30). The project tools were larger, with a mean length of 8.0 cm, while the Fort Bliss tools displayed a 6.54 mean size (Condon et al. 2007:343). The rounded hammerstones found at Fort Bliss bore less resemblance to Carrizozo core tools but appeared to share the theorized functions of crushing, pecking, and pulping.

Rhyolite and quartzite cobbles with battering wear were also recovered at the Castner Range sites near El Paso, Texas. Hard posited that these tools may have been used to process agave leaves or to grind wild seeds into flour (Hard 1983b:70). However, no grinding wear was noted on these tools; this contrasted with findings from project core tools.

Manos and metates from Castner Range were usually manufactured from rhyolite and quartzite.

Wear on these tools resembled the lighter wear observed on project handstones. Hard had noted that heavy wear on some tools likely occurred off-site. Interestingly, corn, mesquite, and yucca dominated the ethnobotanical assemblage from this project, but no large manos of abrasive materials were recovered. This may indicate that both grown and gathered foods could have been processed with the small, minimally abrasive tools found at the site.

The multifunctional nature of manos and metates was illustrated by Wright (1994:241–242) who provided an exhaustive list of food and non-food items processed with tools from such diverse groups as Californian hunter-gatherers, ancient Mesopotamians, and the prehistoric Levant. Wright stressed that wear patterns, rather than tool morphology, were most indicative of tool multi-functionality (1994:242). For example, cereals were husked in Turkey by the light pounding of a volume of seeds; this rubbed the husks off and left the seeds relatively whole (Wright 1994:243; Hillman 1984:142). This style of manipulation seemed to represent a more likely use for the low-abrasion tools found in Carrizozo.

While there was a functional variation of tools within the assemblage, the full range of potential processing activities for cultivated and gathered foods was disproportionately represented. Larger, more abrasive grinding tools associated with the production of large quantities of flour were represented here by a single trough metate found in a pit structure lacking both a hearth and companion tools. This could have indicated that the site instead reflected a series of warmer-season occupations or that the metate served a ceremonial function.

In considering the relative amount of tools used to process wild versus cultivated foods, it was interesting to note that maize had a greater tendency to occur in flotation samples. Hard noted that maize parts were enhanced over most other taxa (Hard 1997:95). This was due to cooking methods that increased the chance of charring, the use of cobs for fuel, and the tougher qualities of maize parts as compared to those of other plants.

Hard also noted a marked increase in maize ubiquity from Pithouse to Pueblo periods in the southern Jornada Mogollon, and the Tularosa Basin, through a comparison of ethnobotanical remains from the Mesilla and Doña Ana phase sites.

Rocek examined the flotation data from two Lincoln County sites to assess relative mobility and subsistence patterns (1995). He suggested that mobile or sedentary patterns were not direct implications of dependence on a hunter-gatherer versus agricultural lifestyle and concluded that the earlier, lower elevation Dunlap-Salazar pithouse site (early sixth to mid-seventh centuries) appeared to have been more mobile than the later, higher elevation Robinson pueblo site (two components: pre-AD 1200 and AD 1200–1450).

Rocek concluded that settlement patterns were not a direct link to subsistence patterns, suggesting "a significant degree of dependence on crops may not 'exist' based on comparative evidence from the Dunlap-Salazar and Robinson sites" (Rocek 1995:231).

Sedentism did not become the dominant settlement pattern in the southern Jornada until AD 1100. Analyzing site distribution in the southern Jornada, Carmichael stated that even the most substantial Pithouse period sites, with the best indications of intensive use, appeared to represent seasonal settlements (1990:122, 124, 126) and that mobile and sedentary strategies may have been concurrent, or may have alternated seasonally and included reversals in sedentary patterns.

More recent research indicated that Mesilla phase settlements reflected a highly mobile pattern during the Pithouse period (Carmichael 1990:125); while the project sites may not have represented mobility at this level, some was indicated.

Whalen said it was clear that all Mesilla people remained heavily reliant on food collection (1994a:627). He also compared pit structure size, presence of interior features, artifact diversity, and density for the Archaic and Mesilla phases, and though concerned with Late Archaic sites, his observations appeared to be applicable to the mid-Mesilla phase as well.

The majority of calibrated radiocarbon dates from LA 120973 and LA 120972 ranged from the late seventh to the late tenth centuries, well within the period suggested by Whalen to have been dominated by mobile settlement patterns.

A different pattern was noted for the Upland Mogollon region, west of the project area. After examining a large mano assemblage from 15 Mogollon Pithouse period sites, Diehl concluded that mano surface areas increased during the San Francisco phase, AD 700–850 (1996:110).

Many contributing factors have been described, most of which were directly related to the need for increased tool efficiency. Diehl concluded that Upland Mogollon subsistence strategies began to shift from a foraging and horticulture mode to a classically sedentary, agricultural mode around AD 650 (1996:114).

The mean surface area for large, maize grinding manos was at least quadruple that for all whole manos from the Carrizozo project sites (Table 13.14) perhaps providing additional evidence that these Carrizozo tools were best suited for tasks other than corn flour production. This also was evident at the Carrizozo sites where mean mano dimensions suggested that these tools were most likely associated with the processing of gathered foods.

Using archaeological data from the Mogollon Highlands and the San Augustin Plains, Wills examined the seasonal use of both low and high elevation resource zones, noting the importance of each in subsistence strategies (Wills 1989).

The extensive highland grasslands of the San Augustin Plains ranged from 2,065–2,118 m (6,775–6,950 ft) in elevation (Potter 1957:113). These juxtaposed environments were very similar to the project area where the foothills and mountains rise 2,000–6,000 ft above the grasslands.

Wild resources were collected from grasslands in winter and spring; upland areas were exploited during summer and fall. Interestingly, maize cultivation was practiced in both areas, with nearly contemporaneous beginnings (Fish et al. 1986:570).

Wills' analysis of the seasonal use of each zone led to his theory that competition for fall resources may have led to spring cultivation in higher elevations.

Surplus generated from spring cultivation allowed for optimal hunting and gathering in higher elevations; this further implied that "cultigens were first adopted at lower elevations and then transferred to higher locations" (Wills 1989:145).

A similar subsistence pattern may have been employed in the project area. Here, the ground stone assemblage appeared to reflect both the mobility and sedentism of agriculture and hunter-gatherer subsistence.

This "forager-farmer" adaptation was based on several factors. The majority of ground stone tools was portable and non-formal and was suggestive of a more mobile, gathering strategy; yet the formal tools associated with a sedentary agricultural lifestyle were also present in small frequencies.

Ground stone tools were not ubiquitous, as was the case with sedentary living. Neither were they present in the low frequencies reflective of mobile populations. Best characterized as versatile and multifunctional, these tools were indicative of the processing of a variety of food and non-food materials. While about half of the tools were fragmentary, suggesting trash accumulation usually linked to sedentary sites, the fragments were active, functioning tools, not discarded items.

In short, the ground stone assemblage reflected varying degrees of sedentism and mobility. Based on these characteristics, project sites may have been best described as long term, seasonal occupation areas where a wide range of resources were exploited and processed using variable processing strategies.

13 ⸸ Shell Analysis

Karen Wening

Most project shells were recovered from LA 120973 (n = 11), with a single artifact recovered from LA 120972. Almost all of the shell items were unmodified land snails; most may have been natural occurrences. Two of the artifacts—one freshwater shell fragment and one *Haliotis* fragment—had been modified.

Attributes

The shells were analyzed for a variety of attributes; half of these focused on cultural modification.

Material Type combines the freshwater or marine origin of the shell and species name.

Condition refers to the whole or fragmentary status of the artifact.

Portion describes the specific portion of the shell. For example, a shell portion may represent the internal fragment of a bivalve shell or the distal portion of a univalve.

Manufacturing Stage records the extent of an ornament's completion—fully shaped, partially manufactured, etc.

Manufacturing Process describes the methods used to shape an artifact, if any.

Wear refers to modifications occurring as the result of the ornament being worn or used. In the case of shell artifacts, signs of wear often appear as light, random scratches on iridescent surfaces.

Ornament Type describes the finished artifact as a bead, pendant, bracelet, etc.

Drill Hole Type indicates whether any drill holes on the piece are conical, cylindrical, biconical, etc.

Drill Hole Diameter refers to the dimension of any drill hole found on the exterior surface of the artifact; this is measured on both surfaces of completely drilled pieces.

Count is the number of pieces of a fragmentary artifact.

Length, width, and thickness are measured in millimeters.

Length, width, and thickness condition are recorded as complete or fragmentary.

Weight is recorded in grams.

Weight condition is recorded as complete or fragmentary.

Land Snails (n = 11)

All snail shells found at the project sites appear to be of the species *Succinea grosvenori.* This identification is not completely reliable, however, since the categorization of this species relies primarily on the features of living creatures (Metcalf and Smartt 1997:47). However, this snail is commonly associated with the xeric conditions of several southern New Mexico locations and includes the Tularosa area (Metcalf and Smartt 1997:48–49).

The shells of the Succinea grosvenori are solid white, with some slightly translucent patches, and vary somewhat in size (Table 13.1). Land snails may occur naturally in the project area. However, since the majority of shells were found in feature context (Table 13.2), this suggests their presence might also be cultural.

Pit Structure 11, for example, yielded three land snails; however, these snails were recovered from the sterile fill between Floor 1 and Floor 2.

Fill from Storage Pit 20 contained two snails; it seems likely, however, that these mollusks could have been deposited here along with post-occupational sediment. The same may be true of Storage Pit 6, which also contained two snail shells.

One LA 120973 shell seems to have originated from a non-feature context in Level 1 of Grid 48N/265E and another, from LA 120972, from Grid 247N/98E.

Worked Freshwater Shell Bivalve (n = 1)

The fragment of a freshwater shell bivalve was recovered from the surface of LA 120973 in Grid 14N/269E. The fragment has been ground along a small portion of the exterior and is subtriangular, with the fragment forming the broader portion. The

Table 13.1. LA 120973, mean dimensions for whole land snails.

		Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Land snail	Mean	10.7	6.2	4.6	0.05
	N	10.0	10.0	10.0	10.00
	Standard Deviation	1.9	1.0	1.4	0.03
	Minimum	7.0	5.0	1.0	0.01
	Maximum	14.0	8.0	6.0	0.10
	Range	7.0	3.0	5.0	0.09
Total	**Mean**	**10.7**	**6.2**	**4.6**	**0.05**
	N	**10.0**	**10.0**	**10.0**	**10.00**
	Standard Deviation	**1.9**	**1.0**	**1.4**	**0.03**
	Minimum	**7.0**	**5.0**	**1.0**	**0.01**
	Maximum	**14.0**	**8.0**	**6.0**	**0.10**
	Range	**7.0**	**3.0**	**5.0**	**0.09**

N = count

Table 13.2. Shell artifact distribution, by site and feature.

Site	**Feature**	***Haliotis***	**Land Snail**	**Freshwater Bivalve**	**Total**
LA 120972	247N/98E	–	1	–	**1**
LA 120973	48N/265E	–	1	–	**1**
	14N/269E	–	–	1	**1**
	6	–	2	–	**2**
	10D	–	1	–	**1**
	11	–	3	–	**3**
	20	1	2	–	**3**
Total		**1**	**10**	**1**	**12**

triangle apex is part of the escutcheon, or the curved portion of the shell edge, which is fused to the umbo. The shell could have been a partially manufactured pendant, earring, or irregular bead and measures 21 by 8 by 6 mm. It weighs 0.8 gm.

Freshwater bivalves were likely obtained from the Rio Grande, more than 112 km (70 mi) west of the site. The bivalve may have been curated and worked after the animal inside was consumed. The shell's fragmentary nature precludes identification.

Worked Haliotis Fragment (n = 1)

This artifact, an interior fragment of an abalone shell, represents the only piece of marine shell found at the project site.

Vestiges of the exterior red color (Munsell 5YR 6/8) remain, and the interior edge is iridescent. The edges of the piece appear to have been broken into a rough, triangular shape, and the exterior surface displays several parallel scratches. These scratches appear too random to represent any sort of decorative incision and are rather deep. While the scratches are not typical of shallow incisions usually caused by wear, wear is the most plausible explanation for their presence.

The shell was recovered from the fill of Storage Pit 20 at LA 120973. It measures 15 by 6 by 2 mm and weighs 0.2 gm. The presence of this shell fragment is significant, as it indicates trade or travel to the Southern California coast or the Gulf of California.

Summary

The presence of the *Haliotis* shell fragment indicates trade with or travel to the Pacific Coast. Vokes and Gregory (2007:330–332) stated that prehistoric Southwestern populations obtained marine shell from three sources—the California coast, the Gulf of California, and the Gulf of Mexico. They also noted that some species—including *Haliotis*—are restricted to specific sources found only in "the colder waters off the Pacific coast."

Marine shell was the material of choice for most prehistoric Southwestern ornaments (Vokes and Gregory 2007:330–332). While very few shell pieces dating prior to AD 1000 have been recovered from the Jornada Mogollon area, the earliest shell artifacts—consisting primarily of *Haliotis*—were found at early agricultural sites in the southern Basin and Range province (Vokes and Gregory 2007:332, 335). After this period, both the quantity and variety of shell artifacts increased throughout the Jornada area.

LA 120973 seems to reflect the pre-AD 1000 pattern, however, as the worked bivalve and the *Haliotis* shell represent the only cultural shells in the assemblage.

Marine shell is thought to have been obtained prior to AD 1000 through trade with the Hohokam culture.

In the Jornada Mogollon area, the majority of shell artifacts have been recovered from mortuary deposits dating from before and after AD 1000 (Vokes and Gregory 2007:335). Condon et al. stated that trading practices that first brought marine shell into the Fort Bliss area likely began during the Mesilla phase and expanded into the early Formative period (Condon et al. 2008:54). This theory is reflected by the presence of shells from the Pacific and Gulf Coasts at a number of Fort Bliss sites.

Significant numbers of shell ornaments were recovered from three Mesilla phase sites near the Organ Mountains (Condon et al. 2008:354–355). Excavations of five Hueco, late Mesilla phase sites in the Hueco Mountain area yielded only one fragment (Condon et al. 2008:166).

Two shell ornaments were recovered from LA 126396 and LA 126395, Mesilla phase sites in the Tularosa Basin (Church and Sale 2003:39, 105). While specific shell species were not mentioned in the original report, the authors stated that shell ornaments from Mesilla phase sites are typically marine shell (Church and Sale 2003:14).

Not all of the above sites were contemporaneous with the two largest project sites referred to in this report; however, the numbers of shell ornaments found here make evident potential contrasts between sites.

Glycymeris and olivella shells obtained from the Pacific Coast were transformed into the ornaments found at the Fort Bliss sites. Some of the marine shell artifacts from Fort Bliss appear to have been reworked fragments; this might indicate that every effort was made to extend the life of these ornaments.

The abalone fragment found at LA 120973 does not appear to have been curated. The shell's broken edges are sharp and show no signs of heavy rounding and polish wear, which often results from long-term curation.

Signs of wear were evident on olivella and glycymeris shell ornaments from the Pojoaque corridor sites (Wening, in prep). Interestingly, many of these ornaments also displayed numerous, shallow scratches; it is likely that these scratches were the result of extensive wear or handling. The scratches on the Carrizozo abalone are deeper, but they could have been sustained prior to breakage, through wear.

The Carrizozo abalone fragment is a clear indication of regional exchange or travel to the Gulf or Pacific Coasts. The freshwater bivalve indicates trade or travel to the Rio Grande, the nearest source of this shell.

14 ⸙ Ochre, Stone Ball, and Ornament Analysis

Karen Wening

Reworked Turquoise Pendant (n = 1)

The rectangular turquoise pendant from LA 120973 was broken across the width fairly close to the drill hole and the fractured edge partially reground. The location of the break near the proximal end, and possibly the reworking effort, created a pendant wider than it was long with an off-center drill hole. Though the ornament could have continued to function as a pendant after this reshaping, its reworked asymmetric form may have made it more suitable as a bead.

No wear was evident inside the drill hole, but the edges were highly polished and rounded, which raised the possibility that the artifact was a partially manufactured ornament that was never strung. The flat surfaces were heavily striated across the width from shaping. This ornament was recovered from the fill of Storage Pit 20 at the southern edge of the site, it was 11 by 9 by 1.5 mm with a drill hole diameter of 2.2 mm.

The nearest source of turquoise is the Parsons Mine, east of the project area in Tanbark Canyon. At 2,520 m (8,268 ft), the mine was a historic source of turquoise, gold, limonite, molybdenite, pyrite, quartz, and chalcopyrite, according to information from www.mindat.org. There are few references for prehistoric mining in the Parsons area.

A 1904 study of New Mexico mining districts stated "fairly good" turquoise could be found "near the divide which separates the [Bonito and Nogal] mining districts; old workings, presumably of Spanish origin, are to be seen; turquoise appears to have been the object of their efforts" (F. Jones 1904:170).

Cozzens disputed this theory, stressing project turquoise was more likely to have been retrieved from a prehistoric mine, since Parsons Mine turquoise has been described as low quality (Cozzens 2011:75–76) and was present only as a minor occurrence (Weber 1979:39).

This turquoise may have come from the Jarilla Mountains, south of the project area, which were mined prehistorically (Weber 1979). The Jarilla Mountains likely supplied turquoise to the Jornada Mogollon population and surrounding regions.

Miller and Graves (2009:1) stated that salt, turquoise, and possibly cacti were exported from the Jornada area in exchange for shell, exotic stone, ceramics, and animal hides from other regions. The level of interaction between the Jornada Mogollon and surrounding regions seems to have been underestimated in previous studies, and it has become apparent that the Jornada Mogollon population maintained almost constant social, economic, and ritual contact with Mogollon, Casas Grandes, Salado, and Plains groups.

The turquoise bead from LA 120973 may have been placed in the storage pit as part of a closure ritual similar to those conducted at Madera Quemada at Fort Bliss. Such ornaments are thought to have been used in ritual termination of pits and postholes at Madera Quemada up until the fourteenth century (Miller and Graves 2009:124, 131, 135, 138, 166, 379–412).

Stone Balls (n = 2)

Two small stone balls were recovered from LA 120973. Both items appeared to have been naturally formed. The smaller of the two was made of brown rhyolite and retained hematite stains over much of its surface. The surface of the smaller ball was rougher and the outline less regular than the larger artifact. The smaller item was found in Level 2, west of Pit Structure 11, in Grid 23N/267E and measured 12 by 11 by 11 mm.

The larger stone ball was a hematitic sandstone concretion measuring 13 by 13 by 13 mm. It was found in the fill of Storage Pit 6. No wear was evident on either artifact.

It has been theorized that stone balls served in closure rituals elsewhere in the Jornada Mogollon. Excavations at Twelve Room Pueblo, near El Paso, yielded a room divided into four compartments, one of which contained a wealth of materials, including stone balls (Jackson and Thompson 2005:17).

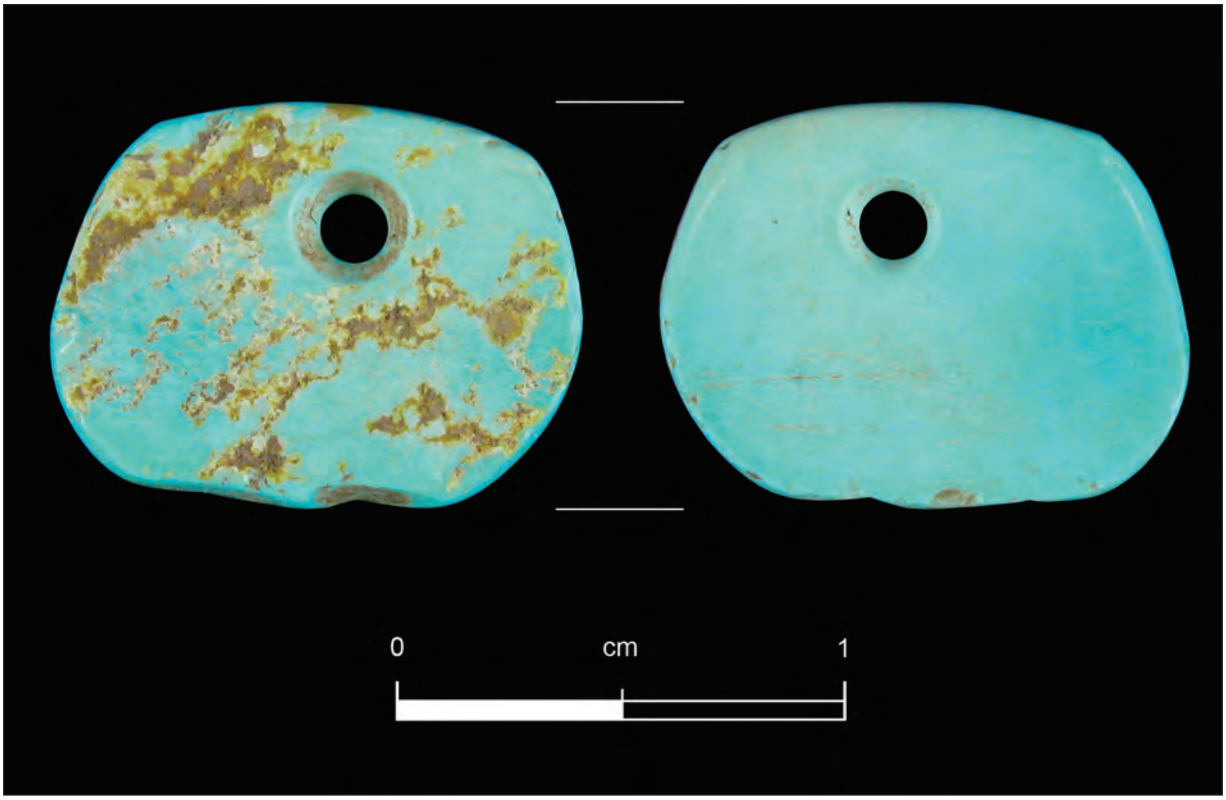


Figure 14.1. LA 120973, reworked turquoise pendant.

Ochres (n = 18)

Mineral specimens were collected from LA 120972 (n = 6) and LA 120973 (n = 12). Red and yellow ochres dominated the assemblage, with some unidentified gray minerals comprising the minority (Table 14.1). Ochres were distributed almost evenly by color and were represented by red (n = 9), yellow (n = 7) and red-and-yellow mixed (n = 2). For mixed-color artifacts, Munsell colors were recorded for each. These ochres will be discussed by weight here, instead of by number of artifacts alone, which will allow for easier comparison.

It is likely that hematite pigment was obtained from Little Black Peak—about 20 mi north of the project area. Pigment here occurs in the extruded basalt rocks and limestone of the San Andreas formation (Smith 1964:97, 98).

Yellow ochres outweighed red, with the majority, 93.2 gm, falling in the 10YR hue range. Within the 10YR hue, value/chroma 5/4—or yellowish brown—accounted for 74.6 gm. The 2.5YR hue dominated the red ochres, totaling 60.1 gm.

Most of the weight of both hue groups was accounted for by one or two samples (Table 14.2). Considerable variation existed within the yellow ochre assemblage; this ranged from gray samples, which differed little from the site soils, to the more saturated Munsell colors of yellow, yellowish brown and brownish yellow. A small amount of yellow ochres fell into the 2.5YR hue, which is a more greenish yellow. The largest red ochre sample was a saturated red color, 2.5YR 6/8.

Most of the found ochres were very small, although a few large samples were recovered (Table 14.3). Mean weights of yellow ochres outweighed the red. The largest yellow ochre sample weighed 74.6 gm; the largest red ochre recovered weighed 60.1 gm.

The most striking aspect of ochre distribution occurred by site (Tables 14.4 and 14.5). LA 120972 yielded the majority of ochre (n= 149.3/162.98 gm: 92 percent) with yellow and red represented in almost equal amounts. Ninety-nine percent of the found ochre recovered from this site was from Feature 1A, the charcoal-filled pit east of the site proper. This feature also contained a ground, compact hematite cube (Chapter 12).

Table 14.1. Ochre sample distribution, by site and Munsell soil-color chart.

Munsell Hue	Value/ Chroma	Color	Site		Hue Subtotal	Total
			LA 120972	LA 120973		
10R	4/6	red	–	1	–	**1**
	4/3	weak red	–	3	–	**3**
	4/8	red	–	2	–	**2**
	7/6	light red	–	1	–	**1**
	3/4	dusky red	–	1	8	**1**
2.5YR	4/6	red	1	–	1	**1**
7.5YR	6/8	strong brown	–	1	1	**1**
10YR	6/6	brownish yellow	–	1	–	**1**
	5/8	yellowish brown	–	1	–	**1**
	7/8	yellow	1	–	–	**1**
	5/2	grayish brown	1	–	–	**1**
	5/1	gray	1	–	–	**1**
	5/4	yellowish brown	2	–	7	**2**
2.5Y	6/4	light yellowish brown	–	1	1	**1**
Total			**6**	**12**		**18**

Table 14.2. Ochre weight distribution, by site and Munsell soil-color chart.

Munsell Hue	Value/ Chroma	Color	Site		Hue Weight Subtotal (g)	Total
			LA 120972	LA 120973		
10R	4/6	red	–	0.4	–	**0.4**
	4/3	weak red	–	4.27	–	**4.27**
	4/8	red	–	1.9	–	**1.9**
	7/6	light red	–	0.08	–	**0.08**
	3/4	dusky red	–	0.1	6.75	**0.1**
2.5YR	4/6	red	60.1	–	60.1	**60.1**
7.5YR	6/8	strong brown	–	2.9	2.9	**2.9**
10YR	6/6	brownish yellow	–	0.7	–	**0.7**
	5/8	yellowish brown	–	3.3	–	**3.3**
	7/8	yellow	1.6	–	–	**1.6**
	5/2	grayish brown	9.1	–	–	**9.1**
	5/1	gray	3.9	–	–	**3.9**
	5/4	yellowish brown	74.6	–	93.2	**74.6**
2.5Y	6/4	light yellowish brown	–	0.03	0.03	**0.03**
Total			**149.3**	**13.68**		**162.98**

LA 120973 contained only 8 percent of the project's entire ochre assemblage. Interestingly, there was a completely different pattern of ochre distributions at either site. The ochres from LA 120972 were recovered from two widely separated proveniences—Level 2 of Feature 1A, the charcoal-filled pit, and Level 3 of Grid 185S/143E, just outside the northwest wall of Pit Structure 3.

In contrast, ochres from LA 120973 were all low-weight samples dispersed throughout the site. In terms of cultural significance, spatial distribution of ochres at LA 120973 was somewhat problematic. Hematite occurred naturally in the site area and was constituent of many material types. Despite this, three-fourths of all of the LA 120973 ochres originated from features and occurred infrequently in non-feature context. This appeared to support the theory that these ochres were indeed cultural objects.

Ochres are most often found in a storage-pit context. While the number of ochres found at

Table 14.3. Ochre weight distribution, by individual sample.

Munsell Hue	Value/ Chroma	Color	Weight (g)	Hue Subtotal
10R	4/6	red	0.4	–
	4/3	weak red	0.1	–
			1.4	–
			2.8	–
	4/8	red	0.1	–
			1.8	–
	7/6	light red	0.1	–
	3/4	dusky red	0.1	6.8
2.5YR	4/6	red	60.1	60.1
7.5YR	6/8	strong brown	2.9	2.9
10YR	6/6	brownish yellow	0.7	–
	5/8	yellowish brown	3.3	–
	7/8	yellow	1.6	–
	5/2	grayish brown	9.1	–
	5/1	gray	3.9	–
	5/4	yellowish brown	25.8	–
			48.8	93.2
2.5Y	6/4	light yellowish brown	0.0	0.0
Total			**163.0**	

Table 14.4. Mean ochre weight distribution, by site and material type; weight in grams.

Site	Material Type	Mean	N	Standard Deviation	Minimum	Maximum	Range
LA 120972	hematite, soft	60.1	1	–	60.1	60.1	0.0
	yellow ochre	17.8	5	19.7	1.6	48.8	47.2
	Total	**24.9**	**6**	**24.7**	**1.6**	**60.1**	**58.5**
LA 120973	hematite, soft	0.8	8	1.0	0.1	2.8	2.7
	yellow ochre	0.4	2	0.5	0.0	0.7	0.7
	red and yellow ochre mixed	3.1	2	0.3	2.9	3.3	0.4
	Total	**1.1**	**12**	**1.3**	**0.0**	**3.3**	**3.3**
Total	**hematite, soft**	**7.4**	**9**	**19.8**	**0.1**	**60.1**	**60.0**
	yellow ochre	**12.8**	**7**	**18.2**	**0.0**	**48.8**	**48.8**
	red and yellow ochre mixed	**3.1**	**2**	**0.3**	**2.9**	**3.3**	**0.4**
	Total	**9.1**	**18**	**17.7**	**0.0**	**60.1**	**60.1**

N = count

each occurrence in this project was low enough to suggest a natural context, it was possible that these pigments also represented ritual deposition.

For example, the pigment and pigment-stained ground stone found in Storage Pit 20 may have been used in a closure ritual. Pigment and pigment-stained artifacts, believed to have been used in termination rituals, were recovered in the earlier excavation of storage pits and postholes at Madera Quemada Pueblo (Miller and Graves 2009:379–412).

While the occurrence of both ochre and ground stone with ochre adhesions was studied at LA 120972 and LA 120973, there did not appear to be a strong correlation between the two at most occurrences. One exception may have been found at Storage Pit 20, at the south end of LA 120973. This feature yielded small samples of both red and yellow ochres and a mano fragment with hematite stains. While ochres were clearly being processed with ground stone at both sites, the dispersion of ochre and associated ground stones did not indicate specific activity areas.

Table 14.5. Ochre weight distribution, by site, feature, and grid unit; weight in grams.

Site	Provenience	Feature or Grid	Level	Hematite, Soft	Yellow Ochre	Red and Yellow Ochre Mixed	Total	Site Subtotal
LA 120972	charcoal-filled pit	1A	2	60.1	87.6	–	**147.7**	149.3
	no association	185S/143E	3	–	1.6	–	**1.6**	
LA 120973	open area south of Storage Pit 10	34N/265E	2	–	–	3.3	**3.3**	13.7
			3	0.2	0.03	–	**0.18**	
	east of Storage Pit 10	38N/266E	full cut	1.8	–	–	**1.8**	
	storage pit	10	full cut	0.1	–	–	**0.1**	
	pit structure	16	floor contact	0.1	–	–	**0.1**	
			subfloor	–	–	2.9	**2.9**	
	storage pit	20	full cut	0.4	0.7	–	**1.1**	
	storage pit	26	full cut	1.4	–	–	**1.4**	
	small storage pit adjacent to larger Feature 32 storage pit	32G	full cut	2.8	–	–	**2.8**	
Total				**66.9**	**89.9**	**6.2**	**162.98**	162.98

15 ↓ Prehistoric Fauna Analysis

Nancy J. Akins

Faunal elements were recovered from prehistoric components at three sites along US 54 near Carrizozo. All bone recovered during excavation, as well as bone found during light fraction cleaning of flotation samples, was analyzed.

General Methods

Project bone was identified using the Office of Archaeological Studies' comparative collection and the established OAS computer-coded format identifying animal or skeletal elements; how and if the animal or animal part was processed for consumption; and how taphonomic and environmental conditions affected the specimen. The following information defines these variables.

Provenience Related Variables: Provenience and stratigraphic information are linked to the data file according to the item's Field Specimen (FS) number. Each database line contains grid coordinates, level number, starting and ending depth, feature designation, and feature type for the item in question. Lot number identifies the specimen or group of specimens that fit the description recorded in that line; count indicates how many specimens are described in that line. In example, a bone broken into a number of pieces during excavation or cleaning is counted as a single specimen.

Taxon: Taxonomic identifications are made to the most specific level possible. Less-than-certain identifications are flagged. Specimens that cannot be identified are assigned to indeterminate categories based on the size of the animal and whether the animal was a mammal, bird, or other type, or if said type cannot be determined. Unidentifiable fragments often make up the bulk of a faunal assemblage. Identifying these fragments as precisely as possible can add to information already gained from identified taxa.

Element Characteristics: Skeletal elements—such as the cranium, mandible, or humerus—are most frequently identified by side, age, and portion recovered. Side is recorded for the element itself or for the portion recovered. This information is crucial in determining whether complete or partial animals are represented at a site and also helps in determining site function. The presence of post-occupational burrowers is often made evident by the recovery of larger body parts, which do not pass through screens, or by parts that are more complete in nature.

At time of occupation, smaller animals, like rabbits, were usually brought to a site or settlement complete. Often, all parts of these animals are found, since the processing needed to render small animals into cooking or consumptive units was fairly minimal. Artiodactyls, with their larger body sizes, were prepared differently depending on how far from a community the animal was killed, how much of the animal was returned to the community, and whether the processing of a complete animal took place at the site of the kill or only high-yield parts were returned. Also of great importance is whether or not the animal was consumed.

Age is estimated at a general level as fetal or neonate; immature, up to two-thirds mature size; young adult, near or full size with unfused epiphysis or young-textured bone; and apparently mature. Criteria used to assign age include size, epiphysis closure, and whether the texture of the bone is compact, as found in mature animals, or porous, as found in less mature animals.

Age determination based on texture alone is not absolute, since most growth in mammals takes place near the articular ends of the bone. Thus, diaphyseal bone can be compact and dense while bone ends retain a roughened or trabecular structure (Reitz and Wing 1999:73). As a result, fragments of the same bone can sometimes be misinterpreted as different bones of different ages; juvenile bone also can sometimes be underrepresented.

Age information is useful for determining the seasons during which a site was occupied. While smaller animals have long breeding seasons that can sometimes obscure season of use, artiodactyls, such as deer, have fairly restricted breeding and calving seasons; thus, age determination—according to size, epiphyseal union, and tooth wear—can provide information about the season in which an animal died.

The portion of skeletal elements represented by a specimen is recorded in detail in order to estimate the number of individual animals present in an assemblage and to aid in the discerning of patterns related to food processing. Indeterminate fragments are generally recorded either as long-bone shaft, end fragments, or flat bone.

Completeness: Completeness refers to how much of the skeletal element is represented in the specimen. Designations here are used in conjunction with the portion represented to estimate the number of individual animals present. This designation also provides information on whether a species was intrusive, as well as the degree of processing, environmental deterioration, animal activity, and thermal fragmentation that appears on an element.

Taphonomic Variables: Taphonomy—or the study of preservation processes and how these processes affect information obtained—is used to identify and evaluate how non-human processes affect the conditions and frequencies in faunal assemblages (Lyman 1994:1). Taphonomic processes include environmental alteration, animal alteration, and alteration through some types of burning.

Signs of environmental alteration include: pitting or corrosion due to soil conditions; sun bleaching caused by extended exposure to the elements; checking or exfoliation due to exposure or soil conditions; root etching caused by acids excreted by roots; polish or rounding due to sediment movement; a fresh or greasy appearance; and damage caused by soil or minerals.

Animal alteration is designated according to source or probable source; these sources can include: gnawing, punctures, and crushing by carnivores; probable scat; rodent gnawing; carnivore- and rodent-caused alteration; and alteration through an undetermined agent. Bones recorded as probable scat display rounded edges, and portions of both inner and outer surfaces are often partially dissolved.

Burning occurring after burial is also considered a taphonomic process. Burning affects the preservation and completeness of individual bones. Heavily burned bone is friable and tends to break more easily than unburned bone (Lyman 1994:389–391; Stiner et al. 1995:223).

Burning: Burning can occur as part of the cooking process; part of the disposal process, when bone is used as fuel or discarded in a fire; or after the bone is buried. Burn color is a gauge of burn intensity: a light brown, reddish, or yellow color or scorch occurs when bones are lightly heated; charred or blackened bone occurs when collagen within the bone becomes carbonized; and when that carbon becomes oxidized, bone becomes white or calcined (Lyman 1994:384–388).

Burns sometimes appear graded, reflecting the thickness of the flesh that covered the bone before burning was initiated. Bones can appear dry and light in color on the surface and be black at the core, or they can be blackened only on the interior or exterior, indicating that burning occurred after disposal, when the bone was dry. Graded or partial burns can indicate a particular cooking process, generally roasting, while charred or calcined bones do not. Uniform degrees of burning are possible only after flesh has been removed (Lyman 1994:387) and usually indicate a disposal practice.

While a wide range of burn colors and intensities can occur; this information is summarized in a category referred to as "burn type variable", which identifies intent rather than a detailed visual description of the specimen. Complete and graded burns most often represent discard processes and are recorded as discard. Patterns that suggest the bone was roasted—e.g. graded burns that display signs of scorching, where flesh was likely thick, and black burns at the bones' ends, where there was usually little or no flesh—are recorded as roasted. In other cases, the burn appears to have been accidental or intentional—e.g. dry burns or burned tips—and is recorded as such. Potential boiling is recorded as boiled, which is indicated by color change and waxy or rounded edges, or as boiled(?), when these signs are less clear.

Butchering and Processing: The condition of the bone in many faunal assemblages often obscures or destroys much of the evidence of processing. Evidence of butchering is recorded using a combination of morphology, tool type, and intent variables. These variables identify substantial cuts, chops, fine cuts or defleshing, impact breaks, spiral breaks, marrow breaks, snaps, and saw cuts. The location of these variables on the item is also recorded.

