Testing and Data Recovery Excavations at Eight Sites Along Paseo del Volcan Unser Boulevard to Iris Road, City of Rio Rancho Sandoval County, New Mexico

Report # CEC-2008-9

Criterion Environmental Consulting LLC

NEW MEXICO DEPARTMENT OF TRANSPORTATION
Testing and Data Recovery Excavations at Eight Sites along Paseo del Volcan, Unser Boulevard to Iris Road, City of Rio Rancho, Sandoval County, New Mexico

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Introduction

From August 8, 2005 through October 15, 2005, Parsons Brinckerhoff (PB) completed archaeological testing and/or data recovery at eight sites along a segment of the proposed Paseo del Volcan roadway alignment. Paseo del Volcan has been developed by the New Mexico Department of Transportation (NMDOT) and the Federal Highway Administration (FHWA) as a proposed limited-access facility serving the west side of the Albuquerque metropolitan area and Rio Rancho. The Paseo del Volcan corridor connects Interstate 40 and US Highway 550 and covers a distance of approximately 49.3 kilometers (km) (30.8 miles [mi]). The current investigations were conducted at the request of the NMDOT and the City of Rio Rancho prior to the initiation of construction of a 6.8-km (4.2-mi) segment of the proposed corridor between Unser Boulevard and Iris Road in the City of Rio Rancho, Sandoval County, New Mexico (Figure 1.1). The undertaking includes the construction of a new asphalt paved 2-lane roadway; which as of the date of this final report has been completed and is open to traffic. The testing and data recovery activities represent the final stage of cultural resource investigations for this segment of Paseo del Volcan.

This report documents the findings from the testing and data recovery activities. With the excavations conducted to date, PB has met the goals of the fieldwork as defined in the data recovery plan dated March 2005 and addendum (Campbell 2005, Raymond 2005). Excavation activities were carried out under New Mexico Archaeological Excavation Permit Number SE-229 and New Mexico State Land Office Archaeological Permit No. 113. No further investigations within the proposed segment of the Paseo del Volcan between Unser Boulevard and Iris Road are recommended for the current undertaking. The testing and data recovery activities performed for this project are consistent with federal and state standards for cultural resource management.

Project History

In the mid-1990s, the NMDOT, in cooperation with the FHWA, initiated plans to construct a 30.8-mile limited-access transportation facility between I-40 in Albuquerque and US 550 north of Rio Rancho in Bernalillo and Sandoval Counties, New Mexico. The cultural resource investigations for the Paseo del Volcan corridor began in 1995 with an archaeological survey of the various alternatives then being considered for the roadway. Michael Marshall (1995) performed a 30.5-meter (100-foot) wide survey of each alternative to determine the nature and density of archaeological remains among the prospective alignments. Prior to the initiation of the 1995 survey, three sites—LA 55503, LA 55507, and LA 55509—had been identified for an unrelated project (Hogan 1986) that are within the area of potential effect (APE) of the current undertaking.

In the late 1990s a preferred alternative was selected and in 1999 Parsons Brinckerhoff (PB) performed a 121.9-meter (400-foot) wide archaeological survey for the preferred alternative. This survey identified 43 archaeological sites within the corridor. In 2000, SWCA, Inc. completed a testing plan for the corridor (Phillips 2000), which included 25 sites. However, implementation of this plan was postponed to allow for right-of-way acquisition. The preferred alternative was defined in the Environmental Impact Statement (EIS) issued by the FHWA on August 6, 2001, and a Record of Decision was issued by the FHWA in March 2002 approving the selection of the preferred alternative for the Paseo del Volcan Project, NMP NH-4007(1), CN 2607.
Figure 1.1: Paseo del Volcan Project Area
In 2005, NMDOT, in cooperation with the FHWA and the City of Rio Rancho, proposed the construction of a 6.8-kilometer (4.2-mile) segment of the Paseo del Volcan roadway between Unser Boulevard and Iris Road in the City of Rio Rancho, Sandoval County. This part of the proposed corridor is located on the north side of Rio Rancho and runs parallel to and between 28th and 29th Avenues, both graded dirt roads. Design plans for the Unser Boulevard to Iris Road segment included a minor realignment to avoid the Sandoval County Landfill. An archaeological survey was conducted by PB (Raymond et. al 2005) for the realignment; however, only the portion of the realignment west of Iris Road is included in the current undertaking, and no additional archaeological sites were identified in that portion of the realignment.

Eleven sites are located within the APE of the current undertaking: LA 55503, LA 55507, LA 55509, LA 126402, LA 126403, LA 126404, LA 126405, LA 126406, LA 126407, LA 126408, and LA 126409 (Parsons Brinckerhoff 1999; Raymond et al. 2005). Three sites, LA 126402, LA 126403, and LA 126404, were determined during survey-phase consultations to be not eligible for inclusion in the National Register of Historic Places (NRHP). The remaining eight sites were determined as either eligible for inclusion in the National Register of Historic Places under criterion “d”, or were found to have undetermined eligibility. The eleven sites within the project area are summarized in Table 1.1.

In 2005 a testing and data recovery program was developed to evaluate the information potential and the integrity of the sites with undetermined eligibility, to outline the procedures for making determinations of eligibility after testing, and to perform excavation and research at the eligible sites (Campbell 2005, Raymond 2005).

Table 1.1: Sites in the Paseo del Volcan, Unser Boulevard to Iris Road Project Area

<table>
<thead>
<tr>
<th>LA No.</th>
<th>Discovery Activity/NMCRIS No.</th>
<th>Original NRHP Eligibility</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>55503</td>
<td>1986 Hogan/17371</td>
<td>Eligible Criterion D</td>
<td>Testing/data recovery efforts reflect that site does not contain potential to address research issues.</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 73710 March 9, 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55507</td>
<td>1986 Hogan/17371</td>
<td>Undetermined</td>
<td>Testing efforts reflect that site contains information to address research issues. Eligible, Criterion D - data recovery implemented.</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 73710 March 9, 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55509</td>
<td>1986 Hogan/17371</td>
<td>Eligible Criterion D</td>
<td>Testing/data recovery efforts reflect that site contains information to address research issues. Eligible, Criterion D-data recovery implemented.</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 73710 March 9, 2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126402</td>
<td>1999 PB/63901</td>
<td>Not eligible</td>
<td>No archaeological investigation</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 59853 June 20, 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126403</td>
<td>1999 PB/63901</td>
<td>Not eligible</td>
<td>No archaeological investigation</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 59853 June 20, 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126404</td>
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<tr>
<td>126405</td>
<td>1999 PB/63901</td>
<td>Undetermined</td>
<td>Testing efforts reflect that site does not contain potential to address research issues.</td>
</tr>
<tr>
<td></td>
<td>HDP Log No. 73710 March 9, 2005</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Site Summaries

The following provides a brief summary of each treated site based on information available prior to the testing and data recovery excavations.

**LA 55503**

LA 55503 was recorded as a surficial artifact scatter consisting of flaked stone debitage and grayware sherds. Twenty-five artifacts were identified in total. Most of the artifacts were identified in areas of a two-track road disturbance. Debitage is of locally available chalcedony/Pedernales chert and includes complete and broken flakes, angular debris, and a tested cobble. Ten grayware sherds were identified, likely from the same bowl, exhibiting interior polish, sand temper, and a medium gray to brick red paste. One spent historic cartridge was also noted. The western portion of the site has exposed gravels of the Santa Fe Formation. Erosion from wind, water, and bioturbation is evident.

**LA 55507**

LA 55507 consisted of a large, dispersed lithic scatter, likely representing a lithic procurement and testing area. The site is located on a series of ridges and knolls with extensive outcroppings of Santa Fe gravels containing cobble-sized fragments of various materials. Numerous large flakes and tested cobbles were found throughout the site area. The site overlooks a broad, open valley to the west, south, and east associated with the Arroyo de la Baranca. Surface sediments are primarily eolian deposits and residual gravels, although there are areas of more substantial deposits. Artifacts are visible on hill slopes, eroding out of redeposited sediments and in shallow drainages. The majority of the flaked stone artifacts are of chalcedony, with chert and silicified wood also represented. Very few artifacts showing later stages of reduction were identified, suggesting the site served as a procurement locale where raw materials were tested and gathered, to be processed in other locations.

**LA 55509**

LA 55509 consists of a dispersed artifact scatter with flaked stone debitage, ceramic sherds, and ground stone artifacts located on eroded or disturbed surfaces on a low ridge northeast of the Arroyo de la
Baranca. Surface sediments are eolian deposits. Artifacts and fire cracked rock are visible on the slopes and in eroded areas of the dune. Sediments appear stable, suggesting a high probability of buried deposits. Flaked stone artifacts include cores, core reduction flakes, thinning flakes, a utilized flake, and angular debris. There is a thermally-altered mano fragment and a slab metate fragment. The only ceramic artifact is a Rio Grande Glaze A sherd. An obsidian projectile point was identified as a San Jose type (3200 – 1800 BC).

**LA 126405**

LA 126405 consists of a single ash stain identified in profile in the north road cut of 28th Avenue. The feature is a dark stain with fine ashy sediments, located approximately 1 m below the modern ground surface. No artifacts were identified in association with this feature. Eolian sands overlay the entire site.

**LA 126406**

LA 126406 consists of four ash stains identified in road cut profiles along a 70-m stretch of 28th Avenue. Three of the features (1-3) are on the north side of the road cut, approximately 1 m below the modern ground surface. Feature 4 is on the south edge of the road cut, about 40 cm below the modern ground surface. All of the features appear to be associated with the same buried surface. One artifact (a metate fragment) was recorded on the surface. Eolian sands overlay the entire site and the hill margins show evidence of active erosion.

**LA 126407**

LA 126407 consists of six ash stains identified in road cut profiles along a 50-m stretch of 28th Avenue. Three of these features were identified during the original site recording, and three were identified on a site revisit. Features 1, 5, and 6 are located on the south side of the road cut. Feature 1 is approximately 30 cm below the modern ground surface; no depth was recorded for Features 5 and 6. Features 2, 3, and 4 are located on the south side of the road cut. Features 2 and 3 are located 30 and 50 cm below the modern ground surface, respectively. No depth was recorded for Feature 4. All of the features consist of darkly stained sediments in amorphous shapes. Three grayware sherds from the same vessel were identified on the surface in a tight cluster. Phillips (2000) notes that the sherds may not be associated with the stains. Eolian sands overlay the entire site and the hill margins show evidence of active erosion.

**LA 126408**

LA 126408 consists of a single ash stain identified in the south road cut profile of 28th Avenue. The stain is amorphous with two bands of ashy sediments approximately 1 m below the modern ground surface. The lack of stained sediments in the road surface (approximately 10 cm below the stain) suggests that the feature is relatively shallow. No artifacts were identified. Eolian sands overlay the entire site and the hill margins show evidence of active erosion.

**LA 126409**

LA 126409 consists of seven ash stains. Feature 1 was identified on the modern ground surface above the 28th Avenue road cut. Five features were identified in the 28th Avenue road cut profiles, two on the north side at approximately 70 cm below the modern ground surface, and three on the south side of the road approximately 80 cm below the modern ground surface. Feature 5, on the north side of 28th Avenue, is approximately 4.3 m long and may be the remains of a structure or may be associated with Feature 7.
Feature 7 extends across 28th Avenue and is exposed in plan view. Feature 7 is approximately 20 m long and may be a midden remnant or remains of a structure associated with Feature 5. Eolian sands overlay the entire site and the hill margins show evidence of active erosion.

**Summary of Proposed Approach**

Major goals of the testing and data recovery investigations were as follows:

- Determine the nature and extent of buried cultural deposits at the sites to assist in the evaluation of eligibility.
- Determine the extent of buried cultural deposits in the APE beyond the site boundaries.
- Establish the chronology of the sites.
- Investigate features to determine site function and range of activities.
- Collect lithic samples to examine technological organization.
- Collect botanical samples from feature fill to determine economic activities.

The methodologies followed for excavation, data collection, and sample collection are set out in Chapter 4, Testing and Data Recovery Plan.

Dr. Stephen Hall of Red Rock Geological Enterprises conducted geological studies, including evaluation of the stratigraphy and identification of buried soils, in conjunction with the archaeological investigations. The geomorphic characteristics of the project area and the identification of buried paleosols and their association with prehistoric occupation of the area were integral to the formulation of sampling strategies for buried cultural deposits. To assist in dating, the geologist collected soil samples for Optically-Stimulated Luminescence (OSL) analysis.
CHAPTER 2
ENVIRONMENT

Natural Environment

The Paseo del Volcan corridor contains a linear arrangement of sites that stretch east-west for 6.8 km (4.2 mi) along 28th Avenue NE, between Unser Boulevard and Iris Road, in the city of Rio Rancho, Sandoval County, New Mexico. The project area is shown near the center of the Loma Machete 7.5-minute USGS quadrangle and is located within a desert scrub-grassland setting. The dominant landform in the area is the hill Loma Duran, less than a mile northwest of the project area and visible from most of the project corridor. The surrounding landscape consists of low rolling hills and ridges, with intermittent washes that flow to the southwest, towards the Rio Grande Valley.

Physiographic and Geologic Overview

The Paseo del Volcan project area is situated within a rolling section of the Llano de Albuquerque (also referred to as the Ceja Mesa, and locally as the West Mesa) along the west side of the Albuquerque Basin, in the middle part of the long Rio Grande Rift. The Rio Grande Rift is within the larger Basin and Range physiographic province, which covers large portions of the southwest and is characterized by narrow, uplifted mountain ranges that are separated by broad fault block basins; these basins and ranges run roughly parallel to one another in a north-south orientation (Hawley 1986). The Rio Grande Rift is a broad, elongated north-south trending topographic and structural depression or trough (Kelley 1977). The rift is composed of a series of broad fault-bounded basins (grabens), such as the Albuquerque Basin, in which late Cenozoic volcanic and sedimentary rocks accumulated (Connell 2008; Kelley 1969, 1977). The basins filled with sediments and lava flows from the surrounding landforms and after the southern Rocky Mountains and adjacent areas were strongly uplifted between about 7 and 4 million years ago (Chapin 1979), increased runoff from the newly elevated uplifts linked the basins to form a through-flowing drainage and the ancestral Rio Grande was formed between 4 and 5 million years ago. The river began eroding the trough-filled deposits into an inner valley between the flanking mesa rims.

The land flanking the Albuquerque Basin on the east is predominantly mountainous, with merging colluvial-alluvial fans and stream terraces sloping down and westward toward the Rio Grande. The geologic surface west of the river is ancestral Rio Grande alluvial deposits with isolated mountains and volcanoes. The west side of the Albuquerque Basin generally slopes up to the Llano de Albuquerque, a 68-mile-long geomorphic feature, which separates the Rio Grande and Rio Puerco valleys.
The mesa is a remnant of the broad floor of the Rio Grande rift and has since uplifted (Kelley 1969) and is now as much as 400 feet above the present floodplain of the Rio Grande. The Paseo del Volcan project area is located within this setting, on the east side of the Llano de Albuquerque. The landform extends north-south for approximately 110 km (68 mi), beginning south of the Nacimiento Mountains to near the confluence of the Rio Puerco and Rio Grande near Bernardo; it is about 19 km (12 mi) wide at its maximum width and extends east-west from the Rio Puerco to the Rio Grande (Fitzsimmons 1959; Dello-Russo 1999:29 [Ceja Mesa; Kelley 1977]). The Llano de Albuquerque is characterized by a series of north-south trending ridges resulting from parallel faults, with poorly consolidated sediments of the Santa Fe Group, carried to the area by the Rio Grande before it deepened its present valley, or recent gravel and sand washed from nearby mountains (Chronic 1987:51). The mesa contains a rolling topography of low ridges, incised arroyos, and tablelands; surface sediments consist mostly of eolian deposits, which form dunes or sheets that overlay the alluvial sands and gravels of the Santa Fe Group and later Quaternary deposits.

The sedimentary and volcanic fill in the rift basins, including the Albuquerque Basin, is referred to as the Santa Fe Group (Chapin and Cather 1994). Generally, the Santa Fe Group is composed of two subgroups—the lower Santa Fe sub-group is the deposition within the original internally drained basins of the rift, where streams from the emerging basin-margins uplifts terminated onto broad alluvial plains or into intermittent plays lakes and alluvial flats. The upper-Santa Fe group is usually defined as the later deposits related to the through-going axial fluvial drainage (Rio Grande) that linked the previously isolated basins of the lower subgroup (Chapin and Cather 1994). Santa Fe Group deposition ceased about 1 million years ago, when the Rio Grande and Rio Puerco began to cut their present valleys and incise into older basin fill. In the Albuquerque Basin, the top of the Santa Fe Group is marked by relict basin-floor surfaces, such as the Llano de Albuquerque (Connell 2008), and petrocalcic soils associated with this surface usually have advanced pedogenic carbonate morphology (Machette et al. 1997). The gravels of the Santa Fe Group, including recycled deposits of the gravels, and later secondary Quaternary fluvial deposits from upstream sources provided local deposits of quartzite, chert, Pedernal chert, petrified wood, basalt, and obsidian (Cole et al. 2007; Personius et al. 2000). These deposits were a source of lithic material for prehistoric groups on the West Mesa.

In the immediate vicinity of the project area, the topography is characterized by irregular hills and dendritic drainages, which have dissected the slopes of the mesa, carrying sediments into the Rio Grande Valley. Gravel deposits are exposed on ridge tops, whereas the arroyo bottoms contain reworked fluvial deposits overlain by eolian material. Areas dominated by fluvial processes often experience erosion of valley walls, exposing cultural deposits in the process (Bailey 2000:5). The dominant landform in the area is Loma Duran, which is located less than a mile northwest of the Paseo del Volcan corridor and reaches an elevation of about 5,820 ft (1,774 m) above-mean-sea-level (amsl). Within the corridor, elevations are highest at the west end, with a maximum elevation of 5,671 ft (1,729 m) amsl, compared to an elevation of about 5,400 ft (1,646 m) at the east end. Four sites (LA 126406, LA 126407, LA 126408, and LA 126409) are located on top of a low ridge; these sites are referred to by Phillips (2000) as the “intensively used sites of the Loma Duran Cluster”, which he describes as “clustered on top of a gentle ridge that crosses the project corridor between the Arroyo de los Montoyas and the Arroyo de la Baranca.” From here, the corridor drops off the ridge surrounding Loma Duran and descends a gradual slope to the east, eventually crossing the southeast-trending Arroyo de la Baranca, which is the primary drainage in the area. LA 126405 is located on an east-facing slope, and LA 55509 and LA 55507 are located along Arroyo de la Baranca. LA 55503 is located at the east end of the corridor in an area of flat low tablelands. There are no permanent water sources within the project area, no doubt an important
factor in prehistoric land use patterns along the Paseo del Volcan corridor. The Arroyo de la Baranca drains toward into the Rio Grande, approximately four miles to the southeast.

During the early and middle Pleistocene, sediments of the Santa Fe Group were eroded, forming the present-day topography. Erosional processes created two or more Pleistocene surfaces that grade southeast towards the Rio Grande Valley. These surfaces are defined by the presence of calcic paleosols, indicating the landscape was stable for long periods of time. During the Late Pleistocene, erosion from streams and wind continued, further modifying the landscape and creating low escarpments formed by resistant calcic paleosols and gravels. At the end of the Pleistocene (ca. 10,000 to 15,000 years before present [BP]), the erosional surface was covered with a deposit of eolian sand, which conformed with the Pleistocene topography. The current physical landscape within the project area, then, is a culmination of deposition of Santa Fe Group gravels, subsequent periods of erosion and fluvial and alluvial deposits during the Pleistocene, followed by the eolian deposition of a comparably thin layer of loose sand. In some limited areas, such as at a rise about ¼ mile west of the Arroyo de la Baranca, there is little in the way of eolian deposits and gravels are exposed on the surface (at LA 55507).