A more conservative approach is taken during the recording of marks and fractures that may or may not be indicative of the processing of animals for food, tools, or hides, since many natural processes result in similar marks and fractures. While spiral fractures are recorded by morphology, it is also recognized that there are other causes for such fractures that can occur well after discard. Impact fractures require an indication of an impact, which may include flake scars or evidence of percussion. These are not recorded when they appear to be ambiguous or are accompanied by carnivore gnawing.

Modification: Tools or ornaments, manufacturing debris, utilized bone, possible modification, and pigment stains are identified as modified. Categories are broad as worked-bone analysis most often defines item type.

Comments: The comment section is used to flag specimens recovered from flotation and to make verbal comments. For example, when a more specific age can be assigned, this would be recorded as a comment.

Data Analysis: This is where data are entered and checked, and provenience and provenience group information is added. Data are tabulated and analyzed using SPSS.

Site Assemblages

Faunal remains were relatively sparse at these sites (Table 15.1). LA 130331 had a very small sample size, and assemblages from LA 120972 and LA 120973 were quite different. The slightly later assemblage at LA 120973 contained 22.8 percent more large-body forms and cottontail remains, while LA 120972 contained a majority of small-mammal and jackrabbit remains and held few large forms, or 8.8 percent, without the cattle.

A considerable amount of project bone could not be identified beyond the size of the animal. Fragmentation and heavy pitting and rounding, resulting from soil conditions, rendered much of the collection unidentifiable. It also made estimating age possible only when a distinct size difference or unfused epiphyses was evident.

In addition, more than one-third of the bone from LA 120973 was burned; these heavy and dry burns indicated disposal rather than cooking processes. Condition of the bone obscured any rodent or carnivore damage and all but the most obvious processing, impact, or spiral fractures. It is important to remember that such fractures can occur through natural processes.

LA 120972

With the exception of fragments of two cattle phalanges recovered during testing, all fauna from this site (Table 15.2) was either from the area around Feature 1A or from Pit Structure 3. Nearly all of the found bone was highly fragmented; more than half of it was pitted from soil conditions or checked from exposure. Few were burned; these were all small fragments of small-mammal flat or long bones.

Feature 1A, a large, trash-filled pit, held the largest sample of bone; the sample was made up of rabbits or other small mammals. Also found were kangaroo rat tibias, three mandibular molars from a pronghorn, and long-bone and rib-shaft fragments from a medium-sized artiodactyl. At least two cottontails—one mature and one immature—and two jackrabbits—one mature and one juvenile—were represented by six specimens.

A smaller sample from the general fill of the pit structure and the surrounding area contained the partial lower limb of an immature jackrabbit, cranial fragments from both a pocket gopher and a cottontail, the long bones and a scapula of a jackrabbit, and most of a badger tibia.

LA 120973

General excavation grids and six features at this site contained fauna (Table 15.3). Only Pit Structure 11 and Pit 20 contained samples. Specimens from the grids and the features tended to be highly fragmented and pitted. Burning was more common here than at LA 120972, especially in Features 11 and 20.

Grid excavations produced little bone. Of the 18 grids with fauna, 14 held a single specimen. The others had sample sizes of two, 83N/300E at Level 4; three, 53N/301E at Level 1; six, 33N/261E at Level 1; and eight, 49N/254E at Level 1.

All turtle carapace fragments were recovered from upper level fill in grids and could represent road kills rather than portions of the prehistoric assemblage. The same could be true of the gray fox ulna. All bone was in small fragments; environmental alteration included sun bleaching, from exposure. Burned bone fragments consisted of

Table 15.1. Fauna recovered from prehistoric sites.

Common Name	LA 120972		LA 120973		LA 130331		Total	
	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %
Small mammal	48	52.7%	92	28.5%	–	–	**140**	**33.7%**
Small–medium mammal	3	3.3%	21	6.5%	1	50.0%	**25**	**6.0%**
Medium–large mammal	1	1.1%	53	16.4%	–	–	**54**	**13.0%**
Large mammal	–	–	4	1.2%	–	–	**4**	**1.0%**
Small squirrel	–	–	1	0.3%	–	–	**1**	**0.2%**
Large squirrel	–	–	2	0.6%	–	–	**2**	**0.5%**
Spotted ground squirrel	–	–	2	0.6%	–	–	**2**	**0.5%**
Yellow-faced pocket gopher	1	1.1%	3	0.9%	–	–	**4**	**1.0%**
Banner-tailed kangaroo rat	1	1.1%	–	–	–	–	**1**	**0.2%**
Woodrat	–	–	1	0.3%	–	–	**1**	**0.2%**
Medium–large rodent	–	–	1	0.3%	–	–	**1**	**0.2%**
Large rodent	–	–	2	0.6%	–	–	**2**	**0.5%**
Cottontail rabbit	7	7.7%	55	17.0%	1	50.0%	**63**	**15.1%**
Black-tailed jackrabbit	19	20.9%	24	7.4%	–	–	**43**	**10.3%**
Gray fox	–	–	1	0.3%	–	–	**1**	**0.2%**
Badger	1	1.1%	–	–	–	–	**1**	**0.2%**
Medium artiodactyl	2	2.2%	43	13.3%	–	–	**45**	**10.8%**
Medium–large artiodactyl	2	2.2%	–	–	–	–	**2**	**0.5%**
Pronghorn	3	3.3%	6	1.9%	–	–	**9**	**2.2%**
Cattle	3	3.3%	–	–	–	–	**3**	**0.7%**
American kestrel	–	–	1	0.3%	–	–	**1**	**0.2%**
Ornate box turtle	–	–	11	3.4%	–	–	**11**	**2.6%**
Total	**91**	**100.0%**	**323**	**100.0%**	**2**	**100.0%**	**416**	**100.0%**
Total from flotation	**1**	**1.1%**	**25**	**7.7%**	**–**	**–**	**26**	**6.2%**
Element Completeness								
<10%	71	78.0%	242	74.9%	1	50.0%	**314**	**75.5%**
10–50%	8	8.8%	46	14.2%	–	–	**54**	**13.0%**
50–75%	6	6.6%	15	4.6%	1	50.0%	**22**	**5.3%**
75–95%	3	3.3%	7	2.2%	–	–	**10**	**2.4%**
Complete	3	3.3%	13	4.0%	–	–	**16**	**3.8%**
Total	**91**	**100.0%**	**323**	**100.0%**	**2**	**100.0%**	**416**	**100.0%**
Environmental Alteration								
None	37	40.7%	110	34.1%	1	50.0%	**148**	**35.6%**
Pitting/corrosion	48	52.7%	204	63.2%	–	–	**252**	**60.6%**
Sun bleached	–	–	3	0.9%	1	50.0%	**4**	**1.0%**
Checked/exfoliated	3	3.3%	4	1.2%	–	–	**7**	**1.7%**
Root etched	3	3.3%	2	0.6%	–	–	**5**	**1.2%**
Total	**91**	**100.0%**	**323**	**100.0%**	**2**	**100.0%**	**416**	**100.0%**
Burning								
Unburned	86	94.5%	205	63.5%	2	100.0%	**293**	**70.4%**
Discard burn	5	5.5%	117	36.2%	–	–	**122**	**29.3%**
Deliberate partial burn	–	–	1	0.3%	–	–	**1**	**0.2%**
Total	**91**	**100.0%**	**323**	**100.0%**	**2**	**100.0%**	**416**	**100.0%**

long-bone shaft fragments from small mammals (n = 2), large mammals (n = 2), medium artiodactyls, and a jackrabbit tibia fragment.

The small assemblage from Pit 6 was made up almost completely of small-body forms, mainly cottontails and small mammals. A rodent and a burned medium-to-large mammal specimen were also found. Almost all were heavily pitted and fragmentary.

A very small sample (n = 3) was recovered from structure fill at Pit Structure 7 and another (n = 2) from posthole Feature 7D. Samples from the posthole were from a cottontail lumbar vertebra,

Table 15.2. LA 120972, distribution of fauna, by area and feature.

	Testing		North Area						South Area				Total	
			Fill		Feature 1 - Surface		Feature 1A - Pit		Fill		Pit Structure			
	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %
Fauna														
Small mammal	–	–	–	–	–	–	29	51.8%	–	–	19	70.4%	**48**	**52.7%**
Small–medium mammal	–	–	–	–	–	–	1	1.8%	–	–	2	7.4%	**3**	**3.3%**
Medium–large mammal	–	–	–	–	–	–	1	1.8%	–	–	–	–	**1**	**1.1%**
Yellow-faced pocket gopher	–	–	–	–	–	–	–	–	–	–	1	3.7%	**1**	**1.1%**
Banner-tailed kangaroo rat	–	–	–	–	–	–	1	1.8%	–	–	–	–	**1**	**1.1%**
Cottontail rabbit	–	–	–	–	–	–	6	10.7%	–	–	1	3.7%	**7**	**7.7%**
Black-tailed jackrabbit	–	–	–	–	–	–	13	23.2%	3	100.0%	3	11.1%	**19**	**20.9%**
Badger	–	–	–	–	–	–	–	–	–	–	1	3.7%	**1**	**1.1%**
Medium artiodactyl	–	–	–	–	–	–	2	3.6%	–	–	–	–	**1**	**1.1%**
Medium–large artiodactyl	–	–	1	100.0%	1	100.0%	–	–	–	–	–	–	**2**	**2.2%**
Pronghorn	–	–	–	–	–	–	3	5.4%	–	–	–	–	**4**	**4.4%**
Cattle	3	100.0%	–	–	–	–	–	–	–	–	–	–	**3**	**3.3%**
Total	**3**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**56**	**100.0%**	**3**	**100.0%**	**27**	**100.0%**	**91**	**100.0%**
Element Completeness														
<10%	1	33.3%	1	100.0%	1	100.0%	45	80.4%	–	–	23	85.2%	**71**	**78.0%**
10–50%	1	33.3%	–	–	–	–	4	7.1%	–	–	3	11.1%	**8**	**8.8%**
50–75%	1	33.3%	–	–	–	–	4	7.1%	1	33.3%	–	–	**6**	**6.6%**
75–95%	–	–	–	–	–	–	–	–	2	66.7%	1	3.7%	**3**	**3.3%**
Complete	–	–	–	–	–	–	3	5.4%	–	–	–	–	**3**	**3.3%**
Total	**3**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**56**	**100.0%**	**3**	**100.0%**	**27**	**100.0%**	**91**	**100.0%**
Environmental Alteration														
None	–	–	–	–	–	–	22	39.3%	2	66.7%	13	48.1%	**37**	**40.7%**
Pitting/corrosion	3	100.0%	1	100.0%	1	100.0%	30	53.6%	–	–	13	48.1%	**48**	**52.7%**
Checked/exfoliated	–	–	–	–	–	–	2	3.6%	–	–	1	3.7%	**3**	**3.3%**
Root etched	–	–	–	–	–	–	2	3.6%	1	33.3%	–	–	**3**	**3.3%**
Total	**3**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**56**	**100.0%**	**3**	**100.0%**	**27**	**100.0%**	**91**	**100.0%**
Burning														
Unburned	3	100.0%	1	100.0%	1	100.0%	52	92.9%	3	100.0%	26	96.3%	**86**	**94.5%**
Discard burn	–	–	–	–	–	–	4	7.1%	–	–	1	3.7%	**5**	**5.5%**
Total	**3**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**56**	**100.0%**	**3**	**100.0%**	**27**	**100.0%**	**91**	**100.0%**

N = count

while fill contained portions of a cottontail scapula and two jackrabbit tibias. All were fragments and were either pitted or root etched.

Feature 10, the collared pit, also contained little fauna. More than half of the samples (n = 8) were found in pit fill and included a small mammal, pocket gopher, woodrat, cottontail, and one jackrabbit specimen. The rest were from postholes.

Feature 10A held fragments of large rodent and jackrabbit. Feature 10D had fragments from a large rodent, two jackrabbit calcanea, and a medium artiodactyl tooth fragment. Feature 10F held a piece of medium-to-large mammal long-bone. Most were fragmented and pitted or root etched. Burned specimens included a long-bone fragment from a small mammal and a complete jackrabbit calcaneus.

Nearly a third of the Pit Structure 11 assemblage was recovered from flotation samples; two were from the structure; 23 were from Pit 11B. These account for 35 percent of the small-mammal count, all of the large squirrel count, 19 percent of the cottontail count, 40 percent of the jackrabbit count, and 74 percent of the burned-bone count.

Bone recovered from Structure 11 fill (n = 58) was mostly small mammal (n = 33) and cottontail (n = 13), including immature, juvenile, and mature cottontail

Table 15.3. LA 120973, distribution of fauna, by area and feature.

	Fill		Feature 6 Pit		Feature 7 Pit Structure		Feature 10 Collared Pit		Feature 11 Pit Structure		Feature 14 Posthole		Feature 20 Pit		Total	
	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %	N	Col. %
Fauna																
Small mammal	8	24.2%	4	40.0%	–	–	3	20.0%	52	61.2%	2	100.0%	23	13.3%	**92**	**28.5%**
Small–medium mammal	–	–	–	–	–	–	–	–	1	1.2%	–	–	20	11.6%	**21**	**6.5%**
Medium–large mammal	2	6.1%	1	10.0%	–	–	1	6.7%	1	1.2%	–	–	48	27.7%	**53**	**16.4%**
Large mammal	2	6.1%	–	–	–	–	–	–	–	–	–	–	2	1.2%	**4**	**1.2%**
Small squirrel	–	–	–	–	–	–	–	–	1	1.2%	–	–	–	–	**1**	**0.3%**
Large squirrel	–	–	–	–	–	–	–	–	2	2.4%	–	–	–	–	**2**	**0.6%**
Spotted ground squirrel	–	–	–	–	–	–	–	–	–	–	–	–	2	1.2%	**2**	**0.6%**
Yellow-faced pocket gopher	–	–	–	–	–	–	2	13.3%	–	–	–	–	1	0.6%	**3**	**0.9%**
Woodrats	–	–	–	–	–	–	1	6.7%	–	–	–	–	–	–	**1**	**0.3%**
Medium–large rodent	–	–	1	10.0%	–	–	–	–	–	–	–	–	–	–	**1**	**0.3%**
Large rodent	–	–	–	–	–	–	2	13.3%	–	–	–	–	–	–	**2**	**0.6%**
Cottontail rabbit	4	12.1%	3	30.0%	3	60.0%	1	6.7%	16	18.8%	–	–	28	16.2%	**55**	**17.0%**
Black-tailed jackrabbit	4	12.1%	1	10.0%	2	40.0%	4	26.7%	5	5.9%	–	–	8	4.6%	**24**	**7.4%**
Gray fox	1	3.0%	–	–	–	–	–	–	–	–	–	–	–	–	**1**	**0.3%**
Medium artiodactyl	1	3.0%	–	–	–	–	1	6.7%	7	8.2%	–	–	34	19.7%	**43**	**13.3%**
Pronghorn	–	–	–	–	–	–	–	–	–	–	–	–	6	3.5%	**6**	**1.9%**
American kestrel	–	–	–	–	–	–	–	–	–	–	–	–	1	0.6%	**1**	**0.3%**
Ornate box turtle	11	33.3%	–	–	–	–	–	–	–	–	–	–	–	–	**11**	**3.4%**
Total	**33**	**100.0%**	**10**	**100.0%**	**5**	**100.0%**	**15**	**100.0%**	**85**	**100.0%**	**2**	**100.0%**	**173**	**100.0%**	**323**	**100.0%**
Total from flotation	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**25**	**29.4%**	**–**	**–**	**–**	**–**	**25**	**38.5%**
Element Completeness																
<10%	26	78.8%	7	70.0%	2	40.0%	9	60.0%	68	80.0%	2	100.0%	128	74.0%	**242**	**74.9%**
10–50%	7	21.2%	1	10.0%	2	40.0%	3	20.0%	7	8.2%	–	–	26	15.0%	**46**	**14.2%**
50–75%	–	–	–	–	1	20.0%	1	6.7%	2	2.4%	–	–	11	6.4%	**15**	**4.6%**
75–95%	–	–	1	10.0%	–	–	1	6.7%	2	2.4%	–	–	3	1.7%	**7**	**2.2%**
Complete	–	–	1	10.0%	–	–	1	6.7%	6	7.1%	–	–	5	2.9%	**13**	**4.0%**
Total	**33**	**100.0%**	**10**	**100.0%**	**5**	**100.0%**	**15**	**100.0%**	**85**	**100.0%**	**2**	**100.0%**	**173**	**100.0%**	**323**	**100.0%**
Environmental Alteration																
None	15	45.5%	1	10.0%	–	–	2	13.3%	50	58.8%	–	–	42	24.3%	**110**	**34.1%**
Pitting/corrosion	14	42.4%	9	90.0%	4	80.0%	11	73.3%	35	41.2%	2	100.0%	129	74.6%	**204**	**63.2%**
Sun bleached	3	9.1%	–	–	–	–	–	–	–	–	–	–	–	–	**3**	**0.9%**
Checked/exfoliated	1	3.0%	–	–	–	–	2	13.3%	–	–	–	–	1	0.6%	**4**	**1.2%**

Table 15.3 (continued)

	Fill		Feature 6 Pit		Feature 7 Pit Structure		Feature 10 Collared Pit		Feature 11 Pit Structure		Feature 14 Posthole		Feature 20 Pit		Total	
	N	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**
Root etched	–	–	–	–	1	20.0%	–	–	–	–	–	–	1	0.6%	**2**	**0.6%**
Total	**33**	**100.0%**	**10**	**100.0%**	**5**	**100.0%**	**15**	**100.0%**	**85**	**100.0%**	**2**	**100.0%**	**173**	**100.0%**	**323**	**100.0%**
Burning																
Unburned	27	81.8%	8	80.0%	5	100.0%	13	86.7%	31	36.5%	2	100.0%	119	68.8%	**205**	**63.5%**
Discard burn	6	18.2%	2	20.0%	–	–	2	13.3%	54	63.5%	–	–	53	30.6%	**117**	**36.2%**
Deliberate partial burn	–	–	–	–	–	–	–	–	–	–	–	–	1	0.6%	**1**	**0.3%**
Total	**33**	**100.0%**	**10**	**100.0%**	**5**	**100.0%**	**15**	**100.0%**	**85**	**100.0%**	**2**	**100.0%**	**173**	**100.0%**	**323**	**100.0%**
Processing																
Impact	–	–	–	–	–	–	–	–	–	–	–	–	3	50.0%	**3**	**50.0%**
Spiral break	–	–	–	–	–	–	–	–	–	–	–	–	3	50.0%	**3**	**50.0%**
Total	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**6**	**100.0%**	**6**	**100.0%**

N = count

samples. Jackrabbit (n = 3) and a small squirrel (n = 1) were also found, along with single pieces identifiable only as small-to-medium mammal and medium-to-large mammal flat bones. Pit fauna (n = 27) was largely small mammal (n = 19), mainly because 85 percent were found in flotation; this included large squirrel (n = 2), cottontail (n = 3), jackrabbit (n = 2), and medium artiodactyl (n = 1).

Feature 14A, a posthole, contained two unburned fragments of bone. Both were small-mammal flat bones.

The largest sample of fauna was from Feature 20, a large pit at the south end of the site. As with other features at this site, most of the bone was highly fragmented and pitted from soil conditions. There was more burned bone here than at all the other locations, except Feature 11, suggesting that some of the fill was material from fire pit cleaning.

This was the only feature assemblage that included worked bone. In this case, the worked bone was a fragment of a pronghorn metatarsal split lengthwise, along the groove, probably to make a tool. However, there was no evidence that suggested the recovered piece was ever used as a tool; burn marks on the item suggested it was discarded as waste.

This feature also produced specimens with impact and spiral breaks that could have been caused during human processing when the bones were broken for marrow or when disarticulating an animal; by carnivore crushing; or even, when fresh, by foot traffic. Specimens here included a pronghorn distal tibia, an astragalus, a calcaneus, and a lateral malleolus that suggested that the lower leg and foot were removed by chops or blows. Two medium artiodactyl, long-bone shaft fragments also had impact breaks.

In addition, two medium-to-large mammal long-bones had spiral breaks. These and other medium-to-large mammal specimens from neonate and immature individuals (n = 30) could be from the neonatal medium artiodactyl represented by a molar fragment; two rib fragments; much of a scapula; part of an ilium and pubis; fragments of a humerus, radius, and femur; and most of a second phalanx. The only signs of burning on this immature individual were on a fragment of long-bone with a small burn on the edge, suggesting accidental burning. This feature also contained the only project bird, most of a tarsometatarsus, from a kestrel.

The cottontail was the most commonly identified animal in Feature 20; at least two or three individuals—an immature, a juvenile, and a mature animal—were represented. A single jackrabbit was indicated by part distribution. Medium artiodactyl specimens could all have been from the pronghorn and neonate. Much of an innominate, from a pronghorn, was also recovered.

LA 130331

Only two specimens were recovered from this site. These included a cottontail ilium, from 93N 100E at Level 1, and a fragment of a small-to-medium mammal acetabulum, from Grid 118N 100E at Level 1. Neither was burned.

Research Questions

While the amount of fauna recovered during the project was fairly small, findings such as these are typical of sites in southern New Mexico basins and add to our knowledge of how the general area was used between the AD 900s and the early 1000s. Research domains that can be addressed through the fauna found at LA 120972 and LA 120973 include site structure, mobility strategies, and subsistence.

Site Structure

Both sites—Feature 1A and Feature 20 at LA 120972 and LA 120973, respectively—had large pits with accumulations of fauna. The Feature 11 pit structure at LA 120973 also held a fair sample of fauna.

The presence of recognized trash-disposal areas as well as signs of routine cleaning—e.g. the burned bone in Feature 20 at LA 120973—suggests that these sites were occupied for a long enough time that specific areas had been designated for waste-control purposes. This was especially true for Feature 20, which not only held burned material that may have indicated hearth-cleaning practices but also primary butchering debris like the pronghorn foot.

Mobility

Few species were recovered at the Carrizozo sites, and all of the animals that were identified could have been acquired in the general area. The presence of a neonate artiodactyl places some site occupations between late spring and summer. In central Arizona, pronghorn fawning occurs between April

Table 15.4. Parts for the most common subsistence animals, by site.

	Long Bone		Flat Bone		Cranial		Vertebral		Thorax		Pelvis		Front Limb		Rear Leg		Foot		Total	
Site	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %
Cottontail Rabbit																				
LA 120972	–	–	–	–	4	57.1%	–	–	–	–	–	–	1	14.3%	1	14.3%	1	14.3%	**7**	**100.0%**
LA 120973	–	–	–	–	9	16.4%	3	5.5%	–	–	7	12.7%	10	18.2%	17	30.9%	9	16.4%	**55**	**100.0%**
Jackrabbit																				
LA 120972	–	–	–	–	4	21.1%	–	–	–	–	–	–	4	21.1%	8	42.1%	3	15.8%	**19**	**100.0%**
LA 120973	–	–	–	–	1	4.2%	2	8.3%	1	4.2%	–	–	3	12.5%	11	45.8%	6	25.0%	**24**	**100.0%**
Medium Artiodactyl																				
LA 120972	1	50.0%	–	–	–	–	–	–	1	50.0%	–	–	–	–	–	–	–	–	**2**	**100.0%**
LA 120973	23	53.5%	1	2.3%	4	9.3%	1	2.3%	6	14.0%	2	4.7%	3	7.0%	1	2.3%	2	4.7%	**43**	**100.0%**
Pronghorn																				
LA 120972	–	–	–	–	3	100.0%	–	–	–	–	–	–	–	–	–	–	–	–	**3**	**100.0%**
LA 120973	–	–	–	–	–	–	–	–	–	–	1	16.7%	–	–	1	16.7%	4	66.7%	**6**	**100.0%**

N = count

and June; deer in Arizona generally fawn between July and September (www.Bison-M). The presence of immature rabbits in the Carrizozo assemblages also suggests that at least some occupation of the sites occurred during spring or summer and possibly into the fall.

Furthermore, the distribution of both rabbit and artiodactyl body parts indicated that these species were most likely the main subsistence animals for those who inhabited these sites (Table 15.4). Missing or sparse rabbit parts were most likely to have been crushed or rendered into small, unidentifiable pieces, and while few pronghorn parts were identified, the medium artiodactyl taxon included bones from all parts of the body.

Use of the site during the warm season would be contrary to Hard's model of biseasonal residential movement during the Formative period, as proposed for Fort Bliss (1983a). In that model, family groups would have spent the warm season in basin environments, at playa margins, and on alluvial fans, exploiting a variety of resources. During the winter, they would have moved to alluvial fans further upland, where preserved and portable foods and predictable resources would have provided subsistence (Condon et al. 2008:397–398).

Instead, meager data indicated intermittent use of these sites that included warm-season occupation. While soil conditions could have caused much of the bone left behind to completely deteriorate, it is more likely that procuring animal resources had little to do with the decision to locate to the area.

Faunal assemblages, made up mostly of rabbits, suggest opportunistic hunting and the possible use of traps and snares as the main means of procuring animals. The apparent absence of deer, but the presence of pronghorn in both assemblages, suggests a focus on nearby grasslands that resulted in the occasional procurement of pronghorn. Cranial or foot waste parts at both sites suggest that pronghorn were not transported from a great distance.

Subsistence

Faunal assemblages from these sites resemble those of other Formative period sites in the Tularosa Basin.

Fort Bliss sites also had assemblages consisting mainly of rabbits. At LA 126395, which was probably occupied during late fall or winter, cottontail was only slightly more common than jackrabbit (n = 64 and n = 59, respectively) and there was almost no artiodactyl (n = 3) (Church and Sale 2003:142).

Sites excavated on the alluvial fans along the

Organ Mountains were dated primarily to the late Mesilla phase and contained more jackrabbit remains than cottontail (n = 890 and n = 479) and a few deer (n = 9). No counts were given for artiodactyls (Condon et al. 2008:396).

Other area sites, referred to by Church and Sale, featured assemblages made up almost entirely of highly fragmented rabbit bones, some with considerable burning. Relative amounts of cottontail and jackrabbit varied (Church and Sale 2003:161–164).

The Carrizozo faunal assemblages appear to represent the same kind of subsistence rounds as seen at other Tularosa Basin sites and are less similar to assemblages in the Pecos Valley.

For example, the Townsend Site, just north of Roswell on Salt Creek, has two Formative period components: one with radiocarbon dates of AD 570 ± 40 and 940 ± 70 and the other with radiocarbon dates of AD 990 ± 40 and AD 1050 ± 80, with structures.

The earlier faunal assemblage (n = 1316) was mainly small mammal (56.4 percent) and rabbit (14.2 percent), with very little bone from artiodactyls (1.7 percent) or large mammals (3.0 percent). The assemblage also contained a range of rodents, turtle, freshwater mussel shell (8.3 percent), and a small amount of fish (0.5 percent).

The smaller assemblage from the later component (n = 363) had fewer small mammals (27.3 percent), a similar amount of rabbit (13.5 percent), fewer artiodactyls (1.7 percent), more large mammals (10.5 percent), more freshwater mussel shell (22.0 percent), and a single fish specimen (Akins 2003:270, 276). Not only were there more bones at the site, but it was evident that a larger variety of animals had been exploited.

How high-elevation sites like Fallen Pine Shelter, in the Sierra Blanca Mountains between the Pecos Valley and Tularosa Basin, fit into the regional system is hard to say, although site occupants probably found animals more easily accessible at this site.

Here, deposits from the earlier ceramic component were slightly later than those from the Carrizozo sites. The faunal assemblage (n = 274) was mainly artiodactyl (50.4 percent medium artiodactyl and 9.5 percent deer) with few rabbits (3.0 percent) or small mammals (1.1 percent). There were, however, considerable turkeys (10.6 percent) and other large birds (6.9 percent).

Newborn and immature deer indicated use from late spring to early summer and from late fall to early spring. Slightly less of the assemblage from the later ceramic levels (n = 107) was artiodactyl (40.2 percent medium artiodactyl and 15.0 percent deer); slightly more was from rabbits (5.6 percent, 0.9 percent small mammal). Very little was from turkey (0.9 percent) (Akins 2004:112, 131).

This brief review of regional faunal assemblages challenges our ideas of where Formative era groups lived during different seasons. Central basin sites were occupied during winter, upland peripheral basin sites during the warm season, and mountain sites throughout much of the year. Clearly, subsistence and mobility during this period was more complex than early models suggest.

16 ⊻ Floral Remains Analysis

Pamela J. McBride

Flotation and macrobotanical samples from pit-structure habitation sites at LA 120972 and LA 120973 and from the Archaic campsite at LA 130331 that consisted of two hearths were examined as part of this report.

LA 120973 can be distinguished by the presence of numerous pits, several of which were collared and had associated postholes. These sites were located on the valley floor near the northeastern margin of the Tularosa Basin.

As described by Tatum, in Chapter 2 of this report, the sites were located within the Chihuahuan Desert Scrub community (Brown 1994), where creosote bush (*Larrea tridentata*), honey mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), sand sagebrush (*Artemisia filifolia*), soaptree yucca (*Yucca elata*), and cholla (*Opuntia imbricata*) make up the dominant shrubby species.

At the upper limits of the Chihuahuan Desert Scrub community, in areas where overgrazing has not yet impacted the vitality of grassland species, curly mesquite grass (*Hilaria belangeri*), black grama (*Bouteloua eriopoda*), and many species of three-awn (*Aristida* spp.) proliferate the Semi-Desert Grassland biotic community.

One-seed juniper (*Juniperus monosperma*) and Semi-Desert Grassland piñon-juniper woodlands can be found approximately 9.6 km (6 mi) to the east, in the foothills of the Sierra Blanca mountain range.

During a brief visit to the project area in the spring of 2010, mustard (*Descurainia* spp.) was in bloom, along with scrambled eggs (*Corydalis aurea*) and twinpod (*Physaria fendleri*). Observed grasses included blue grama (*Bouteloua gracilis*), fluff grass (*Dasyochloa pulchella*), and dropseed (*Sporobolus* spp.). Globemallow (*Sphaeralcea* spp.) and buffalo gourd (*Cucurbita foetidissima*) were also evident, either as remnants of the previous year's growth or as small seedlings.

An occasional mesquite could be seen growing on adjacent ranchland, along with soaptree yucca and narrow leaf yucca (*Yucca glauca*). Patches of snakeweed (*Gutierrezia sarothrae*), usually a clear sign of overgrazing, were also present.

The most unique plant identified was fendler spring parsley (*Cymopterus acaulis var. fendleri*). Considered an economic resource, this plant bears celery-flavored leaves in the spring that can be used fresh in salads or dried as a seasoning; it can also be boiled as a potherb. Young, tender roots are eaten fresh in the spring, while more mature roots are roasted, ground into meal, and used like cornmeal (Harrington 1967:173).

Today, the climate in the area is arid, with an average annual rainfall of about 25 cm (10 in) occurring primarily from July to September. The growing season spans about 203 days, from the last killing frost on or around April 10 to the first killing frost on or around October 30 (Tuan et al. 1973).

A minimum of 15 cm (6 in) of rain is generally considered the smallest amount of precipitation required for maize cultivation, without irrigation (Muenchrath and Salvador 1995). It seems that combined precipitation and growing-season length would have allowed for fairly reliable, dryland farming of traditional maize varieties like Tohono O'odham, or 60-day maize, particularly if farmers waited to plant until the summer monsoons began, as the Akimel and Tohono O'odham of southern Arizona do today (Nabhan 1983).

Traditional cultivars are generally smaller in size, have narrower leaves, and have a better leaf-rolling response for water conservation (Muenchrath and Salvador 1995). Other factors involved in mitigating adverse growing conditions, such as wind and low precipitation, include the thoughtful placement of agricultural fields, water conservation, and harvesting methods.

Modern Tohono O'odham farmers situate their fields on land with sandy surfaces, which overlie darker, clay sediments (Nabhan 1983:60). The upper, sandy layers allow water to infiltrate the lower, finer grained soils below that hold water and nutrients in the root zone of the plants.

The soil structure at LA 120972 and LA 120973 is very similar. Excavators found that, after penetrating the upper silt layers, the underlying soil strata were surprisingly damp (Karen Wening, personal communication, 2011).

Traditional planting methods require minimal soil disturbance; this involves poking a hole in the earth to accommodate the seed. Tilling is not required; therefore, soil erosion and weed proliferation is greatly reduced. Seeds can be planted at considerable depth, taking advantage of the moister soil horizon and promoting germination.

Finally, runoff from rainfall at higher elevations in the Sierra Blanca Mountains, or from monsoon floodwaters, is slowed or channeled into fields with brush weirs or earthen berms; this allows for greater water infiltration (Muenchrath and Salvador 1995:320). Similar methods would have allowed the occupants of LA 120972 and LA 120973 to farm sustainably, augmenting a diet of wild plants gathered not only from the valley floor but from the mountain foothills and banks of washes like Willow Draw.

Archaeobotanical analysis included flotation processing and the identification of plant materials encompassing reproductive and non-reproductive parts and charcoal. Methods used are described below, followed by analysis results and a discussion of possible interpretations of data.

Flotation Methods

Flotation Processing: One hundred eighteen soil samples were collected during excavation. Of these, 48 were selected for archaeobotanical analysis.

The samples were processed at OAS using the simplified "bucket version" of flotation (Bohrer and Adams 1977). Volume sizes of the 48 flotation soil samples analyzed ranged from .43–6.8 liters each. Each sample was immersed in a bucket of water, and 30–40 seconds was allowed for the settling of heavy particles. The solution was poured through a fine screen—about 0.35 mm mesh—lined with a square of chiffon fabric in order to catch organic materials either floating or in suspension. The fabric squares were removed from the solution and laid flat on coarse-mesh screen trays until dry.

Summary information, including the presence of roots, insects, bone fragments, and insect or rodent scats, is reported along with sample volumes before flotation in Table 16.1.

Full-Sort Analysis: Forty-eight samples were sorted using a series of nested geological screens (4.0, 2.0, 1.0, 0.5 mm mesh) and reviewed under a binocular microscope at settings between 7X and 45X. Charred and uncharred reproductive plant parts—seeds and fruit—were identified and counted. Flotation data were reported using a standardized count of seeds per liter of soil, rather than the actual number of seeds recovered. The relative abundance of non-reproductive plant parts, such as piñon nut shell fragments and corn cupules, was estimated per sample. To aid in the sorting of botanical occurrences of cultural significance from the considerable noise of post-occupational intrusions, data were sorted into the following categories: cultural, all carbonized remains; possibly cultural, unidentifiable seeds and plant parts or unburned remains with known economic uses; and non-cultural, unburned materials, especially when of a taxa not economically useful and when found in disturbed contexts with modern roots, insect parts, scats, or other signs of recent biological activity.

Table 16.2 lists plant taxa from flotation and macrobotanical samples by plant category, scientific name, common name, and plant part recovered.

Charcoal Species Identification Methods

From each flotation sample with at least 20 pieces of wood charcoal present, a sample of 20 pieces was identified to species level. This allowed for the testing of up to 10 pieces of wood charcoal from each screen size. In smaller samples, all charcoal from the 4 mm and 2 mm screens was identified. Each piece was snapped to expose a fresh transverse section and was examined at 45X. Identified charcoal from each taxon was weighed on a top-loading digital balance to the nearest tenth of a gram and placed in labeled plastic bags.

Low-power incident light identification of wood specimens often does not allow species- or even genus-level precision; however, the process can provide reliable information useful in distinguishing broad patterns of the utilization of a major resource class.

Macrobotanical Sample Analysis Methods

Macrobotanical samples consisted of specimens collected in the field during excavation. Samples submitted for analysis were examined, identified, and measured, when appropriate. Specimens were

Table 16.1. Flotation sample information, by site.

FS No.	Volume (l)	Roots	Insects	Bone	Feces	Comments
			LA 120972			
1041	3.5	+	+	+	+	–
1105	3.3	+	–	+	–	–
1123	4.6	+	–	+	+	–
1128	4.2	+	–	–	–	–
1130	0.9	+	–	–	–	–
1158	5.5	+	–	+	–	–
			LA 120973			
113	1.9	+	+	–	+	–
168	0.4	+	+	–	+	–
244	3.0	+	+	+	–	–
250	2.8	+	+	–	+	–
258	2.3	+	+	+	+	–
279	1.0	+	+	–	+	–
296	1.0	+	+	–	–	–
318	1.3	+	–	–	+	–
319	0.8	+	–	–	–	–
328	1.2	+	–	–	+	–
330	1.1	+	+	–	+	–
342	1.5	+	+	–	+	–
357	1.8	+	+	+	–	–
358	2.7	+	+	–	+	–
395	8.6	+	+	+	+	–
406	2.3	+	–	+	–	–
407	1.4	+	+	–	–	wood charcoal only
428	2.2	+	+	+	+	–
458	1.5	+	+	–	+	–
460	2.2	+	+	–	+	–
461	1.8	+	+	–	+	–
491	1.2	+	+	–	–	unburned material and wood charcoal only
502	0.1	+	+	–	–	–
504	1.9	+	+	–	+	–
518	2.5	+	+	+	+	–
519	1.9	+	+	+	–	–
521	1.9	+	–	–	–	–
533	2.3	+	+	–	–	unburned material only
536	1.7	+	+	–	+	–
541	3.0	+	+	–	+	unburned material only
546	6.2	+	+	+	+	–
565	1.1	+	+	–	–	–
568	1.5	+	+	–	+	–
569	1.8	+	+	–	+	–
571	1.6	+	+	–	+	–
577	1.2	+	+	–	+	–
589	2.9	+	+	–	–	unburned material only
591	2.0	+	+	–	+	–
592	2.2	+	+	–	+	–
593	2.3	+	+	–	+	–
			LA 130331			
3	3.6	+	+	–	+	–
13	4.1	+	+	–	+	wood charcoal only

+ = present; – = absent

Table 16.2. Plant taxa from flotation and macrobotanical samples, by category.