**Climate**

Overall, New Mexico has an arid to semiarid continental climate, characterized by high temperatures and high degrees of seasonal and topographic variation. The mean annual precipitation at the Albuquerque weather station for the years 1892-1994 is 8.49 inches (21.6 cm) (Tuan et al. 1973). In addition, the precipitation shows extreme variability from year to year; in Albuquerque the standard deviation of the mean annual precipitation for the above period is 2.59 inches (6.58 cm) (Dello-Russo 1999:37). On the West Mesa, however, precipitation may be slightly higher, possibly as high as 10 inches (25 cm) per year (Phillips 2000). Precipitation is greatest during winter and summer periods, with the rest of the year being extremely dry. Winter moisture arrives primarily in the form of snowfall deposited by large, slow-moving frontal systems that originate in the Pacific Ocean. Summer rains follow a monsoonal pattern, with moisture originating in the Gulf of Mexico and arriving in the form of intense convectional storms, which dump large amounts of water in extremely localized areas (Dick-Peddie 1993). Forty-three percent of all precipitation falls between July and September during these intense monsoon storms (Tuan et al. 1973), making overall precipitation highly variable and unpredictable. The geographic and temporal unpredictability of precipitation was most likely a limiting factor for prehistoric groups in the region, which would have been exacerbated by high degrees of evapotranspiration, limiting the overall moisture available.

Temperatures in the Albuquerque area range from less than 20°F in the winter months to over 90°F during the summer. January is the coldest month and July is the warmest; overall, variation is higher in the summer than the winter. Relevant to the project area, Tuan et al. (1973) note that “air drainage and temperature inversions are well developed on gentle piedmont fans” creating high degrees of localized temperature variations in regions such as the West Mesa. In the vicinity of the project area, the frost-free season is usually between 150 and 180 days, lasting on average from May 10 to October 10 (Bennett 1986). The period of highest precipitation begins approximately halfway through the frost-free season. Most likely, agriculture would only have been possible through the use of irrigation or a system designed to capture run-off. It is not surprising, then, that prehistoric groups concentrated their farming efforts along the Rio Grande floodplain, most likely using the West Mesa for a variety of foraging activities.
Vegetation and Fauna

Vegetation along the Paseo del Volcan corridor falls within the transition between Desert Grassland (sometimes referred to as desert savanna or desert-grassland transition) and Plains-Mesa Sand Scrub biotic communities (Dick-Peddie 1993), although some juniper are located in the surrounding area, especially on and around Loma Duran. Plains-Mesa Sand Scrub communities are found in dunal and deep-sand areas, with a large area located “on the west shoulder of the Rio Grande floodplain” (Dick-Peddie 1993:128). This biotic community is dominated by sand sagebrush and other shrubs and grasses, many of which are also found within Desert Grassland communities.

Despite the abundance of shrubs, the immediate vicinity of the project area is probably most accurately described as Desert Grassland, a biotic community that comprises a transition between desert scrubland and true grassland, as the name implies. Desert Grassland areas have been rapidly expanding in recent times at the expense of true grassland, possibly due to livestock grazing and other modern use; therefore, many areas containing Desert Grassland communities may have been true grasslands during prehistoric times (Dick-Peddie 1993). Black grama grass is the dominant species of the Desert Grassland community, but Dick-Peddie (1993) points out that areas dominated by sagebrush, saltbush, or other shrubs are sometimes referred to as Desert Grassland as well (such as within the Paseo del Volcan corridor).

In a study located near the current project area, Dello-Russo (1999) found two distinct vegetative communities, corresponding to different topographic settings. Plant Community 2 occurs on floodplains, alluvial fans, and dissected slopes bordering the Rio Grande Valley. It contains a grass-shrub mixture, with Indian ricegrass being the dominant grass species and sand sagebrush as the dominant shrub, followed by four-winged saltbush, ephedra, wolfberry, rabbitbrush, winterfat, broom dalea, broom snakeweed, and bush mint (Dello-Russo 1999). Plant Community 4 is found on sloping alluvial fans, mesas, and piedmonts and is likely more applicable to the Paseo del Volcan project area. This biotic community is dominated by black grama, but includes other grasses such as dropseed, blue grama, sacaton, bush muhly, and Indian ricegrass. Additional shrub species include broom snakeweed, broom dalea, various cacti, winterfat, catclaw, and numerous other shrubs. Previous studies along the Paseo del Volcan corridor (Phillips 2000) identified snakeweed, four-winged saltbush, Russian thistle, sagebrush, narrow-leaf yucca, prickly pear cactus, cholla, and various grasses within the project area. Within the project area a number of different microenvironments may be present, due to changes in elevation and topography.

Although the data are not conclusive, it seems likely that the West Mesa supported a more lush and diverse biotic community during prehistoric times, possibly containing a parkland of grasses and conifers (Phillips 2000). In early Holocene times, a cooler and wetter climate would have led to the parklands at lower elevations than today; during this period, the West Mesa may have supported ponderosa pine forest (Judge 1973). However, the Archaic period witnessed an overall gradual change to hotter and drier climates, with alternating periods of more xeric and mesic conditions. At the time of prehistoric occupation of the Paseo del Volcan corridor, the biotic community may have more closely resembled that of today, although it may have been more of a true grassland prior to historic grazing activity in the area.

Fauna within the project area include a variety of small and medium-sized mammals, reptiles, and birds. Resident mammals include various rodents, jackrabbit, cottontail, coyotes, badgers, skunks, and bats. Larger mammals that may occasionally travel through the area include antelope, mule deer, black bear, and bobcat (EcoPlan, Inc. 1990; Hink and Ohmart 1984 in Dello-Russo 1999:47). Other now-extinct
fauna, such as peccaries, dire wolves, and bison, may have existed during prehistoric times in the general vicinity of the project area.

**Soils and Stratigraphy**

Soils in the vicinity of the Paseo del Volcan project area consist of two major soil units as defined by the Natural Resources Conservation Service (NRCS). Soils along the Arroyo de la Baranca are of the Sheppard Series. The areas away from the drainage are of the Grieta Series, with a Grieta-Sheppard complex that transitions between the two areas. The Sheppard series consists of deep, loamy fine sand that formed in eolian material derived from sandstone. Sheppard soils are found on structural benches, alluvial fans, dunes on structural benches, and terraces on slopes of 3 to 8 percent in the project area. The Grieta Series are fine sandy loams formed in eolian deposits over fan alluvium derived from sandstone on slopes from 2 to 5 percent. Both soil series are found in the transition area from the arroyo to the flats. Both soil associations overlay sediments of the Santa Fe Group.

The following is a summary of the geological stratigraphy encountered within the project area based on analysis of mechanical trenches excavated both within and between sites. The description and evaluation of the stratigraphy were performed by Dr. Stephen A. Hall, a professional geologist with Red Rock Geological Enterprises. Dr. Hall’s complete report is attached as Appendix A.

**Recent Aeolian Loose Sand.** On most sites in the project area, eolian sand dominates the surficial geology (Photo 2.2) and upper stratigraphic zones. Where present, an 8-12-cm layer of strong brown (7.5 YR 5/6) quartz sand covers all underlying geological deposits. The sand is coarse-to-fine and generally poorly sorted; grains are rounded and lack secondary carbonate coats. These deposits are recent and most likely derive from historic deflation of modern arroyos where sand supply is abundant. No prehistoric archaeological deposits were found within this upper eolian level except at LA 55503, the eastern-most site in the project area, where the mantle is thin (~ 10 cm thick) and artifacts are present at the surface and within this thin mantle.

The only areas where the upper eolian loose sand does not completely mantle the surface is at LA 55507, where gravels and cobbles of the Santa Fe Group are exposed along the denuded hillslope of the surface prominent landform, and along the north edge of LA 55509, where the underlying red paleosol has been exposed by erosional processes in the north portion of the site. At LA 55507 artifacts are dispersed across the surface, and at LA 55509 artifacts are present on the exposed surface of the red paleosol. Within the past 2000 years at LA 55509, gullyng on the hillside eroded the red paleosol down to the underlying calcic horizon. Based on the presence of cultural deposits, the calcic surface was occupied prehistorically at this site. Subsequently, the calcic surface was buried by about 30 cm of eolian sand that is dated to 1,350 ± 150 years BP.

Within a berm along 28th Avenue, a layer of red aeolian sand measuring 11-22 cm thick is found below the ubiquitous loose brown sand. This level is yellowish red (5YR 5/6), poorly sorted, and coarse-to-fine in texture. The grains are rounded-to-subrounded and exhibit a weak coat of iron oxide that produces their yellowish color. Since this level is only found within the roadway berm along 28th Avenue, it likely represents displaced sediments derived from the underlying red paleosol.

A recent A horizon soil is found on top of the red paleosol and immediately beneath the displaced red sand (Photo 2.3). This level is 10-12 cm thick, is dark brown (7.5YR 4/4) in color, and has developed in very coarse-to-very fine quartz sand. As with the displaced red sand, it is found only within the roadway berm along 28th Avenue. This weak soil formed within aeolian sand in a landscape dominated by
grassland, probably during the historic period. Most likely, it has been removed by erosion and disturbance throughout most of the project area and is observed only within the roadway berm, where it has been protected by more recent eolian deposits of historic loose sand.
Late Pleistocene eolian sand and red paleosol. Throughout most of the project area and just beneath the recent eolian loose sand, the landscape is mantled by a 50-150 cm-thick layer of eolian sand that accumulated during the period between 10,000 and 15,000 BP (Photos 2.2 and 2.3). The sand is light brown (7.5 YR 6/4) and is composed of poorly sorted, fine-to-medium, rounded-to-subrounded quartz grains. This level has been severely bioturbated by insects and rodents. This Late Pleistocene eolian sand sits directly on the eroded surface of earlier Pleistocene calcic paleosols.

Most significant to the archaeological record, a red paleosol has formed within the top portion of the Late Pleistocene eolian sand sometime in the past 10,000 years. All subsurface archaeological deposits observed in the project area were found at the top of this red paleosol, which occurs at all the sites except LA 55507, where sediments from the Santa Fe Group are exposed on the surface (as noted above), and at LA 55503 at the far eastern end of the corridor, where the Late Pleistocene eolian level is much thinner and a poorly formed variant of the red paleosol has formed in the top portion. Overall, the red paleosol contains a yellowish red (5YR 4/6) Bt horizon with 10-15 percent clay and a whitened Btk/Bk calcic horizon with stage I carbonate morphology. The red color of the paleosol is the result of clay within the matrix and iron coats on the quartz sand grains. The paleosol exhibits weak ped formation and is nearly structureless. The formation of this paleosol should be seen as the key geomorphic event in the interpretation of archeological remains along the Paseo del Volcan corridor, as this horizon provided a stable surface for prehistoric activity and, therefore, contains all of the subsurface archeological deposits within the project area.

Pleistocene and older pre-archaeological deposits. Because no archeological remains are found below the red paleosol that formed in Late Pleistocene eolian sand, the underlying Pleistocene deposits will be only briefly described. For a more full description of the entire stratigraphic sequence, see Appendix A.

The Late Pleistocene eolian sand and red paleosol rest on the eroded surface of older Pleistocene paleosols and associated deposits. These horizons were observed near the bottom of most trenches in the project area, but they are found closer to the modern ground surface at LA 55503, where the red paleosol is poorly formed and much thinner.

Immediately below the Late Pleistocene eolian sand is a coarse yellowish sand and a stage II calcic paleosol made up of fine pink sand. This paleosol represents an old surface from a paleo-topography that differs from the present-day topography. Below this horizon is a much older Miocene-Pliocene paleosol, which was exposed only in trenches at LA 125405 and LA 55503. This horizon exhibits stage III carbonate morphology, with a matrix of quartz sand and unsorted pebbles, indicating the sediments originated as colluvium that may have once been an overlying surface of the Santa Fe Group. Solution pipes have formed within this horizon, possibly representing groundwater solution of carbonates during a time of wetter climate during one of the major periods of glaciation. Overall, the paleosol matches the soil morphology and topographic position of the Rincones surface in the northwest Albuquerque Basin, making it older than the Llano de Albuquerque surface (ca. 2.0-2.5 million years).

Optimally Stimulated Luminescence (OSL) Analysis

A number of sand samples taken from trenches within the Paseo del Volcan corridor were subjected to Optically Stimulated Luminescence (OSL) analysis, a new method of thermoluminescence dating that relies on laser light instead of heat to stimulate the sand grains. The amount of light given off is directly related to the amount of time the sample has been buried (or the age of the sample). OSL dating can be used to provide geochronology of deposits that are not readily datable by radiocarbon methods, with
eolian sand especially suitable for such dating. For a more complete description of OSL dating methods used during the Paseo del Volcan project, see Appendix A.

Wherever it occurs in the project area, OSL methods consistently date the Late Pleistocene eolian sand containing the red paleosol to 10,000-15,000 BP. The oldest OSL date for the eolian sand is 15,130 ± 1070 years BP, obtained from a trench at LA 55509; the youngest age of 11,210 ± 770 years BP derives from a sample taken from near the top of the eolian level, in a trench at LA 126407. All other OSL dates from the Late Pleistocene eolian horizon fall within this range, providing a consistent date range of 10,000-15,000 BP for the deposition of these sediments. A single OSL date of 130,000 ± 30,000 years BP for the Pleistocene stage II calcic paleosol that underlies this level should only be viewed as a rough estimate. These dates do establish, however, that archaeological deposits will not be found in these lower levels and are unlikely to occur within the Late Pleistocene eolian sand below the red paleosol.

Dating the red paleosol that occurs at the top of the Late Pleistocene eolian sand (and which contains intrusive archaeological deposits) is much more difficult. A linear regression of the depth versus OSL age (mid-point value) from samples at LA 126407 and LA 126409 indicates a net sedimentation rate of 10 cm of eolian sand deposition every 370 years. This suggests that sand was deposited slowly and continuously between 10,000 and 15,000 BP, an interpretation that is reinforced by the lack of any soils within the sand body, indicating there were no episodes of landscape stability during this period. Extrapolation of this regression line provides a date of 10,185 BP for the current top of the red paleosol. Based on stratigraphic analysis by geologist Stephen A. Hall, it is estimated that at least 30 cm of the red paleosol has been eroded, including the original A horizon.

Based on these interpretations, the terminal age of deposition of the original eolian sand would have been ca. 9000 BP. However, this should be viewed only as a rough estimate, as a number of uncertainties are contained within this analysis. Most importantly, it is not clear if pedogenesis resulting in the red paleosol occurred throughout or only during part of the Holocene. However, the fact that the A horizon of the eolian sand is missing implies that the red paleosol may have formed in the early or middle Holocene, with subsequent erosion of the surface occurring later in the Holocene (ca. 5000-6000 years ago).

**Geomorphic and Geoarchaeological Interpretations**

The following is a brief summation of the geologic history that has led to the current stratigraphy within the Paseo del Volcan corridor. This sequence is ordered from oldest to youngest.

1. Erosion of the Rincones surface in the northwestern Albuquerque Basin, stage III calcic paleosol development on the eroded surface, and subsequent erosion of this paleosol <2.5 million years ago.
2. Late Pleistocene eolian sand deposition, surface stability and stage II calcic paleosol development, and subsequent erosion of this paleosol 15,000 to over 100,000 years ago.
3. Late Pleistocene eolian sand deposition 10,000 to 15,000 years ago.
4. Landscape stability and formation of red paleosol at the top of the eolian sand after 10,000 years ago.
5. Erosion of the top of the red paleosol and prehistoric occupation of this eroded surface after ca. 9000 BP (prehistoric occupation likely occurred after 6000 BP).
6. Short-lived landscape stability leading to the formation of a weak A horizon in the past 200 years, followed by partial erosion of this horizon and the deposition of a thin layer of loose eolian sand. Although the red paleosol was identified at most of the trenches across the project area, the stratigraphic sequence is spatially variable across the Paseo del Volcan corridor. More simply, the eight sites in the project area are not identical geomorphologically, and the above interpretations cannot be equally applied to all sites.

The complete geomorphic sequence described above (including the recent A horizon and the displaced sand associated with the roadway berm along 28th Avenue) is found at the four sites (LA 126409, LA 126408, LA 126407, and LA 126406) located on top of the ridge at the west end of the corridor and at LA 126405, located on the east-facing slope between this ridge and Arroyo de la Baranca. Collectively, these sites are referred to as the Loma Duran Cluster. They contain a 90-170 cm-thick layer of Late Pleistocene eolian sand and a well formed red paleosol, although the paleosol is more yellow in color at LA 126405. The paleosol is especially thick at LA 126406 (170+ cm), and the underlying calcic horizons do not appear in the mechanical trenches. At LA 126405, the stage II calcic horizon that normally underlies the eolian sand is not present; most likely, it was completely removed by erosion due to its position along the slope. At all of these sites, archaeological features occur only at the top of the paleosol and are intrusive into the truncated surface of the red paleosol, indicating that prehistoric activity took place on a surface after the paleosol had formed.

The remaining three sites contain geomorphic variations on the above sequence. LA 55509 sits on a low south-trending ridge on the east side of Arroyo de la Baranca. At the north end of the site, sheet erosion has removed the overlaying loose eolian deposits, exposing the red paleosol and associated archeological deposits. In the southern part of the site, shallow gully erosion has removed the entire red paleosol down to the underlying whitened calcic horizon, where archeological deposits are now located in an extremely deflated condition. This surface has subsequently been buried by additional eolian sand removed from the northern part of the site. The result is a complicated and spatially variable stratigraphy, with mixing of cultural deposits from different temporal affiliations.

Slightly further east, LA 55507 occupies the top and southwest slope of a prominent hill formed by resistant gravels of the Santa Fe Group and the adjacent basin where colluvium has collected. In this dynamic geologic setting, Santa Fe Group gravels and cobbles are exposed on the surface, and artifacts relating to lithic procurement are either found on the surface or shallowly buried at the base of the slope. This area contains no red paleosol and none of the horizons summarized above. At the east end of the corridor, LA 55503 sits in a swale on a low gradient. Here, the recent loose eolian surface layer is present, but the red paleosol is absent in many areas; where it occurs, it is poorly formed and yellowish in color. The underlying Pleistocene calcic horizons are very close to the surface at this location, and no archaeological deposits are intrusive into the paleosol.

The above exceptions aside, some clear patterns in the geomorphic record emerge, with clear implications for the interpretation of the sites along the Paseo del Volcan corridor. Clearly, towards the end of the Pleistocene (between about 10,000-15,000 BP) homogenous layers of eolian sand were deposited on top of earlier eroded surfaces. After this depositional process, the topography has remained similar to today, evidenced by the undulations of stratigraphy in the trenches, which follow the modern-day topography. Around 9,000-10,000 BP, the area stabilized, eolian deposition ceased, and a red paleosol and weak calcic horizon formed at the top of the eolian sand. It is possible that this stabilization of the landscape corresponded with the Pleistocene-Holocene transition. It is not entirely clear, however, when and how
quickly this paleosol developed, although extrapolation of OSL dates suggest it may have formed by ca. 9000 BP.

Following this period of stability, the paleosol began to erode, with as much of 30 cm of it eventually being removed. Again, how quickly this process occurred in unclear, but erosion most likely took place between 9000 and 6000 BP. During or after this process, the eroded surface of the paleosol was occupied by prehistoric groups, evidenced by the numerous features intruding into the truncated surface of the paleosol. A composite schematic of the entire stratigraphic sequence is shown in Figure 2.1.

However, this interpretation leaves several questions unanswered. For example, it is not clear if prehistoric groups were occupying a stable or erosional surface, and it seems possible that erosional processes continued during and after prehistoric occupation, removing some of the features. This raises the possibility that the current truncated surface of the red paleosol does not represent the prehistoric living surface, which is supported by the lack of depth of many features and the low number of artifacts present. Also, it should be noted that if up to 30 cm of the red paleosol were removed by erosion (including the entire A horizon), earlier archeological deposits could easily have been removed as well. Assuming that the paleosol surface was stable by 9000 BP, any subsequent Early Archaic or later occupation of the area would likely have been removed when the top of the paleosol was eroded away.

Clearly, the processes of eolian deposition, erosion, and redeposition have created a complicated stratigraphic record where the normal laws of superimposition cannot necessarily be applied and must be informed by a geological framework for the area.

Figure 2.1: Schematic Representation of Stratigraphy at Loma Duran Sites in Project Area
Summary

A careful analysis of the geomorphic record combined with OSL dating has provided valuable information on the complicated stratigraphy along the Paseo del Volcan corridor that otherwise would not have been revealed. Prehistoric occupation in the project area has resulted in limited-activity sites, which produce features that often contain very few artifacts or macrobotanical remains, and sometimes none at all. In addition, the features contain little intact charcoal; the charcoal that does exist is usually juniper, creating an “old wood” problem and making interpretation of radiocarbon dating difficult and sometimes unreliable. While archaeological investigations are normally intended to supply information on chronology and various behavioral research issues such as subsistence strategies and technology of prehistoric groups, the limited remains obtained from features along the Paseo del Volcan corridor have made it difficult to address these research domains. In such cases, shifting some of the in-field focus to the geomorphic record is a valid approach for maximizing the information obtained from such sites. As many projects are plagued by similar problems of limited archaeological remains (especially on the West Mesa where limited-activity sites are the norm rather than the exception), the methods outlined in this chapter may be useful in the interpretation of such archaeological occupations.

Two significant geoarchaeological observations for this area of the West Mesa are apparent:

1. Most of the sites in the project area contain either very few or no surface artifacts as a result of the layer of loose eolian sand, which has been deposited fairly recently (in historic times) and has covered archeological deposits with overburden approximately 8-12 cm thick. Features are only visible in road cuts or in trenches, and most were not identified until the entire layer of recent eolian sand was removed by mechanical equipment. Thus, in areas with high eolian activity, such as the West Mesa, archaeological remains may not reveal themselves on the surface, and additional investigation may be required to identify and delineate sites during survey and testing phases.

2. It appears that up to 30 cm of the red paleosol has been removed by erosion (including the entire A horizon) throughout much of the project area, and that most archeological deposits were removed as well and only the basal remnants of features remain. Identification of the extent of this unconformity is important in future archaeological data recovery investigations on the West Mesa for the efficiency and success of any research design.

Cultural Environment

The project area is bounded by 28th Avenue, a graded dirt road, on the south, and open undeveloped lands to the north. The Sandoval County landfill is near the east end of the project area. At the time of the archaeological investigation, little residential or commercial development had occurred in the immediate project area. Since 2005, the project segment of Paseo del Volcan has been constructed and is open to traffic. Other development includes a civic arena and new municipal building as part of Rio Rancho’s new master planned downtown area (City Center). Paseo del Volcan will provide access to City Center as well as the rapidly developing portions of northern Rio Rancho.
The culture history of the West Mesa extends back for at least 11,000 years. However, the mesa was peripheral to most of the cultural developments along the Rio Grande and areas to the west and was never the site of large-scale prehistoric habitation. Throughout prehistory, use of the area was primarily ephemeral or transitory in nature, leaving behind an archaeological record consisting of mostly “limited activity” sites and making the construction of a strict cultural chronology of the area problematic. Despite these difficulties, a detailed culture history is essential for placing these sites into the larger context of prehistoric land use on the West Mesa.

The following discussion is an attempt to integrate the data collected on the Paseo del Volcan project into the culture history of the West Mesa and synthesize the previous archaeological investigations that have been conducted in the area, particularly the proliferation of recent projects that have resulted from the rapid development in the Rio Rancho area. Cultural chronologies of the Middle Rio Grande Valley tend to overlap, with various, and often incongruent, classifications used by different researchers. For the sake of clarity and coherence, the following discussion divides the Archaic period into Early, Middle, and Late and employs the Rio Grande Classification of Developmental, Coalition, and Classic for the Ancestral Pueblo period. However, any discussion of the Archaic in northern New Mexico is indebted to the work of Irwin-Williams (1973), and her Oshara Tradition sequence is retained to some degree. The additional phases proposed by Reinhart (1968) for the Middle Rio Grande Valley are also discussed, and Pecos Classification periods (i.e., Pueblo I, Pueblo II) are provided when necessary, in order to provide clarity to the discussion.

**Paleoindian Period (ca. 11,500 - 7500 B.P.)**

The Paleoindian period represents the earliest human occupation of the New World and is believed to have begun by 11,500 B.P. throughout North America. This period was a time of environmental transition, bridging the end of the Pleistocene glaciations and the transition to Early Holocene conditions, which included the period of megafauna extinction. General attributes of the Paleoindian period are lanceolate projectile points, distinctive lithic material and technology, and a subsistence strategy predicated on high mobility and large game hunting. The following discussion is based largely on the pioneering work of Judge (1973), as well as more recent research in the area by Huckell (2000, 2002). A chronological outline is first presented, with the period subdivided into Clovis, Folsom, and Late Paleoindian (Plano) Complexes, followed by a discussion of site location patterns, as they relate to the Paseo del Volcan corridor.

Although the Clovis Complex is the earliest cultural sequence generally accepted by American archaeologists, dates from a few sites in both North and South America suggest a pre-Clovis occupation. However, some of the early dates are not widely accepted; for example, a proposed ca. 12,000-37,000 B.P. occupation of Pendejo Cave near Orogrande, New Mexico, is not generally accepted by southwestern archaeologists (Chrisman et al. 1996; but see Farrand 2005). Sandia Cave, located in the Sandia Mountains 15 miles northeast of Albuquerque, was touted as containing pre-Clovis materials (Hibben 1955). Questions later arose regarding stratigraphic associations within the cave and reinvestigations have not demonstrated that the artifacts are pre-Clovis, and “the finds are generally viewed with considerable skepticism” (Cordell 1979:10). Hermit’s Cave, located in the Guadalupe Mountains of southeastern New Mexico and excavated in 1938 by C. B. Schultz and E. N. Ferdon of the University of Nebraska (UN) (Ferdon 1946) and again in 1955 by UN and the West Texas Museum of
Texas Technical College (Schultz and Martin 1970), has been proposed as older than Clovis as well. Sebastian and Larralde (1989:30) suggest that Hermit’s Cave should be counted “among those possible but not undisputed cases of very early human occupation of the New World [emphasis in original].”

Recent investigations of sites in Virginia (Cactus Hill), South Carolina (Topper Site), and Chile (Monte Verde) do seem to reveal intact cultural deposits that date before 13,500 B.P. (Madsen 1999; Collins 2005). The site of Meadowcroft Rockshelter in Pennsylvania, for which controversial pre-Clovis claims have been advanced and dismissed for decades, is once again a candidate for representing much older occupations (Hadingham 2004; National Park Service 2005:4).

Recently, Waters and Stafford (2007) have reexamined 11 sites with Clovis artifacts in secure geological contexts, and obtained AMS radiocarbon dates for five previously imprecisely dated sites. The dates from those sites and other precisely dated sites reflect that non-Clovis sites contemporaneous with Clovis exist in both North and South America. Given the time it would have taken to spread across the continents, the contemporaneous dates imply that Clovis does not represent the earliest occupation of the Americas. Waters and Stafford (2007) argue that stone tools and butchered mammoth remains dating to \(~12,500\) \(^{14}\)C at the Schaefer and the Hebior sites in Wisconsin, older butchered mammoth remains dating to \(~13,500\) \(^{14}\)C at the Mud Lake site in Wisconsin, and the \(~12,500\) \(^{14}\)C occupation at Monte Verde indicate pre-Clovis inhabitants in the Americas and they call for a new model of the peopling of the Americas. Thus, numerous questions remain unanswered regarding the earliest occupation of the Americas. Although earlier occupations of the New World seem likely based on the recent evidence, no such sites have been conclusively dated in the southwest, where Clovis (at Lehner, Arizona and Murray Springs, Arizona) remains the earliest universally accepted occupation.

**Clovis Complex (ca. 11,500 to 10,500 B.P.)**

The Clovis Complex is defined by the distinctive Clovis projectile point, which is a large, bifacial, lanceolate point with a concave base and a flute that is normally bifacial and tends to extend only a short distance up the point (Cordell 1979). Clovis points exhibit heavy basal and lateral grinding. Other Clovis artifacts include transverse end scrapers, side scrapers, knives, gravers, and a variety of bone tools. Clovis lithic technology relies almost exclusively on chert, procured from a small number of sources, meaning that lithic material was often transported long distances from its source. The Clovis Complex appears to have focused largely on the hunting of now-extinct Pleistocene megafauna, particularly mammoth. Although paleoenvironmental conditions on the West Mesa during this period are largely unknown, Huckell (2002) argues that the megafauna extinction was likely already underway when Clovis groups reached the area. The Clovis period was most likely a time of warming temperatures and dryer conditions, leading to the reduction of glacial lakes, lower water tables, and reduced stream flow by 11,000 B.P. (Huckell 2002:4). Around 11,000 B.P., however, “a short, sharp return to near-glacial temperatures and moisture conditions known as the Younger Dryas occurred” (Huckell 2002:4); this period lasted until ca. 10,000 B.P. and may have been a time of rising water tables, leading to the temporary refilling of many of the glacial lakes. Other researchers (Holliday 2000), however, argue that the Younger Dryas was a time of episodic droughts. It is clear that additional research is necessary in order to establish a reliable environmental reconstruction of the Clovis period on the West Mesa and elsewhere.

In this environmental context, the traditional argument has been that Clovis groups relied primarily on hunting of megafauna (based on the common association of mammoth remains with Clovis artifacts), with the subsequent extinction of such species leading to the establishment of a new lithic tradition.
(Folsom). However, the remains of other, smaller, animals and a variety of plants have also been found at Clovis processing stations (Cordell 1979:19), and the ubiquitous presence of mammoth remains at Clovis sites may be partially the result of an overrepresentation of kill sites and an underrepresentation of campsites in the archaeological record. In addition, Cordell (1979:19) points out that bones of large mammals are more likely to be preserved than plant remains, and “tools associated with the killing and processing of large game are more distinctive and likely to be preserved than tools associated with the harvesting and processing of plants.” Although Clovis groups most likely relied heavily on the hunting of mammoth and other megafauna, their subsistence strategy clearly relied on the procurement of other resources, which may be less visible in the archaeological record.

Clovis sites have been found throughout the United States in a variety of geographic settings. The type site for the Clovis Complex—Blackwater Draw Locality No. 1—is located on the Llano Estacado in eastern New Mexico, near the town of Portales. The site is located in a gravel pit that initially revealed Pleistocene fossils and also contains overlying later cultural deposits, including Folsom, Agate Basin, and Cody Paleoindian components (Boldurain and Cotter 1999). Closer to the project area, the Mockingbird Gap site is a significant Clovis campsite located approximately 30 miles southeast of Socorro, New Mexico (Weber and Agogino 1968). However, archaeological investigations have revealed very little evidence of Clovis remains on the West Mesa or within the Middle Rio Grande Valley. During his extensive survey of the Middle Rio Grande Valley, Judge (1973:74) found only one Clovis site, one “locality,” and “a number of isolated finds of Clovis points.” The single site was a large campsite located “on a very low shelf separating two shallow arroyos” (1973:255). Cordell (1979:11) cautions that the lack of additional Clovis remains may be attributable to the “site pattern recognition” sampling strategy used by Judge, which relied on identifying environmental correlates of known Paleoindian sites and investigating such locations. Cordell (1979:17) goes on to point out that Paleoindian sites in general are likely underrepresented in the archaeological record due to geological processes that tend to obscure remains, low site visibility due to low population density, and problems of site recognition. However, recent surveys conducted in the Petroglyph National Monument (Brandi 1999) and in the vicinity of the Albuquerque volcanoes (Huckell 2002) have also failed to identify Clovis sites. Both of these surveys (as well as Judge’s) identified numerous Folsom and Late Paleoindian sites, and it presumably the problems outlined by Cordell would apply to these periods as well. It remains possible that geomorphic preservation and sampling strategies have served to obscure the Clovis record, but increasing evidence suggests that the West Mesa and Middle Rio Grande Valley may not have been heavily used by Clovis groups.

**Folsom (Midland) Complex (ca. 10,500 to 9500 B.P)**

The Folsom period is marked by the arrival of a new diagnostic projectile point and a shift to a subsistence strategy based primarily on the hunting of *bison antiquus*. Folsom points are lanceolate, fluted on both sides for the length of the point, and basally concave; they normally have basal ears, exhibit grinding in their lower portion, and are smaller than Clovis points (Cordell 1979:12). Midland points are similar in size but are thinner and lack fluting; they are thought to be contemporaneous or temporally overlapping with Folsom. Judge (1973:164) found that 84 percent of Folsom points in his survey were of chert, jasper, or chalcedony, “with only a slight preference for chert.” This suggests that there was a shift away from the transportation of high quality, distinctive chert from distant sources toward exploitation of locally available material during the Folsom period. Folsom sites have yielded a variety of other tools, including end scrapers, bifacial knives, and denticulates, with side scrapers and bone tools slightly less common than in Clovis assemblages (Cordell 1979:12).
Climatically, the early part of the Folsom period corresponded with the Younger Dryas, during which numerous small playas may have contained water. However, around 10,000 B.P., the climate became warmer and dryer with the onset of the Holocene (Huckell 2002:5). The combination of a decrease in effective moisture and the apparent extinction of the megafauna led Folsom groups to target migratory herd animals such as bison (Stuart and Gauthier 1981:31), which were now the dominant species on the grasslands of the southwest. This change in climatic conditions and hunting strategies led to a distinct pattern in site location and landscape use during the Folsom period. Judge (1973:193-196) reports that 73 percent of Folsom sites in his survey were found near playas, usually on a gentle slope north or east of the playa, with all sites near a topographic overview that provided a view of the “hunting area.” Judge (1973:196) interprets this data to mean that Folsom groups camped downwind from hunting areas and “would either wait for the animals to come to water, or possibly drive them towards the playa area where they could be surrounded and killed.” Huckell (2002:26) also found Folsom locations existing near playas on the West Mesa, although he cautions that although Judge assumes the playas contained water, this fact “remains to be demonstrated,” and he points out that trenching at the playa at Boca Negra Wash suggests that “no permanent lake ever existed here” (2002:23). It seems likely that during the early Folsom period associated with the Younger Dryas, many playas did contain water, making these desirable locations for people and fauna alike. As the climate became warmer and dryer with the onset of the Holocene, many playas likely dried up; however, any that retained water would have been especially desirable locations as effective moisture decreased, and even those that became dry may have contained more favorable vegetation for bison or may have been used as hunting “traps” for topographic reasons. Regardless of whether most playas contained water, it seems clear that topographic features such as playas and arroyos were often used by Folsom groups to trap or surround bison herds during hunting.

Unlike the Clovis period, many Folsom sites have been found in the Middle Rio Grande Valley and on the West Mesa. The first Folsom site excavated in the Middle Rio Grande valley was the Rio Rancho Folsom Site, which contains five distinct loci scattered along 350 m of an east-west trending ridge near a playa (Dawson and Judge 1969). Activities represented at this base camp include weaponry manufacture and maintenance, meat processing, hide processing, and tool manufacture (Huckell 2002:8). In his extensive survey of the Middle Rio Grande Valley, Judge (1973:163) recorded 15 Folsom sites and 14 “localities,” some of which were located on the West Mesa. The Petroglyph National Monument inventory resulted in the discovery of two Folsom sites on the West Mesa (Brandi 1999). Finally, recent work by Huckell and Kilby (2003) has focused on the Boca Negra Folsom site, located along Boca Negra Canyon on the West Mesa; this site is located near a playa that Huckell (2002:23) believes may have contained a more luxuriant plant community that would have been attractive to bison. In addition, Huckell’s (2002:15) survey in the area of the Albuquerque volcanoes revealed an additional Folsom site (Deann’s Site), although he was unable to relocate three Folsom sites recorded by Judge which fell within his survey area. Other Folsom sites have been reported on the West Mesa, and it seems clear that this area was heavily used by Folsom groups.

Late Paleoindian Complexes (ca. 9500 to 7500 B.P.)

Late Paleoindian times are marked by the proliferation of regional traditions and complexes containing non-fluted projectile points, whose chronological associations are not entirely clear. Collectively, these complexes are often referred to as the Plano Complex. Judge (1973) divides points from this period into the Laterally-Thinned Series (including Plainview, Belen, Fredrick, and Milnesand), the Constricted Base Series (Agate Basin and Hell Gap), and the Indented Base Series (Firstview and points of the Cody Complex). The Plainview Complex is usually thought to exist on the southern plains from 10,000 to 7500
B.P. (Irwin-Williams 1979), possibly in association with Firstview, while Hell Gap and Agate Basin are found on the northern plains at this time. A hiatus of approximately 1000 years has often been proposed between Folsom and Cody Complex occupations for the Middle Rio Grande Valley based on the lack of Firstview and Hell Gap points (Cordell 1979:16). However, Judge (1973) reports finding both Plainview and Agate Basin points in isolated settings, although he does not elaborate. Belen points may also serve to fill in this gap, a type that Judge proposed as a separate localized complex, specific to the Middle Rio Grande Valley. Belen points are non-fluted, laterally thinned, have a slight basal concavity, and are similar in style to Plainview points (Cordell 1979:16). Judge viewed them as distinctive for both typological (1973:69) and site location (1973:226-230) reasons. He recorded nine Belen sites and four “localities” and found their locations to be less often near playas but more often at “hunting overview” locations than preceding Folsom sites (Judge 1973:224-225). Despite some morphological differences, Huckell (2002:6) states that Belen “seems more likely to be a variant of Plainview” than a separate complex, and when discussing a Plainview point found during his survey, he notes that “if this specimen had been found by Judge, he would have classified it as Belen,” while his assignment of Plainview reflects his opinion that “Belen is most likely a regional variant of a geographically widely distributed, lanceolate, concave-based point type” rather than a separate Paleoindian complex (2002:16). Regardless of whether Belen represents a separate complex or a local Plainview variant, these points, along with Plainview specimens identified on the West Mesa near the volcanoes (Huckell 2002) and within Petroglyph National Monument (Brandi 1999) indicate that the area was used by Paleoindian groups between the Folsom and Cody periods.

The Cody Complex is nearly universally accepted as the terminal Paleoindian occupation in the southwest and is defined by the presence of Eden and Scottsbluff points and the distinctive Cody Knife. Cordell (1979:17) places the beginning date for the Cody Complex at 8550 BP; Judge (1973:74) reports an average date of 9448 BP for the three Cody sites in his survey that were excavated, although he places them at the end of the Paleoindian sequence and calls the date of 8590 BP for the Hell Gap site “broadly representative of the Cody occupation.” Judge (1973:72) recorded five Cody sites and four “localities” in his survey, with four of the sites containing Eden points and the other site defined by the presence of a Cody Knife; Cordell (1979:16) reports one additional Cody site (the R-6 Site, located northwest of Sapello, New Mexico) in the Middle Rio Grande Valley. A basal fragment of a Cody (Eden) point was recovered at LA 124756 within the Petroglyph National Monument, on the West Mesa (Brandi 1999).

Judge (1973:245) found that Cody sites were far less likely to be located near playas than sites from the proceeding periods and that the nearest water source was usually a stream or arroyo rather than a playa. Cody sites were also more likely to be found in steep or broken terrain and further from hunting “overlooks.” By Cody times, effective moisture may have decreased to the point that none of the playas contained water; thus, they no longer attracted bison, and hunters were forced to pursue herds in other locations and situate their camps near reliable water sources such as streams. Another distinguishing characteristic of Cody is that it appears to represent a specialized, large-scale bison-hunting adaptation; kill sites contain an average of 128 bison compared with 15 for Folsom (Cordell 1979:21), and Judge (1973) notes that Cody points appear specially designed for piercing functions. By 7500 B.P., Paleoindian adaptations came to an end, as groups were either replaced by or evolved into more generalized hunter-gatherers associated with the Archaic period.