Scientific Name	Common Name	Charred/Uncharred	Plant Part
Annuals			
Amaranthus	amaranth	C, U	seed
Amaranthus graecizans	prostrate amaranth	U	seed
Cheno-am	goosefoot/amaranth	C, U	seed
Chenopodium	goosefoot	C, U	seed
cf. *Cleome*	beeweed	C	seed
Corispermum	bugseed	U	seed
Descurainia	tansy mustard	C, U	seed
Euphorbia	spurge	U	seed
Helianthus	sunflower	C	seed
Kallstroemia	caltrop	U	seed
Nicotiana	tobacco	C, U	seed
Portulaca	purslane	C, U	seed
Trianthema	false purslane	C, U	seed
Cultivars			
Cucurbita	squash	C	rind
Zea mays	corn	C	cob fragment, cupule, embryo, glume, kernel
Grasses			
Poaceae	grass family	C, PC, U	caryopsis, floret, rhizome, stem
Sporobolus	dropseed grass	C, U	caryopsis
Other			
Asteraceae	aster family	C, U	seed
Boraginaceae	borage family	U	seed
Chenopodiaceae	goosefoot family	C, U	seed
Fabaceae	bean family	U	seed
Labiatae	mint family	C	seed
Monocotyledonae	monocot	C	stem
Oenothera	evening primrose	U	seed
Polygonaceae	knotweed family	C	seed
	unidentifiable seed	C	seed
	unknown taxon	C, PC, U	fruit, plant part
Verbesina	crownbeard	U	seed
Perennials			
Atriplex	saltbush	C	wood
Atriplex canescens	four-wing saltbush	C, U	fruit, leaf
Cactaceae	cactus family	C	areola
Cryptantha	hidden flower	U	seed
Cylindropuntia	cholla	C, PC	wood
Juniperus	juniper	C, U	twig, wood
Larrea	creosotebush	C	wood
Pinus	pine	C	wood
Pinus edulis	piñon	C, PC	nutshell, wood
Platyopuntia	prickly pear	C, PC, U	embryo, seed
Prosopis	mesquite	C, U	endocarp, leaf, seed, wood
Quercus	oak	C	wood
Sphaeralcea	globemallow	C, U	seed
Gymnospermae	unknown conifer	C	wood
	unknown nonconifer	C	wood
Yucca	yucca	C	possible caudex
Yucca baccata	banana yucca	C	seed

C = carbonized, PC = partially charred, U = uncharred, cf. = resembles taxon

Table 16.3. LA 120972, flotation plant remains, by category and feature.

		Feature 1	Feature 3		Feature 7	Feature 4	Feature 6
		Fire Pit in XM* Activity Area	Pithouse, SW 1/2	Hearth in Feature	Vent	Pit on NE Edge of Feature 3	Pit on SE Edge of Feature 3
Category	**Common Name**	**FS 1041**	**FS 1123**	**FS 1128**	**FS 1158**	**FS 1105**	**FS 1130**
			Cultural				
Annuals	amaranth	19.3	0.4	–	–	–	–
	cf. beeweed	0.3	–	–	–	–	–
	cheno-am	6.2	–	–	–	–	–
	false purslane	0.3	–	–	–	–	–
	goosefoot	2.0	–	–	–	–	–
	purslane	0.3	–	–	–	–	–
	sunflower	0.3	–	–	–	–	–
Cultivars	maize	+ c, + g, 0.6 k	–	–	–	–	–
	squash	+ rind	–	–	–	–	–
Grasses	dropseed grass	169.7	–	–	–	–	–
Other	monocot	+ stem	–	–	+ stem	–	–
	unidentifiable seed	1.4	–	–	–	–	–
	unknown taxon	5.1 pp	–	–	–	–	–
Perennials	juniper	+ twig	–	–	–	–	–
			Noncultural				
Annuals	amaranth	–	0.4	1.5	18.4	–	53.8
	caltrop	–	0.4	–	0.4	–	–
	false purslane	–	–	0.5	–	–	–
	goosefoot	1.1	0.8	27.6	2.4	0.3	8.6
	purslane	10.5	0.8	21.0	3.4	–	5.4
	spurge	2.8	–	0.5	–	–	–
	winged pigweed	1.1	–	–	–	–	–
Grasses	dropseed grass	–	–	1.0	0.2	–	–
	grass family	–	–	–	0.2	–	–
Perennials	juniper	–	–	–	–	+ twig	–

Plant remains are seeds unless indicated otherwise.
Cultural plant material is charred; noncultural material is not.
+ = 1–10/sample, c = cupule, cf. = resembles taxon, g = glume, k = kernel
*XM = Extramural

identified as to taxon and plant part by comparison to modern reference collections; specimens were weighed on a digital, top-loading balance with .01 g accuracy. When necessary, fragile specimens were wrapped in acid-free tissue or polyester fiber and placed in durable containers to protect them from further breakage.

Results

LA 120972: Aside from a burned amaranth seed recovered from the Feature 3 pithouse and monocot stems recovered from the vent on the western edge of the structure, the only considerable cultural plant material at the site was found in the extramural activity area of the Feature 1 fire pit (Table 16.3).

Annual taxa included amaranth seeds; a seed that compared favorably to beeweed and cheno-am; false purslane; and goosefoot, purslane, and sunflower seeds.

All of these, except perhaps the false purslane, have documented ethnobotanical uses. The greens were boiled and eaten, while the seeds were parched and ground; the resulting meal was often combined with cornmeal and made into either cakes or gruel (Castetter 1935; Dunmire and Tierney 1997; Whiting 1966; V. Jones 1930).

Cultivars were represented by maize cob parts,

Table 16.4. 17.4. LA 120972, flotation wood charcoal taxa, by category and feature.

	Feature 1		Feature 3	Feature 7	
	Fire Pit in XM* Activity Area		Pithouse, SW 1/2	Vent	
Taxa	**FS 1041, Bag 1**	**FS 1041, Bag 2**	**FS 1123, Bag 1**	**FS 1158, Bag 1**	**FS 1158, Bag 2**
Conifers (count/weight in grams)					
Juniper	5/.19	1/.04	–	–	–
Piñon	1/.02	–	–	–	–
Nonconifers (count/weight in grams)					
Cholla	–	3/.09	–	–	–
Creosotebush	–	1/.02	–	–	–
Mesquite	–	–	–	1/.01	3/.03
Saltbush	13/.58	15/.55	2/.01	2/.01	–
Unknown nonconifer	1/.02	–	–	–	–
Total	**20/.81**	**20/.70**	**2/.01**	**3/.02**	**3/.03**

*XM = Extramural

Table 16.5. LA 120972, macrobotanical wood taxa, by category and feature; count and weight in grams.

Taxa	**Feature 1**	**Feature 3**	
	Fire Pit in XM* Activity Area	**Pithouse, SW 1/4**	**Pithouse, NW 1/4**
	FS 1041	**FS 1123**	**FS 1124**
Nonconifer - mesquite	–	–	4/.10
Saltbush	1/2.5	15/0.6	16/.90
Unknown nonconifer	–	–	1/.01
Total	**1/2.5**	**15/0.6**	**21/1.01**

like cupules and glumes, as well as kernels and squash rind. Maize was not just a nutritious food resource; the shelled cobs were a good source of fuel.

Cob fragments usually comprise a large percentage of archaeobotanical assemblages at agricultural sites. These fragments and cupules show up in a number of contexts due to their ubiquitous association with fire pit debris. Cucurbita rinds recovered from this project followed the pattern found at a majority of open-air sites—carbonized rind fragments were miniscule, few in number, and measured less than 1 mm in thickness.

A large number of carbonized, dropseed grass seeds were recovered from Feature 1. Often ground, the seeds were used by the Navajos to make dumplings, rolls, and griddle cakes; the Hopis ground the seeds to mix with cornmeal (Castetter 1935:28). Even though dropseed grass grains are very small, the positive qualities of abundant seed production and the retention of these grains by the plant after maturation, which helps prevent loss before harvesting, probably outweighs the small seed size (Doebley 1984).

Burned juniper twigs were the only signs of perennial plant use at the site and were probably fuel wood debris. Feature 1 was the only feature in which juniper wood charcoal was recovered, even though the dominant wood taxon was saltbush (Table 16.4). One fragment of piñon was also present. Mesquite wood was restricted to the Feature 7 vent in the pithouse. Macrobotanical wood consisted of one piece of saltbush from Feature 1, 31 saltbush fragments from two quadrants of the pithouse, 4 pieces of mesquite, and 1 piece of unknown non-conifer, also from the pithouse (Table 16.5).

The inhabitants of LA 120972 were probably practicing incipient agriculture, growing maize and squash, and gathering wild annuals and dropseed grass seeds, which were processed for consumption in the extramural activity area. The primary source of fuel wood came from local shrubs, particularly saltbush, with minor use of piñon-juniper woodland resources and shelled corncobs.

LA 120973: This was the largest of the excavated sites and consisted of numerous pits, associated postholes, and three pit structures. Archaeobotanical remains from the features will be discussed by their occurrence from north to south, beginning with the most northerly feature, Feature 19, a collared pit.

Unfortunately, the only cultural flotation floral material found was made up of unknown plant parts (Table 16.6); the feature was also devoid of wood charcoal. Feature 23 held much better evidence of resource utilization, yielding amaranth and mesquite seeds, piñon nut shell, grass stems, maize cupules, and squash rinds.

While mesquite was not observed growing anywhere near the sites today, this riparian shrub may have been present in the area in the past. Charred mesquite seeds, consisting primarily of fragments, were recovered in this pit and in several other contexts at the site. This indicates that the pods were ground into meal and the seeds discarded and burned.

Mesquite was a major food resource for several indigenous Southwestern groups (Bell and Castetter 1937). Although Bell and Castetter indicate that the Papagos, or Tohono O'odham, ground the seeds into flour, a more recent ethnobotany study (Rea 1997) on the Pimas, or Akimel O'odham, discusses use of the pods exclusively. Large quantities of pods were crushed with a wooden or stone pestle in a wooden or stone mortar; the resulting meal was either eaten raw or mixed with water and made into dough for cakes. These cakes were baked and consumed; any remaining seeds were either spat out or swallowed.

One account describes how the Maricopas dug elliptical holes in the ground and poured mesquite flour inside. Water was sprinkled on top of the flour, and more flour was added until the hole was full. Finally, the hole was covered with dirt, and the mixture was allowed to sit overnight. The next day, the hard cylinder of flour was removed and stored for future use. The resulting cakes were about 46 by 30 by 25 cm (18 by 12 by 10 in) (Bell and Castetter 1937:30).

This intriguing account suggests the possibility that some of the postholes found at LA 120973 could have been used for such a purpose. However, the majority of cylindrical pits at the site were much deeper and ranged from about 40–45 cm. Exceptions include three pits designated as postholes in Pit Structure 27, which were 10–17 cm deep, and several postholes at Pit Structure 16, which were even shallower and ranged in depth from 4–17 cm. The average depth of the postholes surrounding the Feature 32 pit was 25 cm.

It was surprising to find piñon nutshell at LA 120973 since the site was at least 9.6 km (6 mi) from the nearest nut-bearing tree. The presence of nutshell and the complete absence of pinecone scales indicated that the nuts may have been processed closer to the source. The recovery of cone scales offered evidence of home-based processing that likely involved gathering the nuts "in the cone" and later burning the cone "off the nuts after the return home" (Reagan 1928:146–147). However, since no scales were found at LA 120973, the nuts were probably burned off the cones near the place they were gathered.

Feature 13 was an isolated, rodent-disturbed pit on the other side of US 54, just east of the main portion of the site. The most numerous plant parts found at the feature were burned and partially burned grass rhizomes and stems, which were present in both flotation and macrobotanical samples (Table 16.6 and Table 16.7). It is possible that the pit was lined with grasses; however, the pit did not display oxidation, so burning in situ is highly unlikely. Another possibility is that these grasses were burned during roadside clearing and that rodents brought these to the burrow at a later time.

A few dropseed grass seeds were also identified in the pit, perhaps hinting at the identity of the grass stems and rhizomes. A number of goosefoot seeds were present, along with four-wing saltbush fruit and globemallow seeds. The four-wing saltbush fruit may have been related to firewood use, although no wood charcoal was present in the feature.

Globemallow, a colorful and weedy perennial, may have been used here for medicinal purposes. The root was used by the Hopis and Pimas to treat digestive problems (Whiting 1966; Curtin 1949); the Picuris pounded globemallow root to form a paste that was applied over broken bone and allowed to dry, forming a cast (Krenetsky 1964).

Other features in the northern half of LA 120973 yielded repetitive plant taxa, including annual seeds, maize, dropseed grass, and a number of unknown plant parts; these were present in nearly every feature.

Table 16.6. LA 120973, flotation plant remains, by category and feature.

Category	Taxon	Feature 19 Collared Pit FS 460	Feature 23 Pit FS 428	Feature 13 Pit FS 330	Feature 10 Collared Pit FS 258	Feature 10-A Posthole FS 358
Cultural						
Annuals	amaranth	–	0.5	–	–	–
	goosefoot	–	–	26.8	–	1.1
	purslane	–	–	–	–	0.7
Cultivars	maize	–	+ c	–	+ c	+ c
	squash	–	+ rind	–	–	–
Grasses	dropseed grass	–	–	3.6	1.3	0.4
	grass family	–	+ s	+++ rh, + rh pc, ++ s	–	+ s
Other	goosefoot family	–	–	0.9	–	–
	monocot	–	–	–	+ s	–
	unidentifiable seed	–	–	0.9	1.8	–
	unknown taxon	0.5 pp	1.8 pp	–	5.3 pp	1.5
Perennials	four-wing saltbush	–	–	1.8 fruit	–	–
	globemallow	–	–	0.9	0.4	0.4
	mesquite	–	6.9	–	4.9	–
	piñon	–	+ ns	–	–	–
Possibly Cultural						
Other	unidentifiable seed	–	–	0.9	–	–
Noncultural						
Annuals	amaranth	–	–	–	1.3	–
	caltrop	–	–	–	0.4	–
	cheno-am	–	–	–	–	1.1
	goosefoot	4.5	–	125.9	2.7	6.3
	purslane	0.5	–	10.7	0.4	–
	spurge	2.3	0.9	9.8	0.4	4.1
	tansy mustard	–	–	–	2.7	0.7
Grasses	dropseed grass	5.5	0.5	–	0.9	–
	grass family	0.5	–	–	–	–
Other	goosefoot family	–	–	0.9	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

Category	Taxon	Feature 10-B Posthole, S 1/2 FS 357	Feature 14 Posthole FS 342	Feature 14-A Posthole FS 504	Feature 17 Collared Pit FS 395	Feature 17-A Posthole FS 461
Cultural						
Annuals	goosefoot	0.6	–	0.5	0.1	–
	purslane	–	–	–	–	0.5
Cultivars	maize	+ c	+ c	–	+ c	–
Grasses	grass family	–	–	–	–	+ s
Other	monocot	+ s	–	–	–	–
	unknown taxon	–	0..6 pp	2.7 pp	0.2 pp	0.5 fruit, 1.1 pp
Perennials	piñon	+ ns	–	–	–	–
Noncultural						
Annuals	amaranth	–	–	–	0.1	–
	caltrop	–	–	–	1.0	–
	goosefoot	–	7.1	1.1	6.6	15.8
	prostrate amaranth	–	–	–	0.2	–
	purslane	–	0.6	0.5	0.3	–

Table 16.6 (continued)

	spurge	–	–	–	1.2	6.5
	tansy mustard	–	–	–	0.1	1.6
Grasses	grass family	–	–	–	0.1	–
Other	borage family	–	–	–	0.6	0.5
	crownbeard	–	–	–	0.1	–
	evening primrose	–	–	–	0.1	–
Perennials	globemallow	–	–	0.8	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

		Feature 6		Feature 6-C Posthole	Feature 24 Posthole F	Feature 25 Collared Pit
		Pit, 32N/265E	Pit, 32N/265E			
Category	**Taxon**	**FS 113**	**FS 168**	**FS 502**	**FS 491**	**FS 458**
			Cultural			
Annuals	goosefoot	–	2.3	20.0	–	–
	tansy mustard	–	–	40.0	–	–
Cultivars	maize	cf. + c	+ c	+ c	–	–
Grasses	grass family	–	2.3	–	–	–
Other	unknown taxon	2.6 pp	2.3 pp	–	–	0.7 pp
Perennials	banana yucca	2.1	–	–	–	–
			Noncultural			
Annuals	amaranth	–	–	–	–	1.4
	goosefoot	0.5	4.7	–	–	4.8
	purslane	0.5	–	–	3.3	11.7
	spurge	–	–	–	5.7	7.6
	tansy mustard	0.5	2.3	20.0	–	1.4
Grasses	dropseed grass	2.6	–	–	–	0.7
	grass family	0.5	–	20.0 floret	0.8	–
Other	bean family	–	–	–	–	0.7
	goosefoot family	0.5	–	–	–	–
Perennials	globemallow	1.6	–	–	–	–
	prickly pear	–	1.9	–	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

		Feature 27-C Pit	Feature 27-K Niche	Feature 27-L Posthole	Feature 11 Pit Structure	Feature 11-A Posthole
Category	**Taxon**	**FS 533**	**FS 536**	**FS 541**	**FS 546**	**FS 565**
			Cultural			
Annuals	amaranth	–	–	–	0.2	–
	cheno-am	–	–	–	0.2	–
	goosefoot	–	–	–	0.3	–
	purslane	–	0.6	–	–	–
Cultivars	maize	–	–	–	+++ c, 0.2 cofr., 0.2 e, + g, 0.2 k	+ c, + g
	squash	–	–	–	+ rind	–
Grasses	dropseed grass	–	–	–	1.4	–
	grass family	–	–	–	+ rh, + s	–
Other	mint family	–	–	–	0.2	–
	unidentifiable seed	–	–	–	2.2	–
	unknown taxon	–	–	–	1.3 pp	1.0 pp
Perennials	mesquite	–	–	–	1.0, 0.2 en	–
	piñon	–	–	–	+ ns, + ns pc	–
			Noncultural			
Annuals	amaranth	–	–	1.7	–	–
	caltrop	–	–	–	–	1.0

Table 16.6 (continued)

	goosefoot	6.5	4.8	2.3	0.5	3.8
	purslane	0.4	3.0	14.3	0.2	–
	spurge	–	0.6	4.7	12.0	1.0
	tansy mustard	–	0.6	1.3	–	–
Grasses	dropseed grass	–	–	1.3	0.2	–
	grass family	–	0.6 floret	–	–	–
Perennials	globemallow	–	–	–	0.3	–

(LA 120973, flotation plant remains, by category and feature, continued)

		Feature 11-D Posthole	**Feature 11-E Posthole**	**Feature 8 Pit, E 1/2**	**Feature 7 Pit Structure, W 1/2**	**Feature 7-A Bell-shaped Pit**
Category	**Taxon**	**FS 568**	**FS 569**	**FS 244**	**FS 250**	**FS 318**
			Cultural			
Annuals	cheno-am	–	0.5	–	–	–
	goosefoot	–	–	1.7	0.4	–
Cultivars	maize	poss. + c	–	+ c, + g	+++ c, + g, 0.7 k	–
Other	unidentifiable seed	–	–	–	–	1.5
	unknown taxon	–	–	2.0 pp, 0.3 pp[pc]	–	–
Perennials	prickly pear	–	–	0.3	–	–
			Noncultural			
Annuals	amaranth	0.7	–	–	–	2.3
	goosefoot	0.7	–	5.4	0.7	16.9
	purslane	–	–	6.0	0.4	3.8
	spurge	–	–	9.4	2.2	1.5
Grasses	dropseed grass	2.0	0.5	2.3	0.4	1.5
Perennials	globemallow	1.3	–	–	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

		Feature 7-B Posthole	**Feature 9 Pit, E 1/2**	**Feature 31 Pit**	**Feature 2 Pit**	**Feature 5 Hearth**
Category	**Taxon**	**FS 319**	**FS 279**	**FS 571**	**FS 521**	**FS 296**
			Cultural			
Annuals	goosefoot	–	1.1	–	–	–
Cultivars	maize	+ c	++ c, 4.2 k	+ c, + g	–	–
Other	aster family	–	–	–	–	1.1
	unknown taxon	–	–	–	–	2.1 pp
Perennials	globemallow	–	–	–	0.5	–
			Noncultural			
Annuals	amaranth	–	–	–	0.5	–
	goosefoot	–	3.2	–	1.0	3.2
	purslane	6.1	–	–	1.0	–
	spurge	–	–	–	–	2.1
	tansy mustard	–	–	1.3	–	2.1
Grasses	dropseed grass	–	–	1.3	–	5.3
	grass family	–	–	1.3	–	–
Other	goosefoot family	–	–	–	–	3.2
	unknown taxon	–	–	0.6 fruit	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

Table 16.6 (continued)

		Feature 12 Hearth	Feature 16 Pit Structure	Feature 16-G Posthole	Feature 20	
					Pit, W 1/2	Pit, E 1/2
Category	**Taxon**	**FS 328**	**FS 406**	**FS 407**	**FS 518**	**FS 519**
			Cultural			
Annuals	amaranth	–	–	–	3.2	–
	goosefoot	–	0.4	–	176.2	19.5
	purslane	–	–	–	7.9	2.1
	tobacco	–	0.4[u]	–	1.6[u]	1.1
Cultivars	maize	+ c, + g	+ c	–	++ c, 1.2 cofr., 0.8 e, + g, 2.8 k	+ c, + g, 1.1 e
	squash	–	–	–	+ rind	+ rind
Grasses	dropseed grass	–	–	–	282.5	106.8
	grass family	–	–	–	+ s	–
Other	aster family	–	–	–	0.4	–
	knotweed family	–	–	–	–	0.5
	unidentifiable seed	–	–	–	–	1.1
	unknown taxon	–	0.4 pp	–	–	1.6 pp
Perennials	cactus family	–	–	–	–	poss. 1.1 areola
	four-wing saltbush	–	–	–	–	0.5 fruit
	globemallow	–	–	–	9.5	3.2
	prickly pear	–	–	–	1.2 e, 0.8, 0.8[pc]	0.5 e
			Possibly Cultural			
Perennials	prickly pear	–	–	–	1.2 e[u]	–
			Noncultural			
Annuals	caltrop	3.3	–	2.1	–	–
	goosefoot	2.5	–	2.1	198.4	1.1
	purslane	5.7	–	2.9	1.6	2.1
	spurge	–	–	0.7	–	–
	tansy mustard	1.6	0.9	–	–	–
Grasses	dropseed grass	0.8	0.4	–	–	–

(LA 120973, flotation plant remains, by category and feature, continued)

		Feature 32 Pit	Feature 32-D Posthole	Feature 34 Posthole	Feature 35 Posthole	Feature 36 Posthole
Category	**Taxon**	**FS 589**	**FS 577**	**FS 591**	**FS 592**	**FS 593**
			Cultural			
Annuals	cheno-am	–	–	–	0.9	–
	goosefoot	–	0.8	1.5	–	0.4
Other	unknown taxon	–	1.7 pp[pc]	–	–	–
Perennials	four-wing saltbush	–	–	–	0.5 fruit	–
			Noncultural			
Annuals	amaranth	–	–	0.5	–	–
	caltrop	–	0.8	–	–	–
	goosefoot	–	11.8	2.6	0.9	13.8
	purslane	–	5.0	–	0.5	0.4
	spurge	0.7	1.7	–	0.5	6.7
	tansy mustard	–	0.8	–	–	–
Grasses	dropseed grass	0.7	–	–	–	16.4
	grass family	–	–	–	+ rh	–
Perennials	globemallow	–	1.7	–	–	–

Plant remains are seeds unless indicated otherwise. Noncultural plant material is uncharred.
+ = 1–10/sample; ++ = 11–25/sample; +++ = 25–100/sample; c = cupule, cofr. = cob fragment; e = embryo;
g = glume; k = kernel; ns = nutshell; pc = partially charred; pp = plant part; rh = rhizome; s = stem; u = uncharred

In addition to the unknown plant parts and maize cupules, the Feature 6 pit contained banana yucca seeds; these seeds were also recovered in the macrobotanical sample from Feature 10, another collared pit. The seeds of banana yucca are easily distinguishable from other species due to their thick-walled, grooved seed coats.

Banana yucca might have been found at slightly higher elevations, where the Semi-Desert Grassland biotic community intergrades with Chihuahuan Desert Scrub. The fruit of the banana yucca was most often collected when only partially ripe, due to the predation of ripe fruits by insects, deer, and birds. Collected fruits were ripened, roasted or boiled, and split open. The seeds were removed, dried, and stored (Bell and Castetter 1941).

A sample from the Feature 11 pit structure in the central portion of the site contained one of the more diverse floral assemblages found at LA 120973. Three annual taxa, various maize parts, squash, dropseed grass, grass rhizomes and stems, mint, mesquite, and piñon nut shell were recovered. In addition to mesquite seed, a fragment of endocarp was also recovered, offering further evidence for processing. An endocarp is the tough outer covering that encloses a seed, which is decidedly difficult to pry away from the seed without pounding.

The Feature 20 trash pit, one of the more southerly situated features, revealed a diverse array of plant material that included large numbers of goosefoot and dropseed grass. There were few maize parts, but like the assemblage from Feature 11, these included cupules, cob fragments, embryos, glumes, and kernels. A single maize cob was collected from this feature. The 12-rowed cob had a rachis diameter of 8.0 mm (Table 16.8). There was no comparative material from nearby sites, but even if there had been, a single cob would not have represented of the type of maize grown at LA 120973.

Prickly pear cactus seeds and embryos were also present. This suggests that the fruits were processed, probably after removal of the glochids, which is often done by rolling the fruits in sand or singeing the spines off over a fire. The fruits can be eaten either raw or boiled or as part of a cornmeal mush into which dried, ground fruits are added (Castetter 1935). A possible cactus areola—the structure from where the glochids emerge—was also recovered from Feature 20. A prickly pear seed was found in the Feature 8 pit just south of Structure 11.

Features even further south consisted of the Feature 32 pit and several postholes either surrounding or to the east of the pit. These features contained unburned, weedy, annual seeds; grasses; globemallow; a small number of charred annual seeds; unknown plant parts; and four-wing saltbush fruit.

The flotation wood assemblage from LA 120973 (Table 16.9) was dominated by saltbush; cholla came in a distant second, followed by mesquite. Saltbush was the most frequently encountered wood in macrobotanical samples as well; however, pine rather than cholla was the second most common taxon; a large number of conifer fragments designated as pine were recovered from Pit Structure 7.

Juniper was identified in nine of the 26 flotation contexts yielding wood charcoal, while piñon was restricted to just one fragment recovered from a single posthole (Feature 11E). This was one of just a few cases in which a posthole contained only one wood taxon. Saltbush was recovered from Postholes 10B and 16G, juniper from Posthole 35, and an unknown conifer from Posthole 11D.

Juniper would have been the best material for posts due to its outstanding natural durability (Barger and Ffolliott 1972:25). Piñon would have been far less favorable, since straight lengths long enough for posts occur infrequently, and untreated posts seldom endure longer than 4 to 6 years (Barger and Ffolliott 1972:26). Saltbush was readily available and may have been used simply because it was expedient to do so; saltbush was used not only for fuel but most likely for building materials as well.

Based on the extant vegetation community, collection forays into the foothills of the Sierra Blanca Mountains for piñon, juniper, and banana yucca would have been required. It is possible that the search for mesquite extended as far south as present-day Oscura, since mesquite does not occur today in any abundance north of Oscura. Additional juniper and piñon wood could have come in the form of driftwood from Willow Draw.

This settlement could represent a seasonal camp to which roasted piñon nuts, mesquite pods, banana yucca fruits, and conifer wood were brought and where dropseed grass was gathered and prepared along with annual seeds and cactus fruits. Maize and squash were cultivated here, taking advantage of monsoon rains and runoff from Willow Draw.

LA 130331: The Feature 1 hearth at LA 130331 was the only hearth of the two thermal features

Table 16.7. LA 120973, macrobotanical plant and wood taxa; count and weight in grams.

Feature	23	13	10			6		34N/265E	35N/264 E
	Pit	Pit	Collared Pit		Collared Pit, E 1/2	Pit	Pit, W 1/2		
FS No.	**428**	**330**	**258**	**297**	**356**	**165**	**499**	**331**	**325**
Wood: conifers, juniper	–	–	–	–	1/.03 g	–	–	–	–
cf. piñon	–	–	–	1/.04 g	–	–	–	–	–
Unknown conifer	1/.01 g	–	–	–	–	–	–	–	–
Nonconifers: cf. cholla	10/.40 g	–	–	1/.03 g	–	7/.07 g	–	1/.03 g	2/.07 g
Mesquite	11/.29 g	–	–	–	–	1/.01 g	–	–	1/.02 g
Saltbush	4/.35 g	–	–	–	1/.01 g	2/.01 g	1/.09 g	–	–
Total wood	**26/1.05 g**	**–**	**–**	**2/.07 g**	**2/.04 g**	**10/.09 g**	**1/.09 g**	**1/.03 g**	**3/.09 g**
Non wood: cultivars, maize	3 c/.06 g	–	–	–	–	–	–	–	–
Grasses: grass family culms, rhizomes	–	36/1.32 g, 15 pc/.43 g	–	–	–	–	–	–	–
Other: unknown taxon	–	–	–	–	–	–	–	–	1 pp/.01 g
Perennials: banana yucca seed	–	–	1/.03 g	5/.21 g	4/.18 g	2/.06 g	–	1/.04 g	1/.02 g
Mesquite	1 endo/.11 g	–	–	–	–	–	–	–	–

(LA 120973, macrobotanical plant and wood taxa; count and weight in grams, continued)

Feature	27	11		8	7		9	31	5
	Pit Structure	Pit Structure	Pit Structure, Floor 1	Pit	Pit Structure		Pit, E 1/2	Pit	Ash from Hearth
FS No.	**538**	**553**	**574**	**244**	**143**	**341**	**279**	**571**	**295**
Wood: conifers, juniper	1/.40 g	–	–	–	–	–	–	–	–
Pine	–	–	–	–	27/9.87 g	–	–	–	–
cf. piñon	–	–	–	–	1/1.53 g	–	–	–	–
Nonconifers: cf. cholla	–	–	2/.04 g	22/1.26 g	6/1.63 g	40/3.7 g, 2 pc/.04 g	6/.12 g	–	4/.04 g
Mesquite	–	–	12/1.13 g	–	–	1/.01 g	5/.13 g	–	14/.30 g
Oak	–	–	8/1.38 g	–	–	–	–	–	–
Saltbush	–	–	20/2.5 g	2/.06 g	2/1.21 g	1/.24 g	1/.01 g	–	6/.31 g
Total wood	**1/.40 g**	**–**	**42/5.05 g**	**24/1.32 g**	**36/14.24 g**	**44/3.99 g**	**12/.26 g**	**–**	**24/.67 g**
Non wood: cultivars, maize	–	2 c/.07 g	5 c, 3 cfr/ .29 g	2 c/.02 g	–	–	15 c/.27 g	7 c/.15 g	–

Table 16.7 (continued)

(LA 120973, macrobotanical plant and wood taxa; count and weight in grams, continued)

Feature	12	20	13N/267E	29	Total Wood	
	Hearth	Pit, E 1/2		Pit		
FS No.	**327**	**519**	**485**	**527**	**Weight**	**Column %**
Wood: conifers, juniper	–	–	–	–	**0.43 g**	**1.2%**
Pine	–	–	2/.09 g	–	**9.96.g**	**27.3%**
Piñon	–	–	–	–	**1.57 g**	**4.3%**
Unknown conifer	–	–	–	–	**0.01 g**	**0.0%**
Nonconifers: cf. cholla	1/.10 g	–	2/.01 g	–	**7.54.g**	**20.7%**
Mesquite	6/1.23 g	–	4/.10 g	1/.08 g	**3.3 g**	**9.0%**
Oak	–	–	–	–	**1.38 g**	**3.8%**
Saltbush	25/7.03 g	–	11/.49 g	–	**12.31 g**	**33.7%**
Total wood	**32/8.36 g**	**–**	**19/.69 g**	**1/.08 g**	**36.5 g**	**100.0%**
Non wood: cultivars, maize	–	1 c/.01 g	1 c/<0.1 g	–		
Other: unknown taxon	–	–	2 pp/<0.1 g	–		

c = cupule, cf. = resembles taxon, endo = endocarp, pc = partially charred, pp = plant part, cfr = cob fragment

Table 16.8. LA 120973, Zea mays cob morphometrics.

FS No.	Feature	Row	Type	Shape	Length (mm)	Rachis Segment Length (mm)	Rachis Diameter (mm)	Cupule (mm)
518	20 - Pit, W 1/2	12	Straight	Cylindrical	16.8	2.2	8.0	3.3

present to produce carbonized non-wood remains that included unknown plant parts and material closely resembling yucca caudex fragments (Table 16.10). These plant parts displayed a distinct, warty, bark-like surface and were first recognized during analysis of plant material for a project along NM 128 near Carlsbad (McBride and Toll 2009).

Uncharred, dropseed grass; hidden flower; members of the aster family; several species of annual seeds; four-wing saltbush fruits; and mesquite and saltbush leaves also were recovered. These probably represented detritus from modern vegetation introduced either during excavation or by rodents, wind, or other natural causes.

Mesquite was the most common wood identified in flotation and macrobotanical samples from both hearths (Tables 16.11 and 16.12). This is not surprising considering that the site was situated in an area of mesquite-covered dunes, approximately 26 km (16 mi) south of LA 120972 and LA 120973. Creosote bush, saltbush, and a fragment of cholla were also recovered.

Yucca caudex fragments could imply that these succulent leaf stems were used as food. Ethnobotanical accounts compiled by Bell and Castetter (1941) describe the collection of young flower stalks of *Y. glauca* by the Mescalero Apaches. The stalks were roasted on a bed of embers for about 15 minutes. Later, the burned portion was scraped away, leaving behind the central, white portion of the plant often regarded as the best part.

The crowns of the plant were gathered by the same group from the middle of March to the end of summer. The portion of plant found between the ground and the leaves was often peeled and baked overnight in an underground oven, a method similar to that used to roast agave hearts (Bell and Castetter 1941:19). Roasted portions were dried in the sun and stored for future use; pieces were soaked in water to render them edible.

The outer bark-like material from the base of the stem could represent residue from preparing the stems or crowns as described above. Equally plausible is the possibility that the very dry, easily gathered material was used as tinder and that locally available shrubs were utilized for fuel.

Discussion

Plant remains from four other early Formative sites were compared with LA 120972 and LA 120973 in Table 16.13. Remains from pit-structure fill, features, and an extramural hearth at LA 71276 (Toll 1997); from fill and features from five structures and several extramural features at the scorpion site in Alamogordo (McBride 2008); from a depression with a hearth, a large pit structure, and three extramural storage pits at LA 457 (Toll 1998); and from Turquoise Ridge samples taken in southern New Mexico (Minnis and Goldborer 1991) were all examined.

The plant assemblage from the scorpion site most closely resembled that from the current project. Both included a similar array of annuals and perennials, maize and squash, and dropseed grass. Agave, hedgehog cactus, and beans were all present at the scorpion site, but not at the Carrizozo site. Piñon, banana yucca, and several plants listed in the "other" category were identified at LA 120972 and LA 120973, but were not recovered from the scorpion site.

The absence of piñon and banana yucca at the scorpion site is somewhat puzzling considering the site's proximity to upland resources, especially since the use of these resources was evident in wood specimen analysis results. Piñon wood was identified in two macrobotanical samples from the scorpion site; ponderosa pine wood was present in three samples. One specimen had common reed stems attached to it, indicating that ponderosa was used for roof beams and that common reed was used for closing material.

If piñon wood had been used to some extent, it is difficult to imagine that the nuts would not have been

Table 16.9. LA 120973, flotation wood charcoal taxa; count and weight in grams.

Feature No.		23 Pit	10 Collared Pit	10-A Posthole	10-B Posthole, S 1/2	14 Posthole	17-A Posthole
FS No.		**428**	**258**	**358**	**357**	**342**	**461**
Conifers	juniper	1/.01 g	–	–	–	1/.01 g	1/.01 g
Nonconifers	cholla	8/.09 g	9/.13 g	16/.17 g	–	1/.01 g	1/.01 g
	creosotebush	–	–	–	–	–	1/.01 g
	mesquite	7/.06 g	10.05 g	–	–	1/.01 g	1/.01 g
	saltbush	4/.04 g	1/.01 g	4/.05 g	2/.01 g	3/.02 g	–
Total		**20/.20 g**	**20/.19 g**	**20/.22 g**	**2/.01 g**	**6/.05 g**	**4/.04 g**

(LA 120973, flotation wood charcoal taxa; count and weight in grams, continued)

Feature No.		6 Pit, 32N/265E	6-C Posthole	24 Posthole F	11 Pit Structure	11-A Posthole	11-D Posthole
FS No.		**113**	**502**	**491**	**546, Bags 1–4**	**565**	**568**
Conifers	juniper	–	1/.01 g	–	3/.07 g	–	–
	unknown conifer	–	–	1/.01 g	–	–	3/.04 g
Nonconifers	cholla	2/.01 g	3/.02 g	–	18/.30 g	6/.10 g	–
	mesquite	2/.01 g	–	–	5/.16 g	6/.10 g	–
	saltbush	–	3/.04 g	4/.03 g	54/2.86 g	8/.10 g	–
	unknown nonconifer	–	–	1/.01 g	–	–	–
Total		**4/.02 g**	**7/.07 g**	**6/.05 g**	**80/3.39 g**	**20/.30 g**	**3/.04 g**

(LA 120973, flotation wood charcoal taxa; count and weight in grams, continued)

Feature No.		11-E Posthole	8 Pit, E 1/2	7 Pit Structure W 1/2	7-A Bell-shaped Pit	7-B Posthole	9 Pit, E 1/2
FS No.		**569**	**244**	**250**	**318**	**319**	**279**
Conifers	juniper	–	–	–	1/.01 g	–	1/.01 g
	piñon	1/.02 g	–	–	–	–	–
Nonconifers	cholla	–	27/.39 g	10/.30 g	–	1/.01 g	–
	mesquite	–	–	4/.10 g	–	–	3/.01 g
	saltbush	–	–	6/.40 g	1/.01 g	2/.01 g	–
Total		**1/.02 g**	**27/.39 g**	**20/.80 g**	**2/.02 g**	**3/.02 g**	**4/.02 g**

(LA 120973, flotation wood charcoal taxa; count and weight in grams, continued)

Feature No.		31 Pit	2 Pit	12 Hearth	16 Pit Structure	16-G Posthole	20 Pit, W 1/2
FS No.		**571**	**521**	**328**	**406**	**407**	**518**
Conifers	juniper	–	2/.02 g	–	–	–	–
Nonconifers	cholla	–	–	3/.10 g	–	–	1/.07 g
	creosotebush	–	–	–	–	–	1/.02 g
	mesquite	–	–	5/.10 g	1/.01 g	–	3/.06 g
	saltbush	1/.01 g	–	12/.40 g	19/.20 g	2/.02 g	15/1.0 g
Total		**1/.01 g**	**2/.02 g**	**20/.60 g**	**20/.21 g**	**2/.02 g**	**20/1.15 g**

(LA 120973, flotation wood charcoal taxa; count and weight in grams, continued)

Feature No.		20 Pit, E 1/2	35 Posthole	Total			
FS No.		**519**	**592**	**Weight**	**Column %**		

Table 16.9 (continued)

Conifers	juniper	–	1/.03 g	**.18 g**	**2.1%**		
	piñon	–	–	**.02 g**	**0.2%**		
	unknown conifer	–	–	**.05 g**	**0.6%**		
Nonconifers	cholla	2/.05 g	–	**1.76 g**	**20.5%**		
	creosotebush	–	–	**.03 g**	**0.3%**		
	mesquite	5/.18 g	–	**.86 g**	**10.0%**		
	saltbush	13/.46 g	–	**5.67 g**	**66.1%**		
	unknown nonconifer	–	–	**.01 g**	**0.1%**		
Total		**20/.69 g**	**1/.03 g**	**8.58 g**	**100.0%**		

Table 16.10. LA 130331, flotation plant remains, by category and feature.

Category	Taxon	Feature 1 Hearth, E 1/2 FS 3	Feature 2 Hearth FS 13
Cultural			
Other	unknown taxon	4.2 plant part	–
Perennials	cf. *Yucca caudex*	+ stem	–
Noncultural			
Annuals	bugseed	0.3	–
	goosefoot	0.3	2.4
	mustard	–	0.7
	purslane	–	0.2
	spurge	–	0.2
Grasses	dropseed grass	2.5	0.2
Other	aster family	3.4	–
Perennials	four-wing saltbush	2.2 fruit	–
	hidden-flower	25.2	–
	mesquite	+ leaf	+ leaf
	saltbush	–	+ leaf

Plant remains are seeds unless indicated otherwise.
Cultural plant material is charred; noncultural material is uncharred.
+ = 1–10/sample, cf. = resembles taxon

gathered as well. It may be that nutshell simply did not preserve well or was among plant parts categorized as unidentifiable due to erosion or fragmentation.

Beans have thin, fragile seed coats that break easily, leaving the endosperm exposed to environmental factors that can cause deterioration (Gasser and Adams 1981). Other seeds with tougher seed coats have a distinct preservation advantage, so the absence of beans at the Carrizozo sites may have been either the result of a different taphonomic issue or from lack of use.

The lack of agave at LA 120972 and LA 120973 can be explained by the absence of this resource in proximity to the sites, while at least two species of agave are found in the foothills and bajadas of the Sacramento Mountains less than 8 km (5 mi) away from the scorpion site.

Of the three sites from which more than 10 flotation samples were analyzed, LA 120972 and LA 120973 had the greatest incidence of maize, along with a high percentage of goosefoot. Amaranth and tansy mustard occurred most frequently in samples from the scorpion site. Since tansy mustard is one of the first plants to appear in early spring, the scorpion site is one of two sites with clear floral evidence of occupation around this time of year. Ricegrass, which also sets seed in the spring, was recovered at LA 71276.

The higher percentage of goosefoot at the Car-

Table 16.11. LA 130331, flotation wood charcoal taxa, by category and feature; count and weight in grams.

Category	Taxon	Feature 1 Hearth, E 1/2	Feature 2 Hearth	
		FS 3	FS 13, Bag 1	FS 13, Bag 4
Nonconifer	creosotebush	–	–	1/.01
	mesquite	20/0.20	20/.55	14/.20
	saltbush	–	–	5/.01
Total		**20/0.2 0**	**20/.55**	**20/.21**

Table 16.12. LA 130331, macrobotanical wood taxa, by category and feature; count and weight in grams.

Category	Taxon	Feature 1	Feature 2	
		Hearth, E 1/2 FS 3	Hearth, W 1/2 FS 11	Hearth FS 13
Nonconifer	cf. *cholla*	–	–	1/.03
	creosotebush	–	12/.40	3/.20
	mesquite	52/4.80	40/2.40	55/3.7
	saltbush	–	1/.01	13/.90
Total		52/4.80	53/2.81	72/4.83

cf. = resembles taxon

rizozo sites, and amaranth at the scorpion site, suggests that occupants took advantage of annual volunteers in agricultural fields, collecting them for edible greens and seeds. The high incidence of these pioneer, weedy species may indicate subsistence intensification (Matthews 1986). Although cheno-ams were evident in a high percentage at Turquoise Ridge, maize ubiquity was low.

When wood charcoal taxa were compared, vast differences were seen not only in the diversity of taxa but in the percent presence of taxa (Table 16.14). Flotation samples from the scorpion site were scanned and charcoal taxa recorded as present, without weights.

Wood samples collected in the field are usually an entirely different class of specimen than samples recovered through flotation. Collected samples generally consisted of larger pieces and were easily observed during excavation; samples tended to represent roof fall or other construction materials.

For comparison purposes, both sets of data from the scorpion site are presented in Table 16.14. There is a distinct difference between the two data sets. Wood from vegetal samples is heavily weighted toward conifers, with only traces of non-conifers appearing. When flotation sample presence data are added to that of vegetal samples, saltbush and ponderosa pine appear co-dominant.

Ponderosa pine was probably used exclusively for roof beams and was possibly harvested from the higher, north-facing slopes of the canyons approximately 2.4 km (1.5 mi) northeast of the site. Saltbush was used for both roof-closing material and for fuel. Juniper was the most common taxon present at LA 71276, where Great Basin conifer woodlands surround the site (Toll 1997:95). Ash and alder-willow wood, along with mesquite—normally a bosque species that prefers to grow near permanent or semi-permanent water sources—offer a glimpse of riparian resource use. Shrubs common to the Chihuahuan Desert Scrub or Semi-Desert Grassland community, including cholla, saltbush, and sagebrush, were also present.

Wood procurement seems to have been largely dependent on what was available locally or within a reasonable distance from any given site, a pattern repeated throughout the Southwest.

Table 16.13. Carbonized plant taxa recovered from Early Formative agricultural sites.

Site	LA 120972, LA 120973[1]	LA 71276[2]	Scorpion Site (LA 119530)[3]	LA 457[4]	Turquoise Ridge
Location	**Alluvial Fan, NE Margin of Tularosa Basin, US 54**	**Alluvial Plain, Eastern Margin of Rio Grande Valley, US 380**	**Near Base of Alluvial Fan, South Edge of Alamogordo**	**Alluvial Fan at Mouth of Dry Canyon, Easter Edge, Tularosa Basin**	**(4:132)[5], Upper Edge of Hueco Bolson**
Elevation	**5100 ft**	**6310 ft**	**4400 ft**	**4400 ft**	**4000 (?) ft**
Samples with charred remains	**33**	**6**	**23**	**7**	**78**
Annuals					
Amaranth	x	–	x	x	–
Beeweed	x	–	–	–	–
Bugseed	–	–	–	–	x
Cheno-am	x	–	x	–	x
False purslane	x	–	–	–	–
Goosefoot	x	x	x	–	–
Pepperweed	–	–	x	–	–
Purslane	x	–	x	–	x
Sunflower	x	–	x	–	x
Tansy mustard	x	–	x	–	–
Tobacco	x	x	–	–	–
Cultivars					
Beans	–	–	x	–	x
Maize	x	x	x	x	x
Squash	+ rind	–	+ rind	–	–
Grasses					
Dropseed grass	x	–	x	–	x
Grass family	x	–	–	x	x
Ricegrass	–	x	–	–	–
Other					
Aster family	x	–	–	x	–
Bean family	–	–	–	–	x
Goosefoot family	x	–	–	–	–
Knotweed family	x	–	–	x	–
Mallow family	–	x	–	–	–
Mint family	x	–	–	–	–
Mustard family	–	–	–	–	x
Pink family	–	–	–	–	x
Sage	–	–	–	x	–
Wild potato	–	–	–	x	–
Perennials					
Agave	–	–	x	–	–
Banana yucca	x	–	–	–	x
Cactus family	+ areola	–	–	–	–
Cholla/prickly pear cactus	–	x	–	–	–
Four-wing saltbush	+ fruit	–	+ fruit	–	–
Globemallow	x	–	x	–	–
Hedgehog cactus	–	–	x	x	x
Juniper	–	+ twigs	–	–	–
Mesquite	x	–	x	–	x
Piñon	x	–	–	–	–

Table 16.13 (continued)

Site	LA 120972, LA 120973[1]	LA 71276[2]	Scorpion Site (LA 119530)[3]	LA 457[4]	Turquoise Ridge
Location	**Alluvial Fan, NE Margin of Tularosa Basin, US 54**	**Alluvial Plain, Eastern Margin of Rio Grande Valley, US 380**	**Near Base of Alluvial Fan, South Edge of Alamogordo**	**Alluvial Fan at Mouth of Dry Canyon, Easter Edge, Tularosa Basin**	**(4:132)[5], Upper Edge of Hueco Bolson**
Elevation	**5100 ft**	**6310 ft**	**4400 ft**	**4400 ft**	**4000 (?) ft**
Samples with charred remains	**33**	**6**	**23**	**7**	**78**
Prickly pear cactus	x	–	x	x	x
Screwbean mesquite	–	–	–	–	x
Sumac	–	–	–	–	x
Yucca	+ caudex	–	x	–	–
Total	**22**	**7**	**17**	**9**	**16**

[1]current project; [2]Toll 1997; [3]McBride 2008; [4]Toll 1998; [5]Minnis and Goldborer 1991
x = present, – = absent

Table 16.14. Wood charcoal taxa recovered from Early Formative agricultural sites; percent, by weight or percent of samples with taxon.

Site	LA 120972, LA 120973[1]	LA 71276[2]	Scorpion Site (LA 119530)[3]	
Total Weight (g)	**10.15**	**5.59**	**309.30 (Vegetal Samples)**	**23 Samples**
		Conifers		
Juniper	4.0%	96.0%	–	4.0%
Pine	–	–	8.0%[u]	4.0%
Piñon	<1.0%	–	25.0%[u]	4.0%
Ponderosa pine	–	–	64.0%	30.0%
Unknown conifer	1.0%	3.0%	–	–
		Nonconifers		
Alder/willow	–	–	<1.0%	9.0%
Ash	–	–	1.0%	4.0%
Cholla	18.0%	–	–	–
Creosotebush	1.0%	–	<1.0%	9.0%
Mesquite	9.0%	–	1.0%	17.0%
Saltbush	67.0%	<1.0%	1.0%	30.0%
Sagebrush	–	1.0%	–	–
Unknown nonconifer	<1.0%	–	<1.0%	9.0%

[1]current project; [2]Toll 1997; [3]McBride 2008

Conclusions

Early Formative subsistence at LA 120972 and LA 120973 was a mixture of farming and the collection of wild plants from the Chihuahuan Desert Scrub community where the sites are located, as well as from the Semi-Desert Grassland found at slightly higher elevations. Possible food-related plant material from LA 130331 was restricted to yucca caudex fragments, which may indicate processing of the young flower stalks for food.

Wood from early Formative sites consisted largely of saltbush and some cholla, while mesquite overwhelmingly dominated the assemblage at LA 130331, thus reflecting the expedient use of local resources for fuel or construction.

17 ⩡ Pollen Analysis

Dr. Timothy E. Riley

This study focuses on 27 pollen samples collected from Prehistoric sites LA 120972 and LA 120973, which were excavated during the Carrizozo project. Ten of these samples were pollen washes from ground stone artifacts recovered during excavation. The remaining 17 samples were sediment samples collected from feature fill during excavation. Basic provenience data for all samples are presented in Tables 17.1 and 17.2.

LA 120972 was on a gradually sloping, alluvial floodplain associated with Willow Draw. Most of the ceramics identified at this site were Jornada Brown Ware and Chupadero Black-on-white. A large pithouse structure was encountered during the testing phase at an area designated Component B. Sediment samples FS 1125, FS 1127, and FS 1158 were collected in association with this feature and were submitted for pollen analysis (Table 17.2). Two pollen wash samples from this site were also submitted (Table 17.1).

LA 120973 was a large prehistoric site on the alluvial floodplain near Willow Draw. Ceramics recovered at this site consist of Jornada Brown, Mimbres Black-on-white, and Chupadero Black-on-white. This site featured an extensive pit-structure village, with both pithouse structures and storage pits. Many of the pits contained burned plant material, including maize (*Zea mays*) and various seeds. Fourteen sediment samples were submitted for pollen analysis (Table 17.2). An additional eight pollen wash samples from this site were also submitted (Table 17.1).

The primary goal of this analysis was to search for evidence of past agricultural use of the land near LA 120972 and LA 120973. Such use is often inferred by the presence of economic pollen, notably maize (*Zea mays*), beans (*Phaseolous* sp.), squash (*Cucurbita* sp.), and cotton (*Gossypium* sp.). While each of these may occur as a part of the fossil pollen record associated with agricultural landscapes, their absence does not automatically rule out the presence of agriculture, as each type has a different method of production, dispersal, and preservation; this is often the reason for underrepresentation in pollen records.

Despite being wind-pollinated, maize pollen has a very limited dispersal distance due to its large size and fast sinking speed. Maize pollen rarely occurs in any frequency outside of active maize fields (K. Adams 1988). Thus, the presence of even one or two maize pollen grains in a sample is evidence of the presence of maize agriculture at the location. Beans are insect-pollinated and have low pollen production; therefore, they are unlikely to be included in the pollen spectrum of a sample not directly associated with bean plants in flower. Both cotton and squash plants are insect-pollinated; each produce more pollen than beans and are more likely to be incorporated, in small quantities, into the pollen spectrum of associated sediment samples.

Agricultural production also can be inferred by the dominance of weedy flora in the fossil pollen spectrum (Fish and Fish 1994). This is particularly clear in areas lacking natural disturbances. However, the degree of disturbance associated with agriculture tends to be greater than those of natural disturbances resulting from fire or flooding. Many of the early successional, or weedy, species that colonized agricultural fields were annuals and were prolific pollen producers. This is particularly true of plant taxa designated as the cheno-am type in pollen analysis. As many of these useful but weedy species have been maintained in the cultivated fields of the Southwest during the ethnographic present (Castetter 1935), the prolific pollen production of species within the cheno-am type should contribute significantly to the pollen spectrum collected from prehistoric agricultural landscapes.

Recent experiments have shown that expectations for maize pollen accumulating on ground stone as a result of maize processing should be low. In their 2008 study, Geib and Smith collected maize botanical samples at different stages of processing and checked for pollen recovery. Nearly all of the maize pollen recovered in the experimental study was collected

Table 17.1. LA 120972 and LA 120973, ground stone pollen wash samples, by site and level.

FS No.	Provenience	Feature	Level	Artifact Type	Sample
LA 120972					
1	250N/112E	–	surface	mano fragment	1
1124-6	187S/142E	3	full cut	abrader	2
LA 120973					
15	14N/262E	–	2	mano fragment	3
143-2	17N/266E	7	3	core/hammerstone/ abrader	4
237	14N/257E	–	surface	core/abrader	5
267	30N/263E	–	1	mano	6
309	22N/265E	–	1	mano	7
322	12N/265E	–	1	core/abrader	8
500	33N/265E	–	full cut	core/abrader	9
574	21N/266E	11	Floor 1	trough metate	10

from the outer and middle husks of maize. Very little maize pollen was observed on the inner husks, silks, or husked ears; only one out of 10 shelled kernels contained appreciable maize pollen. This was further emphasized, in the same article, by the absence of maize pollen on manos and metates used in experimental grinding (Geib and Smith 2008).

Thus, there should be little expectation of recovering maize pollen from ground stone tools as a direct result of maize processing. Perhaps a better approach might be to incorporate searches for starch and possible phytoliths in ground stone washes. These microbotanical components are much more likely to be captured in the microcracks of a ground stone tool than pollen, due to the pre-grinding removal of outer husks and other external plant components with adhering pollen (Geib and Smith 2008). In addition, starch granules can provide direct evidence of maize processing associated with that tool. Although ground stone wash samples in the current study were processed primarily for pollen analysis, items were also checked for starch granules and phytoliths.

Dispersion and Preservation

The interpretation of pollen data must address the factors of production and dispersion that influence the composition of the original pollen rain, as well as the taphonomic factors that impact the buried pollen assemblage. A number of factors determine the original pollen rain in a region, these include: the type of pollination; differences in pollen production between taxa; differential dispersion patterns; and the size, weight, and ability of pollen types to remain airborne. Other factors influence the eventual loss or recovery of specific pollen types, including: pollen recycling or mixture due to wind, water, humans, or burrowing animals; the chemical composition of a pollen grain's wall, or exine; the morphological shape and surface ornamentation of each pollen type; and the susceptibility of each pollen type to various degradation processes including those caused by mechanical, chemical, or biological agents (Bryant et al. 1994; Bryant and Hall 1993; Holloway 1989; King et al. 1975; O'Rourke 1990). Each of these will be briefly explored in the following section.

Differences in Pollination Type and Pollen Dispersal

There are substantial differences among plant taxa in terms of pollen production, method of dispersal, and the ability of pollen grains to remain aloft and travel various distances from their dispersal source (Jackson and Lyford 1999).

These differences create an uneven distributional relationship between the amount of pollen that will fall to the ground, called pollen rain, and the actual vegetational coverage of each plant taxon. This is further complicated as a large number of plants produce small amounts of pollen; these plants most often rely on insect or other animal pollinators (zoophilous pollen types). These pollen types are rarely found in the pollen rain of a region, even if

Table 17.2. LA 120972 and LA 120973, sediment samples, by site and feature.

FS No.	Feature No.	Feature Type	Provenience	Depth Below Datum (cm)	Pollen Sample No.	Amount of Soil Processed (g)
			LA 120973			
295	5	pit	13N/265E	32-34	11	20.0
318	7	pit structure	17N/266E	90	12	20.0
330	13	pit, east side	38N/302E	48	13	20.0
357	10B	posthole	34N/262E	44-88	14	20.0
358	10A	posthole	34N/262E	46-73	15	20.0
373	7	pit structure subfloor	16N/264E	89-105	16	20.0
395	17	collared pit	30N/260E	68	17	20.0
407	16	posthole	11N/267E	53-55	18	20.0
460	16G	bell-shaped pit	39N/262E	70	19	20.0
519	29	pit	9N/263E	64	20	20.0
531	27F	posthole	27N/261E	91	21	20.0
532	27E	posthole	27N/261E	101	22	20.0
546	11	pit structure with mealing bin	23N/266E	54-56	23	20.0
562	30	pit	14N/266E	33-74	24	20.0
			LA 120972			
1125	3	pit structure	148N/142E	–	25	20.0
1127	3.1	pit	188S/142E	117-119	26	20.0
1158	(?) 3.2	pit	(?) 187N/142E	? 96-97	27	20.0

the plants compose a major portion of the regional vegetation. Additionally, animals and humans gathering plants for food or other purposes can introduce additional amounts and types of pollen into the pollen rain of a region.

Pollen Preservation

A number of taphonomic factors influence the preservation of pollen once it has been deposited in a sedimentological context. Due to differences in durability, some types succumb to destruction much more rapidly than others. This can create patterns of fossil pollen recovery in the sedimentary record, which can be easily misinterpreted by those with minimal knowledge of botany or palynology (Bryant and Hall 1993).

One of the first agents that can affect pollen grains is the mechanical degradation of the exine, or the pollen wall. Pollen can become abraded or broken during the transportation.

These alterations can result from impact or from changes in climatic conditions. Studies have shown that atmospheric changes from low to high humidity can result in large numbers of exine ruptures in thin-walled pollen taxa such as those produced by plants in the Cupressaceae (*Juniperus* and *Thuja*) family (Duhoux 1982).

Many of the thin-walled pollen types, as well as other pollen types, can become further abraded by animal disturbances or by the cultural practices of humans after deposition. Cultural activities, including grassland burning, land surface modifications, construction activities, and agricultural practices each impact pollen rain and pollen deposition in different ways. The mechanical abrasion of pollen in the natural environment can be caused by impact against objects; exposure to water; recycling; wind erosion; changes in temperature; changes in atmospheric or soil moisture levels; volcanic eruptions; and soil movement caused by earthquakes, creep, faulting, or uplifts.

The morphological structure and the ornamentation of pollen walls seem to be important factors in determining potential susceptibility to mechanical degradation. Protruding structures, such as the bladders attached to pollen grains of many conifer species (pine, spruce, fir) or the spines on the surfaces of some pollen types (cotton, mallows, morning glory) have a tendency to break or erode through a variety of mechanical processes. In some cases, the actual appearance of a pollen grain may become so altered after the loss of an appended structure, or structures, that accurate identification is no longer possible.

In addition, structural alteration through mechanical processes can cause cracks or exine weakening, hastening the eventual destruction of the entire grain. Soil chemistry, acting on the natural chemical composition of a pollen grain's exine, often plays an important role in pollen preservation. While the exine is composed mostly of cellulose and various proteins it also contains interlocking strands of the highly durable protein sporopollenin. Early studies discovered a critical link between sporopollenin and pollen preservation in sedimentological contexts (Brooks and Shaw 1968; Rowley and Prijanto 1977; Rowley et al. 1990; and Shaw 1971). Differences in both the amount of sporopollenin and in the specific molecular structure of sporopollenin within the pollen exine often impact the preservational potential of pollen.

In a 20-year study beginning in 1964 and ending in 1984 Havinga reported that the relationship between the morphological structure and the percentage of sporopollenin in the pollen grain wall seemed to determine the pollen's susceptibility to eventual destruction by oxidation. Pollen grain walls with higher ratios of sporopollenin-cellulose were preserved much longer, regardless of soil conditions. Pollen taxa with thin walls, and with walls containing minimal amounts of sporopollenin, tended to decompose very quickly in soils with both high pH and Eh values.

Soil pH is one of the primary indications of potential pollen preservation in sediments. While pH is not entirely responsible for pollen destruction, it is an important factor. Most soils with an acidic pH seem to provide good conditions for pollen preservation. Once soil pH levels reach a weakly acidic level, around 6.0, significant pollen destruction begins to occur (Dimbleby 1957).

Since Dimbleby's original study, other studies by palynologists have demonstrated that fossil pollen can be recovered from slightly acidic soils and even from some alkaline soils with a pH as high as 8.9 (Bryant et al. 1994; S. Hall 1981; Martin 1963). Nevertheless, in most cases fossil pollen recovered from alkaline sediments is often in a poor state of preservation, is highly deteriorated, and frequently reflects evidence of differential taxa preservation, leaving behind only the most durable pollen types (Bryant and Hall 1993).

A related indicator of pollen preservation potential is Eh, or oxidation potential. Tschudy (1969) noted that Eh seems to be a better indicator of potential pollen preservation than pH. Sediments with a low Eh, between -1 and 0, create a reducing, anaerobic environment. This decreases oxygen levels and lowers pH values. Since a reducing environment retards oxygen retention, which plays a key role in oxidizing organic compounds, it is ideal for pollen preservation. In addition, reducing environments often create unfavorable habitats for microbes such as bacteria and fungi, some of which are known to feed on pollen.

As the Eh potential of sediments rises from 0 to +1, it indicates oxidizing conditions that will speed the destruction of pollen. Oxidizing conditions create two types of destruction for fossil pollen. First, direct oxidation occurs when pollen grains come in contact with free oxygen. Second, indirect oxidation occurs when pollen grains come in contact with oxygenated water that percolates downward into subsurface levels. This second type of oxidation is often the most destructive to fossil pollen, especially in well drained soils with ample sand content. The oxygenation of subsurface soil levels also provides an ideal habitat for species of pollen-eating bacteria and fungi.

Biological agents, including certain species of fungi and bacteria, can cause damage to pollen grains, which speeds its eventual destruction. Studies by Holloway (1981, 1989) noted that some species of Phycomycete fungi will seek out and feed on nutrient materials in the cytoplasm of recently deposited pollen grains. Holloway's experimental studies showed that the filamentous threads of fungi, called hyphae, often enter a pollen grain through one of the grain's natural aperture openings. At other times, fungal hyphae seem to have the ability to dissolve areas of the pollen wall in order to create an opening in the pollen grain. Both types of fungal attacks weaken the wall structure of the pollen and speed the grain's eventual destruction by other forms of chemical and mechanical degradation.

Some years earlier, Goldstein (1960) conducted experiments with various species of Phycomycete fungi and found that these were a causative factor in the destruction of fossil pollen. Goldstein's original study revealed that certain species of Phycomycetes are selective in their preference for certain pollen types. One type of Phycomycetes, for example, infected and fed only on certain types of conifer pollen, even when other pollen types were more plentiful and more available. That type of selective pollen destruction by fungi becomes an important factor when trying to estimate the impact of differential pollen loss in certain sediments. When high numbers and a large variety of fungal types are found in a sediment sample it almost always indicates a high potential for the damage and destruction of fossil pollen.

Elsik (1966) was the first to note the occurrence of bacterial degradation of pollen grains. Elsik found that certain bacteria, especially certain species of *Actinomycetes*, have the ability to degrade pollen and that the results of this process form a specific type of decay pattern in the pollen walls. Elsik found that, even though much of the bacterial infection of pollen seems to occur soon after the pollen grains are dispersed—when pollen still contains cytoplasm—bacterial destruction continues long after pollen grains have lost their cytoplasm and become part of the sedimentary fossil record.

Finally, one of the most destructive forces of fossil pollen in sediment seems to come from repeated cycles of wetting and drying. The walls of many pollen grains are elastic, which enable fresh, viable pollen grains to expand and contract without destruction. Depending upon the changing levels of atmospheric humidity, some pollen grains may expand and contract dozens of times before reaching their intended destination, and starting the fertilization process, or before falling to the surface as part of the pollen rain. Those that fall to the surface continue to expand and contract as moisture levels change. Eventually, this process weakens the grain and causes it to rupture or crack. Once weakened, pollen grains are much more susceptible to other processes of mechanical destruction.

The OAS uses the following method for pollen washing and collection of residue from ground stone artifacts: A clean scrub brush is used to clean any loose dirt from the artifact, leaving a thin film of dirt on the artifact surface. The outside non-use-surface of the artifact is washed and the liquids discarded. The artifact is then placed in a clean tub and a solution of hot distilled water and 10 percent hydrochloric acid is squirted onto the use-surface. The use-surface of the artifact is then alternately scrubbed and dampened with the hydrochloric acid solution. After this acid scrub, distilled water is sprayed into any cracks, holes, or crevices on the use-surface in order to force pollen out. When this process is completed, the liquids collected in the tub are transferred to clean containers, ready to be shipped to the analyst.

Extraction Methods

During the sample processing for this project, all work was conducted using sterile, surgical gloves under a fume hood in the sealed Palynology Laboratory at Texas A&M University. The extraction procedure used for these samples can be found below.

1. From each sample, 20 grams of soil were placed it into an 800 ml plastic beaker. Two Lycopodium tablets—each of which contained 18,583 tracer spores—and 50 ml of concentrated HCl were added to each sample in order to dissolve calcium carbonates in the soil. After all reaction with the HCl had stopped, the beaker was filled with distilled water and allowed to stand for 4 hours. After 4 hours, all fossil pollen will settle at the bottom of the container and the liquid portion can be poured or siphoned off without loss of fossil pollen, provided the sediment at the bottom of the beaker remains undisturbed (Lentfer et al. 2003). The liquid portion was siphoned off.

2. Each sample was screened through a 150 μm mesh. This process removes the larger-sized components of the sediment sample through a combination of settling and screening.

3. Exactly 20 ml of concentrated HF (56 percent) was added to the sediment in each of the beakers that were covered to prevent potential contamination and left to sit overnight in the fume hood. The HF process removes most of the fine grained silicates from the sample without damaging the pollen. The following day, each beaker was filled with water and allowed to stand for 4 hours. The liquid portion of each sample was siphoned off, and another 50 ml of concentrated HCl was added to each beaker. This HCl step is necessary to ensure removal of fluorosilicates that often form during the HF treatment. After 4 hours, the liquid portion of the sample was siphoned off and the process repeated two or three times, depending on visible inspection of the samples.

4. Each sample was rinsed into a 50 ml centrifuge tube (CT) with distilled water. The samples were centrifuged at 2,500 rpm for 30 seconds and decanted. This process was repeated until the supernatant was visibly clear. Each sample was rinsed into a 15 ml CT for the remaining steps.

5. Each sample was rinsed in glacial acetic acid and centrifuged. The glacial acetic acid was carefully decanted.

6. About 5–10 ml of a mixture of one part sulfuric acid to nine parts acetic anhydride was added to each sample. This is known as the acetolysis process (Erdtman 1960). After heating each sample in a heating block at 180°F for 10 minutes, the CT was topped off with glacial acetic acid to quench the reaction. Each sample was then centrifuged, decanted, and rinsed again in glacial acetic acid, then centrifuged and decanted again. It is essential to rinse the sample in glacial acetic acid both before and after the acetolysis process. The acetolysis mixture does not mix with water and will react violently if it comes in contact with water.

7. The samples were rinsed twice in distilled water.

8. Each CT was filled half full of zinc bromide having a specific gravity of 2.0. The solution was thoroughly mixed with the sample for 30 seconds on a vortex stirrer to ensure complete mixing of all solid material in the CT. The samples were placed in a test tube rack and allowed to sit for 5 minutes. The samples were then spun at 500 RPMs for 5 minutes. This was followed by a spin of 5 minutes at 2000 RPMs. The upper layer was carefully pipetted off and transferred to a second CT. The second CT was topped off with 95 percent ETOH to reduce specific gravity and permit the pollen to sink during centrifuging. Each CT was then centrifuged and decanted.

9. The final step consisted of rinsing the residue in each sample twice in water, then twice in ETOH, adding two drops of safranin-0 stain, stirring the sample, and then rinsing each CT once more in ETOH. The remaining residue was pipetted into a 2 ml plastic, centrifuge tube with an O-ring, sealed screw top. Five drops of glycerine was added to each sample, and the samples were placed in a rack on a warming plate to enable the remaining ETOH to evaporate overnight.

Counting and Identification

Slides of each sample were prepared following Jones and Bryant (2001). Pollen counting was conducted using a Nikon Optiphot compound microscope at magnifications of 400X and 600X.

Micrographs were taken with a Nikon Coolpix 950 camera attached to the trinocular head. Identification of pollen in each sample was checked against reference materials on file at the Texas A&M Palynology Laboratory. Modern pollen reference materials include the Texas A&M Modern Pollen Reference Collection, the Mobil Oil Modern Pollen Reference Collection, the Meredith Lieux Modern Pollen Reference Collection, and the AMOCO Modern Pollen Reference Collection.

A minimum of 200 pollen grains were counted for each sample, with reasonable preservation (Barkley 1934; Jones and Bryant 2001; Traverse 2007). In samples from the lower three soil horizons, pollen preservation was so poor that 200 pollen grain counts were not possible. In these cases, a minimum of 200 tracer spores were counted.

Pollen was identified to the genus level whenever possible. In some cases, the pollen types in a plant family were so similar that it was nearly impossible to distinguish individual genera or species without detailed scanning electron microscopy (SEM) or transmission electron microscopy (TEM). Those types of pollen were identified and listed by family only.

Major Pollen Types

Asteraceae: *Asteraceae* pollen can be divided into a number of categories. One primary, insect-pollinated group is called the “high-spine group”. Usually of the *Helianthus* sp., or sunflower type, pollen grains in the high-spine group have a surface morphology consisting of spines greater than 2.5 microns in length (Martin 1963).

Three other major pollen groups within the composite family include: the ragweed (*Ambrosia* sp.) group, which consists of wind-pollinated types also called low-spine types; another group that is insect-pollinated and has pollen with a fenestrate morphology, such as dandelions, belongs in the *Lactuceae* category; and the *Artemisia* or sagebrush group.

A few of the other pollen types produced by plant genera within the composites are also distinctive enough that they can be identified and listed separately as a genus. Several of these include *Centaurea* (star thistle), *Cirsium* (thistle), and *Mutisia* (mutisia). However, for most of the more than 1,500 genera of composites, pollen morphology is not distinctive enough to warrant precise separation into a genus without extensive regional pollen keys produced at the resolution level of a scanning electron (SEM) or transmission electron microscope (TEM).

Cheno-am (Chenopodiaceae and amaranthus): There are more than 100 genera and 1,300 species of plants in this group. These plants are some of the more common weedy plants found in cultivated fields, especially between rows of maize. All species in the cheno-am group produce small, wind-pollinated pollen grains; most produce vast amounts of pollen carried easily on wind currents. These annuals grow quickly, doing best in direct sun, and thrive in disturbed habitats and grasslands. Many species are salt tolerant and have adapted to growing in harsh, alkaline soils in desert and semidesert habitats. The percentage of cheno-am pollen in samples is often over-represented in relation to the actual importance of these plants in an environment.

Martin (1963), while examining deposits from sites in the American Southwest, was the first to propose the term "cheno-am" for combined groups of pollen in the family *Chenopodiaceae* and the genus *Amaranthus,* in the *Amaranthaceae* family. Pollen grains in both of these groups are nearly identical in appearance, since all are similar in size and shape and all are periporate, or have many pores on the surface. These characteristics generally make the genera in this group indistinguishable using LM, or light microscopy.

Pinus (pine): As a group, pines are one of the most prolific pollen-producing plants. Individual, mature pine trees produce and disperse billions of individual grains. A single mature branch can produce hundreds of millions of pollen grains, all of which have air bladders that enable the pollen to be carried easily even in light air currents.

When pines are found in a region, the local pollen rain is usually completely dominated by that pollen type. Pines are part of a ubiquitous group that grows in many regions of the world. They are an old group of plants dating back more than 200 million years. Such a history can occasionally cause problems with samples, since pine pollen from ancient deposits can often be recycled into new deposits as older sediments weather.

All pine pollen has bladders, and all types are similar in shape and design to the pollen of other conifer groups, like spruce and fir. Pine pollen is usually smaller and can be separated from other genera in the *Pinaceae* family. The genus *Pinus* contains more than 90 species, which can be divided into two major groups based on various characteristics including leaf morphology and the presence or absence of verracae on the underside of the grain. These two groups were first separated into diploxylon (verracae absent) and haploxylon (verracae present) by Uneo (1958).

In the Southwest, the most common diploxylon pine species are *Pinus contorta* and *Pinus ponderosa*, while the most common haploxylon species are *Pinus edulis* and *Pinus cembroides*. The importance of the distinction between these pine pollen types is that it allows for the suggested existence of open piñon-juniper woodlands, present at lower elevations, or a mesic environment and ponderosa forests, which are common at higher elevations in the Southwest.

While this is complicated by the differences in pollen production by these species, with the piñon species being among the least productive of all, the differentiation of pine pollen into these two types allows for a more nuanced vegetative reconstruction of sites in the Southwest, where pine is prevalent in both the pollen spectrum and the landscape. In this report, damaged pine grains that could not be classified were placed in the diploxylon pollen group. Individual pine bladders were counted as half a pollen grain.

Poaceae (grasses): Grasses are pandemic, and various species are found in almost every habitat. Most grasses disperse limited amounts of pollen close to the ground that does not become airborne and, normally, does not travel far from its point of dispersion. In most ecological situations, grass pollen percentages in surface soil samples are under-represented and do not reflect the actual importance of this plant in the natural environment.

It is virtually impossible to categorize the pollen of grasses into separate genera or species. As such, all grass pollen is generally included in a single category, at the family level, called *Poaceae*. Grass pollen is fairly durable but easily broken. Once broken, fragments cannot be identified as being from grass pollen unless a very distinctive, round, pore area is visible.