**Paleoindian Site Locations and the Paseo del Volcan Corridor**

The above research provides a detailed view of typical Paleoindian site locations, which can be applied to the topographic and geologic setting along the Paseo del Volcan corridor. Specifically, Paleoindian sites
are most often found near playas (especially during the Folsom period), and no playas are located in the immediate vicinity of the project area. However, numerous Paleoindian sites have been found in other settings, such as along ridges and near streams or arroyos, especially during later occupations. The Paseo del Volcan corridor contains numerous low ridges and is bisected by the fairly substantial Arroyo de la Baranca, which intermittently flows southeast across the project area. It is important to note that the red paleosol that occurs at many of the sites in the Paseo del Volcan project area most likely formed during the Paleoindian period, and analysis of the regression line based on OSL dating provides a date of 10,185 B.P. for the current top of the red paleosol. Based on stratigraphic analysis by geologist Stephen A. Hall, it is estimated that at least 30 cm of the red paleosol has been eroded, including the original A horizon. Based on these interpretations, the terminal age of deposition of the original eolian sand would have been ca. 9000 B.P, during the Folsom or Late Paleoindian period. Once again, this should be viewed only as a rough estimate, as a number of uncertainties are contained within this analysis. However, it seems likely that a stable soil was present during the Paleoindian period, much of which may have eroded away based on the current truncated surface. The presence of the paleosol itself may be significant; when describing both of the Paleoindian sites Huckell (2002:15) located in the area of the Albuquerque volcanoes, he notes that “the sand within which the site is located has a well-developed soil, suggesting that it had been in place since the late Pleistocene.” Although no Paleoindian artifacts were recovered during the Paseo del Volcan project, the possible presence of Paleoindian occupations at these locations should not be ruled out.

The Archaic Tradition

The Archaic culture history of southwestern North America has been divided into the Oshara (Irwin-Williams 1973, 1979), Cochise (Sayles and Antevs 1941; Sayles 1983), and Chihuahua (MacNeish and Beckett 1987) regional traditions. The most widely used chronology for north-central and northern New Mexico has been the Oshara Tradition. This tradition was defined by Irwin-Williams (1973) on the basis of survey and excavation work in the Arroyo Cuervo portion of the Rio Puerco drainage, to the northwest of the current project area. Irwin-Williams (1973) proposed a series of phases for the Archaic based on changes in projectile point types and settlement patterns. This sequence is rooted in the view that the phases represent an in-situ development leading to the more complex manifestations of the Ancestral Pueblo period (Irwin-Williams 1973).

The Oshara Tradition chronology and sequence has gained wide use, and its phases are commonly used by archaeologists to assign temporal and cultural affiliations at all levels of research. However, the data from the Arroyo Cuervo project have never been fully published, and the phases are based on very few chronometric dates (Anschuetz 1995). Reinhart (1968) developed a more localized Archaic cultural chronology specifically for the Albuquerque/Rio Rancho area. The Reinhart (1968) sequence includes the Atrisco (pre-1000 B.C.), Rio Rancho (1000 B.C.—A.D.1), and Alameda (A.D. 1—550) phases. However, due to the paucity of independent dates from secure depositional contexts (Vint and Cook 1999) to support the phase dates, this sequence has not been widely accepted and applied to the area.

Because of the problems associated with both the Oshara Tradition and Reinhart’s sequence for the area, Huckell’s (1996) more generalized framework for Archaic culture history will be used in this research. The broad divisions used by Huckell (1996) are: Early Archaic (8000—5500 B.P.), Middle Archaic (5500—3500 B.P.), and Late Archaic (3500—2000/1500 B.P.). Since the Irwin-Williams chronology and terminology have been extensively used since the 1970s and is the most familiar for many researchers, each of her phases will be discussed and related to the Huckell framework. Because the
Reinhart systematic is a local sequence and is directly applicable to the project area, those phases will also be mentioned. Of course, the entire discussion is presented with the caveat that all phase-based chronologies and “normative” interpretations of prehistoric cultural development contain inherent problems, and that such systems tend to overlook important sources of variability in the archaeological record (Cordell and Plog 1979).

**Early Archaic Period (8000—5500 B.P.)**

Huckell (1996) uses the appearance of ground stone artifacts in the archaeological record around 8500—8000 B.P. to mark the beginning of the Archaic period, although both the date at which Archaic developments began and how these developments came about are in question. Irwin-Williams (1973, 1979) argued that because the Paleoindian Period and the Archaic “differ so greatly in technology, typology, and functional classes”, the 500-year gap between the occupations in the Rio Puerco Valley indicate that big-game hunters had left the region in response to the onset of the Altithermal and were replaced by an influx of new populations with a suite of Archaic traits. However, other researchers (Cordell 1979, 1984; Stuart and Gauthier 1981; Judge 1982) have suggested that the proposed hiatus may not, in fact, exist and that Archaic adaptations likely developed out of the preceding Paleoindian period in response to changing environmental conditions. Vierra (1994) points out that a better understanding of Cody and other Late Paleoindian manifestations in northern New Mexico is required in order to address this issue. Regardless of whether the shift from Paleoindian to Archaic represents migration of new populations or indigenous shifts in adaptive strategies, the results are the same. At about 8000 B.P., there was a shift to a broader, more generalized hunting and gathering strategy, with an increased emphasis on wild plant resources and small-game hunting.

The Early Archaic period incorporates the Jay and Bajada phases of Irwin-Williams’ (1973) Oshara Tradition, which she originally dated to 7500-6800 B.P., and 6800-5200 B.P., respectively. The Jay phase is characterized by the presence of large, shouldered projectile points, lanceolate bifacial knives, and well-made side scrapers; sites were located primarily in sheet sand deposits on cliff tops and near canyon heads. Sites included base camps, limited-activity locations, and quarries. Irwin-Williams (1973) argued that the archaeological evidence from this period suggested mixed-spectrum hunting and gathering, adapted to year-round local resources that were most concentrated along permanent water sources. Judge (1982), on the other hand, argued for a more focal economy, similar to that of Paleoindians but focused on modern fauna. Anschuetz (1995) notes that many researchers have associated the overall lack of ground stone with a subsistence strategy that was not yet focused on seed resources. However, Wiens (1994) found that ground stone was often present on Jay sites on Gallegos Mesa near Farmington, indicating a broad-spectrum economy with the common exploitation of seeds. Wiens (1994) dated Jay sites on Gallegos Mesa to 7950—6970 BP.

The Bajada phase (6800-5200 B.P.) is characterized by projectile points that are smaller than Jay points and contain a concave base. This phase is roughly contemporaneous with the Altithermal, a long period of warmer and dryer climate conditions and widespread arroyo cutting (Antevs 1983). Settlement patterns were similar to the Jay phase, although sites were generally more numerous; a development Irwin-Williams (1973) believed to be an indication of increased population. Anschuetz (1995) attributes the greater number of sites to increased mobility and settlement instability during the period. Base camps continued to be located primarily at canyon heads, and small cobble-filled hearths and earth ovens were common features (Irwin-Williams 1973). In addition to Bajada projectile points, the tool kit included well-made side scrapers and bifacial knives, as well as an increased use of chopping tools and irregular
flakes, which may indicate increased vegetative consumption. Overall, however, the Bajada phase is usually viewed as representing considerable continuity with the Jay phase.

Research has shown that Early Archaic sites are common throughout the southwest, although they occur less frequently than Middle Archaic sites (Huckell 1996). Jay and Bajada points have been found throughout northern New Mexico and the San Juan Basin (Chapman 1977; Wiens 1994; Vierra 1994). Jay and Bajada points were found on the OLE project (Turnbow 1997), located north of the West Mesa, and both Anschuetz (1995) and Vint and Cook (1999) report Early Archaic sites on the West Mesa. A few Early Archaic components are also listed in the site records compiled by Crollett et al. (1995) for the Albuquerque area, but these reports seem to indicate that Early Archaic sites are rare in the area. Although Jay and Bajada points have been found on survey, there is a general lack of securely dated Early Archaic deposits from excavations on the West Mesa, and none of the sites along the Paseo del Volcan corridor contain Early Archaic components. However, geomorphological analysis reflects a paleosol identified across much of the project area that may have formed by 9000 BP, and any subsequent Early Archaic or later occupation of the area would likely have been removed when the top part of the paleosol was eroded away.

**Middle Archaic Period (5500—3500 B.P.)**

During the Middle Archaic, regional differences tend to blur (Huckell 1996), and the number of different projectile point types increases. Common Middle Archaic projectile points in northern New Mexico include San Jose, Pinto, Gypsum, Armijo, and Elko. During this period, a wider variety of resources were exploited, base camps became larger and more intensively used, and settlement patterns became more complex. Near the end of the Middle Archaic period, cultigens were introduced into the subsistence strategy for the first time. The presence of simple structures associated with this period was first noted by Irwin-Williams (1973); pit structures have now been dated to as early as 4000-4500 B.P. in a variety of locations, including the Rio Grande Valley north of Albuquerque (Huckell 1996). Extramural features include basin-shaped hearths, roasting pits, storage pits, fire-cracked rock concentrations, and ground stone caches (Huckell 1996).

The Middle Archaic period includes the San Jose phase (5200—3800 B.P.) and part of the Armijo phase (3800-2800 B.P.), as defined by Irwin-Williams (1973). It also subsumes Reinhart’s (1968) Atrisco phase. Although Irwin-Williams put the beginning of the San Jose phase at 5200 B.P., other researchers have reported San Jose points as early as 5500 B.P. (Justice 2002) or 5600-5900 B.P. (Del Bene and Ford 1982). Regardless of the exact date, the San Jose phase appears to have corresponded with the end of the Altithermal and the onset of a period of improved environmental conditions and increased moisture, leading to greater predictability of floral and faunal resources and more reliable water sources (Vint and Cook 1999). The San Jose phase also witnessed significant changes in technology and settlement patterns.

The San Jose projectile point has a straight-to-expanding stem, concave base, and is often characterized by basal and lateral grinding, heavy resharpening, and serration (Justice 2002). This point exhibits technological continuity with Bajada, and some temporal overlap is therefore expected (Justice 2002:135). San Jose points are also morphologically similar to the Pinto type, which is usually considered to be primarily a Great Basin variety; numerous researchers (Huckell 1996; Justice 2002) have pointed out the difficulty in differentiating between the two types. The San Jose phase tool kit includes a larger proportion of choppers, poorly made side scrapers, and utilized flakes, while bifacial knives and
well-made side-scrapers become rare (Irwin-Williams 1973). The addition of shallow basin-shaped grinding slabs and cobble-lined roasting pits suggests a trend towards a mixed foraging subsistence base. Irwin-Williams (1973) noted an increased number of sites and larger base camps during the San Jose phase, although sites continued to be located near canyon heads. Artifact densities and the number of features increased from the preceding Bajada phase, suggesting a more formalized use of space, longer-term occupation of sites, and an increase in the size of groups, and perhaps greater overall population in the region (Vint and Cook 1999). Although sites became larger and more complex, there is no evidence of seasonal or functional differentiation at base camps (Irwin-Williams 1973). Although the Armijo phase begins in the Middle Archaic period, it will be discussed with other Late Archaic manifestations, as the changes in adaptation (including the adoption of agriculture) and the questions surrounding the chronology of this phase are more easily addressed within the Late Archaic context.

Although Middle Archaic sites are common in much of New Mexico, particularly the Puerco Valley (Irwin-Williams 1973), few have been excavated on the West Mesa. Kovacik (1998) reports one Late Bajada/Early San Jose site and two San Jose phase sites from excavations along the proposed Northwest Loop roadway corridor on the western edge of the West Mesa. These sites contain average radiocarbon dates of 4190 B.P., 3770 B.P., and 3480 B.P. Although the occupation of one of these sites likely extends into the Late Archaic, the other two sites are firmly dated within the San Jose phase. Brandi and Dilley (1998) excavated one site in Rio Rancho that yielded radiocarbon dates from the very end of the Middle Archaic period (3820-3780 BP), and the occupation appears to extend into the Late Archaic (Armijo phase). Along the Paseo del Volcan corridor, LA 126409 is the only site with a definitive Middle Archaic component. Although one feature yielded a later Ceramic period date, five features contain radiocarbon dates ranging from 5340 B.P. to 4330 B.P., which places the site securely within the Middle Archaic period (San Jose phase). At the early end of this range, Feature 12 contains three separate dates between 5340 and 5120 B.P. Features 13, 27, and 33 yielded radiocarbon dates that cluster in the 4800 B.P. to 4300 B.P. period. These dates are corroborated by the recovery of a San Jose projectile point from cultural deposits, providing multiple lines of evidence for a Middle Archaic occupation at this site.

Late Archaic Period (3500—1500 B.P.)

The Late Archaic period in north-central and northern New Mexico subsumes most of the Armijo phase and all of the En Medio phase of the Oshara Tradition, as well as the Rio Rancho and Alameda phases proposed by Reinhart for the Rio Grande region. This period has long been referred to as Basketmaker II under the Pecos Classification, and the En Medio phase correlates to a local Basketmaker II adaptation. It is contemporaneous with the San Pedro phase of the Cochise Archaic tradition of southern Arizona and New Mexico, and some researchers (Gerow 1998; Justice 2002) have applied the San Pedro term to northern New Mexico as well. Irwin-Williams (1973) noted that the earliest cultigens were introduced toward the end of the Armijo phase (3800—2800 B.P.). Basketmaker II has been recognized as the earliest agricultural period on the Colorado Plateau since the early 20th century (Matson 1991), and subsequent research has pushed the Basketmaker II period back to at least 3500 B.P. (Smiley 1994). Recent research has confirmed that agriculture was introduced to various parts of the southwest, including northern New Mexico, by at least 3500—4000 B.P. (Huckell 1996). Due to the significant changes in subsistence, settlement systems, and organization caused by the introduction of agriculture, Huckell (1996) has recommended using the term “Early Agricultural” to refer to sites that fall chronologically within the Middle Archaic or Late Archaic period but contain evidence of early cultigens. Huckell (1996) also suggests that because many groups likely continued practicing an
“Archaic” hunting and gathering lifeway, the term “Late Archaic” should be retained for cultural manifestations lacking evidence of agriculture.

The introduction of Mesoamerican cultigens to the southwest has been the focus of much research (e.g., Berry 1982; Ford 1984, 1985; Huckell 1995; Matson 1991; Smiley 1994; Wills 1988, 1995). Matson (1991) argued that the lack of evidence of Late Archaic occupation in areas of abundant Basketmaker II/Early Agricultural sites suggests that domesticates were introduced to the southwest by migrants from the south. Berry (1982) also saw migration as the stimulus for the adoption of agriculture, which he believed caused a sudden and drastic change in subsistence strategies. However, most recent research (Minnis 1985; Wills 1988, 2005; Vierra 1994) has argued for a gradual adoption of agriculture through diffusion and only modest immediate changes in subsistence patterns. Part of the migration/diffusion discussion has centered on the “Cochise intrusion” argument (Cordell 1979), which suggests an influx of people from the southern southwest to the Colorado Plateau during the Late Archaic. The discussion is further confounded by the observation that the Albuquerque area appears to have been, at times, intermediary between the Oshara and Cochise traditions (Anschuetz 1995). Regardless of how and precisely when agriculture entered northern New Mexico, the adoption of cultigens led to significant changes in settlement patterns. Most notably, it may have involved a transition from residential to logistical mobility (Wills 1988). It also led to increased sedentism, greater labor commitment to storage features, the creation of surpluses, and shifts in lithic technological organization (Huckell 1996).

As noted above, the Late Archaic period includes the Armijo and En Medio phases of the Oshara Tradition, as well as Reinhart’s Rio Rancho and Alameda phases. Irwin-Williams (1973) noted that the Armijo phase (3800-2800 B.P.) witnessed the most significant changes in land use patterns of the Archaic period, including the adoption of cultigens and the development of seasonal patterns of aggregation (Irwin-Williams 1973). Base camps were located on cliff tops and in canyon head environments; they tended to be more concentrated than San Jose examples, with evidence of structures, large thermal features, and patterned activity areas. Specifically, Armijo Shelter—located in a cliff base overhang—contained evidence of multiple living floors and large cobble-filled ovens, indicating repeated occupation by relatively large groups (Irwin-Williams 1973).

The tool kit for the Armijo phase includes the Armijo projectile point, which is similar to the San Jose but contains a shorter stem and/or flaring ears. Some researchers (Turnbow 1997) have proposed numerous subgroups for the Armijo type, while others (Huckell 1996; Justice 2002) have noted that the Armijo may simply be a smaller variant of the San Jose. Gypsum and Elko points are also common during the Armijo phase. San Pedro points have also been noted at early agricultural sites from this period, such as the San Luis de Cabezon village in the Puerco Valley (Gerow 1998). The Armijo phase contains a wider variety of tool classes than previous phases, particularly an increase in ground stone types, suggesting an increased reliance on gathered seeds, as well as maize (Vint and Cook 1999).

The En Medio phase dates from 2800 B.P. to 1600 B.P. (800 B.C-A.D. 400); it is the terminal phase in the Oshara Tradition, and Irwin-Williams (1973) believed it contained the clearest evidence of Ancestral Pueblo continuity. En Medio projectile points are often used to identify the Basketmaker II period on the Colorado Plateau, and this phase bridges the transition from Archaic to Ancestral Pueblo in the Pecos Classification. The En Medio phase is characterized by the presence of formal structures, large storage pits, and increased sedentism. Canyon heads and cliff tops were largely abandoned, and large seasonally occupied sites were found on dune ridges and along washes for the first time (Irwin-Williams 1973). Rockshelters continued to be used and contained formal slab-lined storage pits (Anschuetz 1995). Overall land use patterns became more diverse, although overall mobility was likely reduced. A wide
variety of ground stone tools were developed, including large basin metates, slab and trough metates, and two-hand manos.

The diagnostic En Medio projectile point is large, with deep corner notches and prominent barbs (Turnbow 1997). Lithic technological organization shifted from largely curated to expedient technology, which may also indicate increased sedentism (Parry and Kelley 1987). Although Irwin-Williams also included the Trujillo phase (A.D. 400-600) in the Oshara Tradition, both ceramics and the bow and arrow appear in this period, and these technological innovations are usually used to mark the onset of the Ancestral Pueblo period. Therefore, the Trujillo phase is not discussed in this report as part of the Archaic section. Reinhart’s (1968) Rio Rancho phase is largely consistent with the En Medio phase; however, it is characterized by more evidence of formal architectural remains and the intermixing of San Pedro with En Medio projectile point types. These differences may be due to his small sample size or may represent local variation in the Albuquerque area.

Late Archaic sites have been found in nearly all portions of the Colorado Plateau (Huckell 1996). At Cochiti Reservoir, Biella and Chapman (1977) report radiocarbon dates of 3100, 2620, and 2540 B.P. from excavated Archaic features. The Office of Contract Archaeology (UNM) report numerous Late Archaic/Basketmaker II sites (both camps and more permanent residences) dating to the 500 B.C.-A.D. 500 period in the Puerco Valley, associated with the Hawk-Rio Puerco Project (Gerow 1998). As noted above, a large pithouse village (San Luis de Cabezon) dating to 3800-3200 B.P. has also been excavated in the Puerco Valley (Gerow 1998). In addition, Irwin-Williams (1973) found evidence of continued habitation at Armijo Rockshelter throughout the Late Archaic period.