Maize and other domesticated grasses have frequently been distinguished from the wild grasses based on size and pore structure (Tsukada and Rowley 1964; Whitehead and Langham 1965). More recent research in the American Southwest has shown that some maize pollen is smaller than previously noted, with some grains ranging down to 70 μm and below (S. Hall 2010).

While this overlaps with some wild grasses, most notably teosinte (wild *Zea* sp.), there are very few wild grasses in the Southwest that even approach the size of maize pollen (S. Hall 2010). In this study, grass pollen grains over 70 µm, with large annulated pores, were identified as maize.

Ephedracea (joint fir): Joint fir pollen occurred in trace amounts in some of these samples. This plant family contains only one genus and at least 65 different species. Most species are native to regions of the Northern Hemisphere, but a few are native to South America.

Most species of *Ephedra* in the western United States occur as small shrubs or bushes. The pollen in the single genus *Ephedra* (joint fir) can be divided into four major groups (Steeves and Barghoorn 1959). Two of these are common in North America; pollen grains in both groups look similar, yet each one has unique morphological characteristics.

The first of these two, the *Ephedra nevadensis* group, contains a number of individual species. Each species produces pollen with fewer furrows; many of the raised ridges, called *plica*, have furrows with hyalines. The second is the *Ephedra aspera* group, and it also contains a number of individual species. The species in this group produce pollen grains with more plica and furrows; however, none of these have hyalines.

The regions of Texas and the American Southwest where *Ephedra nevadensis* and *Ephedra aspera* types grow are small; however, pollen produced by all groups of joint fir plants is wind dispersed. The relatively small size and slow sinking speed means that pollen dispersed by these plants can occasionally be carried long distances on strong wind currents and individual grains can sometimes be deposited in distant regions hundreds or even thousands of miles away.

Quercus (oak): Oaks pollinate in the early spring before trees leaf. They produce many tassels that release vast numbers of pollen grains. In areas in which oaks make up a major component of the vegetation, they are usually over-represented in regional pollen spectra and surface samples.

Results

Twenty-nine pollen taxa were encountered in the 17 sediment samples analyzed in this study. Twenty-nine pollen taxa were identified in the 10 ground stone wash samples submitted for analysis. Thirty-six different pollen taxa were identified in this study. Most samples were dominated by cheno-am type pollen, and most had reasonable pollen preservation, as evaluated by concentration values and the diversity of pollen taxa identified (Bryant and Hall 1993). Concentration values for samples with sufficient preservation ranged from 6,740–14,297 pollen grains per gram of sediment. Pollen results are presented by site and are further divided into sediment samples and ground stone wash samples.

LA 120972

Sediment Samples: Several sediment samples from this site (FS 1125 and FS 1127) displayed concentration values that suggest the pollen spectrum in these samples may have been subjected to significant post-depositional alteration (Table 17.3) (Bryant and Hall 1993). This is further corroborated by the degraded nature of several of the pollen taxa. Most pine pollen encountered in these samples consisted of individual bladders rather than complete pollen grains. The remaining sediment sample (FS 1158) reflects a weedy grassland community with regional pine and juniper woodlands.

Ground Stone Washes: The pollen spectra from the two ground stone wash samples (FS 1 and FS 1124-6) from this site were dominated by cheno-am type pollen. The abrader sample (FS 1124-6) also displayed elevated levels of grass pollen. Pollen in these samples exhibited evidence of mechanical abrasion likely associated with the grinding activities performed with these artifacts (Bryant and Morris 1986). Like all of the ground stone washes submitted for analysis, these samples contained numerous starch granules (Fig. 17.1), most of which appeared to be from maize, but no maize pollen. This finding will be examined further in the following discussion section.

LA 120973

Sediment Samples: Overall, the pollen spectra from sediment samples from LA 120973 were dominated by cheno-am pollen (Table 17.3). This, along with the high level of ragweed-type pollen, is suggestive of a disturbed habitat commonly associated with human settlements and agricultural fields. Most of the pine pollen encountered was classed as diploxylon (probably *Pinus contorta* or *Pinus pon-*

Table 17.3. LA 120973, pollen counts from sediment samples.

FS No.	295		318		330		357		358		373	
	Count	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**
Abies sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Acer sp.	0	0.0%	1	0.4%	2	0.8%	0	0.0%	0	0.0%	0	0.0%
Apiaceae	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Ambrosia* sp. type	17	7.4%	14	5.7%	17	6.8%	3	1.3%	15	6.4%	23	9.3%
Asteraceae - *Artemesia* sp. type	0	0.0%	0	0.0%	2	0.8%	0	0.0%	3	1.3%	0	0.0%
Asteraceae - *Cirsium* sp. type	0	0.0%	0	0.0%	6	2.4%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Helianthus* sp. type	1	0.4%	4	1.6%	7	2.8%	4	1.7%	9	3.8%	4	1.6%
Brassicaceae	0	0.0%	6	2.4%	0	0.0%	0	0.0%	2	0.9%	0	0.0%
Celtis sp.	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Cheno-am type	141	61.2%	122	49.4%	148	59.2%	76	32.1%	98	41.8%	103	41.4%
Dasylirion sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Ephedra aspera type	6	2.6%	7	2.8%	6	2.4%	7	3.0%	7	3.0%	11	4.4%
Fabaceae	1	0.4%	0	0.0%	1	0.4%	0	0.0%	1	0.4%	1	0.4%
Juniperus sp.	5	2.2%	2	0.8%	1	0.4%	5	2.1%	0	0.0%	5	2.0%
Lamiaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Larrea sp.	0	0.0%	0	0.0%	2	0.8%	0	0.0%	0	0.0%	1	0.4%
Opuntia sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Picea sp.	1	0.4%	0	0.0%	2	0.8%	5	2.1%	0	0.0%	0	0.0%
Pinus sp. - Diploxylon and unknown	23.5	10.2%	37	15.0%	29	11.6%	85	35.9%	44.5	19.0%	36.5	14.7%
Pinus sp. - Haploxylon	12	5.2%	17	6.9%	15	6.0%	30	12.7%	16	6.8%	5	2.0%
Poaceae	2	0.9%	13	5.3%	7	2.8%	7	3.0%	28	11.9%	42	16.9%
Pseudotsuga sp.	3	1.3%	2	0.8%	0	0.0%	4	1.7%	0	0.0%	0	0.0%
Quercus sp.	4	1.7%	5	2.0%	1	0.4%	1	0.4%	5	2.1%	5	2.0%
Sarcobatus sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	4	1.6%
Sphaeralcea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Urtica sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Vitis sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Yucca sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Zea mays	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Indeterminate	12	5.2%	13	5.3%	4	1.6%	10	4.2%	6	2.6%	8	3.2%
Total	**230.5**	**100.0%**	**247**	**100.0%**	**250**	**100.0%**	**237**	**100.0%**	**234.5**	**100.0%**	**248.5**	**100.0%**
Lycopodium	49		37		56		32		36		61	
Concentration value (grains/g)	8742		12,405		8296		13,763		12,105		7570	

Table 17.3 (continued)

FS No.	395		407		460		519		531		532	
	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %	Count	Col. %
Abies sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Acer sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Apiaceae	3	1.3%	1	0.4%	0	0.0%	0	0.0%	1	0.4%	0	0.0%
Asteraceae - *Ambrosia* sp. type	12	5.3%	17	7.0%	16	6.3%	18	7.2%	40	17.1%	18	7.5%
Asteraceae - *Artemesia* sp. type	5	2.2%	1	0.4%	6	2.4%	3	1.2%	2	0.9%	7	2.9%
Asteraceae - *Cirsium* sp. type	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Helianthus* sp. type	2	0.9%	1	0.4%	6	2.4%	5	2.0%	18	7.7%	7	2.9%
Brassicaceae	5	2.2%	4	1.6%	0	0.0%	4	1.6%	0	0.0%	1	0.4%
Celtis sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Cheno-am type	122	53.9%	108	44.4%	113	44.6%	113	45.2%	77	32.9%	106	44.4%
Dasylirion sp.	0	0.0%	2	0.8%	1	0.4%	0	0.0%	0	0.0%	0	0.0%
Ephedra aspera type	11	4.9%	14	5.8%	21	8.3%	13	5.2%	10	4.3%	11	4.6%
Fabaceae	1	0.4%	0	0.0%	2	0.8%	1	0.4%	4	1.7%	2	0.8%
Juniperus sp.	5	2.2%	7	2.9%	2	0.8%	0	0.0%	1	0.4%	2	0.8%
Lamiaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Larrea sp.	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Opuntia sp.	1	0.4%	0	0.0%	2	0.8%	0	0.0%	1	0.4%	0	0.0%
Picea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pinus sp. - Diploxylon and unknown	18.5	8.2%	35	14.4%	14.5	5.7%	17	6.8%	32	13.7%	21.5	9.0%
Pinus sp. - Haploxylon	6	2.6%	10	4.1%	1	0.4%	4	1.6%	9	3.8%	2	0.8%
Poaceae	21	9.3%	24	9.9%	48	18.9%	58	23.2%	29	12.4%	51	21.4%
Pseudotsuga sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Quercus sp.	2	0.9%	10	4.1%	3	1.2%	2	0.8%	1	0.4%	2	0.8%
Sarcobatus sp.	0	0.0%	0	0.0%	2	0.8%	7	2.8%	1	0.4%	0	0.0%
Sphaeralcea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%
Urtica sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Vitis sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%
Yucca sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%
Zea mays	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Indeterminate	11	4.9%	7	2.9%	15	5.9%	5	2.0%	5	2.1%	8	3.4%
Total	**226.5**	**100.0%**	**243**	**100.0%**	**253.5**	**100.0%**	**250**	**100.0%**	**234**	**100.0%**	**238.5**	**100.0%**
Lycopodium	30		67		41		39		36		31	
Concentration value (grains/g)	14,030		6740		11,490		11,912		12,079		14,297	

Table 17.3 (continued)

FS No.	546		562		1125		1127		1158			
	Count	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**	**Count**	**Col. %**		
Abies sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Acer sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Apiaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Asteraceae - *Ambrosia sp*. type	17	7.6%	5	2.3%	8	3.9%	5	5.1%	25	10.9%		
Asteraceae - *Artemesia sp*. type	7	3.1%	4	1.8%	10	4.9%	0	0.0%	6	2.6%		
Asteraceae - *Cirsium sp*. type	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Asteraceae - *Helianthus sp*. type	3	1.3%	2	0.9%	0	0.0%	4	4.1%	7	3.1%		
Brassicaceae	2	0.9%	0	0.0%	0	0.0%	0	0.0%	1	0.4%		
Celtis sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Cheno-am type	98	43.8%	175	80.8%	83	40.9%	39	40.0%	107	46.8%		
Dasylirion sp.	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Ephedra aspera type	9	4.0%	4	1.8%	10	4.9%	0	0.0%	12	5.3%		
Fabaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Juniperus sp.	7	3.1%	6	2.8%	5	2.5%	0	0.0%	4	1.8%		
Lamiaceae	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Larrea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Opuntia sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Picea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%		
Pinus sp. - Diploxylon and unknown	21	9.4%	5.5	2.5%	55	27.1%	26.5	27.2%	13.5	5.9%		
Pinus sp. - Haploxylon	6	2.7%	1	0.5%	7	3.4%	7	7.2%	5	2.2%		
Poaceae	37	16.5%	9	4.2%	13	6.4%	14	14.4%	42	18.4%		
Pseudotsuga sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Quercus sp.	4	1.8%	1	0.5%	0	0.0%	0	0.0%	0	0.0%		
Sarcobatus sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Sphaeralcea sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Urtica sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Vitis sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%		
Yucca sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Zea mays	4	1.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
Indeterminate	7	3.1%	4	1.8%	12	5.9%	2	2.1%	4	1.8%		
Total	**224**	**100.0%**	**216.5**	**100.0%**	**203**	**100.0%**	**97.5**	**100.0%**	**228.5**	**100.0%**		
Lycopodium	49		7		186		202		51			
Concentration value (grains/g)	8495		57,475		2028		897		8326			

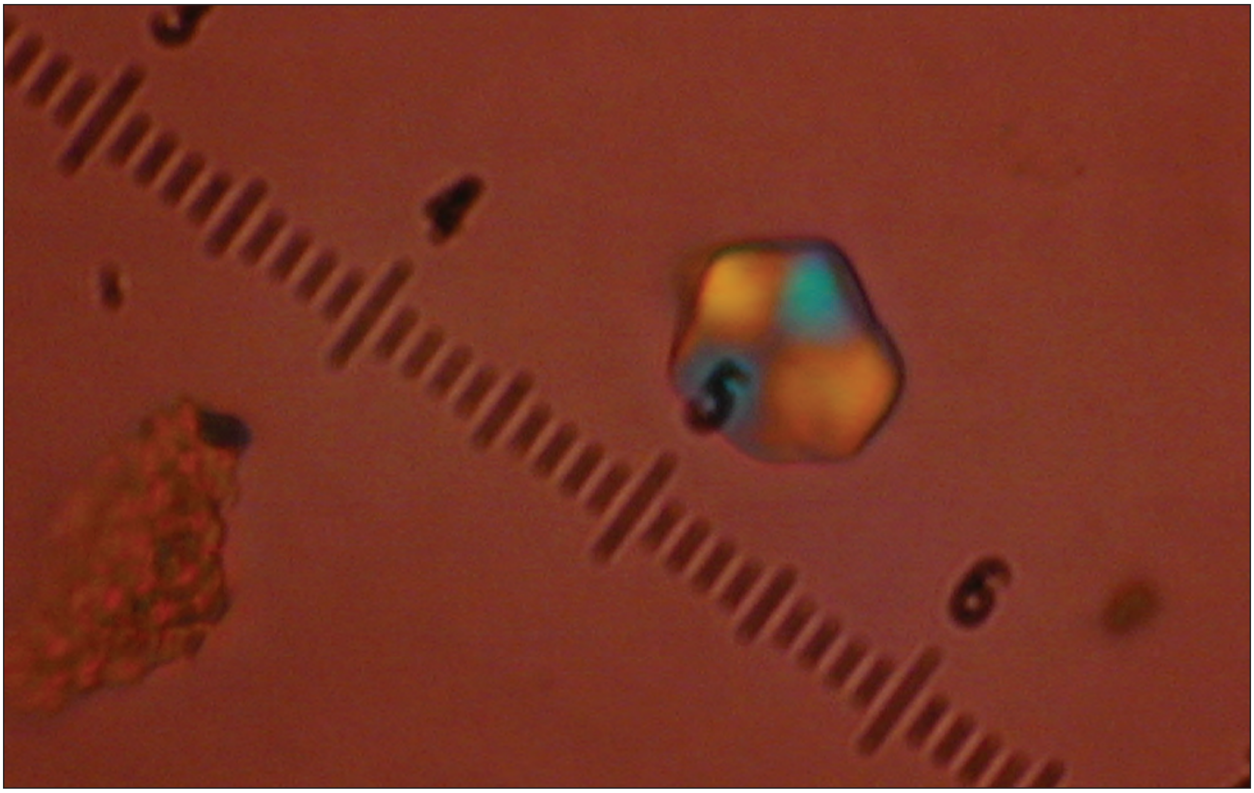


Figure 17.1. Zea mays starch granule, FS 1124-6.

derosa) and unknown, while a smaller amount of the pollen spectra was haploxylon pine pollen, presumably from *Pinus edulis* or *Pinus cembroides*. These samples also had variable levels of other pollen types associated with a weedy grassland habitat, including grass and *Ephedra*.

Overall, the spectra from these samples appeared to reflect a locally disturbed habitat with some contribution from ponderosa pine (*Pinus ponderosa*) forest associated with the higher elevations 9 mi to the east and piñon woodlands in closer proximity. The samples that deviated from this are presented below.

FS 357: Feature 10B, Posthole. The spectrum from this sample showed much higher levels of pine pollen than did other samples from this site; trace amounts of Douglas fir (*Pseudotsuga* sp.) were present (Table 17.3). This does not suggest the local presence of these species, but rather limited, local pollen deposition, perhaps due to seasonality. Cheno-am pollen remains a major component of this spectrum, second only to diploxylon pine.

FS 460: Feature 19, Bell-shaped Pit. This sample has elevated levels of both grass and *Ephedra* pollen (Table 17.3). Overall, the spectrum reflects the same weedy grassland around the site, along with regional woodlands. A single starch granule, visually similar to maize reference samples, also was noted in this sample (Fig. 17.2).

FS 546: Feature 11, Pit Structure with Mealing Bin. While the overall pollen spectrum of this sample accords well with other sediment samples from this site, it also contains evidence of maize agriculture (Table 17.3). Four maize pollen grains were identified in the 200 count analysis of this sample (Fig. 17.3). This feature is a pit structure with an associated mealing bin, which probably accounts for the presence of maize pollen in the sample.

FS 562: Feature 30, Pit. This sample is most notable for the extremely high levels of cheno-am pollen types in the spectrum, which account for more than 80 percent of all pollen counted (Table 17.3). This sample also has an extremely high concentration value well outside the range of the other samples from this site. The dominance of cheno-am pollen types and the high concentration values for the Southwest suggest that this feature may have been used to store vegetal material with high con-

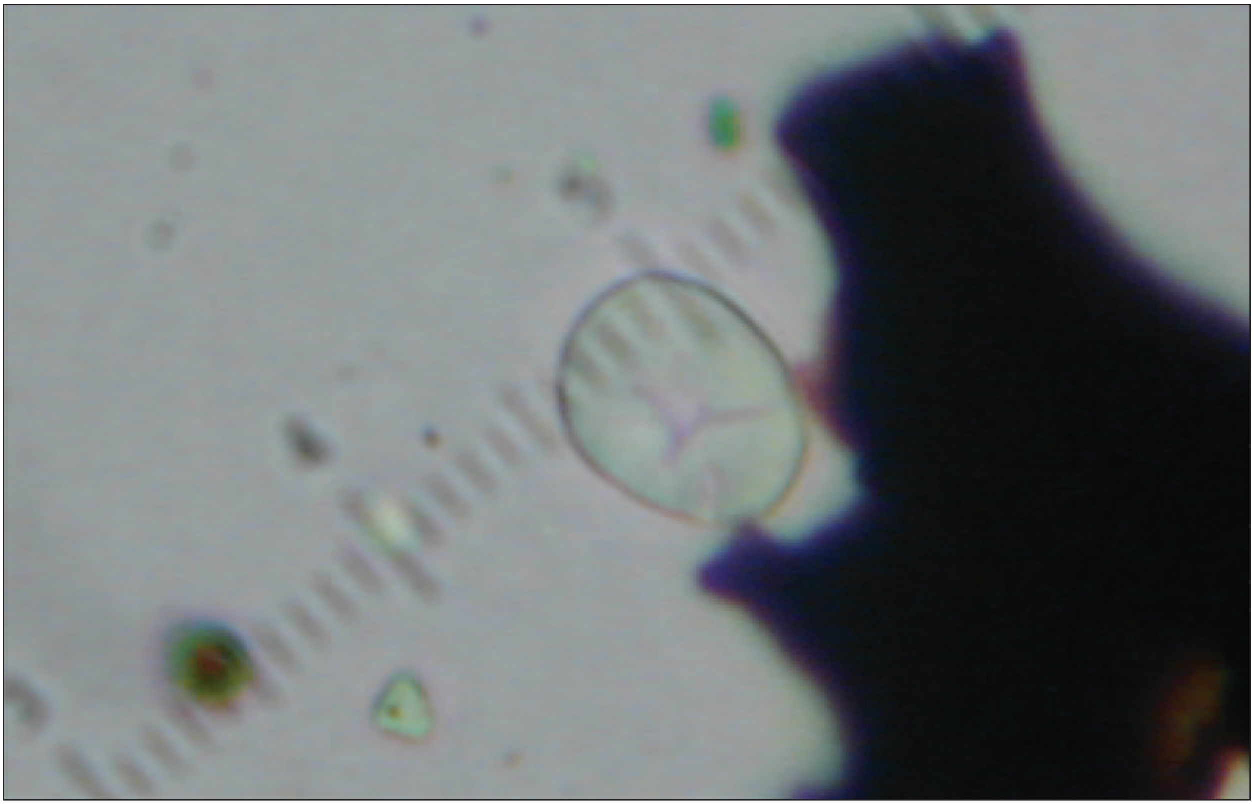


Figure 17.2. Zea mays starch granule, FS 460.

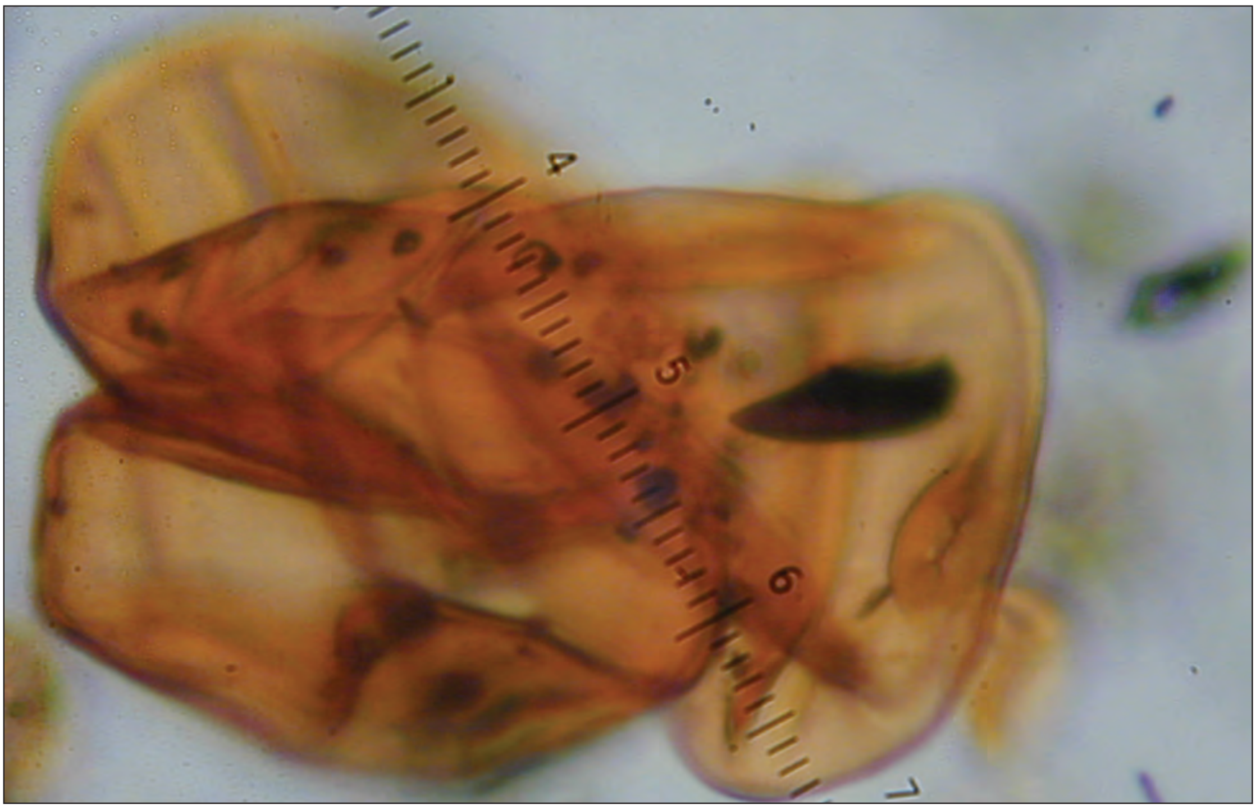


Figure 17.3. Zea mays pollen grain, FS 546.

centrations of cheno-am pollen, possibly the mature seed heads of a *Chenopodium* sp. or *Amaranthus* sp., a known ethnographic food resource (Castetter 1935; Castetter and Opler 1936; and Vestal 1952). This is corroborated by experimental seed processing recently conducted by Geib and Smith (2008) as well as older work by Bohrer (1968, 1972) and K. Adams (1988).

Ground Stone Washes: No evidence of economic pollen types was observed during the analysis of seven ground stone wash samples from this site. Pollen spectra were dominated by cheno-am pollen types. The remainder of pollen types in these spectra was primarily pine, juniper, *Ephedra*, grass, and ragweed, reflecting the same weedy grassland with regional pine forests and woodlands observed in sediment samples from the site (Table 17.4). The pollen in these samples exhibited evidence of mechanical abrasion associated with use of grinding stones (Bryant and Morris 1986). Each ground stone wash submitted for analysis contained numerous starch granules, most of which appeared to come from maize. This will be examined further in the following discussion.

FS 15: One-Handed Mano. While the majority of pollen observed on this sample was non-economic in type, a single maize pollen grain was encountered during analysis.

FS 143-2: Core-Hammerstone-Abrader. The majority of pollen observed on this sample was non-economic in type; two maize pollen grains were encountered during analysis (**Fig. 17.4**). Overall, the pollen spectrum had low levels of cheno-am pollen types and much higher levels of grass pollen.

FS 322: Core-Abrader. The majority of pollen observed on this sample was non-economic in type; however, a single maize pollen grain was encountered during analysis (Fig. 17.4).

Discussion

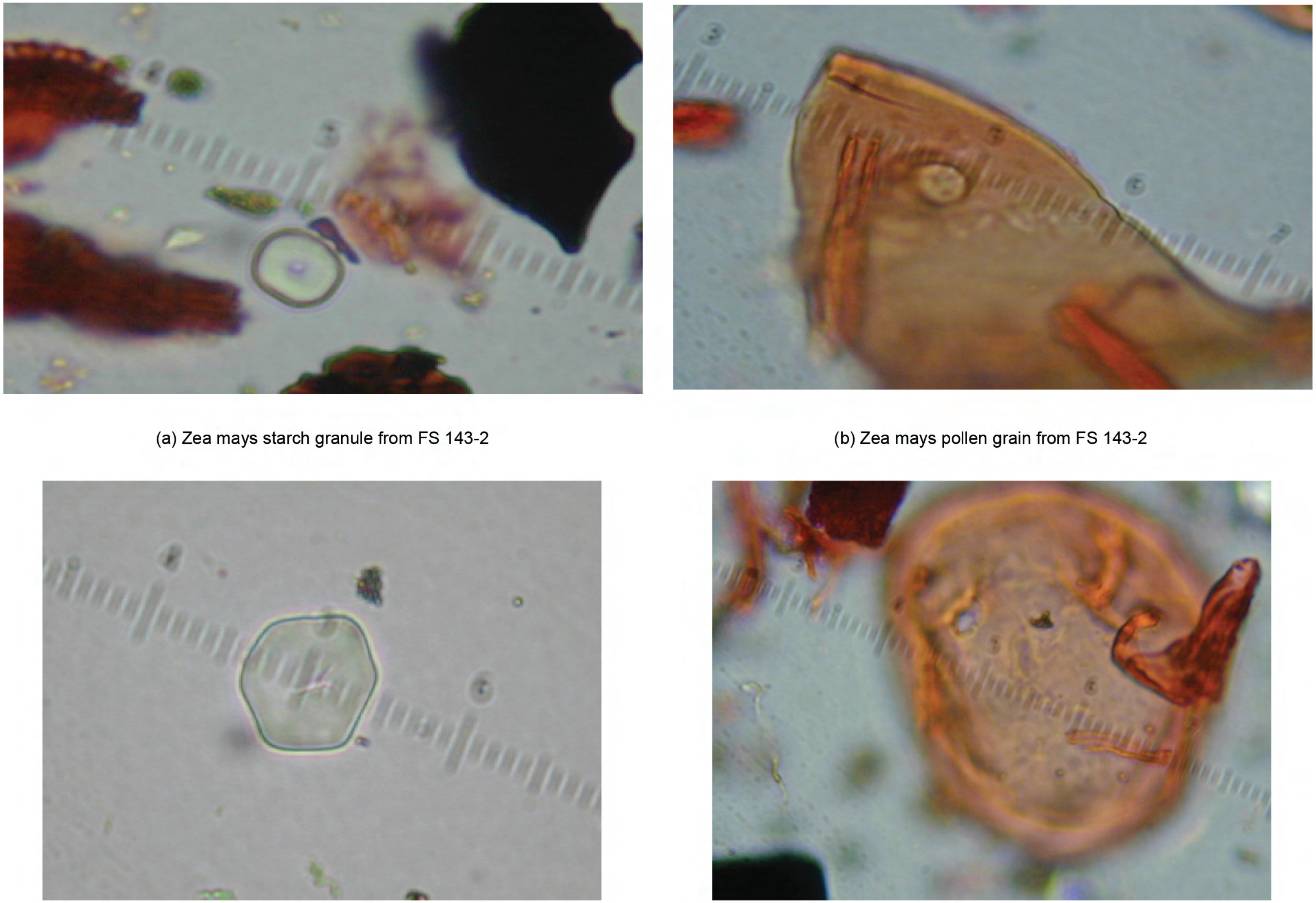
Overall, sediment samples from both sites analyzed in this report provide limited evidence of past economic activity in the area. Exceptions include sediment samples from Features 11 (FS 546), 30 (FS 562), and 19 (FS 460) from LA 120973. The sample from Feature 11 yielded several maize pollen grains, presumably associated with the mealing bin noted as a part of this pit structure. The sample from Feature 30 had an extremely high level of cheno-am pollen types in terms of both relative percentage of the pollen spectrum and pollen concentration value (57,475 gr per gm).

The high levels of cheno-am pollen types associated with this pit suggest it may have been used to store vegetal material, such as seed heads or winnowed seeds of *Chenopodium* or *Amaranthus*, both of which are documented as food resources ethnographically (Castetter 1935). The high level of cheno-am pollen types mirrors the experimental seed processing data of Geib and Smith (2008) who recorded high concentration values of pollen associated with winnowed seeds, chaff, and unprocessed seed heads. These values fall off abruptly for parched seeds and grinding implements (Geib and Smith 2008), and while the pollen spectrum of the sample from Feature 19 (FS 460) contained no economic pollen types, it did contain a single starch granule visually similar to starch from modern maize reference samples.

Pollen from these sediment samples reflected regional and local vegetative communities at the time of deposition as well as weedy grasslands with ponderosa pine and piñon-juniper woodlands in the larger region. The presence of cheno-am, ragweed, and *Ephedra* pollen suggests a local environment with a high degree of disturbance, possibly the result of anthropogenic use of the landscape for habitation and agriculture.

It should be noted, however, that these samples may have limited pollen preservation issues, as was indicated by pollen taxa diversity (Bryant and Hall 1993). While pollen concentration values for most of the samples are above the 1,000 grains per gram cutoff, which was suggested by Bryant and Hall in 1993, each spectrum in this study was dominated by the five pollen types identified by the above authors as easiest to identify, even when degraded. These five types (pine, grass, cheno-am, *Ephedra*, and ragweed) make up the bulk of pollen identified in every sample from these two sites.

While this limited suite of dominant pollen types may indicate degradation (Bryant and Hall 1993), concentration values suggest that pollen preservation in these samples is not so poor as to preclude paleoenvironmental reconstruction. It is possible that the limited suite of pollen types in most of these spectra is a result of the source of these sediment samples. In general, pits, postholes, and depressions accumulate more windborne pollen types



(a) Zea mays starch granule from FS 143-2

(b) Zea mays pollen grain from FS 143-2

(c) Zea mays starch granule from FS 322

(d) Zea mays pollen grain from FS 322

Figure 17.4. Zea mays starch granules and pollen grains, at 400X.

Table 17.4. LA 120972 and LA 120973, pollen counts, from ground stone wash samples.

FS No.	1		1124-6		15		143-2		237		267		309		322		500		574	
	N	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**
Alnus sp.	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Apiaceae	0	0.0%	0	0.0%	1	0.4%	2	0.9%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Ambrosia* sp. type	8	3.1%	7	2.5%	12	4.3%	9	3.9%	7	3.0%	9	3.5%	14	5.3%	5	2.0%	21	7.6%	10	3.2%
Asteraceae - *Artemesia* sp. type	1	0.4%	4	1.4%	0	0.0%	3	1.3%	1	0.4%	0	0.0%	3	1.1%	0	0.0%	0	0.0%	1	0.3%
Asteraceae - *Taraxacum* sp. type	1	0.4%	0	0.0%	0	0.0%	2	0.9%	0	0.0%	1	0.4%	1	0.4%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Cirsium* sp. type	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Asteraceae - *Helianthus* sp. type	5	1.9%	2	0.7%	0	0.0%	4	1.7%	5	2.1%	2	0.8%	4	1.5%	2	0.8%	5	1.8%	4	1.3%
Boerhaavia sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Brassicaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%
Celtis sp.	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	1	0.3%
Cheno-am type	158	61.2%	104	37.1%	172	62.2%	31	13.3%	147	62.8%	156	60.7%	160	60.6%	167	66.3%	145	52.7%	137	43.3%
Ephedra aspera type	1	0.4%	4	1.4%	1	0.4%	4	1.7%	0	0.0%	1	0.4%	4	1.5%	3	1.2%	4	1.5%	7	2.2%
Fabaceae	1	0.4%	0	0.0%	0	0.0%	2	0.9%	1	0.4%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	1	0.3%
Juniperus sp.	5	1.9%	9	3.2%	10	3.6%	17	7.3%	11	4.7%	26	10.1%	14	5.3%	8	3.2%	6	2.2%	4	1.3%
Larrea sp.	0	0.0%	3	1.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Liliaceae	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	12	4.4%	0	0.0%
Opuntia sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Picea sp.	0	0.0%	2	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	1	0.3%
Pinus sp. - Diploxylon and unknown	32	12.4%	37	13.2%	15.5	5.6%	29	12.4%	13	5.6%	14	5.4%	28	10.6%	14	5.6%	10	3.6%	31.5	10.0%
Pinus sp. - Haploxylon	10	3.9%	18	6.4%	2	0.7%	3	1.3%	8	3.4%	3	1.2%	3	1.1%	3	1.2%	4	1.5%	39	12.3%
Poaceae	11	4.3%	46	16.4%	28	10.1%	93	39.9%	22	9.4%	21	8.2%	0	0.0%	31	12.3%	42	15.3%	53	16.7%
Pseudotsuga sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	4	1.5%	0	0.0%	0	0.0%	0	0.0%
Quercus sp.	5	1.9%	4	1.4%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.3%

Table 17.4 (continued)

FS No.	**1**		**1124-6**		**15**		**143-2**		**237**		**267**		**309**		**322**		**500**		**574**	
	N	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**	**N**	**Col. %**
Salix sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%
Sarcobatus sp.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sphaeralcera sp.	0	0.0%	0	0.0%	4	1.4%	0	0.0%	0	0.0%	2	0.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Tilia sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Ulmus sp.	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.3%
Zea mays	0	0.0%	0	0.0%	1	0.4%	2	0.9%	0	0.0%	0	0.0%	0	0.0%	1	0.4%	0	0.0%	0	0.0%
Indeterminate	19	7.4%	37	13.2%	30	10.8%	31	13.3%	16	6.8%	21	8.2%	26	9.8%	16	6.3%	26	9.5%	25	7.9%
Total	**258**	**100.0%**	**280**	**100.0%**	**276.5**	**100.0%**	**233**	**100.0%**	**234**	**100.0%**	**257**	**100.0%**	**264**	**100.0%**	**252**	**100.0%**	**275**	**100.0%**	**316.5**	**100.0%**

N = count

such as cheno-am and pine (Bohrer 1968). Much like sediment-particle deposition in water, windborne grains drop into depressions and remain there, as air flowing across the mouth slows. These depositional phenomena may explain the dominance of these samples by cheno-am type pollen (Bohrer 1968).

The 10 ground stone wash samples submitted for analysis yielded interesting results. While only three of the 10 samples had maize pollen, starch granules were observed in all 10. The majority of these starch granules were visually similar to those found in modern maize reference samples (Holst et al. 2007). It seems likely that this starch accumulated during the use of these tools for maize processing. None of the granules observed on these samples exhibited the type of damage incurred during modern mechanical processing of industrial corn starch, and based on early radiocarbon dates from the sites, these granules are undoubtedly prehistoric in origin. Due to the presence of macrobotanical maize remains at one of the sites, and also to the general context of the sites, it is not unexpected that maize starch granules would be present in some quantity on ground stone tools used primarily for processing maize kernels.

18 ⊻ Conclusions

Yvonne R. Oakes and Dorothy A. Zamora

Excavations along US 54, at four sites between Carrizozo and Oscura, revealed the sites were only a partial representation of what had previously been present on the cultural landscape. Segments of the sites within the project area extend beyond highway construction zones.

Middle Formative Jornada Mogollon sites LA 120972 and LA 120973 continued extensively outside construction limits, possibly indicating the presence of much larger habitation areas than had been recorded during initial surveys. LA 130331 was a small, Late Archaic site containing two hearths and some fire-cracked rock scatters in the highway right-of-way; evidence of other potential hearths, outside known construction limits, could indicate that this location may have been the site of a short-term camp.

LA 114462 is the historic site of Oscura Siding, a rail stop during the late 1800s and early 1900s; bounded by a bar ditch and a fiber-optic line, little remained of the site within the right-of-way.

Despite the aforementioned constraints on obtaining more robust data, a great deal of significant information was gathered from the designated sites.

Three basic research domains were selected for LA 120972, LA 120973, and LA 130331 (see Chapter 5); these can be fleshed out if further additional data is retrieved. Research domains for these sites consisted of accurately dating the sites, assessing site structure and mobility strategies, and defining subsistence adaptations at the project.

The research domain for the historical Oscura Siding, LA 114462, included chronometric dating, determining community layout, assessing function of excavated units, and the describing of demographics.

LA 120972, LA 120973, and LA 130331

The cross-dating of ceramic artifacts and some projectile points has been the most commonly used dating technique in the Jornada Mogollon area; however, due to the broad chronometric span of many of the artifacts found in the region, this relative dating technique also has its drawbacks.

In this study, we relied heavily on absolute methods to accurately date sites when possible. OAS utilized calibrated radiocarbon dating whenever possible and attempted also to employ archaeomagnetic sampling; these attempts failed due to poor soil quality. A total of 32 AMS radiocarbon samples produced a tight clustering of dates for the project sites.

The resulting data for each site is summarized in the site descriptions below. Most dates were obtained from wood charcoal and maize kernels. Radiocarbon dating confirmed the validity of ceramic dating of decorated wares.

LA 120972

Component A at the north end of the extensive Willow Draw site contained a trash-filled pit (Feature 1) with several deflated hearths extending outside the highway right-of-way. A charcoal sample from the pit returned an intercept date of AD 890, with a 1-sigma range of AD 880–970. Red Mesa-style black-on-white and Mogollon Brown Ware found in this area also fall into this time period. A pithouse dwelling (Feature 3) was located in Component B, at the south end of the site. The pithouse produced two radiocarbon dates, one of which matched the date of AD 890. The other intercept date AD 980, with a 1-sigma range of AD 890–1000, was obtained from one of the later, superimposed pits (Feature 5) over the pithouse. The same ceramic wares were present here as well. The two dates of AD 890 and AD 980 are similar to primary dates retrieved from LA 120973, about .9 km, or .6 mi, to the south.

LA 120973

Carrizozo Flats contained 26 prehistoric features consisting of storage pits and pithouses, with 25 radiocarbon dates obtained for the site. Main occupation of the site took place between ca. AD 870 and

AD 890, with a minor reoccupation between AD 980 and AD 1020, which matches LA 120972 occupation dates. One pithouse, across the highway from the main settlement area, dates to AD 1780, with a 1-sigma range from AD 1740–1810. This is perhaps indicative of Apache utilization, since the Apaches were in the region at this time.

Artifacts associated with the pithouse do not indicate cultural identity. Dates for Features 27 and 29 seem aberrant, although not impossible, as they date to AD 40 and AD 570, which would make both Archaic in age. The date of 170 BC for Feature 6 is very likely also aberrant, as two other dates for the same pit fall at AD 890. Decorated ceramics at the site include Mimbres Black-on-white and Red Mesa-style black-on-white, which date to the occupation span of the site.

LA 130331

This is a small, Archaic campsite with two hearths and some scattered fire-cracked rock. The hearths produced two radiocarbon dates each. Hearth 1 yielded intercept dates of 1430 BC and 1400 BC. Hearth 2 produced dates of 1410 BC and 1300 BC. The three earliest dates suggest periodic reuse of the site within a relatively short time span. The 1300 BC date might have been gleaned from old wood or could represent the later reutilization of Hearth 2.

Discussion

Dating of the prehistoric project sites is important for delineating cultural sequences in the northern Tularosa Basin and for understanding population movements and changes in adaptation to settlement systems. The region is not well dated, and any dates obtained are significant.

Since Kelley's 1984 studies on defining cultural groups in the Jornada Mogollon, archaeologists have been assigning dates and listing traits for the different periods, none of which have proven satisfactory. Prehistoric project sites fit somewhat into the Glencoe or Capitan phases based on dates; however, their general structural features are not similar, and geographical distinctions do not work for placement of the sites as they are outside accepted boundaries for the various phases and periods.

The prehistoric project sites contain similar architecture; similar time periods, although some are slightly earlier; and most of the characteristic ceramics. This chronological difficulty exists also for Archaic-appearing sites that sometimes date well into the Formative period. The numerous storage pits and collared features found at the sites are usually associated with the late Formative period, which usually dates to after AD 1000, but does show up here, at LA 120973, as early as the late AD 800s.

Classification systems for various cultural entities are contingent upon the limitations of neither time or space. The problem, in the Jornada Mogollon area is that neither parameter has been satisfactorily employed to define the numerous phases, or the periods present, in the region. From Lehmer's basic division of the Jornada into north and south regions (1948) to Kelley's assignment of the Sierra Blanca areas into three phases (1966, 1984), all have been defined by spatial and chronological boundaries, as is standard culture-historical procedure—but where do LA 120972 and LA 120973 belong?

Chronologically, these sites date back earlier than the Glencoe phase, which began in AD 900; however, architecturally, these sites have more formalized features that are normally found on sites dating prior to AD 1000. Geographically, the two sites are located outside of the Sierra Blanca and Corona areas, and even several of the authors appearing in this volume categorized the sites in different phases. Wilson, in Chapter 10 of this report, for example, found the pottery most compatible with the Claunch Focus to the northwest (Toulouse and Stephenson 1969).

Oakes (2000) attempted to classify the Jornada sites through the sequential ordering of the ceramics present. In 2006, Raily and Ruscavage-Barz, seeing the same dilemma, employed the terms early and late Formative to describe the sites in the Jornada Mogollon, with early Formative covering the period from AD 540–1000. While this system controlled for time and eliminated geographical issues, it did not account for developmental lapses or cultural advancements that might have occurred in specific areas.

Using these measurements, the prehistoric project sites seem to date toward the end of the early Formative period. However, they also exhibit several of the formalized traits found at late Formative sites, suggesting that LA 120973, in particular, is perhaps a precursor for adaptations manifested later in other areas of the Jornada Mogollon.

Site Structure and Mobility Patterns at LA 120972, LA 120973, and LA 130331

Prior to AD 700, pithouses in the Jornada Mogollon area were generally round, or were some variation thereof. Most were shallow with pole or brush superstructures and may have had interior features, such as informal hearths built directly on the floor or small, basin-shaped fire pits. Through time, site structures became more diverse with more variations evident between sites, even in those belonging to the same time period. There does not, however, appear to be a strong standardization of feature types; simply constructed pithouses can occur in any time period, although deeper, more rectangular-shaped structures tend to be present after AD 1150 (Mauldin 2007; Carmichael 1985).

Site structures at LA 130331 consisted of two hearths dating to the Archaic period, with the possibility of more features outside right-of-way limits. The site can be classified as a campsite, but the extent of the activities conducted there is unclear. Were site occupants just passing through the area or were they there to acquire subsistence resources? A large variety of botanical remains were found in the hearths, many of them edible. It is also evident that the hearths were utilized more than once, suggesting that this could have indeed been a resource-acquisition area.

Structural features found at LA 120972 and LA 120973 included pithouses, storage pits, hearths, and postholes; also found were postholes with internal pits and hearths located inside of pithouses. The pithouses found at the sites were somewhat irregular in shape but were characterized as mostly round. Features 16 and 27, both pit structures, at LA 120973, were sub-rectangular.

According to O'Laughlin (1980); Rocek (1990); Whalen (1994b); Railey and Holmes (2002); and Mauldin (2007), the floor areas of similar dwellings seemed to increase with time, although comparison between sites is difficult because time periods are not always similarly divided in every study; some studies, including those by OAS, focused on only one period, and the number of these cases are not always known.

The five pithouses at Carrizozo have a mean floor area of 7.7 sq m, with a range between 4.09 to 10.80 sq m. The pithouses seem to date within the means given by the above researchers for the time period of AD 700–1000. Earlier structures fall between 3.8 and 6.3 sq m, while later ones are noted by Mauldin (2007) to have a mean floor area of 9.5 sq m.

The depth of the Jornada Mogollon pithouses was also measured; Carrizozo structures averaged 48 cm deep, with depths ranging between 26 cm and 70 cm. Other pithouses belonging to the same time period are more shallow, with Turquoise Ridge pithouses at a depth of 30 cm (Whalen 1994b) and Dunlap-Salazar pithouses at 20 cm deep (Rocek 1990). Earlier pithouses, like those at Keystone Dam, can be as shallow as 10 cm (O'Laughlin 1980). Many have argued that such shallow depths could indicate seasonal occupation, perhaps during summer, near agricultural fields (Hard et al. 1996:69).

The floors of the Carrizozo pithouses were not plastered, and Features 7 and 11 both had second floors. Remodeling was not evident in any of the other structures, although according to radiocarbon results, reuse did occur. Internal features found in the pithouses near Carrizozo included postholes, a mealing bin, a hearth, a ventilator shaft, a wall niche, and pits.

It is not uncommon for hearths in the Jornada Mogollon region to be represented by a charcoal stain or a bed of ashes on the floor. Over time, basin fire pits had become the norm. At LA 120973, one probable basin hearth was found inside Feature 16; only two were found on the outside surface of the site. A basin-shaped hearth was also found in the pithouse at LA 120972.

Postholes were found in only two pit structures, Features 16 and 27, at LA 120973. Feature 16 had five postholes placed randomly at the center of the structure. In Feature 27, a much larger pithouse, eight postholes were located near the edges of the pit; however, two smaller holes along the west wall may have been ladder holes. There seems to be no pattern to the placement of these interior postholes.

Also in Feature 27, at LA 120973, a wall niche had been placed just above the floor, in the north wall. In Feature 11, a heavily disturbed mealing bin was present in the northeast quadrant; an adobe wing wall defined the area. A large trough metate was also found at this location.

At LA 120972, a ventilator shaft was found in the west wall, with a hearth in front of the shaft. Pits were found in three of the four pithouses at LA 120973. Feature 7 had a large, bell-shaped pit in the northeast corner, while Feature 11 had no pits. Feature 16 had a large pit on the east side of the structure, and in Feature 27, four pits were found, all of them against and extending under the walls on the north and east.

External features at Carrizozo included storage pits, hearths, a possible adobe-mixing pit, and postholes. Two exterior hearths were uncovered at LA 120973. One was slab-lined (Feature 5) and the other, Feature 12, a basin hearth above Feature 16, a pithouse. At AD 770, the slab-lined hearth had a somewhat earlier date than the other features. One pit at the north end of LA 120973, Feature 21, may have been a clay-mixing pit, as large lumps of clay were present.

Also found at Carrizozo Flats (LA 120973) were an unusually large number of pits, 18 of which included bell-shaped (27.8 percent) and straight-sided (72.2 percent) pits. Most were likely used for storage. The pits were dispersed all through the site, but the majority were located in the north half of LA 120973. A total of 38.8 percent of both types of pits (n = 7) were adobe-collared. Two of the collared features were interior pits within Feature 27. The straight-sided pits ranged in size from .25–.30 m by 1.80 m by 1.36 m, while the bell-shaped pit extended from .72 m by 70 m to 1.3 m by 1.0 m. Average floor areas for all pits was .70 m, with a range of .50–3.54 m. The average depth was .48 m, the same as for the pithouses. Range of depths was .10–.98 m.

Adobe collars were present on the three largest bell-shaped pits; similar collars also were present on three of the larger straight-sided pits. Why the larger pits were selected for more formalized construction is unknown. Also, the question arises as to whether this type of modification had a utilitarian purpose, perhaps to keep flowing water out of the pits? But then, why are these collars not present on all of the pits?

Only Feature 30, at LA 120973, one of the very small pits, held no charcoal. Three of the straight-sided pits had either oxidized soil or ash lens, indicating that burning or roasting had occurred there. The remaining 14 pits (77.8 percent) had charcoal flecking, sandy soil, and a few artifacts. The remaining pits showed no evidence of burning; this includes all of the bell-shaped pits as well. It is probably safe to conclude that the remaining pits were used for storage and, possibly, for waste disposal. Both types of pits are common in the Jornada Mogollon (Railey and Holmes 2002:753); radiocarbon dating of the Carrizozo pits did not indicate any one period of time during which these pits were utilized.

Exterior postholes are located only around straight-sided pits and not around pithouses. Straight-sided pits include three storage pits, one of which had an adobe collar; the clay mixing pit; and one of the burned pits, which also had an adobe collar. Three of the postholes around this last pit, Feature 26, at LA 120973, also had adobe collars. Only one other case of collared postholes is known to exist in the Jornada region, at Hueco Tanks, which dates back to post-AD 1100 (Kegley 1980).

In all cases at LA 120973, postholes circle the related structures at an average of 1 m distance from the pit edge. The number of postholes around each pit varies between six and nine, with the area around Feature 21 not completely exposed due to its extension outside project limits. The reason for utilization of seemingly randomly placed postholes is unknown. Possible supports for ramada-like structures over the pits has been suggested by Peckham (1976) who, at Taylor Draw, found similarly placed postholes around some of the rooms. Exterior postholes also have been recorded at earlier sites near El Paso (Railey and Holmes 2002:35).

Adobe collars around storage pits have not been recorded at any other sites in the Jornada Mogollon, although collared hearths are not uncommon. LA 120973 may be the first case of such hearth types in the region, at about AD 860, followed closely by those found during the Hondo Valley excavations and dating to the mid–AD 900s (Railey and Holmes 2002:146). By the AD 1100s, collared hearths had become somewhat standard in late Formative period rooms.

Discussion

The type and extent of features found at LA 120973 was highly unexpected. The other two prehistoric sites (LA 120972 and LA 130331) were mostly outside of project limits and offered few surprises and limited data.

However, the discovery of pithouses and pits, the collaring of hearths and postholes, and the extent of exterior postholes around the pits was a great surprise that produced a wealth of new information about the construction of sites and about types of features previously unseen in the Jornada Mogollon region. It is clear that there is much more to learn, and understand, about the cultures that occupied the Tularosa Basin prior to AD 1100.

Site layout at LA 120973 was seemingly haphazard (see Fig. 8.3) with pithouses and storage pits interspersed across the site with no associations found between them. Concentrations of artifacts were not present, nor were there any specific trash deposits. Artifacts themselves were few, and there were few diagnostics.

It is possible that the site's location, on an alluvial floodplain, may be the reason for this. It was difficult to determine which specific tasks occurred at the site, other than the storing and preparation of food items.

Mobility Patterns

Systematic movement of peoples over the landscape from one location to another should be expected from Archaic and Formative groups in the Jornada Mogollon region, particularly given the various climatic and vegetational regimes of the area. There are several basin floors with abundant floral diversity and summer precipitation and basin edges where springs offer relief from the heat of the basins; the surrounding mountains possess totally different biomes and resources. Nowhere else in New Mexico is this much diversity present within a defined area. The settlement limits of prehistoric sites, such as those at the Carrizozo project, become a matter of great interest when attempting to understand past lifeways.

Types of sedentism range from short term, to seasonal, to long term. Short-term sedentism involves the movement of a group of any size from one residence to another, for whatever reason, for whatever amount of time is deemed necessary. Resource acquisition is usually a factor in this form of mobility. When this movement strategy is practiced, group size is often small and access to resources is not limited (Nelson and Anyon 1996:278).

Seasonal sedentism implies that a group circulates between specific areas at prescribed times of the year, probably in pursuit of desired resources (Kulisheck 2003:34). The extent of either type of mobility can vary immensely, although seasonal mobility implies specificity in terms of timing.

Climatic variability, resource availability, and the surrounding population density play a large part in determining the size of the emigrating group as well as the length and destination of these journeys over the landscape.

Several indicators may suggest the occurrence of short-term seasonal or long-term sedentism. Architectural complexity at a site is perhaps the most important factor given for determining the mobility of the occupants (Kent 1991; Oakes 1999, Vol. 6:56; Howey and Rocek 2008:27). The amount of labor invested in structures, the depth of pithouses, the formalized construction of features such as hearths, and the presence of extramural storage pits provide architectural insight into the length of the builders' anticipated stay. The presence of seasonally available resources and the amount of diversity in tool assemblages, ceramics, and trash also provide clues as to the length of residency.

One pattern of seasonal sedentism has been noted in the southern Tularosa Basin, where Formative sites consisting of pithouses and storage pits are located along basin edges, while warm weather sites of the same time period are ephemeral (Howey and Rocek 2008:10). Hard (1983a) presented a model in which, much like the historic Apaches, groups planted crops near playas on the basin floors and then left the area, returning to harvest in the fall (Basehart 1974).

During the winter, when water became scarce in the basins, populations would move to better-watered areas, like the alluvial fans at the foot of the mountains, where there were springs and more hunting opportunities and sources for fuel and building materials. Based on this model, Whalen (1994a:24) postulated that a number of small, ephemeral camps might have been located in the basins, with fewer large base camps established along the basin edges in the winter and spring.

These larger base camps would have been associated with storage facilities, greater artifact diversity, and higher artifact density and activity areas. Burials should be, but are seldom found. There is, however, much variation in settlements at the Jornada sites. Mauldin (2007:56) noted that the use of alluvial fans around the basin edges increased after AD 700, with large pithouse villages dating to this time period. Mauldin suggested that this may be due to an increase in the pursuit of agriculture. This pattern was not noted in the early Formative period (Raily and Ruscavage-Barz 2006).

In examining mobility patterns for the Carrizozo sites, the Archaic period LA 130331, with only two hearths present, is definitely a short-term campsite, although a few more thermal features might exist outside project limits. Whether the site was occupied by a resource acquisition group or by people just passing through is unknown.

Although most of LA 120972 is outside the highway right-of-way, both LA 120972 and LA 120973 have corresponding utilization dates of AD 900 and reuse dates of AD 1000. Therefore, these two Formative sites will be considered together.

Based on indicators suggested above, the two sites are not representative of short-term occupations, as the efforts employed in architectural construction are too complex for short-term use. The moderate depth of the pithouses and the formalized collaring of hearths, pits, and postholes indicate labor intensive work. The presence of so many storage units suggests planned usage over time, and although no activity areas were found, the artifact diversity is moderate.

Howey and Rocek (2008:27) believe that pithouse settlements with large, extramural storage pits can be associated with seasonally mobile groups. Gilman (1987) and Whalen (1994b) also correlated storage with seasonal settlements, specifically winter ones. Therefore, because of the great complexity of the architecture, the extensive storage pits, and the location of the sites above the basin floor—on an alluvial fan on or near the perennial Willow Draw, with Willow Springs upstream—the sites are seen as base camps, occupied seasonally from late spring into summer and again in the fall, when food resources were brought in, processed, and stored for the winter.

Subsistence Adaptations at LA 120972, LA 120973, and LA 130331

If, as it is contended, the two Formative period sites at Willow Draw and Carrizozo Flats are base camps—situated on an alluvial fan along the edge of the Tularosa Basin—there should be evidence of the storage of food for overwintering. Site occupants also should have selected for subsistence resources that were readily available and suitable for overwintering.

Maize was recovered from most of the pits, although only one cob was part of the assemblage. Maize is always harvested in the fall, and its presence at Carrizozo Flats may verify Weahkee's interpretation of the alignment of the pits as being ceremonially related to the position of the moon at harvest time. Also found in the storage pits were mesquite pods, piñon nutshells, sunflower seeds, banana yucca, and cactus fruit, all available in the fall.

Dropseed grasses, globemallow, goosefoot, purslane, and cheno-ams mature during summer and fall, depending on precipitation. The diversity of summer- and fall-harvested plants at the sites suggests that these sites were occupied during both seasons and that residents would have processed, parched, or cooked the plants and then stored them for the winter.

Acquisition of these subsistence goods would imply foraging and cultivation. From base camp, women's foraging groups have an average range of 6.6 km, while men average about 9.9 km. This range would have allowed groups to travel, in a single day, east to the foothills, where there were piñon trees and springs, and west to the basin floor, with its floral resources, thus providing a huge diversity of economic biomes.

The several draws and washes running west out of the Sierra Blanca Mountains would have traversed foraging ranges, yielding much needed water. Again, depending on climatic factors, trips to gather resources like piñon nuts, summer grasses, cactus, and mesquite pods, all found in the Carrizozo storage pits, were always a reasonable option and could have required numerous short-term stays.

Hunting was not a primary means of obtaining food for residents of the Carrizozo sites. Most recovered faunal specimens consisted of rabbits or small mammals, with a lesser number of artiodactyls present at Carrizozo Flats. This pattern of small-animal usage may indicate a hunting range relatively diminished in size (Akins 2003:308). Speculatively, the minimal presence of faunal specimens at the site could suggest that no one was consuming much meat in the summer or winter.

The cultivation of maize requires preparation of the soil, and it is likely that crops were either tended during the summer and harvested in the fall or allowed to mature on their own and then harvested. Plots of soil where crops could receive the most water, from minor flooding or mountain runoff, were probably located close to the storage pits, perhaps along Willow Draw.

It is interesting to note that several petroglyphs at the nearby Willow Springs site (see Appendix 1) were interpreted by Native American elders to represent village layouts with garden plots and water diversion channels. Could these petroglyphs be a record of the very fields of corn cultivated by the occupants of these sites?

Discussion

A scenario has been presented of Willow Draw and Carrizozo Flats being base camps for the gathering of summer resources and the overwintering of site occupants. This theory implies the adaptation of summertime migration away from home base by one or more groups for trapping animals and gathering food. Evidence supporting this scenario includes: the numerous storage pits; the presence of maize, squash, and a diverse variety of vegetal foods; pithouses with formalized, interior hearths; and the possible depiction of crop fields on nearby rock art. This particular type of site layout, with stored goods, has never before been recorded in the Tularosa Basin.

Oscura Siding, LA 114462

Oscura Siding, a once vibrant community with all the amenities of a small town, was dated within a chronological framework starting in the late 1800s and continuing into the 1930s, based on archival and literature research, extant newspapers, and oral histories obtained from former occupants. Oscura Siding was also the historic site of a rail stop during the late 1800s and early 1900s.

Archaeological excavation of the community was somewhat less informative. Only a small portion of the site was within highway project limits; bounded by a bar ditch and a fiber-optic line, little remained of the site within the right-of-way. The surface had been mechanically bladed, and two utility lines ran through the project area. A few structural foundations, a basement, a privy, and numerous trash areas were uncovered. These provided confirmation of the early twentieth-century utilization of the land, but revealed little information about site layout, structural functions, business areas, and housing numbers.

The 5,734 historical artifacts recovered from excavated features at Oscura Siding produced a weighted mean artifact date of 1912.0, with a standard deviation of 19.0 years. This meshes well with the peak occupation period of the site during the 1910s and 1920s. Information from U.S. Census records, the New Mexico State Library archives, and newspapers of the time verified occupancy occurred from the late 1800s through the 1930s. A small population inhabited the community during the 1940s and early 1950s; however, the buildings were leveled later in the 1950s.

Acquired images provided some of the only data for the LA 114462 research domain. However, the Oscura community has not been forgotten by the people who once lived there, as evidenced by newspaper records, anecdotal interviews, and the archival photographs still in existence.

In Conclusion

Evidence found deep in the arid region of the Northern Jornada Mogollon near Carrizozo, NM, speaks to the strength, vitality and adaptability of human life present in this brutal land for many thousands of years.

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Appendix 1 ⏚ Willow Springs Petroglyph Site (LA 99888)

Mary Weahkee and Yvonne R. Oakes

The Willow Draw site, designated LA 120972, and the Carrizozo Flats site, designated LA 120973, are located either along or just south of Willow Draw, a major water flow source in the area.

About 8 km (5 mi) up Willow Draw, to the east, is the Willow Springs petroglyph site, designated LA 99888, at the base of the Sierra Blanca Mountains. LA 99888 covers an area of approximately 8.8 acres (3.65 ha) and may contain several thousand symbols. The site was recorded in 1992.

The Willow Springs site may have been of special significance to the early settlements at Carrizozo Flats and Willow Draw. Mary Weahkee, a Native American member of the OAS staff, contacted the elders of several local tribal groups who examined the images mentioned above and interpreted them to the best of their abilities.

It is significant that many of these panels included drawings of fields of corn with waterways—most likely Willow Draw—cutting through them. These panels could represent either an increase in the size of the fields or different areas of the same field. Some of these fields could very likely have been near the Willow Draw and Carrizozo Flats sites.

Twenty-four km (15 mi) to the south is the well-known Three Rivers petroglyph site, LA 4923, which boasts more than 20,000 depictions. This site has been listed on the State Register of Cultural Properties, and recent visits to the Three Rivers site have revealed that many of the petroglyphs are similar to those at Willow Springs.

Only a portion of the Willow Springs petroglyphs will be shown on the following pages (Figs. A1.1–A1.35).

Willow Springs may have been a location considered sacred to prehistoric peoples, starting from the Archaic period and through to the Apache occupation of the area, as indicated by the depiction of horses. Only one historic petroglyph, of a turkey, was found.

The site may also have played some role in the placement of settlements and camps downstream along Willow Draw. Several panels seem to convey stories in which the former occupants of LA 120972 and LA 120973 may have played vital roles, and include animal encounters, rainstorms, and falling stars.

Gary Hein supplied photographs of the Willow Springs petroglyph site. The petroglyphs were interpreted by the elders of several local tribal groups.

Figure A1.1. View to west Willow Draw from petroglyph site; an irrigation system is depicted on this boulder.

Figure A1.2. Petroglyph image of a village layout, with fields and water diversionw channels.

Figure A1.3. Petroglyph image of a village layout, with fields and water diversion channels.

Figure A1.4. Petroglyph image of a village layout, with fields and water division channels.

Figure A1.5. Petroglyph image of a large village with gardens and pithouses.

Figure A1.6. Petroglyph image of a water diversion, probably from Willow Draw, to fields on both sides of land.

Figure A1.7. Petroglyph image of a rainstorm lasting four days, right; a water diversion; and an awanyu, left.

Figure A1.8. Petroglyph image of a lunar eclipse and a bear paw.

Figure A1.9. Petroglyph image of an exploding star.

Figure A1.10. Petroglyph image of a star heading toward Earth, then exploding. Star was watched for four full moons, which are signified by round dots.

Figure A1.11. Petroglyph image of the cycle of the moon around the sun.

Figure A1.12. Petroglyph image of the cycle of the moon around the sun.

Figure A1.13. Petroglyph images of calendars and fields.

Figure A1.14. Petroglyph image of an unfinished calendar.

Figure A1.15. Petroglyph image of a calendar, dots, and lines may indicate Mesoamerican influence.

Figure A1.16. Petroglyph images of the twin war gods.

Figure A1.17. Petroglyph images of a panel and the twin war gods.

Figure A1.18. Petroglyph images of the twin war gods, far right, and a rabbit, left.

Figure A1.19. Petroglyph image of an underworld creature.

Figure A1.20. Petroglyph image of a horned, underworld creature that eats children. According to interpretation, the creature was shot with sacred arrows, made from shiny black rock to cut through the darkness, and was wounded, but not killed; the earth will one day open up again and the creature will return to the surface to capture more children.

Figure A1.21. Petroglyph image of a woman who died of a head injury.

Figure A1.22. Petroglyph image of a man who passed away.

Figure A1.23. Petroglyph image of a person.

Figure A1.24. Petroglyph image of a warrior with shield and lance.

Figure A1.25. Petroglyph image of an awanyu, which symbolizes a river flowing very heavily.

Figure A1.26. Petroglyph image of the location of a bat cave.

Figure A1.27. Petroglyph image of a dead jaguar, indicated by its spots, and three feathered lances. According to interpretation, the animal was killed by a wound to the heart.

Figure A1.28. Petroglyph image of an animal pursuit.

Figure A1.29. Petroglyph image of an antelope or deer kill. According to interpretation, the animal has a wound to the heart.

Figure A1.30. Petroglyph image of deer and a barking dog. According to interpretation, something seems to be chasing the deer. People are also present.

Figure A1.31. Petroglyph image of a dead jaguar, as indicated by its spots.

Figure A1.32. Petroglyph image representing a sun clan; according to interpretation, this petroglyph represents a journey over the mountains.

Figure A1.33. Petroglyph image representing a bear clan.

Figure A1.34. An unusual petroglyph image, not typically found in this area.According to interpretation, the imagery is similar to that of the Huichol Indians in Mexico.

Figure A1.35. Petroglyph image of an unknown creature.

Appendix 2 ⩡ Radiocarbon Analysis Data

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

October 22, 2010

Dr. Robert Dello-Russo
Office of Archaeological Studies
P.O. Box 2087
Santa Fe, NM 87504
USA

RE: Radiocarbon Dating Results For Samples FS3, FS4, FS11, FS13, FS1041, FS1123, FS1124, FS165, FS258 .05g, FS325, FS356, FS519, FS538, FS553, FS571, FS143, FS258 .03g, FS297, FS327, FS330, FS331, FS499, FS527, FS244, FS279, FS295, FS341, FS428, FS485, FS574

Dear Dr. Dello-Russo:

Enclosed are the radiocarbon dating results for 30 samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

Our invoice has been sent separately. Thank you for your prior efforts in arranging payment. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

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BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
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MIAMI, FLORIDA, USA 33155
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beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Robert Dello-Russo — Report Date: 10/22/2010

Office of Archaeological Studies — Material Received: 10/1/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285533	3160 +/- 40 BP	-24.7 o/oo	3160 +/- 40 BP

SAMPLE : FS3
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1500 to 1380 (Cal BP 3450 to 3330)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285534	3070 +/- 40 BP	-23.1 o/oo	3100 +/- 40 BP

SAMPLE : FS4
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1440 to 1280 (Cal BP 3390 to 3230)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285535	3100 +/- 40 BP	-23.0 o/oo	3130 +/- 40 BP

SAMPLE : FS11
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1490 to 1360 (Cal BP 3440 to 3310) AND Cal BC 1350 to 1310 (Cal BP 3300 to 3260)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285536	2990 +/- 40 BP	-22.8 o/oo	3030 +/- 40 BP

SAMPLE : FS13
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1400 to 1190 (Cal BP 3350 to 3140) AND Cal BC 1140 to 1140 (Cal BP 3090 to 3090)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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Dr. Robert Dello-Russo

Report Date: 10/22/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285537 SAMPLE : FS1041 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (wood): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 780 to 990 (Cal BP 1170 to 960)	920 +/- 40 BP	-11.7 o/oo	1140 +/- 40 BP
Beta - 285538 SAMPLE : FS1123 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 780 to 990 (Cal BP 1170 to 960)	900 +/- 40 BP	-10.6 o/oo	1140 +/- 40 BP
Beta - 285539 SAMPLE : FS1124 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 880 to 1020 (Cal BP 1070 to 930)	840 +/- 40 BP	-9.7 o/oo	1090 +/- 40 BP
Beta - 285540 SAMPLE : FS165 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 780 to 980 (Cal BP 1170 to 960)	910 +/- 40 BP	-10.2 o/oo	1150 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285541	850 +/- 40 BP	-8.8 o/oo	1120 +/- 40 BP

SAMPLE : FS258 .05g
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 810 to 1010 (Cal BP 1140 to 940)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285542	960 +/- 40 BP	-12.0 o/oo	1170 +/- 40 BP

SAMPLE : FS325
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 980 (Cal BP 1180 to 970)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285543	840 +/- 40 BP	-10.2 o/oo	1080 +/- 40 BP

SAMPLE : FS356
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 890 to 1020 (Cal BP 1060 to 930)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285544	790 +/- 40 BP	-10.7 o/oo	1020 +/- 40 BP

SAMPLE : FS519
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 970 to 1040 (Cal BP 980 to 910) AND Cal AD 1100 to 1120 (Cal BP 850 to 830)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285545 SAMPLE : FS538 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 130 to 350 (Cal BP 1820 to 1600)	1730 +/- 40 BP	-21.8 o/oo	1780 +/- 40 BP
Beta - 285546 SAMPLE : FS553 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 900 to 920 (Cal BP 1050 to 1030) AND Cal AD 950 to 1040 (Cal BP 1000 to 920)	800 +/- 40 BP	-10.4 o/oo	1040 +/- 40 BP
Beta - 285547 SAMPLE : FS571 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 870 to 1010 (Cal BP 1080 to 940)	850 +/- 40 BP	-9.3 o/oo	1110 +/- 40 BP
Beta - 285548 SAMPLE : FS143 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 780 to 990 (Cal BP 1170 to 960)	1050 +/- 40 BP	-19.4 o/oo	1140 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Robert Dello-Russo

Report Date: 10/22/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285549	960 +/- 40 BP	-10.9 o/oo	1190 +/- 40 BP

SAMPLE : FS258 .03g
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 710 to 750 (Cal BP 1240 to 1200) AND Cal AD 760 to 900 (Cal BP 1190 to 1050)
Cal AD 920 to 960 (Cal BP 1040 to 990)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285550	920 +/- 40 BP	-10.5 o/oo	1160 +/- 40 BP

SAMPLE : FS297
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 980 (Cal BP 1180 to 970)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285551	1110 +/- 40 BP	-21.9 o/oo	1160 +/- 40 BP

SAMPLE : FS327
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 980 (Cal BP 1180 to 970)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285552	100.2 +/- 0.5 pMC	-12.1 o/oo	190 +/- 40 BP

SAMPLE : FS330
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1650 to 1700 (Cal BP 300 to 250) AND Cal AD 1720 to 1820 (Cal BP 230 to 130)
Cal AD 1840 to 1880 (Cal BP 110 to 70) AND Cal AD 1920 to 1950 (Cal BP 40 to 0)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285553	940 +/- 40 BP	-11.6 o/oo	1160 +/- 40 BP
Beta - 285554	2080 +/- 40 BP	-21.7 o/oo	2130 +/- 40 BP
Beta - 285555	1480 +/- 40 BP	-23.6 o/oo	1500 +/- 40 BP
Beta - 285556	970 +/- 40 BP	-10.9 o/oo	1200 +/- 40 BP

Beta - 285553
SAMPLE : FS331
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 980 (Cal BP 1180 to 970)

Beta - 285554
SAMPLE : FS499
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 350 to 290 (Cal BP 2300 to 2240) AND Cal BC 220 to 50 (Cal BP 2170 to 2000)

Beta - 285555
SAMPLE : FS527
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 440 to 490 (Cal BP 1510 to 1460) AND Cal AD 520 to 640 (Cal BP 1430 to 1310)

Beta - 285556
SAMPLE : FS244
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 690 to 900 (Cal BP 1260 to 1050) AND Cal AD 920 to 950 (Cal BP 1030 to 1000)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285557	840 +/- 40 BP	-10.6 o/oo	1080 +/- 40 BP

SAMPLE : FS279
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 890 to 1020 (Cal BP 1060 to 930)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285558	1200 +/- 40 BP	-21.8 o/oo	1250 +/- 40 BP

SAMPLE : FS295
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 670 to 880 (Cal BP 1280 to 1070)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285559	950 +/- 40 BP	-10.8 o/oo	1180 +/- 40 BP

SAMPLE : FS341
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 720 to 740 (Cal BP 1230 to 1210) AND Cal AD 770 to 970 (Cal BP 1180 to 980)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285560	1120 +/- 40 BP	-23.1 o/oo	1150 +/- 40 BP

SAMPLE : FS428
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 780 to 980 (Cal BP 1170 to 960)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 285561	940 +/- 40 BP	-10.4 o/oo	1180 +/- 40 BP
Beta - 285562	1110 +/- 40 BP	-23.0 o/oo	1140 +/- 40 BP

Beta - 285561
SAMPLE : FS485
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 720 to 740 (Cal BP 1230 to 1210) AND Cal AD 770 to 970 (Cal BP 1180 to 980)

Beta - 285562
SAMPLE : FS574
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 780 to 990 (Cal BP 1170 to 960)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.7:lab. mult=1)

Laboratory number: **Beta-285533**

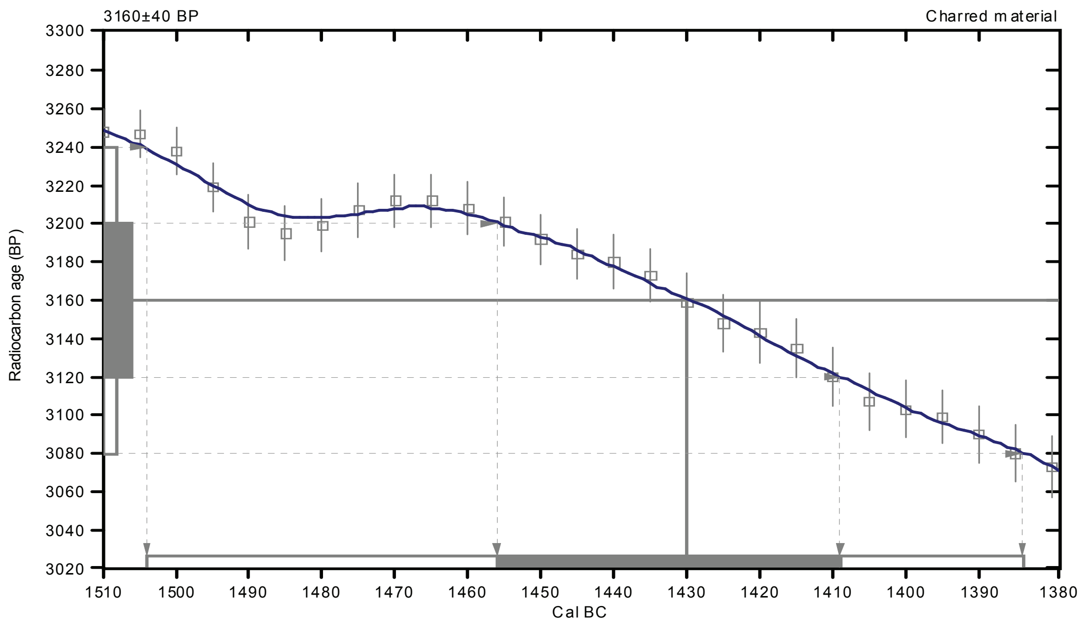
Conventional radiocarbon age: **3160±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 1500 to 1380 (Cal BP 3450 to 3330)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 1430 (Cal BP 3380)