Closer to the Paseo del Volcan project area, numerous survey and excavation projects have reported sites dating to the Late Archaic period on the West Mesa. At Shooting Range State Park, Rodgers and Neal (1981) found Archaic sites to be the most common cultural/temporal affiliation. Using Reinhart’s classification scheme, they recorded Atrisco, Rio Rancho, and Alameda phase sites, with Rio Rancho phase (3000-2000 B.P.) sites being the most numerous. Many of these sites were found in sand dunes or along dissected terraces, similar to the topographic setting of the Paseo del Volcan project area. Rodgers and Neal (1981:122-123) summarize their findings by stating that the Llano de Albuquerque was extensively used between 4000 and 1500 B.P. (during the Late Archaic period), and that after A.D. 1, dissected terraces were used as seasonal residences. They also observed that local West Mesa chert and Ceja chalcedony (likely both transported Pedernal chert that has been exposed on remnant Santa Fe Group terraces) were procured at a number of quarry sites (Rodgers and Neal 1981:123), a pattern that is similar to activity at LA 55507 in the current project area.

Excavations conducted by Keystone Environmental and Planning along the proposed Albuquerque-Rio Rancho Northwest Loop corridor that extends through the Paseo del Volcan project area yielded numerous Late Archaic period radiocarbon dates from three different sites. Many of these dates cluster in the En Medio phase (specifically 900 B.C.-A.D. 500), although some are from the Middle Archaic as well (as discussed above). Of 48 radiocarbon dates obtained, none date to earlier than 2850 B.C. or later than A.D. 335-660 (Kovacik 1998). There are no dates between approximately 1800 B.C. and 800 B.C. (corresponding to the Armijo Phase), causing Kovacik to speculate that there may have been a settlement hiatus on this portion of the West Mesa, before a reoccupation during the En Medio phase. Kovacik (1998) points out that this clustering of dates is consistent with radiocarbon dates obtained from nearby projects (Gerow 1999).

Brandi and Dilley (1998) obtained radiocarbon dates from 11 sites in Unit 22, Rio Rancho, all of which date to the Late Archaic period; most of these sites contain structures and are interpreted as semi-
permanent residences. Seven of the sites contain dates from the Armijo phase, with radiocarbon intercepts ranging from 3655 to 2780 BP (Brandi and Dilley 1998). These dates were obtained from roasting pits, hearths, structures, and “activity areas” (Brandi and Dilley 1998). Eight of the sites exhibit En Medio phase dates, with radiocarbon intercepts ranging from 770 B.C. to A.D. 90. These dates were obtained from similar contexts, and many of the sites contain features from both periods (Brandi and Dilley 1998), suggesting significant settlement continuity throughout the span of the Late Archaic period on the West Mesa. Dates from the Late Archaic are also present from the Mariposa Project about 1.5-2 miles north of the Paseo del Volcan sites (Lundquist, personal communication 2007) and from sites on 30th and 34th Avenues immediately north of the project area (McCullough, personal communication 2009), although these data have not yet been published. These dates demonstrate that the West Mesa was extensively used during the Late Archaic and reflects that many of the previously excavated sites with secure dates are located in topographic contexts similar to the Paseo del Volcan corridor.

Within the current project area, two sites (LA 55509 and LA 126406) contain components that date to the Late Archaic period. Feature 2 at Site LA 55509 yielded a series of radiocarbon dates ranging from 2760 B.P to 2540 B.P., placing this site within the early portion of the En Medio phase. A San Jose projectile point recovered at this site may represent incidental discard or reuse by Late Archaic occupants. It should also be kept in mind that this site is located in a highly dynamic eolian geomorphic setting, which has caused significant mixing of cultural material; the San Jose projectile point was located on the surface in an area of the site that also contained glaze ware ceramics. Three features from LA 126406 yielded radiocarbon dates ranging from 3370 B.P to 3050 B.P., which would place the site in the early part of the Late Archaic period (within the Armijo phase). These features cluster within a fairly tight date range and are likely a reliable indicator of the temporal association of the site. Significantly, the topographic location and geomorphic setting of these sites are consistent with previous research in the area, which suggests that Late Archaic occupations are often found on dune ridges (Irwin Williams 1973), on eroded surfaces (Anschuetz 1995), or along dissected terraces (Rodgers and Neal 1981). Such consistency suggests that geomorphic setting can often be used to identify cultural materials in areas such as the West Mesa.

**Ancestral Puebloan (A.D. 400–1540)**

For the Rio Grande Valley, two cultural sequences have been used to describe post-Archaic cultural developments. The first sequence is the Pecos Classification (Kidder 1927), which includes Basketmaker III, Pueblo I, Pueblo II, Pueblo III, and Pueblo IV periods. It was designed to provide a general framework for organizing data pertaining to Southwestern prehistory. The next sequence was formulated specifically for the Rio Grande Valley by Wendorf and Reed (1955). The Rio Grande sequence includes Developmental, Coalition, Classic, and Historic periods. For post-Archaic developments the following discussion is organized in terms of the Rio Grande sequence, with corresponding dates provided for the Pecos Classification. This overview briefly summarizes major developments and can be supplemented with regional syntheses such as those by Stuart and Gauthier (1981) and Cordell (1997).

The beginning of the Ancestral Puebloan Tradition is characterized by the culmination of several trends that first emerged during the En Medio phase of the Late Archaic period. Ancestral Pueblo populations continued to grow dramatically, and this accelerated population growth may have fueled the further development of these earlier trends. Characteristics of the Ancestral Puebloan Tradition include greater sedentism, architectural and sociopolitical developments, the emergence of ceramic technology, and an increasing dependence on agriculture, as well as the planned storage of agricultural products. The
proliferation and stylistic evolution of Ancestral Puebloan ceramics has further defined the chronological placement of these sites. For the northern Rio Grande Valley of New Mexico, Wendorf and Reed (1955) place the beginning date for ceramics at around A.D. 600. Irwin-Williams (1973) places this date to sometime between A.D. 400-600. In the northern Rio Grande, the Ancestral Puebloan tradition generally is divided into three time periods: the Developmental period, the Coalition period, and the Classic period (Wendorf and Reed 1955).

**Developmental Period (A.D. 400–1200)**

The early part of the Developmental period dates from A.D. 400 to 900, and is contemporaneous with the Late Basketmaker III and Early Pueblo I periods of the Pecos Classification (Kidder 1927). During the Basketmaker III period, Ancestral Puebloan populations adopted two crucial technologies: the bow and arrow and ceramics (Cordell 1979). In this part of the Developmental Period, reliance on hunting and gathering continued with a greater reliance on agriculture. Regionally, the most significant settlement trend to emerge during this period was the appearance of aggregated, sedentary pithouse villages and a shift in site location. Despite their paucity, Early Developmental settlements in the upper Rio Grande were generally larger than communities of previous periods, with some settlements found north of Santa Fe containing between five and 20 pithouses. These pithouses generally lack the architectural complexity of their San Juan Basin counterparts (Cordell 1979). In the northern Rio Grande region, Early Developmental period settlements are found along the first stream terraces of intermittent tributaries of the Rio Grande and on foothills overlooking drainages, gravel bluffs, and hilltops (Anschuetz et al. 1997; Cordell 1979). Artifact assemblages of this time period include ceramics (Lino Gray, Lino Black-on-Gray, San Marcial Black-on-white, polished redwares, and brownwares), basketry, beads, groundstone implements, arrow points, and expedient tools.

Sites dating to this period appear to be less common in the vicinity of the project area than in the Guadalupe area to the north. Corresponding with climatic change, site locations demonstrate a shift into broader valley bottoms, alluvial terraces, or first benches of rivers (Irwin-Williams 1973; Tainter and Bagley-Tainter 1995). Surface evidence suggests that these sites lacked substantial surface architecture. What little excavation data is present indicates sites were relatively small, typically consisting of one to 15 pit structures or crude surface rooms (Irwin-Williams 1973; Gerow 1998). Even the larger numbers of structures at some sites may be the result of overlapping household occupations (Gerow 1998:11), rather than increased village size.

The Late Developmental period (A.D. 900 to 1200) correlates with the Pueblo II and Early Pueblo III periods of the Pecos Classification (Anschuetz et al. 1997; Kidder 1927). Regional settlement patterns, local architecture, and site size characteristics, all changed during this part of the period. The most notable phenomenon in this period was the transition from pithouse to pueblo architecture. In the northern Rio Grande, this was initiated with the construction of a row of surface jacal storage rooms behind a single residential pithouse, sometime afterwards the surface rooms were transformed into domestic residences, and the pithouses were modified into subsurface ritual structures. This transition was not uncomplicated, and in some localities pithouses continued to be constructed and used as residential units for generations to come, including in the Albuquerque area.

Large pueblos first develop in the Chaco Canyon area, and in the surrounding area a system of Chacoan great houses or outliers develops. Aggregates of small pueblo sites, interpreted as communities, are arranged around many of these Chacoan sites. Guadalupe Ruin, located in the Rio Puerco valley some 50 km (31 mi) northwest of the project area is the nearest identified Chacoan outlier site. In the Middle Rio
Grande, relatively shallow pit houses continue as the most common structural type, and were perhaps still occupied only seasonally. However, deeper pithouses have been excavated in the Corrales area (Campbell 2002) and elsewhere and may have represented year-round occupations.

Ceramics were often locally-made copies of San Juan or Mogollon types. The hallmark ceramic type of the period is Red Mesa Black-on-white, which occurs on sites in the Albuquerque area and is often associated with San Marcial Black-on-white. Populations remained relatively sparse, although considerable increases in the numbers of sites in the Rio Puerco and Jemez River Valleys characterize this period. Late Developmental period settlements are also found on the piedmont overlooking the Rio Grande and Santa Fe River floodplains (Dickson 1979). The growth of settlement in these locations highlights the focus on river valleys and is interpreted as further evidence of increases in population size and dependence on agriculture.

Artifacts dating to Pueblo II have been found on several sites in the area, and a handful of sites appear to contain Pueblo II components. Pit structures of this time period in the Albuquerque area have standardized floor features, four post roof supports, ladder holes, ash pits, and sipapus (Cordell 1979:44). Considerable continuity in architecture and artifacts from earlier periods is indicated. Limited faunal evidence suggests that jack rabbits, cottontail, and deer were primary game resources. Most Pueblo II sites in the area are located on low terraces and hills west of the Rio Grande. Fire-cracked rock and burned areas are common.

**Coalition Period (A.D. 1200–1325)**

The Coalition period is contemporaneous with the Pueblo III and Early Pueblo IV periods of the Pecos Classification (Kidder 1927). The beginning of the Coalition period in the northern Rio Grande is archaeologically identified by the replacement of mineral with organic paint for ceramic decoration. The diagnostic type for the period is Santa Fe Black-on-white; however, local potters produced a variety of other types. Many of the Coalition period ceramic types stylistically resemble ceramics from Chaco Canyon and the northern San Juan Basin. Some other types, specifically Galisteo, Pindi, and Poge Black-on-white, were stylistically derived from Mesa Verde ceramics (Anschuetz et al. 1997; Wendorf and Reed 1955). Trade ware types, such as St. Johns Polychrome and Wingate Black-on-red, entered the Northern Rio Grande region from the Little Colorado River area of east-central Arizona.

Ancestral Puebloan population levels increased substantially during the Coalition period, and the Puerco Valley seems to have been an area of population growth, particularly around Guadalupe Ruin. The eastern side of the West Mesa appears to have been relatively well settled as well, with sites located next to arroyos and in the volcano area. The western part of the West Mesa has been thought of as a more sparsely settled area that was primarily used for hunting. The presence of dispersed fields and field houses at this time suggests agricultural expansion (Nordby 1981). This expansion was facilitated in part by ongoing developments in water management techniques, such as check dams, cobble terraces, and reservoirs, which allowed people to inhabit areas and produce crops in cool, dry locales (Anschuetz et al. 1997). By AD 1400 Puebloan populations had vacated the Puerco Valley for settlement and instead concentrated in the Rio Grande Valley.

**Classic Period (A.D. 1325–1600)**

The Classic period corresponds with the mid-to-late Pueblo IV period of the Pecos Classification (Kidder 1927). The development of large nucleated Pueblos and full dependence on agriculture are the hallmarks of Pueblo IV. In the project area, settlement is concentrated in the Rio Grande valley, although use of the
West Mesa continues. Red slips and lead-based glazes are common traits of Pueblo IV ceramics in the Middle and Southern Rio Grande. Elaborate forms of material culture such as wall murals, decorated pipes, and stone effigies also appear in the record. Sites nearest to the project area are the large pueblos of Kuaua Ruins, Alameda Pueblo, and Pueblo Santiago located near the Rio Grande. Pueblo IV artifacts and structures are found on the West Mesa, indicating use of this area for habitation (at least temporarily) and resource gathering.

The agricultural expansion observed during the Coalition period intensified, and by the Classic period Ancestral Puebloan populations in some areas had adopted irrigation technologies. Field houses became more common, and the agricultural fields for which they were constructed were increasingly distant from the main pueblos. The overall image projected is of a few aggregated, compact, and defensive pueblos. By A.D. 1450, raiding by Plains Indians may have resulted in the abandonment of many of the large pueblos. By A.D. 1450, Pecos Pueblo became a major trade center for Plains buffalo meat and Rio Grande ceramics and agricultural products (Nordby 1981; Viklund 1988).

In the Paseo del Volcan project area there is some evidence of Classic Period use of the area. A C\(^{14}\) date of AD 1300 – 1420 from a thermal feature at LA 126409 and two Glaze A sherds at LA 55509 reflect Puebloan use of the area, although there is no indication of Classic period habitation structures in the project area.
CHAPTER 4
RESEARCH DESIGN

Previous Research

The research design for this project was developed within the framework of the models proposed by David Phillips (2000) for study of sites along the Paseo del Volcan corridor, and within a cultural ecology theoretical perspective. Phillips (2000) models are presented in *Archaeological Testing Plan For 25 Sites Along The Paseo Del Volcan Corridor, Bernalillo and Sandoval Counties, New Mexico* (NMCRIS No. 75333). That plan included all of the sites in the current study as well as other sites in the corridor that are beyond the APE of the current project. That plan was further developed and refined for the current undertaking by Campbell (2005) and Raymond (2005).

Phillips (2000) identified three distinct clusters among the 25 sites proposed for testing under his plan. He developed specific research contexts for each cluster, based on spatial patterning, site attributes, and some basic assumptions surrounding links between site attributes and past activity. These three clusters included:

- Group 1: Lithic Procurement Sites of the Arroyo Venada Site Cluster
- Group 2: Early Intensively Used Sites of the Loma Duran Site Cluster
- Group 3: Campsites Along Arroyos of the West Mesa

Group 1 was originally defined for sites outside the limits of the current undertaking; however, LA 55507 is an area with large amounts of Santa Fe gravels available on the surface that exhibited the same characteristics of Phillips’ Group 1. Group 2 included five sites, LA 126405-126409, all of which were included in the current plan. Group 3 was originally defined to encompass sites outside the current project area; however, LA 55503 and 55509 were in close proximity to Arroyo de la Baranca and exhibited some campsite characteristics as described as Phillips.

A summary of the characteristics of the three site groups is presented below. These are primarily taken from Phillips (2000) and Campbell (2005). Due to the lack of surficial evidence at five of the sites, a portion of the research plan was directed toward determining the nature of these sites, partly to verify that the sites were placed in the appropriate group as defined by Phillips and that the research context was valid for the sites. Once those characteristics were established, questions regarding the chronology, subsistence-settlement patterns, and technological organization were addressed. The plan also allowed for the recovery of materials with the potential to inform on other issues.

**Group 1 Sites: Lithic Procurement Sites of the Arroyo Venada Site Cluster**

Group 1 was originally defined as a series of sites clustered at the northeast end of the Paseo del Volcan corridor, near the US 550 junction. As described by Phillips (2000):

> “These sites are located in a hilly area, with small ridges and knolls drained by the Arroyo la Venada. Natural deposits of cobbles and pebbles are common on the hills; some of those deposits are mantled by a thin layer of aeolian sand but others are visible in areas deflated by wind and water erosion. Much of the exposed stone is fine-grained silicate material, usually chert grading into chalcedony.”
The sites in this group tend to be larger than average for the corridor, but according to Phillips’ (2000) observations, low-density. Almost all of the surface remains consist of flaked stone derived from the local deposits – tested pieces, core fragments, core reduction flakes, and shatter. Other items (such as pottery, ground stone, or formal flaked stone tools) are rare. The primary function of each site appears to have been procurement and initial reduction of flaked stone. The sites may have had other functions (e.g. hunting/foraging base, food processing location) but these were secondary and minor.

No staining was identified in any of the sites in Group 1. While none of Phillips’ Group 1 sites are within the current project area, LA 55507 displayed similar characteristics and was examined under this framework.

**Group 2 Sites: Early Intensively Used Sites of the Loma Duran Site Cluster**

Group 2 includes LA 126405-126409, all of which were treated under the current plan. Four of the sites (LA 126406-126409) are clustered on top of a gentle ridge that crosses the project corridor between the Arroyo de los Montoyas and the Arroyo de la Baranca. The fifth site (LA 126405) is on the east slope of the ridge. All the sites are similar in terms of their geomorphic context and known remains. Phillips (2000) describes the geomorphic setting of the sites as follows:

> “On the ridge, an older red sand is capped by a younger tan sand; the known remains occur on the older sand and are entirely capped by the younger sand. It is not yet possible to date the sand strata bracketing the archaeological remains – indeed, this should be one goal of the testing program – but the following sequence can be tentatively described for the area. First, the older red sand formed; then, a period of nondeposition/erosion ensued, during which the prehistoric occupation took place; finally, the younger tan sand was deposited over the archaeological remains, creating today’s ground surface. Given this sequence, the archaeological remains seem likely to predate the Late Archaic, and could conceivably be as old as Paleoindian.”

Phillips (2000) goes on to state that the mantle of overlying sand has completely obscured the underlying archaeological sites, except where they have been exposed in road cuts. Road cut exposures include stains ranging from small, well-defined areas (likely hearths) to larger, more diffuse stains that may represent more intensively used areas. Artifacts are rare and when found are on the surface and not likely associated with the features. Stains are found in the older red sand layer and appear to have been relatively stable through time. Phillips (2000) proposed that the Loma Duran cluster represents “an early, intensive, and often-repeated occupation of a ridge top on the West Mesa”. As he states, this ridge top may have been a seasonal base camp for a single group, which varied the exact location of the camp from time to time.

**Group 3 Sites: Camp Sites Along Arroyos of the West Mesa**

Group 3 was originally defined as a series of spatially disparate sites located along the various arroyos in the project area. Phillips hypothesized that these sites represent the campsites of people traveling from the Rio Grande to the West Mesa in search of natural resources. Sites vary somewhat in their location, from benches next to washes to ridges overlooking (and further from) the washes. Phillips (2000) states that these differences may be temporal/cultural, or functional.

Remains at these sites typically occur within the younger, tan sand layer, and are often exposed in blowouts. Fire cracked rock is common and soil stains do occur, indicating the presence of hearths, but
much of the fire cracked rock is scattered, suggesting many hearths have been destroyed through eolian reworking of the sand deposits. Phillips’ (2000) overall impression is of a series of short-lived campsites, possibly used on several occasions, presumably occupied during hunting or foraging trips to the West Mesa.

Dating of these sites is based on only a few diagnostic artifacts. The most common identification is Pueblo III Anasazi, although other identifications include unspecified Anasazi, and possible Archaic and Paleoindian. The two sites within the current project that fall within this Group, LA 55503 and 55509, contained differences in their surface assemblages, and were thought to have different occupation periods. LA 55503 contained several sherds of sand-tempered grayware, indicating a Developmental Period (AD 600-1200) occupation. LA 55509 contained both a San Jose projectile point (3200-1800 BC) and a Rio Grande Glaze A sherd (AD 1325-1500). The site recorders (Raymond et al. 2005) assigned a Middle to Late Archaic (5500 – 1800 BC) date to the site, which is consistent with the original recording (Hogan 1986). However, the presence of a Classic Period sherd may indicate a later puebloan component as well.