1 Sigma calibrated result: (68% probability) Cal BC 1460 to 1410 (Cal BP 3410 to 3360)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: **Beta-285534**

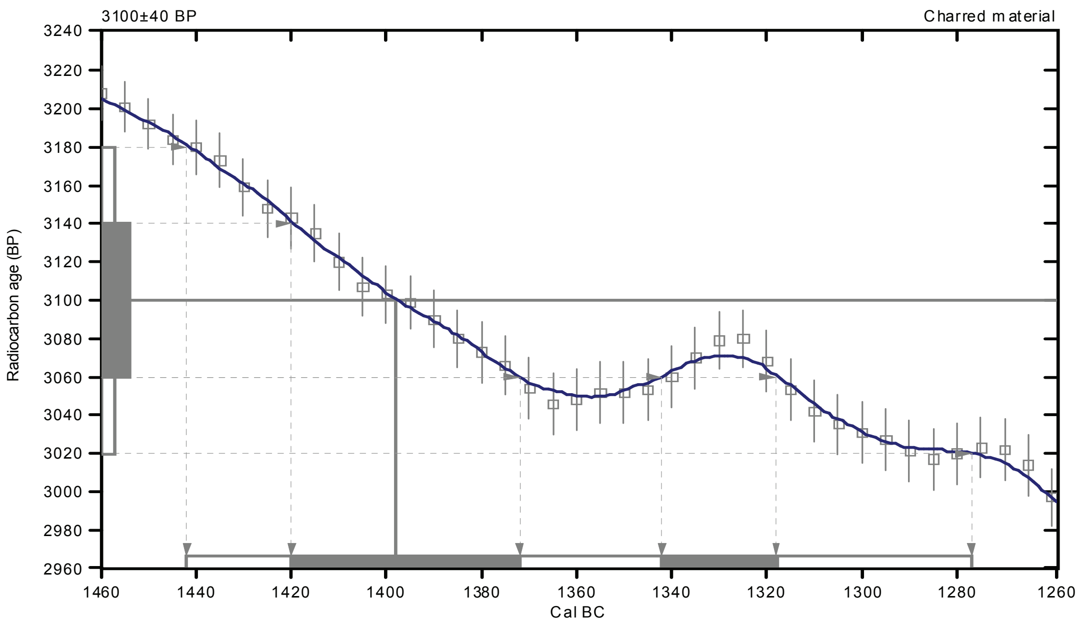
Conventional radiocarbon age: **3100±40 BP**

2 Sigma calibrated result: **Cal BC 1440 to 1280 (Cal BP 3390 to 3230)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1400 (Cal BP 3350)

1 Sigma calibrated results: Cal BC 1420 to 1370 (Cal BP 3370 to 3320) and
(68% probability) Cal BC 1340 to 1320 (Cal BP 3290 to 3270)



References:

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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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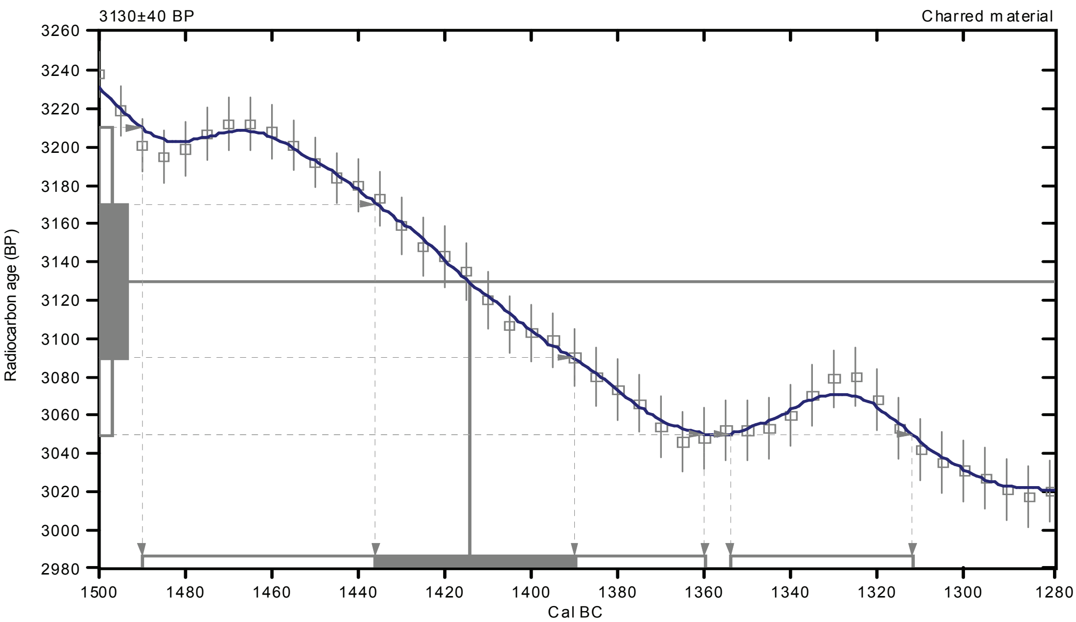
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23:lab. mult=1)

Laboratory number:	**Beta-285535**
Conventional radiocarbon age:	**3130±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 1490 to 1360 (Cal BP 3440 to 3310) and Cal BC 1350 to 1310 (Cal BP 3300 to 3260)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 1410 (Cal BP 3360)
1 Sigma calibrated result: (68% probability)	Cal BC 1440 to 1390 (Cal BP 3390 to 3340)



References:

Database used

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INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.8:lab. mult=1)

Laboratory number: **Beta-285536**

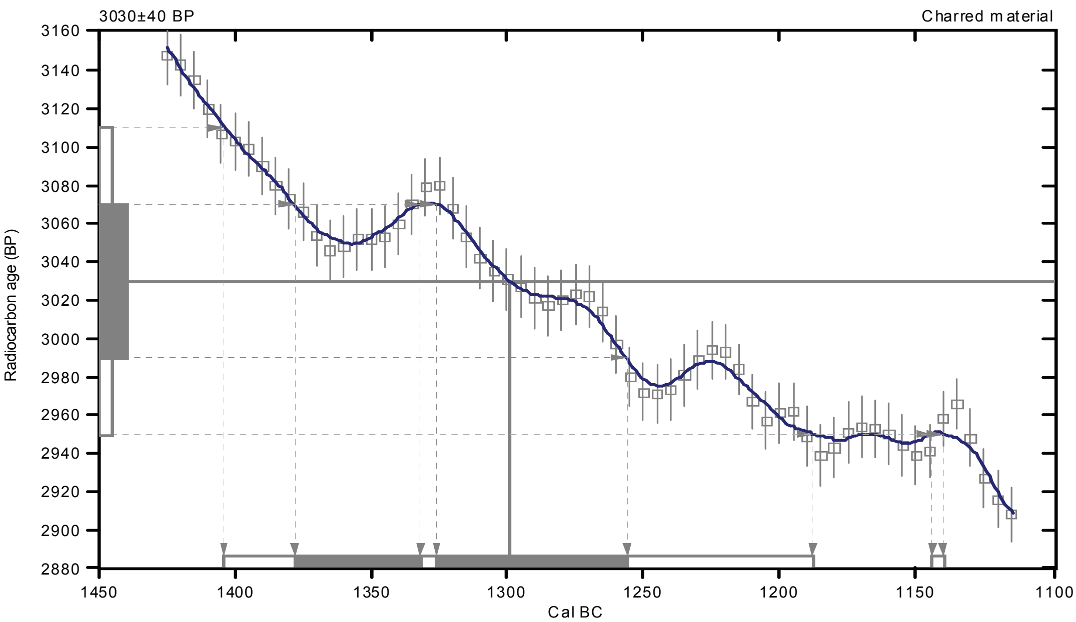
Conventional radiocarbon age: **3030±40 BP**

2 Sigma calibrated results: **Cal BC 1400 to 1190 (Cal BP 3350 to 3140) and**
(95% probability) **Cal BC 1140 to 1140 (Cal BP 3090 to 3090)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1300 (Cal BP 3250)

1 Sigma calibrated results: Cal BC 1380 to 1330 (Cal BP 3330 to 3280) and
(68% probability) Cal BC 1330 to 1260 (Cal BP 3280 to 3210)



References:
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.7:lab. mult=1)

Laboratory number: **Beta-285537**

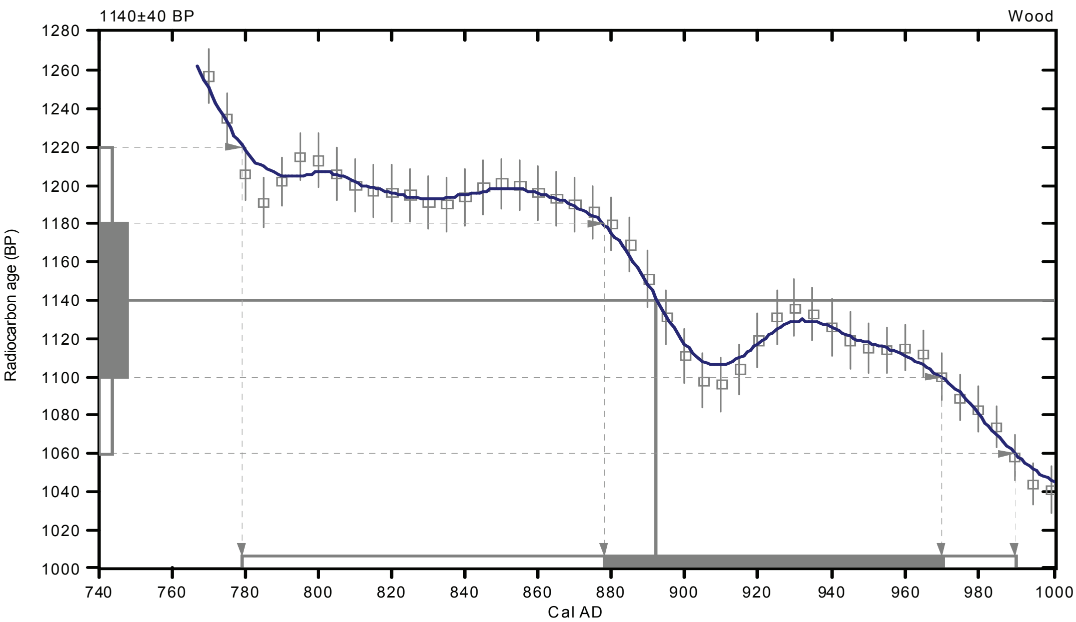
Conventional radiocarbon age: **1140±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 780 to 990 (Cal BP 1170 to 960)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated result: (68% probability) Cal AD 880 to 970 (Cal BP 1070 to 980)



References:

Database used

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Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.6:lab. mult=1)

Laboratory number: **Beta-285538**

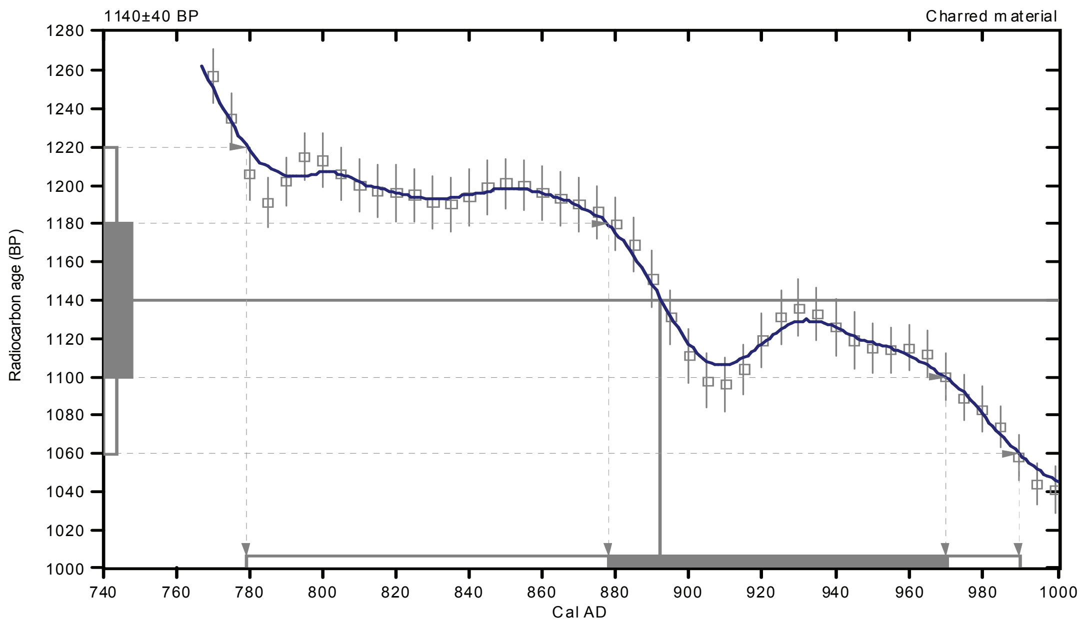
Conventional radiocarbon age: **1140±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 780 to 990 (Cal BP 1170 to 960)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated result: (68% probability) Cal AD 880 to 970 (Cal BP 1070 to 980)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-9.7:lab. mult=1)

Laboratory number: **Beta-285539**

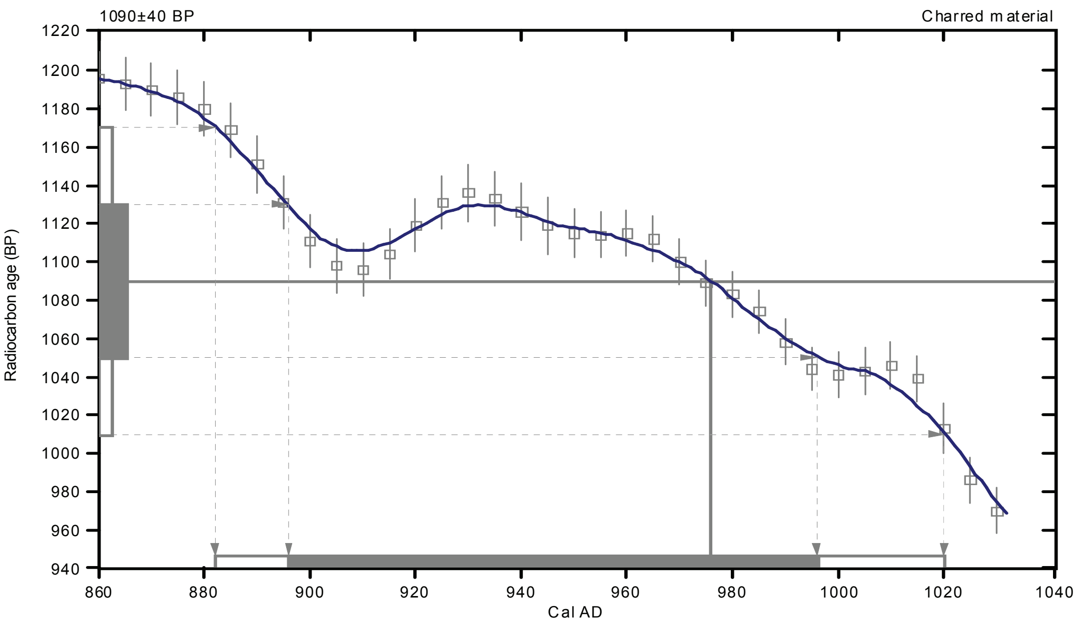
Conventional radiocarbon age: **1090±40 BP**

2 Sigma calibrated result: **Cal AD 880 to 1020 (Cal BP 1070 to 930)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 980 (Cal BP 970)

1 Sigma calibrated result: Cal AD 900 to 1000 (Cal BP 1050 to 950)
(68% probability)



References:

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.2:lab. mult=1)

Laboratory number: **Beta-285540**

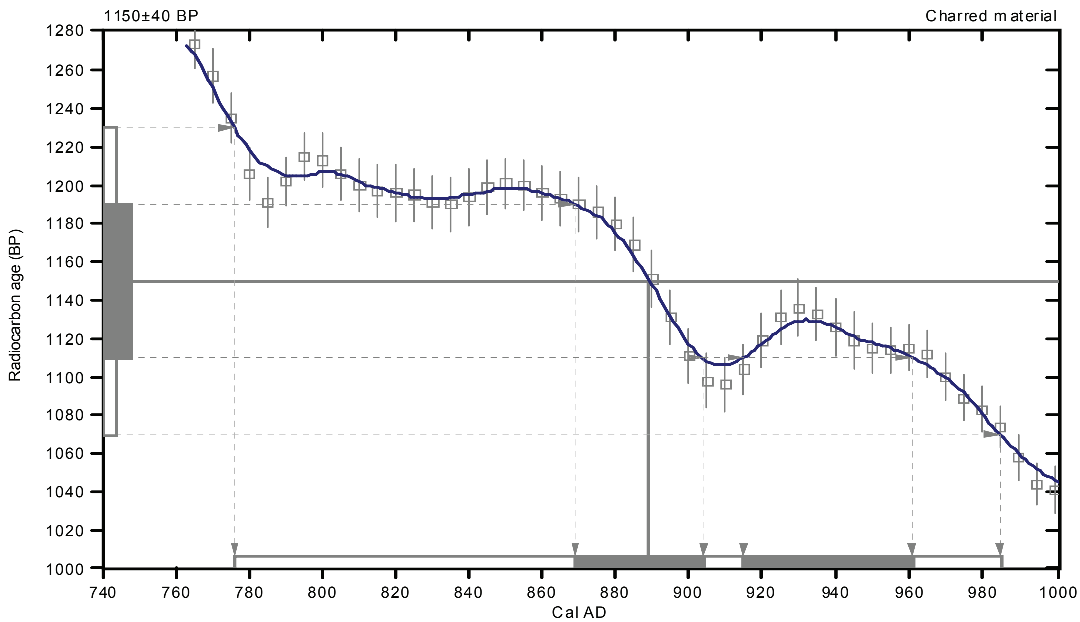
Conventional radiocarbon age: **1150±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 780 to 980 (Cal BP 1170 to 960)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated results: (68% probability) Cal AD 870 to 900 (Cal BP 1080 to 1050) and Cal AD 920 to 960 (Cal BP 1040 to 990)



References:

Database used

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Calibration Database

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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-8.8:lab. mult=1)

Laboratory number: **Beta-285541**

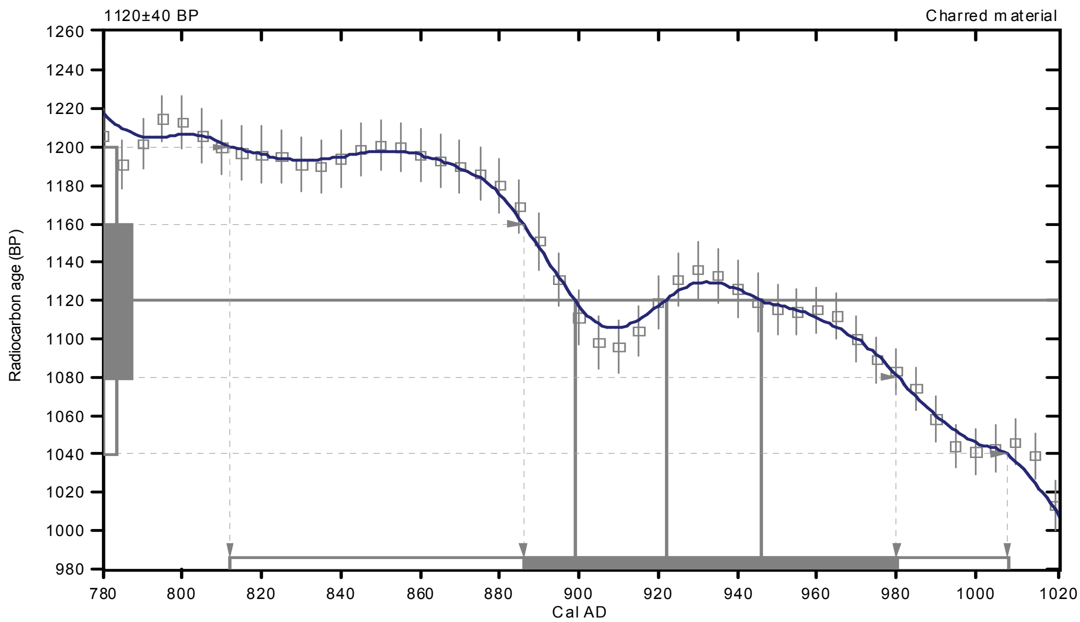
Conventional radiocarbon age: **1120±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 810 to 1010 (Cal BP 1140 to 940)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 900 (Cal BP 1050) and Cal AD 920 (Cal BP 1030) and Cal AD 950 (Cal BP 1000)

1 Sigma calibrated result: (68% probability) Cal AD 890 to 980 (Cal BP 1060 to 970)



References:

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-12:lab. mult=1)

Laboratory number: **Beta-285542**

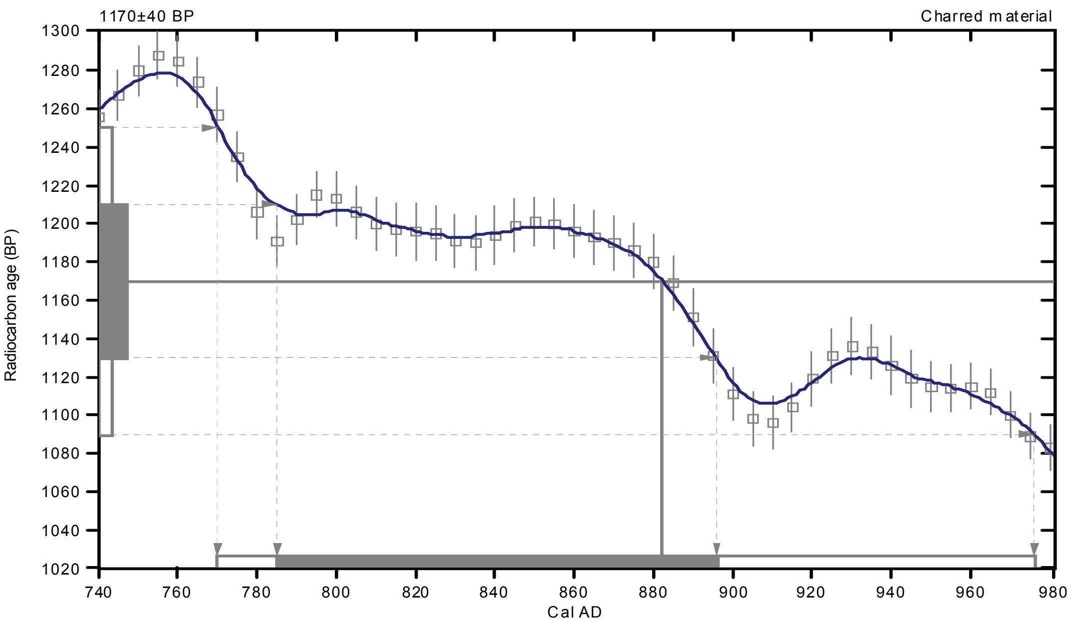
Conventional radiocarbon age: **1170±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 770 to 980 (Cal BP 1180 to 970)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 880 (Cal BP 1070)

1 Sigma calibrated result: (68% probability) Cal AD 780 to 900 (Cal BP 1160 to 1050)



References:

Database used
INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.2:lab. mult=1)

Laboratory number: **Beta-285543**

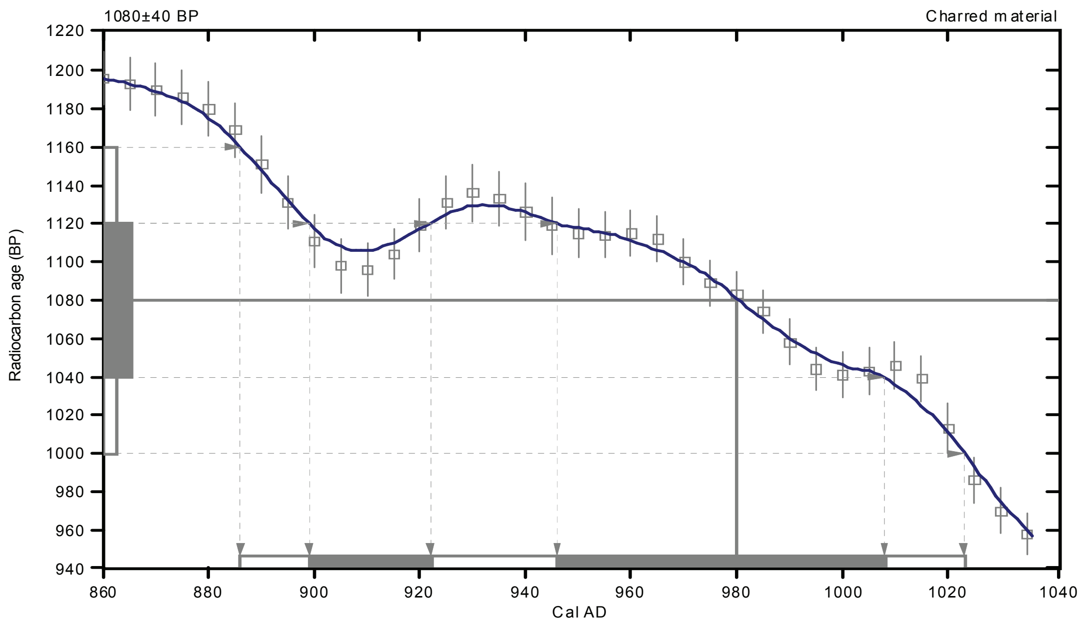
Conventional radiocarbon age: **1080±40 BP**

2 Sigma calibrated result: **Cal AD 890 to 1020 (Cal BP 1060 to 930)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 980 (Cal BP 970)

1 Sigma calibrated results: Cal AD 900 to 920 (Cal BP 1050 to 1030) and
(68% probability) Cal AD 950 to 1010 (Cal BP 1000 to 940)



References:
Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.7:lab. mult=1)

Laboratory number: **Beta-285544**

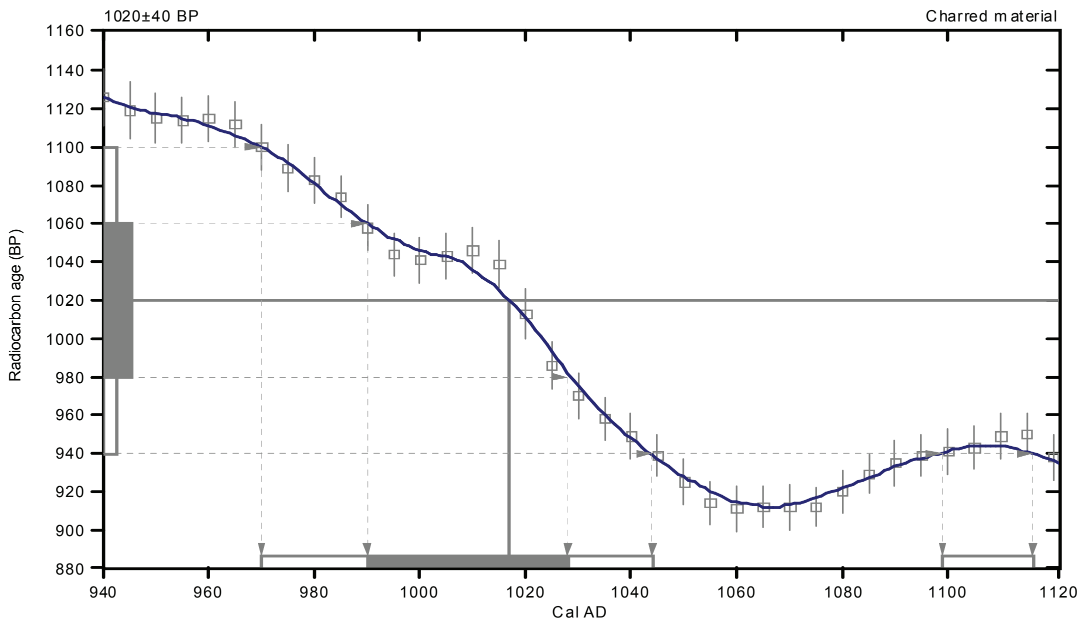
Conventional radiocarbon age: **1020±40 BP**

2 Sigma calibrated results: (95% probability) **Cal AD 970 to 1040 (Cal BP 980 to 910) and Cal AD 1100 to 1120 (Cal BP 850 to 830)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1020 (Cal BP 930)

1 Sigma calibrated result: (68% probability) Cal AD 990 to 1030 (Cal BP 960 to 920)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.8:lab. mult=1)

Laboratory number: **Beta-285545**

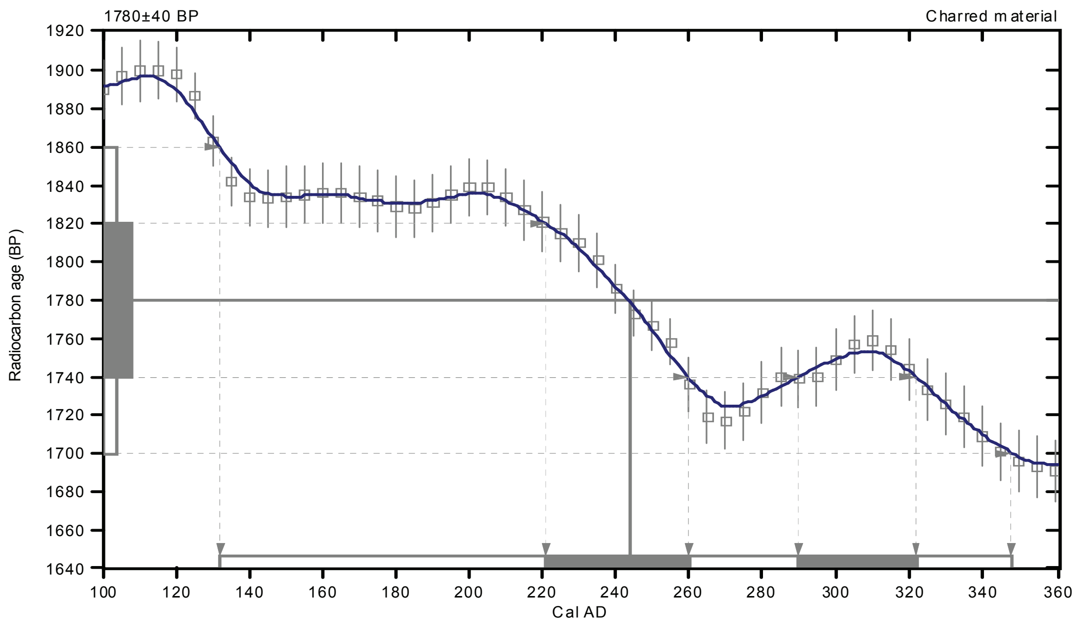
Conventional radiocarbon age: **1780±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 130 to 350 (Cal BP 1820 to 1600)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 240 (Cal BP 1710)

1 Sigma calibrated results: (68% probability) Cal AD 220 to 260 (Cal BP 1730 to 1690) and Cal AD 290 to 320 (Cal BP 1660 to 1630)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.4:lab. mult=1)

Laboratory number: **Beta-285546**

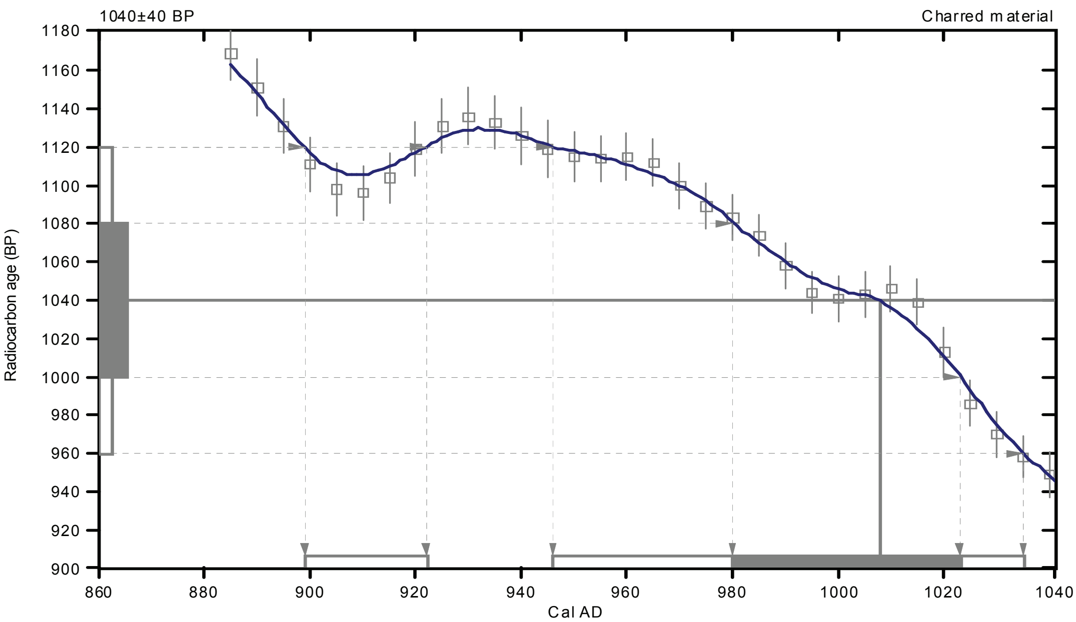
Conventional radiocarbon age: **1040±40 BP**

2 Sigma calibrated results: **Cal AD 900 to 920 (Cal BP 1050 to 1030) and**
(95% probability) **Cal AD 950 to 1040 (Cal BP 1000 to 920)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1010 (Cal BP 940)

1 Sigma calibrated result: Cal AD 980 to 1020 (Cal BP 970 to 930)
(68% probability)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-9.3:lab. mult=1)

Laboratory number: **Beta-285547**

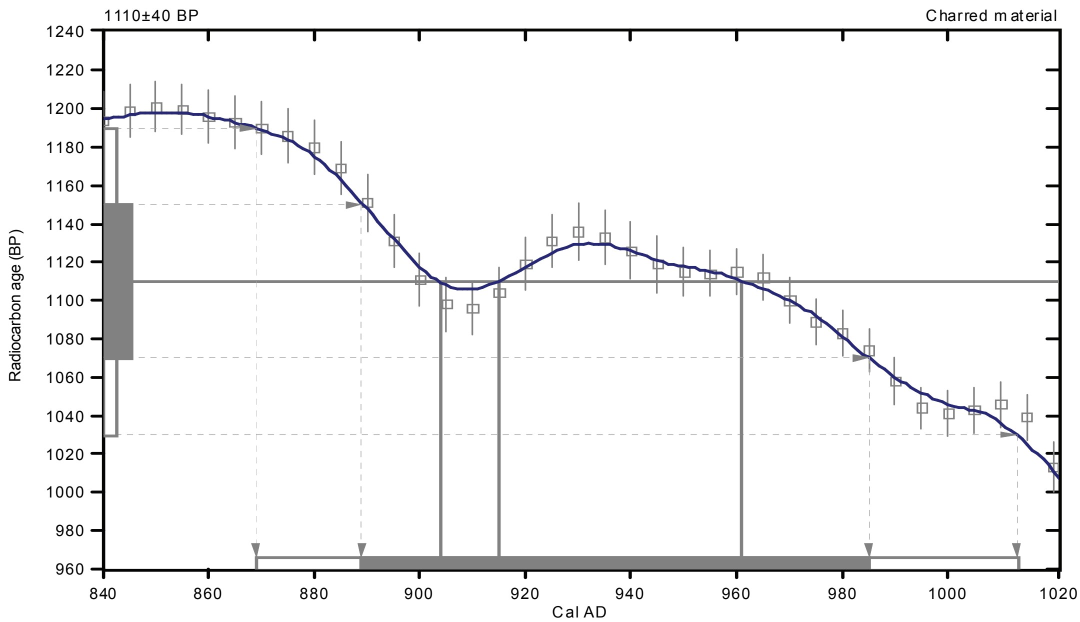
Conventional radiocarbon age: **1110±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 870 to 1010 (Cal BP 1080 to 940)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal AD 900 (Cal BP 1050) and
Cal AD 920 (Cal BP 1040) and
Cal AD 960 (Cal BP 990)

1 Sigma calibrated result: (68% probability) Cal AD 890 to 980 (Cal BP 1060 to 960)



References:
Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-19.4:lab. mult=1)

Laboratory number: **Beta-285548**

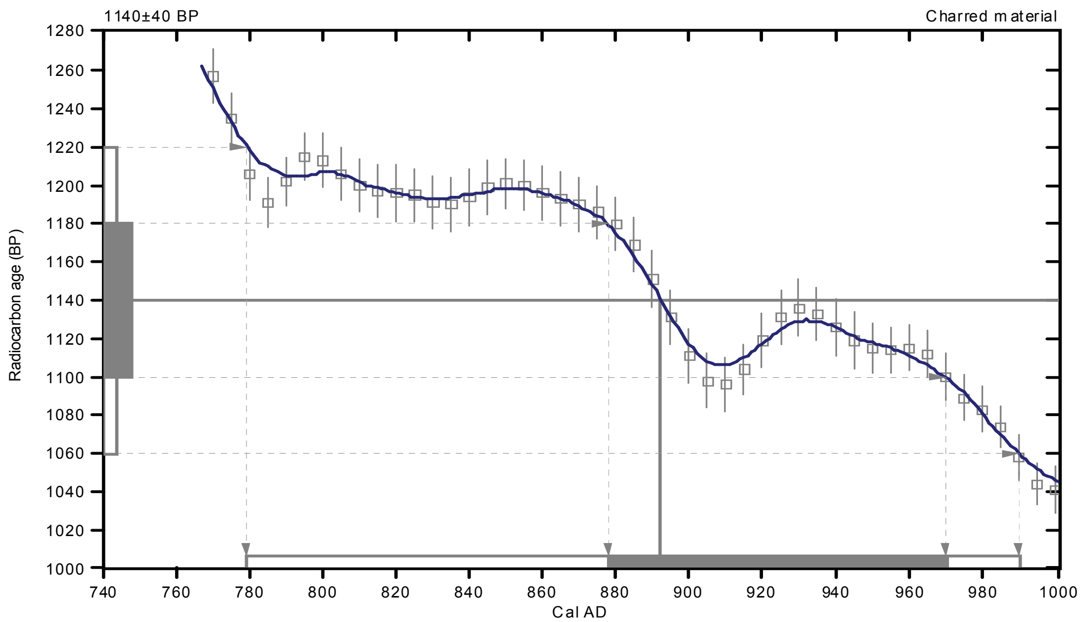
Conventional radiocarbon age: **1140±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 780 to 990 (Cal BP 1170 to 960)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated result: (68% probability) Cal AD 880 to 970 (Cal BP 1070 to 980)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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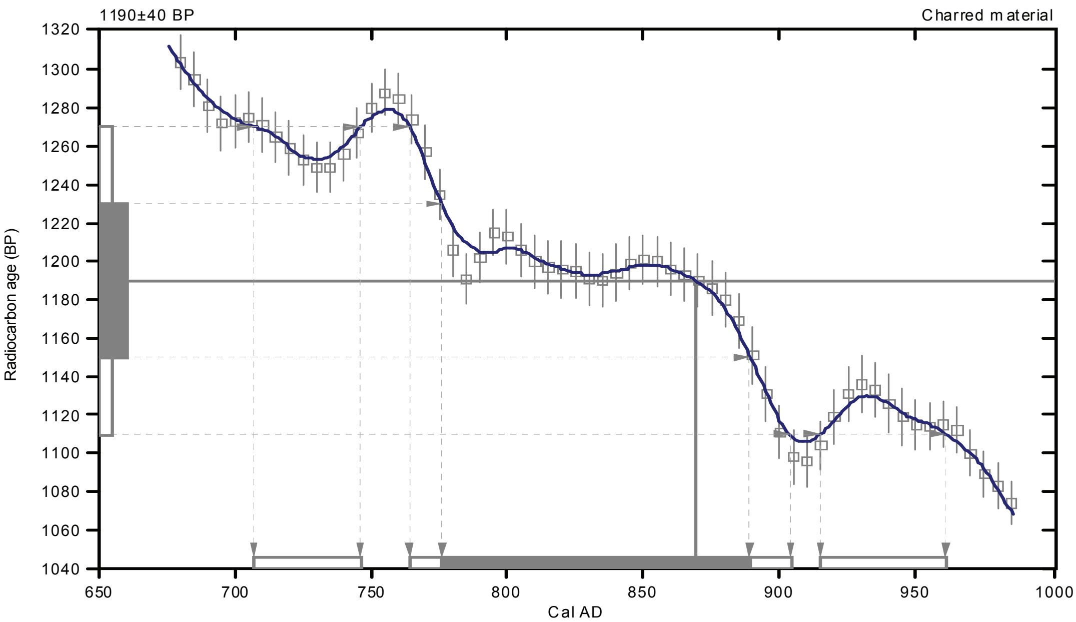
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.9:lab. mult=1)

Laboratory number:	**Beta-285549**
Conventional radiocarbon age:	**1190±40 BP**
2 Sigma calibrated results: **(95% probability)**	**Cal AD 710 to 750 (Cal BP 1240 to 1200) and** **Cal AD 760 to 900 (Cal BP 1190 to 1050) and** **Cal AD 920 to 960 (Cal BP 1040 to 990)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 870 (Cal BP 1080)
1 Sigma calibrated result: (68% probability)	Cal AD 780 to 890 (Cal BP 1170 to 1060)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.5:lab. mult=1)

Laboratory number: **Beta-285550**

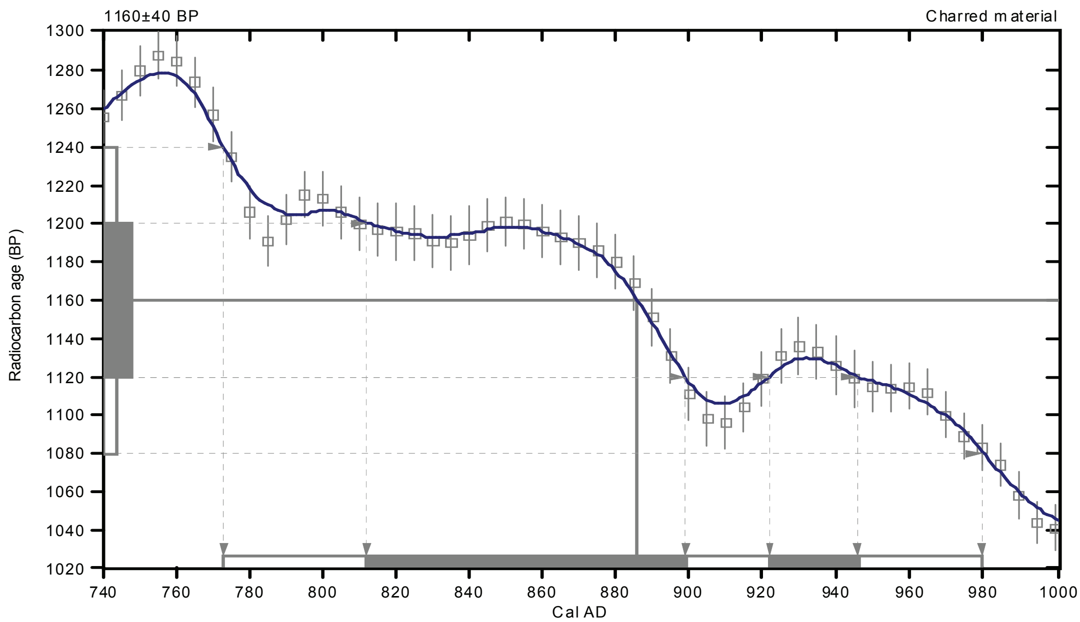
Conventional radiocarbon age: **1160±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 770 to 980 (Cal BP 1180 to 970)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated results: (68% probability) Cal AD 810 to 900 (Cal BP 1140 to 1050) and Cal AD 920 to 950 (Cal BP 1030 to 1000)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

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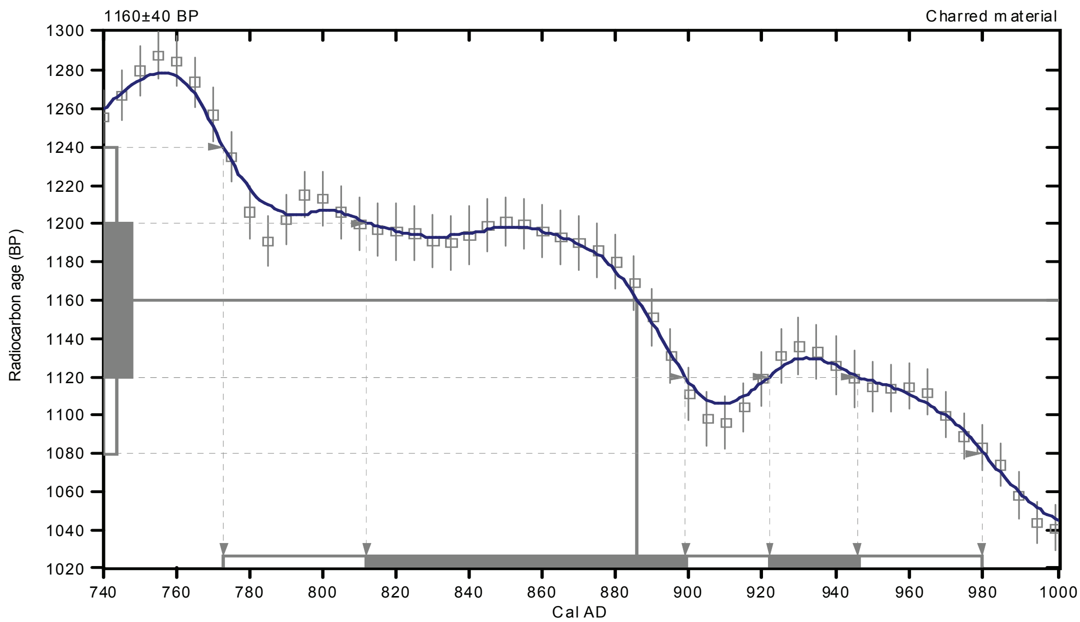
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.9:lab. mult=1)

Laboratory number:	**Beta-285551**
Conventional radiocarbon age:	**1160±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 770 to 980 (Cal BP 1180 to 970)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 890 (Cal BP 1060)
1 Sigma calibrated results: (68% probability)	Cal AD 810 to 900 (Cal BP 1140 to 1050) and Cal AD 920 to 950 (Cal BP 1030 to 1000)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-12.1:lab. mult=1)

Laboratory number: **Beta-285552**

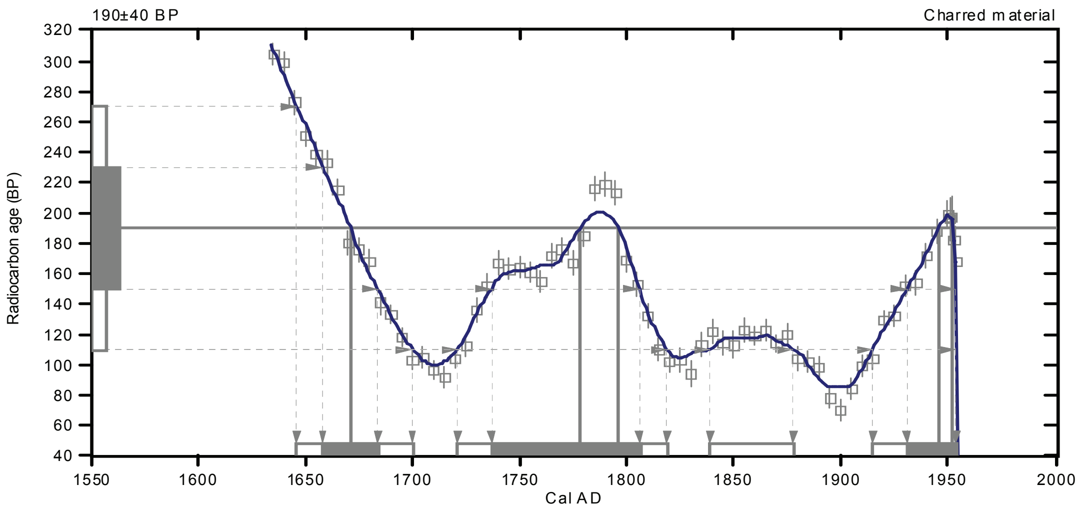
Conventional radiocarbon age: **190±40 BP**

2 Sigma calibrated results: (95% probability)
Cal AD 1650 to 1700 (Cal BP 300 to 250) and
Cal AD 1720 to 1820 (Cal BP 230 to 130) and
Cal AD 1840 to 1880 (Cal BP 110 to 70) and
Cal AD 1920 to 1950 (Cal BP 40 to 0)

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1670 (Cal BP 280) and
Cal AD 1780 (Cal BP 170) and
Cal AD 1800 (Cal BP 150) and
Cal AD 1950 (Cal BP 0) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability)
Cal AD 1660 to 1680 (Cal BP 290 to 270) and
Cal AD 1740 to 1810 (Cal BP 210 to 140) and
Cal AD 1930 to 1950 (Cal BP 20 to 0)



References:
Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.6:lab. mult=1)

Laboratory number: **Beta-285553**

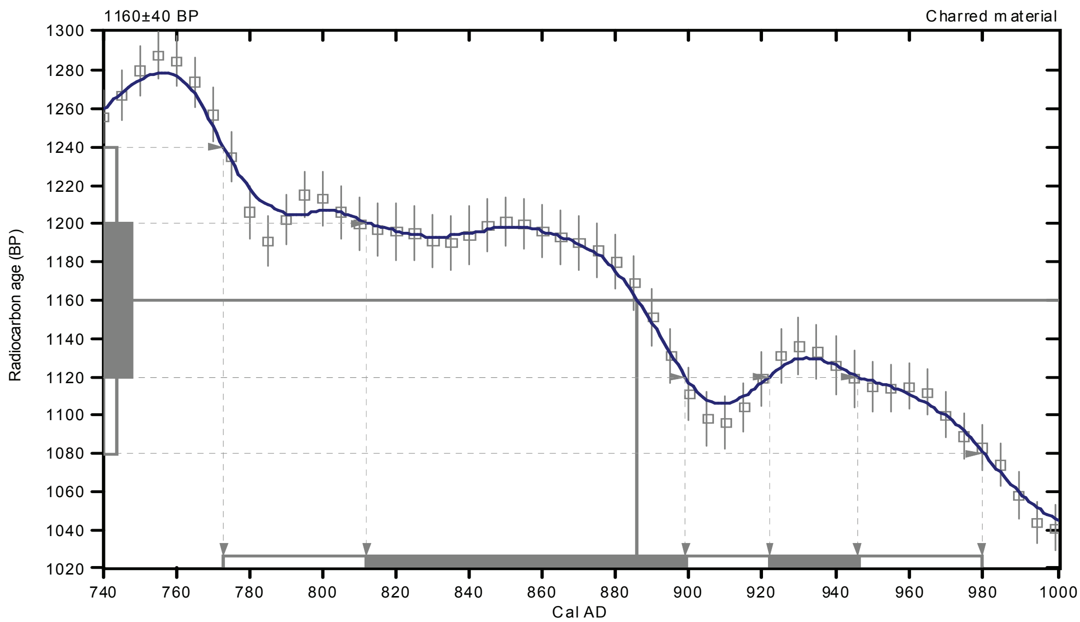
Conventional radiocarbon age: **1160±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 770 to 980 (Cal BP 1180 to 970)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated results: (68% probability) Cal AD 810 to 900 (Cal BP 1140 to 1050) and Cal AD 920 to 950 (Cal BP 1030 to 1000)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.7:lab. mult=1)

Laboratory number: **Beta-285554**

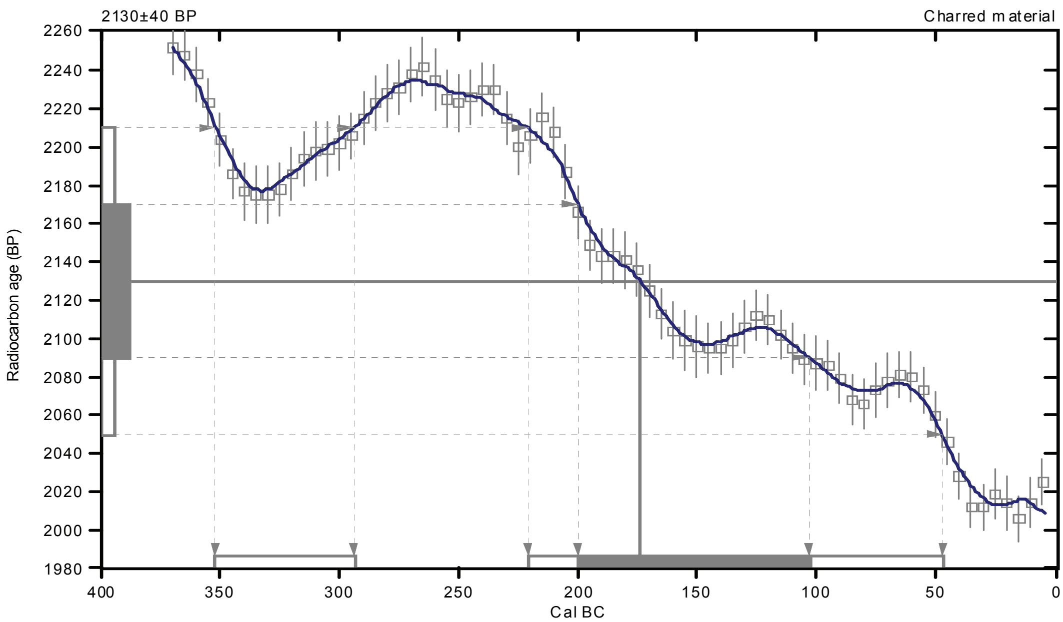
Conventional radiocarbon age: **2130±40 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 350 to 290 (Cal BP 2300 to 2240) and Cal BC 220 to 50 (Cal BP 2170 to 2000)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 170 (Cal BP 2120)

1 Sigma calibrated result: (68% probability) Cal BC 200 to 100 (Cal BP 2150 to 2050)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.6:lab. mult=1)

Laboratory number: **Beta-285555**

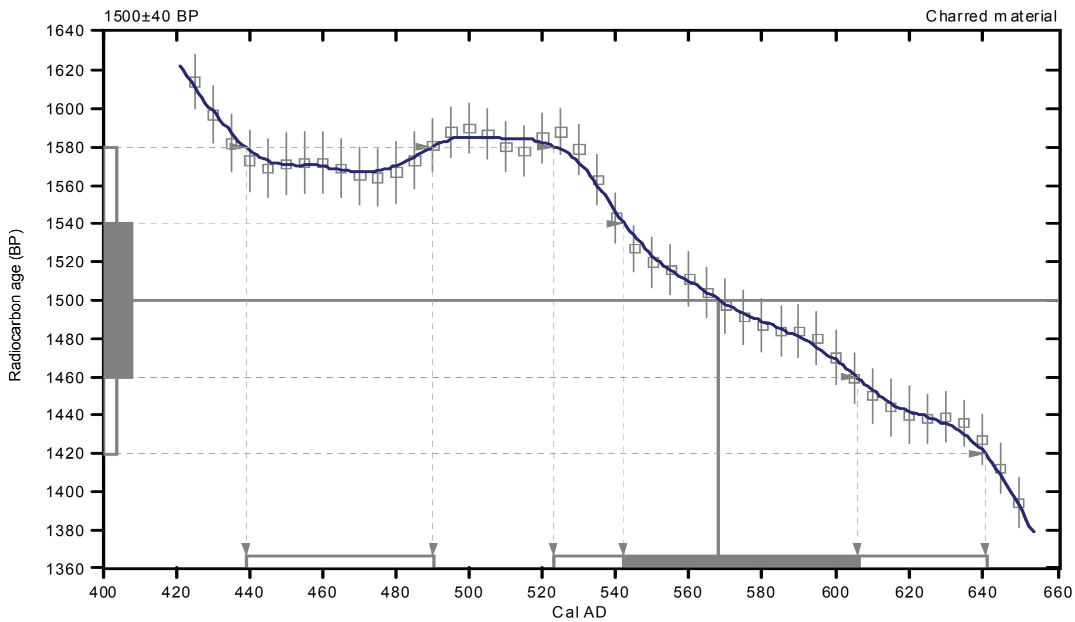
Conventional radiocarbon age: **1500±40 BP**

2 Sigma calibrated results: (95% probability) **Cal AD 440 to 490 (Cal BP 1510 to 1460) and Cal AD 520 to 640 (Cal BP 1430 to 1310)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 570 (Cal BP 1380)

1 Sigma calibrated result: (68% probability) Cal AD 540 to 610 (Cal BP 1410 to 1340)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.9:lab. mult=1)

Laboratory number: **Beta-285556**

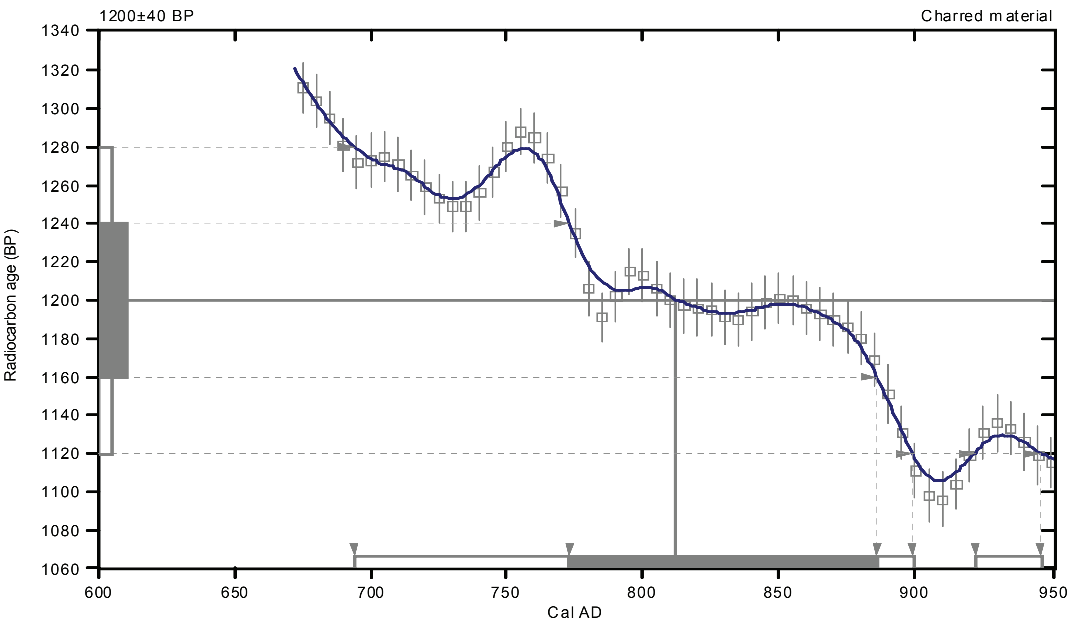
Conventional radiocarbon age: **1200±40 BP**

2 Sigma calibrated results: **Cal AD 690 to 900 (Cal BP 1260 to 1050) and**
(95% probability) **Cal AD 920 to 950 (Cal BP 1030 to 1000)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 810 (Cal BP 1140)

1 Sigma calibrated result: Cal AD 770 to 890 (Cal BP 1180 to 1060)
(68% probability)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.6:lab. mult=1)

Laboratory number: **Beta-285557**

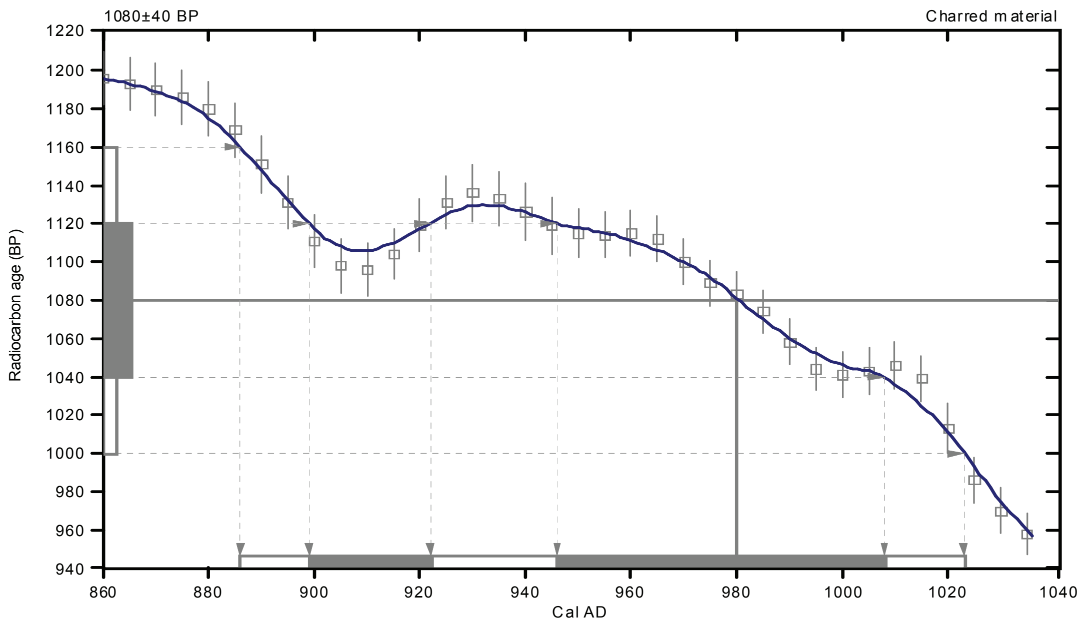
Conventional radiocarbon age: **1080±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 890 to 1020 (Cal BP 1060 to 930)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 980 (Cal BP 970)

1 Sigma calibrated results: (68% probability) Cal AD 900 to 920 (Cal BP 1050 to 1030) and Cal AD 950 to 1010 (Cal BP 1000 to 940)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21.8:lab. mult=1)

Laboratory number: **Beta-285558**

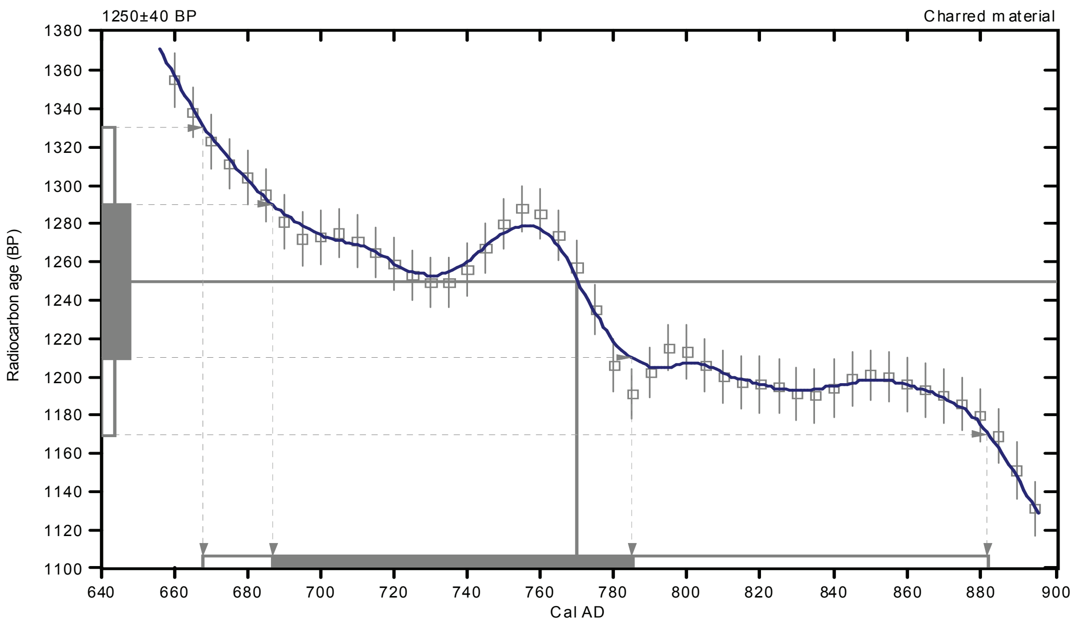
Conventional radiocarbon age: **1250±40 BP**

2 Sigma calibrated result: **Cal AD 670 to 880 (Cal BP 1280 to 1070)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 770 (Cal BP 1180)

1 Sigma calibrated result: Cal AD 690 to 780 (Cal BP 1260 to 1160)
(68% probability)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.8:lab. mult=1)

Laboratory number: **Beta-285559**

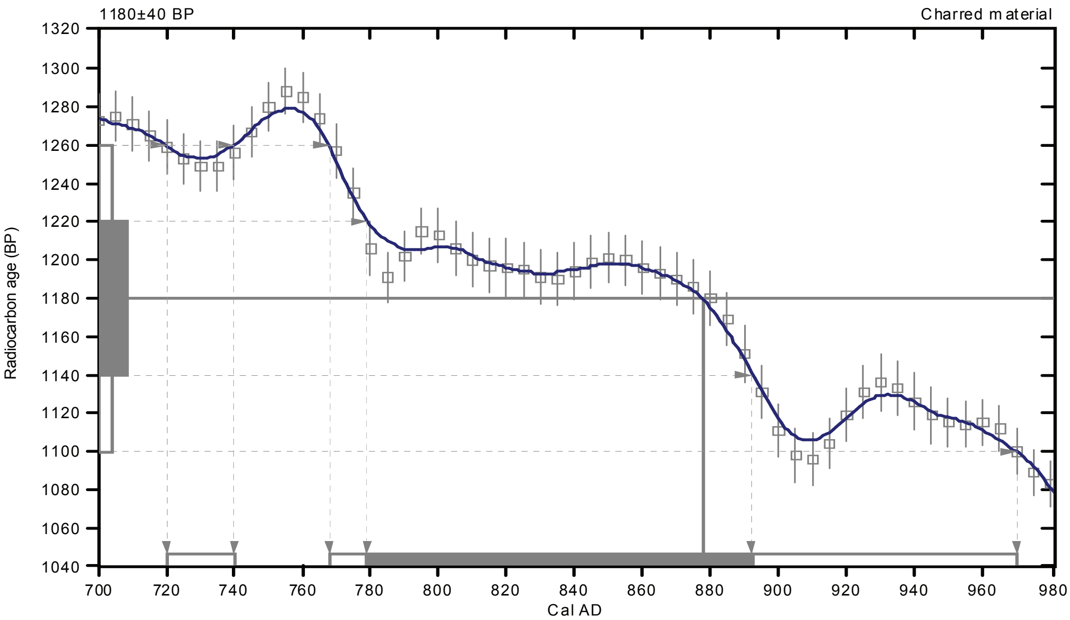
Conventional radiocarbon age: **1180±40 BP**

2 Sigma calibrated results: **Cal AD 720 to 740 (Cal BP 1230 to 1210) and**
(95% probability) **Cal AD 770 to 970 (Cal BP 1180 to 980)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 880 (Cal BP 1070)

1 Sigma calibrated result: Cal AD 780 to 890 (Cal BP 1170 to 1060)
(68% probability)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: **Beta-285560**

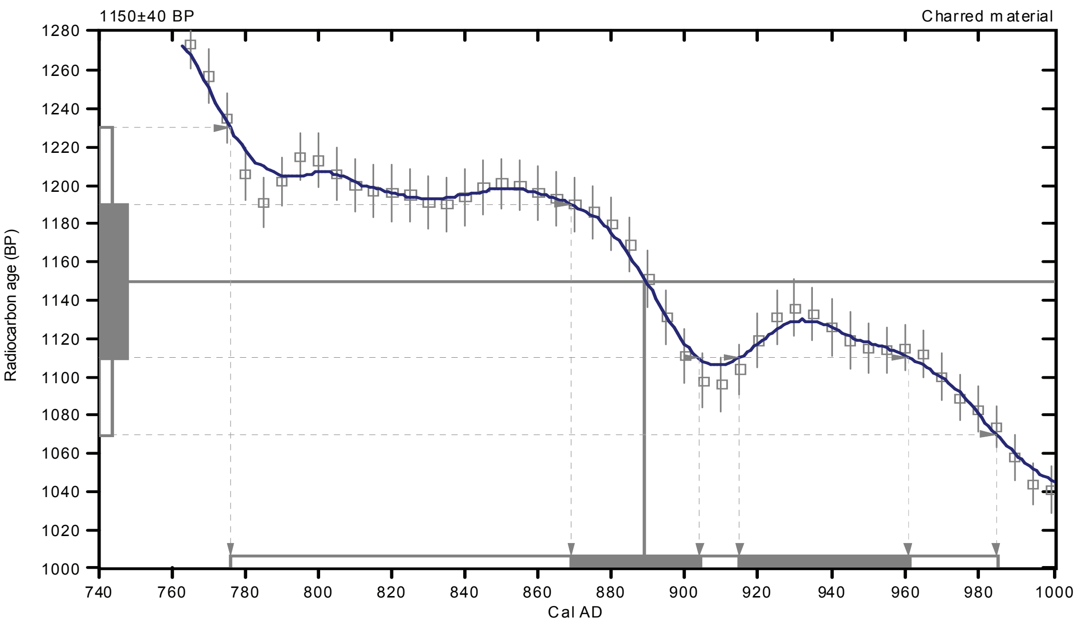
Conventional radiocarbon age: **1150±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 780 to 980 (Cal BP 1170 to 960)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated results: (68% probability) Cal AD 870 to 900 (Cal BP 1080 to 1050) and Cal AD 920 to 960 (Cal BP 1040 to 990)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.4:lab. mult=1)

Laboratory number: **Beta-285561**

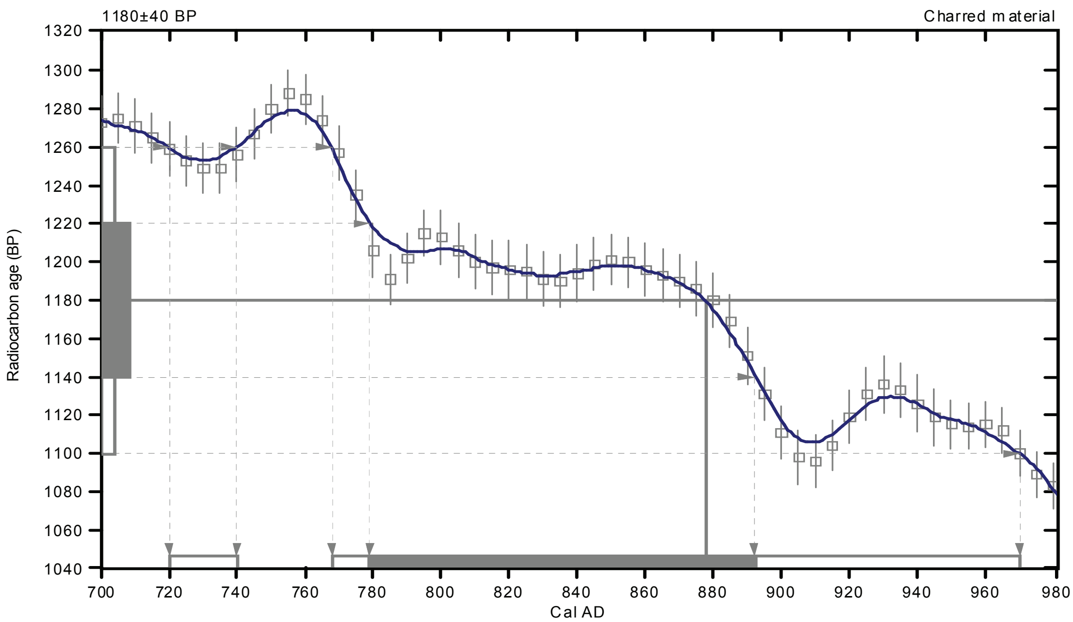
Conventional radiocarbon age: **1180±40 BP**

2 Sigma calibrated results: **Cal AD 720 to 740 (Cal BP 1230 to 1210) and**
(95% probability) **Cal AD 770 to 970 (Cal BP 1180 to 980)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 880 (Cal BP 1070)

1 Sigma calibrated result: Cal AD 780 to 890 (Cal BP 1170 to 1060)
(68% probability)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23:lab. mult=1)

Laboratory number: **Beta-285562**

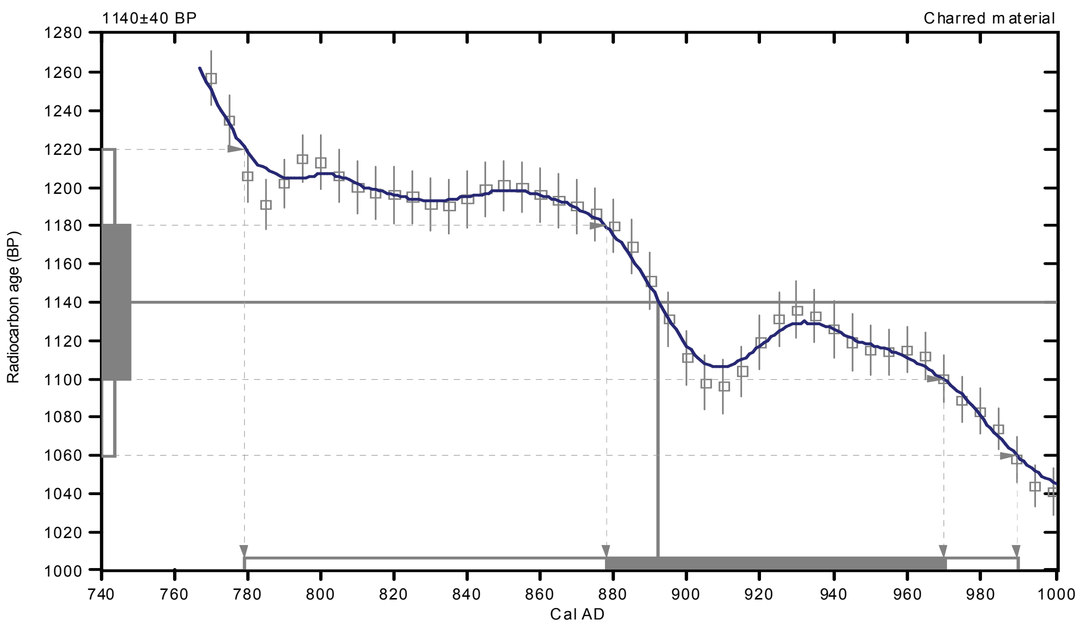
Conventional radiocarbon age: **1140±40 BP**

2 Sigma calibrated result: **Cal AD 780 to 990 (Cal BP 1170 to 960)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated result: Cal AD 880 to 970 (Cal BP 1070 to 980)
(68% probability)



References:
Database used
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Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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