**Research Domains**

In the original research design and data recovery plan, several research domains were identified to test the Phillips (2000) models of the sites. The research domains included topics relating to chronology to address the culture history of the West Mesa and as well as larger issues of systemic adaptations to the local environment. The research domains are: 1) chronology and stratigraphy, 2) site function, 3) subsistence and mobility strategies, and 4) technological organization.

Testing and data recovery at the eight sites resulted in four sites—LA 126406, LA 126409, LA 55507 and LA 55509—being determined eligible for the NRHP, and data recovery was completed at those sites. The remaining four sites—LA 126405, LA 126407, LA 126408, and LA 55503—did not contain sufficient information to address the research questions and were determined to be not eligible to the NRHP. The following discussion focuses on how the research domains were applied to the four eligible sites.

**Chronology and Geoarchaeology**

Of the four eligible sites, none were assigned a temporal or cultural affiliation during the original surveys, although LA 55509 were thought to be Archaic based on the lithic assemblage and the lack of ceramics. LA 55507 was thought to have been used from Archaic through Puebloan times as a source of lithic raw material. Phillips (2000) postulated, based on the presence of thermal features on an “older red sand”, that the buried features at the Group 2 sites (LA 126406 and LA 126409 in this project) predated the Late Archaic, and could conceivably be as old as Paleoindian. However, secure dates for these sites were unknown. Therefore, an important goal of the research was to determine the temporal/cultural affiliation of the sites in order to provide a temporal context for the other information recovered from the sites and to allow diachronic comparisons. This was accomplished for three of the four eligible sites through the use of radiocarbon dating of feature fill in coordination with optically-stimulated luminescence (OSL) dating of the sand layers and geoarchaeological interpretations. The information is important, not only for assigning temporal and cultural affiliations at these sites, but also to expand knowledge at the regional level and contribute to the development of a synthesis of prehistoric adaptive strategies on the West Mesa through time.

An important element of this study is a study of the geology and soils of the project area to understand the chronology, the site formation processes, and other geoarchaeological issues. Phillips (2000) states that
dating the sand strata bracketing the archaeological remains should be one goal of the testing program. When the prehistoric occupation surfaces were identified and exposed at the Loma Duran sites (Group 2 sites), it was found that erosion has displaced most, and in some cases all of the artifacts at the sites and had truncated the thermal features. These conditions significantly compromised the information potential of the sites and limited the research issues that could be addressed. On the other hand, intensive geoarchaeological research at the sites has resulted in information that can be used to guide future research programs that may allow more efficient use of research resources.

Site Function

Questions as to site function usually involve the description of the nature and range of activities carried out at a location and site type, rather than ultimate questions of behavior grounded in a theoretical approach. However, because site function is the result of crosscutting dimensions of the behavior and strategies that occurred at a site, it is a useful tool for examining the role that a site played in a particular adaptive system or sub-system (Fletcher 1994; Fletcher and Irwin 1994). Thus, understanding the role of a site in the adaptive system is fundamental to the examination of variation in systemic strategies such as subsistence, settlement and mobility patterns and technological organization. Interpreting site function requires delineating the nature of behavior and the range of activities conducted at sites. Hypothesized site functions were presented by Phillips (2000) for each of the three groups of sites in this study based on his general observations drawn from descriptions of the sites in survey reports.

The presence of tested cobbles, core fragments, and core reduction flakes at the Group 1 sites led Phillips to posit that the primary function of the site was related to procurement and initial reduction of lithic material (see Phillips 2000, Campbell 2005:7-8). In the research design, LA 55507 was postulated as a Group 1 site that was a source of lithic raw material. A related hypothesis was that the site was a limited activity site where lithic source material was tested for quality, and that good quality material was initially prepared for curated use. As derived from these hypotheses, data at LA 55507 were expected to reveal evidence of cryptocrystalline lithic material, and a high proportion of tested material and early stage reduction debitage. It was expected that activities at the site would reflect stays of short duration and limited to activities related to lithic technology, and that habitation structures or midden areas would be lacking at the site. A large lithic artifact assemblage, as well as a sample of raw material was recovered from this site, and allowed the research issue to be addressed.

Phillips (2000) proposed that the Group 2 sites—the Loma Duran sites—represented “an early, intensive, and often-repeated occupation of a ridge top on the West Mesa”. As he states, this ridge top may have been a seasonal base camp for a single group, which varied the exact location of the camp from time to time. For the research design it was postulated that these sites functioned as seasonal habitation sites. Given the hypothesis, it was expected that the buried stains at these sites would represent hearths, pithouse structures, storage features, and/or middens exhibiting evidence of intensive occupation. In addition, it was expected that the artifact assemblage would reflect a wide range of domestic activities, and that features and faunal and botanical data would reflect a seasonal occupation.

Numerous remnants of thermal features were identified at the two sites determined eligible (LA 126406 and LA 126409) in this group. However, erosion had truncated the occupation surfaces and the features, and few associated artifacts were remaining. The condition of the features and the small size of the artifact assemblages allowed only tenuous conclusions regarding site function, and overall the data was insufficient to address the hypotheses.
Phillips (2000) proposed that the Group 3 sites (LA 55509 in this study) were a series of spatially disparate sites located along the various arroyos in the project area. He posited that the sites functioned as campsites of people traveling from the Rio Grande to the West Mesa in search of resources. The sites vary in location from benches next to washes to ridges overlooking (and further from) the washes. In this study the hypothesis was that LA 55509 functioned as limited activity campsite used by small groups for forays to gather resources on the West Mesa. It was expected that hearths would be present and would exhibit evidence of short-term, possibly seasonal use, but that habitation structures, storage features, and middens would not be present. In addition it was expected that the artifact assemblages would reflect that site activities included floral and faunal resource collection and processing.

Subsurface features were identified and a large lithic assemblage was recovered at LA 55509. The large assemblage and presence of features allowed the hypotheses to be addressed, although results were mixed in terms of meeting the model’s expectations.

**Subsistence and Mobility Strategies**

Prehistoric modes of economic production are intrinsically tied to the resource base and local environmental conditions. A major focus of examining patterns of economic land use for hunter-gathering groups and in mixed economies in marginal environments concerns the composition and nature of the resource base and the mobility system used to exploit those resources. Research questions concerning subsistence and mobility were developed according to Binford’s (1980) collector-forager continuum model. In a forager system the entire social group moves from one camp to the next (residential mobility) and are located at the resource base. Collectors make residential moves to key locations not necessarily defined by food resources, and small task group makes long forays to bring resources to the camp. In general, Binford posits that foragers use high residential mobility to exploit the resource base and invest little in logistical forays, while collectors make few residential moves and numerous, often lengthy, logistical forays. Binford (1980) and Kelly (1995) have examined the local conditions that influence these strategies in terms of the resource base of the area being exploited.

Research questions and hypotheses involving the economic and settlement strategies of the Paseo del Volcan sites were aimed primarily at the Group 2 and Group 3 sites. Group 2 sites were hypothesized to be residential sites in a forager system, utilized during the summer months by small mobile bands. It was expected that the occupational duration would have been in weeks at the Group 2 sites and that structures would not have been substantial, but pithouses would have been used if dunal ridge tops were frequently reoccupied. On the other hand, at the Group 3 sites, it was expected that the occupational duration would have been in days and habitation features would not be present, although thermal features were expected. In addition, it was expected that a wide range of domestic subsistence activities, including gathering, hunting, food storage, food processing and preparation as well as consumption were carried out at Group 2 sites; while a more limited range of subsistence activities were undertaken at the Group 3 sites, mainly related to procurement of targeted subsistence resources to take back to a residential camp.

Data expectations for the subsistence and mobility-related hypotheses were primarily in the form of botanical and faunal remains recovered from features and feature fill. Analysis of human remains and coprolites, while not anticipated, would also have contributed to this research domains. The Paseo del Volcan sites produced very little in the way of botanical or faunal remains and so little could be deduced regarding subsistence strategies. However, data from artifact assemblages did contribute to information regarding site function and thereby mobility strategies. Results were interpreted in terms of the forager-collector model.
Technological Organization

Technological organization examines the relationship of an important aspect of technology, tool curation, and the efficiency of tool production strategies in different settlement and raw material availability contexts. Binford (1973, 1977, 1979) describes one aspect of technological organization on a continuum from curated to expedient. Curated technologies are comprised of tools that are multi-functional, are made in anticipation of use, are maintained, and are transported from locality to locality for use. Expedient technologies are comprised of tools that are made, used and discarded according to the needs of the specific task at hand (Bamforth 1986). Binford (1979) and Shott (1986), among others, have noted the effect of settlement mobility on the technology of forager groups and have shown that mobility imposes carrying costs that constrain technological strategies. In response to costs imposed by high settlement mobility, it is expected that tools should be designed to enhance their portability and to be multi-functional (less specialized) in character, which suggests an emphasis on curated technologies.

Parry and Kelly (1987) have argued that mobile populations employed a curated lithic technology, while sedentary populations employed an expedient core reduction technology, with unretouched flakes the most common tool type. They argue that this was a more efficient strategy than the production, maintenance, and curation of formal tools made from standardized cores. Although a local source of satisfactory lithic raw material is not required for their model, stockpiles of raw materials near the locations where the expedient tools will be used is critical. Parry and Kelley did not fully examine the effect of local sources of raw material upon their model, but others (Schiffer 1975) have noted the relationship and posit that the availability of raw material would result in “less curate behavior”.

The research questions regarding lithic technology for the Paseo del Volcan sites related to the nature of the flaked-stone technology, that is, was the emphasis on curated or expedient organizational strategies? It was hypothesized that LA 55507, the Group 1 site, would contain high-quality, accessible lithic material and that the lithic assemblage would reflect a curated lithic strategy in which cores and core-reduction flakes were transported off-site. Data expectations for this hypothesis included high percentages of microcrystalline materials as well a high percentage of prepared platforms on cores and discarded flakes.

At the Group 2 sites, Phillips (2000) hypothesized that even though residents were assumed to be more mobile, the lithic technology would reflect an expedient strategy due to the availability of local materials. It was expected that the flaked-stone tool assemblages at the Group 2 sites would be dominated by utilized unretouched, core reduction flakes made from locally available materials. However, it was also expected that formal, curated tools would be present in the lithic assemblage and that these tools were associated with the logistical component of the subsistence-settlement system. It was also expected that the flaked-stone assemblage at the Group 2 sites would have a low percentage of cores, but those present would have prepared platforms and a low percentage of cortical material.

The Group 3 sites were hypothesized to have had a curated lithic technology, given that these sites were assumed to be logistical sites used for periodic forays for targeted resources. In this scenario, tool reliability is the critical organizational strategy. It was expected that the flaked-stone tool assemblage at the Group 3 sites would be dominated by formal tools and non-cortical flakes with prepared platforms. It was also expected that the flaked-stone assemblage at the Group 3 sites would have a higher percentage of non-local material than Group 2 sites.

In many cases, lithic assemblages recovered from the Paseo del Volcan sites were too small to make inferences regarding technological organization (LA 55503, LA 126405, LA 126407 and LA 126408).
However, sufficient assemblages were recovered from LA 55507, LA 55509, LA 126406, and LA 126409 to test the hypotheses. Except in the case of LA 55507, the results must be treated with caution as the lithic assemblages were almost certainly affected by post-occupational erosion and may not be representative.

**Summary**

The research design prepared for the Paseo del Volcan testing and data recovery project was developed under a cultural ecological approach and focused on four primary research questions: chronology and stratigraphy, site function, subsistence and mobility, and technological organization. Hypotheses were developed based on Phillips’ (2000) testing plan for the Paseo del Volcan corridor as well as Binford’s (1980) collector-forager model of subsistence. The data collected at the eight sites in the project area contributed differentially to testing these hypotheses. Only four sites produced sufficient data to address research issues at all; one Group 1 site (LA 55507), two Group 2 sites (LA 126406 and LA 126409), and one Group 3 site (LA 55509), and these sites varied in terms of the number of artifacts and features represented. Macrobotanical and faunal information were absent and affected interpretations of subsistence and seasonality at all sites. In addition, geological information indicated that major erosional events in the past had likely removed a portion of most if not all of the sites, also affecting overall interpretations. While most of the research issues were addressed to some degree, many sites produced mixed results and suggest the need to further refine these issues for future projects.
CHAPTER 5
FIELD METHODS, DATA COLLECTION AND ANALYSIS

The following describes the general field and analytical methods outlined in the testing and data recovery plan. Differences between the methods proposed in the plan and the methods employed in the field are discussed following this section. Field methods for testing and data recovery generally followed the steps outlined below, including Site Reassessment, Establishment of Provenience System, Surface Recording, and Sample Unit Excavation, Mechanical Excavation, and (for data recovery), Feature/Structure Excavation. The Provenience Designation (PD) system was used at all sites, regardless of the intensity of investigations.

Field Recording/Proveniencing System

Field recording procedures at the sites were accomplished using a modified version of a method referred to as the Provenience Designation (PD) system. The PD system is a proveniencing system designed to interface the complex variability of field observation with subsequent laboratory and computer database management. It consists of sets of codes for locational, contextual, and categorical information aimed at permitting reconstruction of patterns observed and designations constructed in the field and facilitating data manipulation and analysis.

The PD system is a hierarchically organized set of designations for locations, features, and artifact and non-artifact samples associated with a particular site. At the apex of the hierarchy is the Study Unit (SU). Study unit designations consist of two-number hyphenated codes with the first number representing a particular type of archaeological manifestation and the second number representing each example of that type of study unit. At the general level study units are divided into three types: arbitrary units, structures, and non-structures. Secondary study unit types designate specific categories of study unit within the general types. For the Paseo del Volcan investigations, arbitrary Test Units (TUs) were the primary form of study units utilized.

The secondary grouping of the PD system is the Feature. The feature code consists of the feature type and number. Features represent discrete loci whose limits are defined by a specific cultural manifestation. Feature type designation is determined by descriptive characteristics including morphology, construction, and function. If features are located within structures, they are associated with that structure through assignment of the study unit number and are given unique feature number designations within that study unit. Features located in non-structure study units or arbitrary units that are not parts of structures are given unique number designations across a site, regardless of study unit. For this study, where the cultural manifestations were usually discrete and usually lacked association, the feature was used as a major organizing analytical and locational unit.

The third level of grouping in the PD system is the Provenience Designation (PD) number. The PD number is a number given to a particular provenience unit (study unit or feature), portion of a provenience unit, or special archaeological manifestations of a provenience unit. The PD number is a unique number within a site and is not duplicated by any other provenience designation at that site. Associated with each PD number is a set of encoded information recording its horizontal and vertical locations, description, context, and method of excavation associated with the unit which it designates. The encoded information is designed to link related proveniences, and to facilitate the grouping of PDs based on crosscutting dimensions of data.
The fourth level of information in the PD system is the Field Specimen (FS) number. The FS number is a combination of the PD number and a sample number that uniquely labels individual artifacts, groups of artifacts, or non-artifact samples recovered. Accompanying the FS number are codes that identify the specimen class and type of the samples collected. The sample number allows each artifact/sample a unique status within a particular PD. Association with the PD number permits provenience information for each sample to be tracked, located, and grouped.

**Site Reassessment**

Initial fieldwork involved a reassessment of the sites, including checking the condition of the sites. The crew assessed any changes in the condition of the site since it was last recorded. Provenience markers (such as each site datum/tag) left at the site at the completion of survey were reidentified and the effects of environmental factors such as winter and early spring weather conditions on the sites, features, and the proveniencing markers were examined. If the site datum was missing or was located within the data recovery project limits, a new, permanent datum was established outside of the work zone. This datum served as a permanent benchmark to which all horizontal and vertical provenience information were linked. Site reassessment was completed prior to the instigation of testing and data recovery procedures.

**Establishment of Provenience/Locational System**

Initial excavation procedures involved establishing key locational and proveniencing positions. A site grid was laid out across the portion of the sites within the project limits with electronic surveying equipment, based on Cartesian coordinates. The grid served as the means for locational designations within the sites, with the site datum serving as the prime locational point at the sites.

**Surface Collection and Recording**

Because the surface artifact density on most of the project sites was low to non-existent, surface artifacts were mapped using a sub-meter accurate GPS unit. For LA 55507, where surface artifacts were numerous and widespread, artifacts were collected according to the site grid in systematic units of area. Sample surface recording was employed as the number of surface artifacts is excessively large for 100% collection. Surface features and artifact concentrations identified were described and, in addition to site boundaries, were mapped. The general site and specific features were photographed.

**Sample Unit Excavations**

Surface features and/or artifact concentrations were then excavated through arbitrary hand excavated units 1 x 1 m in size, or in multiples of 1 x 1 m units as a feature(s) was revealed. The number of units excavated was determined by the size of the proveniences and the frequency and nature of features identified. The units were aligned to the site grid and the SW corner of the unit was used as the point of reference.

The degree of vertical control applied to each of the grid-aligned unit excavation units was determined by the depth, stratigraphic circumstance of the location, and the frequency of artifacts encountered. Units in shallow deposits were excavated in a single level following natural stratigraphy to a remnant use surface or caliche/bedrock or in arbitrary 10-cm levels, whichever was most appropriate based on the nature of the deposits. Units in deeper deposits were excavated in 10-cm levels. All of the excavated fill with the exceptions of sediments collected as samples were screened through 1/4-inch mesh. Non-artifact samples
(i.e., flotation, pollen) were taken from base fill or base locations where appropriate. Pollen samples were collected immediately after exposure of such surfaces.

Backhoe trenches were placed judgmentally according to the location of previously identified features and cultural deposits where present. All surface artifacts within the trench corridor, an adjacent buffering strip, as well as equipment staging areas, were collected prior to trenching. All use of mechanical equipment was monitored by an archaeologist. Examination of the excavated area occurred after the removal of each extracted unit of soil or sediment. All backhoe trenches were mapped in profile by the project geologist. The backhoe trenches were used to reveal the nature of subsurface stratigraphy and to provide geomorphological information. A soils/geomorphology specialist, Dr. Stephen Hall of Red Rock Geological Enterprises, examined all trench profiles to inform on the age of geological strata. When a feature was discovered in a backhoe trench, excavation in that trench and feature ceased, and excavation of the trench resumed at a sufficient distance from the feature to preserve the undisturbed remains of the feature. For sites where there were no known features, trenches were excavated in order to determine the presence and depth of subsurface cultural deposits.

All of the sites in the Loma Duran area of the project were identified by the presence of ash stains in the road cut of 28th Avenue, as most of these sites did not have cultural material present on the ground surface. Therefore, a sampling plan including mechanical trenching and surface stripping was developed to test for the presence of buried remains in the area of the five Loma Duran sites (LA 126405-LA 126409). The sampling included testing both within and outside of mapped site boundaries (see Appendix B). The sampling plan was carried out with appropriate modifications based on geological information provided by the project geologist, and based upon the results of ongoing trenching and mechanical stripping. A total of 11 trenches totaling approximately 669 m (2194 ft) were placed on the five Loma Duran sites and another 15 trenches totaling 450 m (1476 ft) were placed beyond the five sites (see Appendix B). A total area of approximately 8,100 square meters (2.0 acres) was mechanically stripped on, adjacent to, and beyond the known sites to test for buried cultural remains. The sampling plan resulted in the exposure of 57 ash stain features in the mechanically stripped areas, while five features were identified in all the trenches. All of the features were identified within known site boundaries.

**Surface Stripping**

The methods employed for surface stripping varied depending on the depositional context of each site. Most features were buried approximately 30 cm below the ground surface and mechanical surface stripping was employed to remove the overburden. The surface stripping was accomplished with a mechanical backhoe to allow a careful examination of the upper paleosol as it was exposed to identify features. Based on the geoarchaeological information developed during the project, large areas within the APE were surface stripped to the identified paleosol and the exposed features were then assigned a PD number, mapped, and were then hand excavated.

**Structure Excavations**

No above-ground foundations or rooms were encountered, although some stain features were of sufficient size to be pit structures. Following exposure of these features in plan view, a control unit was excavated within or across the potential structure. The objectives of the control unit were to find and define the walls of the structure, examine the stratigraphy and sample the fill of the structure, and to determine the depth to the base/floor of each structure. The control unit was excavated in arbitrary 10-cm or 20-cm
levels to the structure base. The fill removed was screened through 1/8-in mesh. Non-artifact samples were collected from general fill, and from floor fill or floor contact locations. Samples collected from the general fill furnished a means to examine upper fill contents and was used for comparative purposes with samples collected from floor fill and floor contexts. Profiles were drawn for one wall of the control unit, if warranted. No definite floor surfaces were identified and the excavations were completed to the bottom of the arbitrary level.

**Feature Excavation**

Initially all features were examined and probed to determine the presence and integrity of subsurface deposits. Features that were determined to be at least potentially cultural and showed some degree of integrity were excavated. Extramural features were excavated using methods similar to those used to dig internal features of structures as described above. Most features were bisected and one-half of the feature was excavated. The exposed profile of the feature was drawn after completion of the excavation. Excavation of the other half of the feature was optional, depending upon the nature of the fill and the need for additional samples. Where the pit fill exhibited complex stratigraphic patterns, excavation in natural/cultural layers was considered.

In most cases, non-artifact samples were collected from each feature. Pollen samples were collected from walls and bases of pits as appropriate. Flotation samples were collected from the basal portions of the pit fill. Chronometric samples were collected as encountered and along with pollen samples were point provenienced.

**Laboratory and Analytical Procedures**

The purpose of the laboratory procedures is to facilitate subsequent analyses and to prepare artifactual material for curation. These procedures include artifact processing, organization, checking of field paperwork, and data entry. Artifact processing involves inventorying and sorting all artifact and non-artifact samples collected in the field in terms of provenience and contextual information, washing and drying and/or processing of artifact and non-artifact samples, and rebagging and boxing of the materials. Organization and checking of field paperwork involves collating and sorting of field forms and notes into one central filing system and matching information on field forms with the artifacts and non-artifact samples collected. The final step in the laboratory procedures involves computer data entry. Laboratory procedures were under the supervision of the Principal Investigator, Field Director, or Supervisory Personnel, acting in the capacity of Laboratory Director. Analyses were performed on artifacts from all of the sites under investigation.

The objective of the various analytical procedures conducted during the data recovery phase was to address the research issues discussed in Chapter 4. Included within the analytical procedures are general procedures that pertain to all artifact and non-artifact samples. These procedures concern the overall organization of the analysis and are meant to insure production of the most information possible. General analytical procedures include (1) data grouping and (2) prioritizing and sampling. At the same time, there are specific analytical procedures associated with each class of archaeologically relevant data. These data classes include structures and features, spatial and distributional data, chronometric samples, ceramics, flaked stone, ground stone, fauna, macrobotanical remains, pollen, and special studies. Analytical procedures for each data class are described below. Analytical methods and results for each analysis are incorporated in this report.
Structures and Features

Data on structures and features provide information on site structure and function as well as duration and seasonality of occupation. The data were taken from plans, profiles, and notes and descriptions made in the field. Analyses during the data recovery phase were both descriptive and comparative. Information on structure/feature morphology, architecture, function, and internal features (in the case of structures) was examined and compared in attempts to define broader spatial/temporal categories and patterns. However, as most of the features excavated had been subject to significant erosion in the past, the information provided was limited. Because only basal remnants of features were encountered, information on feature size and morphology was difficult to obtain and was of limited use in determining function, method of construction, or spatial organization.

Spatial and Distributional Data

Spatial data is the raw material for analyses of site structure. These data are taken from artifact and non-artifact sample collection from both within structures and extramural areas. Patterning of the individual as well as combined artifact and non-artifact data collected was examined in an attempt to define divisions or groupings within each site related to temporal differences or the use of space. These data were subject to the same limitations as the features, discussed above.

Chronometric Samples

Collection of chronometric samples is essential for providing the raw data for determining temporal controls at the sites in question. Radiocarbon dating was the primary method utilized. Use of AMS procedures to dates samples indicates the importance of collecting even small bits of charcoal for dating purposes in addition to collection of bulk sediment samples. Use of the AMS procedures was utilized on all samples submitted for radiocarbon dating. The samples collected were prioritized to obtain the best dating information within existing budget constraints.

Ceramics

The ceramic artifacts made up a very small percentage of the artifacts (<1 percent) collected at the sites and contained only limited information potential to address the research topics. Analyses concentrated on the collection of data necessary to type the wares and provide some chronological information.

Flaked Stone

Flaked stone materials were by far the largest percentage of artifacts recovered at each site, except LA 55503. Analysis of flaked stone artifacts focused on addressing the research topics of chronology, site function, site structure, subsistence, site reuse, and resource procurement. The goals of the flaked stone analysis were to identify the frequency, range, and proportion of technological classes, tools, and raw material types at each of the sites. Collection and analysis of flotation heavy fractions that could contain microlithic artifacts were made to assess recovery of the full range of flaked stone technological types. Analyses focused on collection of data using variables that permit technological and functional analyses of the flaked stone assemblages, including use wear variables. The attributes measured to address the research issues are discussed in Chapter 7 of this report. The relatively small size of the flaked stone assemblages allowed analysis of all artifacts collected.
Ground Stone

Ground stone artifacts provide information on site function, site structure, subsistence practices, site reuse, and resource procurement. Analysis of ground stone items focused on identifying the artifact type, raw material type, dimensions, morphological characteristics, and attributes relating to nature and extent of use. The small numbers of ground stone artifacts recovered did not allow for extensive statistical treatment of the assemblage, and analyses concentrates on simpler quantitative and qualitative methods.

Faunal Remains

Faunal remains provide information on research topics of environmental setting, subsistence practices, and site function. However, fewer than 25 faunal specimens were recovered and the assemblage did not retain sufficient information to address the research questions. Therefore, the faunal remains were not submitted for analysis.

Botanical Remains

Macrobotanical and pollen analyses provide complementary information on plant utilization related to subsistence practices, site function, and past environmental setting. Analyses concentrated on the identification of specific plant types, their abundance and ubiquity, and their context. The procedures used for identification and analysis are presented in Chapter 8.

Deviation from Proposed Field and Analytical Methods

Early in the data recovery effort geoarcheological investigations identified a buried paleosol at approximately 30 cm below the ground surface, which was consistent with the identification of stains in the 28th Avenue road cuts. Mechanical trenching was employed to reveal the stratigraphy, and was instrumental in establishing the stratigraphic sequence and history at each site and across the project area. The trenching revealed this prehistoric paleosol at most of the sites approximately 30 cm below the surface, however, only a few thermal features were exposed by the trenching. Surface stripping using a backhoe was employed to efficiently reveal large surface areas at the level of the paleosol identified in the trenches. When the overburden was removed, some sites contained numerous stains, many of which were cultural based on the nature of the fill material. What was not anticipated was the paucity of associated artifacts and fire-cracked rock. This condition was evident at all of the Loma Duran sites, including LA 126405, LA 126406, LA 126408, and LA 126409.

Based on geological examination of the subsurface stratigraphy by the project geologist, it is apparent that an erosional unconformity exists at the top of the buried paleosol and an estimated 30 cm of the prehistoric living surface had been removed. The erosional processes apparently displaced and removed most of the artifacts associated with the features and removed the upper portion of the thermal features, leaving only the basal remnants. Based on this information, the excavation methodology was redirected to emphasize the collection of fill material at the thermal features using bisection hand excavation of the features. One-by-one-meter test units were still employed where a feature’s boundaries could not be clearly defined, or where there was potential for associated, extramural cultural material. In at least one case a 1 x 1-m unit was used to pedestal a feature in danger of collapsing out of a road cut.
CHAPTER 6

EXCAVATION RESULTS

Results of testing and data recovery excavations are presented in two groups. The first group consists of the four sites that, after testing, were determined to have little or no information potential and were determined to be either not eligible for inclusion in the NRHP, or to have undetermined eligibility based on the presence of unexcavated portions remaining outside the project limits. Only limited excavation activities were carried out at these sites, which include LA 55503, LA 126405, LA 125407, and LA 126408. The second group consists of those sites determined to have some information potential (either large numbers of artifacts or buried features, or both). More extensive excavations were carried out at these sites, which include LA 55507, LA 55509, LA 126406, and LA 126409. Site locations are presented in Appendix B.

Sites Determined Not Eligible/Undetermined

LA 55503

Previous Work
LA 55503 was originally identified during a 1986 archaeological survey (Hogan 1986) as a low-density artifact scatter composed of 10 items. At that time, the scatter measured 14 x 9 m (46 x 30 ft). Due to a change in the alignment of the proposed Paseo del Volcan roadway and the anticipated impact on LA 55503, PB revisited the site in 2005. During the 2005 site visit, 25 artifacts were identified, and the site boundary was expanded to encompass the additional artifacts. The expanded LA 55503 consisted of a prehistoric and historic artifact scatter measuring 90 m (295 ft) north-south by 35 m (115 ft) east-west. The assemblage consisted of 14 pieces of debitage, 10 grayware sherds, and one historic center-fire cartridge casing. The majority of the cultural materials were observed in the disturbed context of a two-track roadbed, at levels ranging from five to 10 cm (2 to 4 in) below the surrounding ground surface. Because there appeared to be a high potential for intact buried cultural material, the site was determined eligible for the NRHP under criterion “d” (HPD Log 73710, March 9, 2005).

Physical Setting
LA 55503 is in a grassland environment on the west mesa of the Rio Grand Valley about 4.4 km (2.75 mi) west of the river. Surface vegetation covers approximately 50 percent of the site, and includes grama grass, dropseed grass, Indian rice grass, narrow-leaf yucca, sagebrush, snakeweed, Russian thistle, cholla cactus, prickly pear cactus, small barrel cactus, as well as annual forbs. The site and adjacent surfaces are covered by about 10 cm of loose blow sand. The site has 360-degree exposure and views over the surrounding landforms and drainages. Disturbances include natural wind and water erosion, bioturbation, fencing, and off-road vehicle traffic on a two-track road.

The site is situated on a relatively flat area that slopes gently to the southeast toward the Rio Grande. It is about 750 ft (229 m) northeast of a small, unnamed drainage and about 2.75 miles southwest of the river. The site is south of a low east-west trending dune ridge, which lies between Arroyo Venada to the north and Arroyo de la Baranca to the south.
Investigation Strategy

The testing and data recovery plan as applied to the site involved survey, mechanical trenching, surface collection units (SCU), and test units (TU) (Figure 6.1). Two different testing methods were used to investigate the northern and southern portions of LA 55503. The northern half of the site, which contained only a few surface artifacts and no evidence of features but was located within the construction zone, was surface collected and then tested by mechanical excavation for subsurface cultural deposits. The southern half of the site, which contained the artifact concentrations, was south of the construction limits but within the proposed roadway right-of-way. This portion of the site was surface collected using collection unit grids at the artifact concentrations. All artifacts beyond the concentrations were collected and their provenience documented using UTM coordinates. The areas within the artifact concentrations were subsequently tested by hand excavated 1 x 1 m test units.

Survey and Surface Collection

The site was systematically surveyed using transects spaced 15 m (49 ft) apart. Two flaked stone artifacts were recovered from the surface in northern half of the site. In the southern half of the site, two surface collection units (SCU 1 and SCU 2) were placed over the two artifact concentrations previously identified. SCU 1 (5 m x 5 m) was placed over the scatter of grayware sherds, located 28 m southwest of the site datum. SCU 2 (5 m x 5 m) was placed over a flaked-stone scatter, located within 10 m south of the site datum. The artifacts on the surface were collected within the surface collection units, and subsequently the sediments were excavated as test units. In addition, artifacts identified outside the collection units were piece-plotted and collected.

In total, 121 artifacts were recovered during surface collection in the southern portion of the site. One hundred six (106) grayware sherds, of the same type and likely from the same vessel, were collected from SCU 1; six lithic artifacts were collected from SCU 2. Nine lithic artifacts were recovered outside the surface collection units dispersed across the southern portion of the site.

Mechanical Excavations (northern portion) and Site Stratigraphy

Mechanical excavation in the northern half of LA 55503 incorporated four backhoe trenches, totaling 97 m (318.16 ft) in length. The trenches ranged from 20 m (66 ft) to 29 m (95 ft) in length and averaged 0.75 m in width and 1.5 m (5 ft) in depth. Three parallel trenches (Trenches 1 through 3) cut across the site from northwest to southeast; the fourth cut through the other three in an approximate north-south direction. Trench locations were selected to test the subsurface sediments for buried cultural materials along a low dune within the proposed construction limits. Wall profiles were drawn for each trench.

No cultural deposits were identified within any of the backhoe trenches. The stratigraphic sequence of each trench was examined by Dr. Stephen Hall. Based on his observations and the input from the archaeological field director, Dr. Hall provided a geoarchaeological interpretation of the site. The following description and profile schematic (Figure 6.2) is taken from Hall’s report, which is attached as Appendix A of this report.
Figure 6.1: LA 55503 Site Map
Figure 6.2: Stratigraphy at LA 55503. The site surface is covered with approximately 10 cm of loose eolian sand not shown in this drawing.

The site surface is covered with about 10 cm of loose eolian sand. Beneath the loose blow sand are three separate thin eolian sand units that overlie an ancient (Miocene-Pliocene) calcic paleosol. In some areas there is a 30-cm thick coarse yellowish brown eolian sand (C in above figure) with a reddish yellow paleosol (Bw) at the top that appears to correlate with the late Holocene red paleosol documented at most of the other sites throughout the project area. In some places at the site, the coarse eolian sand and the associated red paleosol are not present, and there is a fine eolian sand and stage II carbonate nodules that likely reflect an eroded, weathered Pliocene remnant of a paleosol. Both the coarse yellow sand unit and the fine eolian sand sit on a weathered Miocene-Pliocene stage III calcic paleosol. In some places the yellow sand is present at the surface and at other places the yellow sand is not present at all. The lateral discontinuity of the three units indicates a history of active sheet erosion at various times at this locality.

All cultural deposits at LA 55503 occur in the upper 15 cm of the loose eolian sands that mantle the site. Based on the thin mantle of eolian sand in this portion of the project area, the potential for buried cultural remains is very low, although young features at or near the surface could be intrusive into the older sedimentary horizons. However, no features or other buried cultural deposits were observed in the subsurface testing or during survey of the site.

Test Unit Excavations (southern portion)

To investigate the nature of the two artifact concentrations in the southern portion of the site, test units (TUs) were excavated either within a surface collection unit (TU 1), or adjacent to it (TU 2). TU 1 measured 3 x 3 m and was placed in the sherd concentration located within SCU 1. The unit was excavated in two 10 cm levels and contained 45 sherds. The majority of the sherds were in Level 1, and no artifacts were collected from the lowest 5 cm (2 in) of Level 2. All of the sherds appear to be derived from the same vessel. The small size of the sherds and their concentration in the two-track road indicate that the sherds are likely the remains of a “pot drop” and that vehicular traffic further crushed the sherds.

Test Unit 2 also measured 3 x 3 m and was placed adjacent to SCU 2 along its northern edge. One chalcedony core and 21 pieces of chalcedony/Pedernales chert debitage were collected within the upper 5 cm of the unit. The unit was terminated at Level 1, as no artifacts were recovered from the lower 5 cm the unit.
In both test units all artifacts were recovered from the loose eolian sand that mantles the site. The reddish yellow paleosol (Bw), described by Hall as just below the eolian blow sand as seen at other sites in the project area, was encountered at ~20 cm below the surface in TU 1 and at ~5 cm below the surface in TU 2. The occurrence of the artifacts in the upper loose eolian sand suggests a more recent use than at most sites in the project area, where the artifacts largely are deposited on the red paleosol. A more recent use of the site is consistent with the occurrence of ceramics.

**Materials Collected and Analysis**

Artifacts collected at LA 55503 included lithics and ceramics. Because no features were identified, no macrobotanical samples were collected, and no material was recovered for radiocarbon dating.

**Ceramic Analysis**

One hundred fifty-one sherds were recovered from a ceramic concentration in a two-track road in the southern portion of the site. The assemblage consists of 106 plain gray jar body sherds collected from the surface of SCU 1, and 45 plain gray jar body sherds collected from TU 1. The sherds have quartz sand and ground mica/schist temper. The interiors are smudged and the exterior are oxidized. The sherds range between 6 and 9 mm thick. All of the sherds appear to be from the same vessel, and are either Tijeras Gray, which is relatively thick like these sherds and tempered with local schist, or late micaceous graywares, both of which appear in the Rio Grande sequence around AD 1300.

**Lithic Analysis**

A total of 36 pieces of debitage and one core was recovered from the site. Most of the lithic artifacts were from a lithic concentration in the southeast portion of the site and recovered from SCU 2 (n=6) and the upper 5 cm of TU 2 (n=22). The remainder of the lithics (n=9) was dispersed across the site.

The core is tan chalcedony with white and gray mottling, and has less than 50 percent of its cortex remaining. The core measures approximately 7.5 x 7.1 x 5.5 mm and at least eight irregular flake scars are present. The grain of the core is microcrystalline; however, there are numerous voids (pitting), and the presence of step fractures indicate that the material is of inferior quality for lithic reduction.

All of the debitage (n=36) at the site is chalcedony/Pedernales chert from Santa Fe gravels, and 91.9% of the material is microcrystalline. The debitage is dominated by flake fragments (75%), with smaller numbers of whole flakes (11.1%), and angular debris (13.9%). The site has a high flake fragment-to-whole flake ratio (6.75 to 1), there are no bifacial thinning flakes, and one of the six flakes with platforms exhibits lipping.

Most of the assemblage is composed of tertiary flakes (67.7%), followed by secondary flakes (25.8%), and primary flakes (6.5%). Generally, flake size is small, with 61.1% of the debitage being Size 1 and 2. Nine pieces of debitage (25%) exhibit evidence of thermal alteration.

The recovery of a core among the 37 flaked-stone artifacts at LA 55503 suggests that initial-stage core reduction occurred at the site. The low percentage of primary and secondary flakes, and the high number of small, tertiary flakes indicates that later stage reduction also occurred, although the later stage reduction does not appear to be the result of bifacial reduction as no bifacial thinning flakes or bifaces were recovered. Due to the small assemblage (n=37), any conclusions regarding the lithic strategy is tenuous, although it does appear that a local chalcedony/Pedernales chert nodule was tested and discarded.
due to the inferior quality of the material. Due to the lack of diagnostic artifacts recovered from the site, a cultural/temporal affiliation cannot be made on the basis of the lithic assemblage.

**Summary and Management Recommendations**

Only two flaked stone artifacts were recovered within the north half of LA 55503 during surface collection. Four mechanically excavated test trenches placed in the northern portion of the site identified no evidence of buried cultural material.

Surface collection in the southern half of the site recovered 119 artifacts, and 67 artifacts were recovered from the subsurface test units. The artifacts were largely concentrated in two loci, a lithic concentration containing 28 artifacts, and a pottery concentration containing all 151 sherds at the site. Of the 151 sherds, 106 were on the surface and 45 were recovered from the upper 15 cm of a test unit in the concentration. At the lithic concentration, six lithics were recovered from the surface and 22 were recovered from the upper 5 cm of a test unit in the concentration.

The site is interpreted as a surface manifestation of a “pot drop”; and the lithic assemblage is too small (n=37) too draw any meaningful conclusions regarding lithic strategies. At both artifact concentrations most of the artifacts were on the surface, and others had migrated a few cm downward into the loose eolian mantle of sand. The occurrence of the plain grayware sherds indicates use of the area during the Classic Period, ca. A.D. 1300. The association between the ceramic assemblage and the lithic assemblage is not known, and the assemblages may represent separate activities.

Given the small quantity of artifacts and the nature of the assemblages derived from the site, the information collected is not sufficient to address the research issues posed in the data recovery plan. The mechanical excavations and test units identified no intact subsurface remains within the portion of the site in the proposed construction limits and right-of-way. There is no evidence of subsurface cultural material at the site with important information potential to add to the understanding of prehistoric life ways on the West Mesa. The site was recommended as not eligible for inclusion in the National Register of Historic Places and concurrence with this recommendation was received from the New Mexico SHPO (Log. No. 77199, March 2, 2006). No further archaeological investigations were completed at the site.

**LA 126405**

**Previous Work**

LA 126405 was originally recorded during a 1999 archaeological survey of the Paseo del Volcan roadway corridor (Parsons Brinckerhoff 1999). At that time, the site consisted of a single ash stain in the profile on the north side of the 28th Avenue road cut, identified as Feature 1. No artifacts were identified in association with this feature. Eolian sands overlay the entire site.

In 2000, SWCA, Inc. revisited the site for the purpose of developing an archaeological testing for the Paseo del Volcan corridor (Phillips 2000). At that time, Feature 1 was described as an 88-cm, dark, ashy stain located 30 cm above the road surface and approximately one meter below the modern ground surface. No artifacts were identified on the surface or in association with this feature; however, Phillips (2000:82) stated that, “[a]n extensive site could be present at this location, without being detectable through exposures such as the 28th Avenue NE road cut.”

The site was again revisited on November 2, 2004 by representatives of NMDOT and PB to assess the potential impact of a proposed realignment of the Paseo del Volcan roadway. They determined that the
nature and the horizontal extent of buried cultural remains were unknown beyond the feature exposed in the road cut, and that additional buried cultural materials might be located across the road from the exposed features in approximately the same stratigraphic horizon. Therefore, LA 126405 was recommended as having “undetermined” eligibility for inclusion in the NRHP.

**Physical Setting**

LA 126405 is approximately 2.25 km (1.4 mi) west of Arroyo de la Baranca. It sits on the southeast side of a prominent terraced landform extending from Loma Duran, a prominent hill located to the northwest of the site. The site provides a clear view in all directions. Local vegetation consists of various types of bunch grass, cholla, snakeweed, prickly pear cactus, fourwing saltbush, chamisa, and sage. The surface sediments are loose eolian blow sand disturbed by active eolian erosion and road maintenance activities. The cut-slopes along the north and south margins of 28th Avenue have been repeatedly scraped by road maintenance equipment.

**Investigation Strategy**

Feature 1 could not be located upon initiation of testing in 2005. Given Phillips’s (2000) assessment of the possibility of an extensive site at the location however, testing and data recovery activities at LA 126405 were conducted within an 1800 sq m area on the north side of 28th Avenue, where the stain had previously been identified. The testing strategy applied to the site incorporated surface survey, mechanical trenching, mechanical stripping and hand-excavated test units.

**Surface Survey**

Prior to testing for subsurface cultural deposits, the entire site was surveyed for archaeological remains. No artifacts or features were observed and no artifacts were collected.

**Mechanical Trenching and Site Stratigraphy**

Mechanical excavations at LA 126405 involved excavation of a single backhoe trench (BHT 1). This trench was 25 m (82 ft) long and 75 cm wide, with its south end placed at the recorded location of the previously identified Feature 1, which could not be relocated in the road cut (Figure 6.3). BHT 1 extended north 25 m (82 ft) from the north cut-slope of 28th Avenue. It was excavated to a maximum depth of 1.5 m (5 ft).

BHT 1 revealed a thin horizon of dark staining and charcoal flecks resting on top of the buried red paleosol. The stain was 11 m (36 ft) from the southern end of BHT 1, and 12 cm below the modern ground surface. This stain was designated as Feature 2. In the trench cut at Feature 2, several pieces of thermally altered rock but no artifacts were observed.

The stratigraphy observed at LA 126405 is illustrated in Figure 6.4. The surface of the site is covered by several centimeters of loose eolian sand (not fully represented in the figure). Beneath the loose sand is an eolian sand unit (Bw1 and Bw2) with a yellowish red paleosol at the top. A stage I calcic horizon (Bk) occurs with the paleosol, which sits on the parent eolian sand unit (C). Based on OSL dates, the red paleosol and its stage I carbonate horizon formed after 10,000 yrs BP. The red paleosol is present through the entire length of the trench, several cm below the loose historic eolian surface. In the south end of the site, the red paleosol package (Bw, Bk, and C) rests directly on a Miocene-Pliocene stage III calcic paleosol, which drops in depth and disappears below the base of the trench at the north end. Archaeological remains were encountered at the top of and intrusive into the red paleosol.
Figure 6.3: LA 126405 Site Map
Figure 6.4: Sketch of stratigraphy at LA 126405 with a Miocene-Pliocene calcic paleosol (stage III); the calcic paleosol has numerous pipes; an OSL age of pipe fill is 19,780 ± 1,960 yrs BP; archaeological features occur at the top of the red paleosol; recent loose eolian sand covers the site but is not shown here.

**Mechanical Surface Stripping**

Mechanical surface stripping of a 20-m x 17-m area (340 sq m [3658 sq ft]) was conducted to expose the area around Feature 2, on both sides of BHT 1, down to the red paleosol. The area stripped extended from the north edge of 28th Avenue to the northern limits of the site. Stripping exposed three other stains. All four stains were excavated by hand (see Test Unit Excavations and Feature Excavation below).

**Test Unit Excavation**

Test unit (TU) excavation focused on a 3 m x 2 m (10 ft by 6 ft) area of the stripped surface surrounding Feature 2. Six 1 m x 1 m units were placed over and adjacent to Feature 2 at the area immediately east of the test trench. Excavations within the block of six test units at Feature 2 identified the stain feature within two of the units. Four flakes and one projectile point fragment, one piece of unmodified bone, and a few pieces of fire-cracked rock were observed in association with the feature. The staining exposed in four other test units was determined to be the result of erosion and bioturbation of Feature 2. No additional definable cultural feature(s) was revealed in the block of six test units. The soil stratigraphy in the test units was similar across units, and conformed to the stratigraphy in BHT 1.

**Feature Excavation**

Feature 2 was originally identified in the east wall of BHT 1 as a thin band of carbon-stained sediments with charcoal inclusions. After excavation, Feature 2 was found to be a circular to ovoid-shaped earthen pit, measuring 98 cm north-south by 33 cm east-west. Its maximum depth was 6 cm. The fill consisted of dark brown-colored silty loam and loam with one percent charcoal and one percent gravel inclusions. No artifacts were identified in the fill. Feature 2 was interpreted as the basal remnant of thermal feature that had lost much of its integrity through bioturbation and erosion.
Feature 3 was an oval area of carbon-stained sediments located 6.5 m (21.3 ft) east of Feature 2. The stained sediments were excavated by bisection. Feature 3 had clear morphology and organic dark fill, but no cultural materials or fire-cracked rock were recovered from within the feature. After excavation the feature consisted of an earthen pit with a basin-shaped profile that measured 35 cm wide, 50 cm long, and 23-24 cm deep. Most of the feature fill was very dark brown (10YR 2/2) sandy loam that contained organic materials. Root, rodent, and insect bioturbation was clearly evident. Feature 3 appeared to have been the basal remnant of a thermal feature.

Two other stains were tested by bisection; however, the staining was determined to be natural rather than cultural.

**Table 6.1: Features Investigated at LA 126405**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Size (LxWxD m)</th>
<th>Profile/Plan Shape</th>
<th>Artifacts Recovered*</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Not Relocated</td>
</tr>
<tr>
<td>2</td>
<td>0.98 x 0.33 x 0.06</td>
<td>Shallow Basin/Oval</td>
<td>None</td>
<td>Hearth/Thermal</td>
</tr>
<tr>
<td>3</td>
<td>0.35 x 0.50 x 0.24</td>
<td>Moderate Basin/Oval</td>
<td>None</td>
<td>Hearth/Thermal</td>
</tr>
</tbody>
</table>

**Materials Collected and Analysis**

Five artifacts were recovered from LA 126405, all of which were lithic artifacts associated with or near Feature 2 (Table 6.2). The assemblage consists of two flake fragments, two whole flakes, and a distal fragment of a projectile point. All five artifacts were manufactured on locally available chalcedony/Pedernales chert of various colors. All four flakes were large (3.0 - 4.0 cm), tertiary flakes. Table 6.2 reflects the provenience of the artifacts.

**Table 6.2: LA 126405 Lithic Artifacts by Provenience**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Level</th>
<th>Feature</th>
<th>Whole flake</th>
<th>Flake fragment</th>
<th>Projectile fragment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU 1</td>
<td>II</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>TU 3</td>
<td>II</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>TU 4</td>
<td>I</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>TU 5</td>
<td>III</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

The assemblage from LA 126405 has no diagnostic artifacts and its cultural/temporal affiliation could not be established. The assemblage is too small to draw any conclusions regarding site activities or function.

**Summary and Management Recommendations**

Testing and data recovery excavations at LA 126405 failed to relocate Feature 1, which was previously identified in 1999 as a dark stain within the north cut-bank of 28th Avenue. Four additional areas of discolored sediments were identified by mechanical excavation and stripping. Subsequent hand excavation of these stains reflected that two (Features 2 and 3) were cultural and two were non-cultural in origin.

Features 2 and 3 consisted of carbon-stained sediments contained within basin-shaped earthen pits. Excavations within both pits failed to identify either diagnostic artifacts or sufficient amounts of datable
charcoal. Both features appear to have been strongly affected by erosion and bioturbation. Their condition and presence within the eroded red paleosol suggests that they are likely the basal element(s) of hearths or other thermal features that were subsequently truncated by heavy eolian and alluvial erosion.

Only five lithic artifacts were recovered from the site, including two whole flakes, two flake fragments and a distal fragment of a projectile point. All the artifacts were manufactured on local materials. The sample size is too small to draw any firm conclusions regarding the nature of LA 126405 or the organization of technology represent by the lithic assemblage at the site.

Given the nature and small quantity of the artifacts derived during testing and data recovery and the truncated condition of the only two features identified, there is no information available at LA 126405 sufficient to address the research issues posed in the data recovery plan. Therefore, LA 126405 was determined “not eligible” for inclusion on the NRHP. No further archaeological investigations were completed at the site.

LA 126407

Previous Work

LA 126407 was first recorded during a 1999 archaeological survey of the Paseo del Volcan roadway corridor (Parsons Brinckerhoff 1999). At that time, the site consisted of three charcoal stains along a 125 m (410 ft) stretch extending along both sides of the 28th Avenue road cut. Based on the location and depth of the charcoal stains (Features 1-3) the site was recommended “undetermined” for inclusion in the National Register of Historic Places.

SWCA, Inc. revisited the site in 2000 for the purpose of developing an archaeological testing plan for the Paseo del Volcan corridor (Phillips 2000). At that time, three additional charcoal stains were identified (Features 4-6), and three corrugated grayware sherds were observed on the surface southwest of Feature 1. The sherds were identified as pieces of a single vessel. The site boundaries were expanded to 165 m x 60 m to include the additional features and artifacts.

The site was revisited again on November 2, 2004 by representatives of NMDOT and PB to assess the impact of proposed design changes to the Paseo del Volcan roadway project. At that time, it was determined that a portion of the site boundary north of 28th Avenue extended into the APE of the redesigned undertaking.

Physical Setting

LA 126407 is located southeast of Loma Duran on a southeast-to-northwest oriented terrace, west of Arroyo de la Baranca. The surface sediments are eolian sand deposits. The vegetation is a desert scrubland community, containing sagebrush, cholla, narrow-leaf yucca, fourwing saltbush, Indian rice grass, snakeweed, grama grass, prickly pear cactus, ground cholla, tumbleweed, and various other plants common to excavated or disturbed areas. The site has good views to the east, south, and west and generally slopes east-southeast. Disturbances associated with active road maintenance along 28th Avenue and eolian and sheet erosion have affected the exposed portion of the site within the cut-bank and hill slopes.
**Investigation Strategy**

All activities at LA 126407 were conducted north of 28th Avenue, and extended north of the defined site limits to cover the entire construction zone of the proposed Paseo del Volcan roadway (Figure 6.5). Based on the presence of the buried stains exposed in the 28th Avenue road cut, the testing strategy used to examine the site consisted of mechanical trenching, mechanical stripping, and test unit excavation.

**Surface Survey**

Prior to testing for subsurface cultural deposits, the portion of the site along and north of 28th Avenue was surveyed for surface artifacts. Only one lithic artifact was identified and collected. The survey failed to relocate the three features (Features 1, 5, and 6) previously identified in the south road cut and Feature 3 and 4 in the north road cut. Only Feature 2 in the north road cut was relocated.

**Mechanical Trenching and Site Stratigraphy**

Mechanical trenching was undertaken to test for the presence of subsurface cultural deposits. Two trenches were excavated; one 62-m (203-ft) long (BHT 1), and another 66-m (216-ft) long (BHT 2). BHT 1 was positioned at the approximate location of Feature 3 (not relocated) and extended north. BHT 2 was initiated approximately one meter north of Feature 2 and extended north. The trenches extended across the site boundary north of 28th Avenue and the construction limits, and were excavated to average depth of 1.5 m (4.9 ft). At this depth, a culturally-sterile loamy sand containing calcium carbonate filaments and nodules was encountered.

No cultural material was observed in BHT 1. BHT 2, however, exposed a dark carbon stain in the east wall, 10.5 m (34 ft) from the northern end of the trench and 20-30 cm below the surface. The feature was designated as Feature 5, although this feature number had previously been assigned in 2000 during the SWCA site revisit. In this report the feature is referred to as Feature 5n. No artifacts were observed in BHT 2.

The stratigraphic sequence was similar in both BHT 1 and 2. The stratigraphy for this site is similar to the others in the Loma Duran group. The surface is mantled by 6 to 12 cm of loose eolian sand. The site occurs on an eroded red paleosol with weak calcic horizon that is developed in 90 cm of eolian sand. Three OSL ages of the eolian sand are 13,110 ± 690, 13,890 ± 840, and 11,210 ± 770 yrs BP, base to top, respectively (Figure 6.6). An eroded late Pleistocene stage II calcic paleosol occurs beneath the eolian sand at the north end of the site. Archaeological features at the site are at the surface at the top of the eolian sand unit and its red paleosol. Features intrude into the red paleosol.

**Test Unit Excavation**

Two test units (TU) were excavated at LA 126407 to investigate Feature 2 and Feature 5n. The TUs were excavated to define the nature and extent of the features prior to undertaking any mechanical stripping.

A 1 x 1 m test unit (TU 1) was placed over Feature 2. Four arbitrary 10-cm levels were excavated. The unit consisted of brown-colored sandy loam with no artifacts. An irregular charcoal stain was exposed in Level 3, but it was determined that the stain represented a rodent burrow containing charcoal-flecked fill.

Test Unit 2, a 1 x 1 m hand-excavated unit, was excavated over the irregular charcoal stain (Feature 5n) located in the east wall of BHT 2. Three 10-cm levels were excavated. All the levels contained light yellowish brown and yellowish brown sandy loam. No artifacts were recovered in any of the levels. The
Figure 6.5: LA 126407 Site Map
charcoal stain was determined to be either non-cultural in origin, or so badly eroded that it lacked any recognizable morphology.

**Mechanical Stripping**

Based on the identification of the red paleosol in both trenches, mechanical stripping of an area approximately 225 sq m (2421 sq ft) between the two test trenches at the south end was conducted to test for the presence of buried cultural deposits. The stripping revealed two stains. Both stains were bisected and excavated, and both were determined to be non-cultural. No artifacts or fire-cracked rock were observed in the test units, test trenches, or the paleosol exposed by mechanical stripping.

**Materials Collected and Analysis**

One lithic artifact was collected from the surface of LA 126407, a chalcedony flake fragment. No ceramics were observed at the site.

**Summary and Management Recommendation**

In total, four stains were investigated at LA 126407. Each was found to be either non-cultural in origin, or lacking in integrity and information potential. Feature 2 (identified in 1999) was determined to be the remnant of a rodent burrow containing charcoal-flecked fill. Feature 5n, identified in BHT 2 was determined to be either non-cultural in origin, or so badly eroded that it lacked any information potential. The other two stains revealed by mechanical stripping were found to be non-cultural, likely the remnants of burned roots.

For these reasons, LA 126407 failed to provide information to address the research issues posed in the data recovery plan. Testing activities did not identify any subsurface cultural material with the potential to add to our understanding of prehistoric lifeways on the West Mesa. LA 126407 was determined “not eligible” for inclusion in the NRHP. No further archaeological investigations were completed at the site.
LA 126408

Previous Work

LA 126408 was originally recorded during a 1999 archaeological survey of the Paseo del Volcan roadway corridor (Parsons Brinckerhoff 1999). LA 126408 was recommended as having “undetermined” eligibility for inclusion in the NRHP, based on the potential for buried cultural material as seen in the road cut profile. The material consisted of a single ash stain in the south side of the road cut profile of 28th Avenue. In 2000, SWCA, Inc. revisited LA 126408 for the purpose of developing a testing plan for the Paseo del Volcan corridor. The feature was relocated and the site was included in the Loma Duran group (Group 2) for testing purposes (Phillips 2000).

On November 2, 2004 representatives of NMDOT and PB again revisited the site to assess the potential impacts of proposed design changes to the Paseo del Volcan roadway project. Eolian sands were found to overlay the entire site, with the hill margins showing evidence of active erosion. A single ash stain was identified in the south side road cut profile of 28th Avenue. The stain was amorphous, with two bands of ashy sediments about 48 cm long running parallel to the road. It was located approximately one meter below the modern surface, and approximately 10 cm above the road surface. No artifacts were observed in association with the stain or on the surface of the site.

Physical Setting

LA 126408 is located approximately 2.6 km (1.6 mi) west of Arroyo de la Baranca and 1.4 km (0.9 mi) east of Arroyo de los Montoyas. The site lies on the first crest and slopes of a series of low hills. The broad topography grades south and west into Arroyo de los Montoyas, a wash that drains the area. The north edge of the site is on the edge of a low swale or closed depression. The present-day ground surface is covered by 5-12 cm of loose eolian sand, except along the roadside berm of 28th Avenue, where as much as 60 cm of recent historic sand has accumulated.

The site provides clear views to the east, south and west. The surface vegetation consists of various types of bunch grass, cholla, snakeweed, prickly pear cactus, fourwing saltbush, chamisa, and sage bushes. The surface sediments consist of fine aeolian sand and sandy loam. Disturbances to the site are associated with erosion and road maintenance activities. Active eolian erosion has occurred along hill slopes and along the cut-slopes and drainage gullies at 28th Avenue. Additionally, the cut-slopes along the north and south margins of 28th Avenue have been repeatedly scraped by road maintenance equipment.

Investigation Strategy

All testing and data recovery activities at LA 126408 were conducted within the limits of the construction zone and right-of-way for the proposed Paseo del Volcan roadway project, all of which is north of 28th Avenue (Figure 6.7). The strategy used to examine the site area within the construction zone included survey, mechanical excavation, and mechanical stripping.

Surface Survey

Prior to testing for subsurface cultural deposits, the entire site and adjacent area were surveyed for archaeological remains. Feature 1 could not be relocated and no artifacts or additional features were observed.
Figure 6.7: LA 126408 Site Map
**Mechanical Trenching and Site Stratigraphy**

Mechanical trenching included one 21-m (69-ft) long trench (BHT 1). The trench was approximately 75 cm wide and was excavated to an average depth of 1.5 m (5 ft). The trench was placed on the north side of 28th Avenue, opposite the previously recorded location of Feature 1, to test for the presence of buried cultural deposits within the construction zone of the Paseo del Volcan project. No evidence of buried cultural deposits was observed in the profiles of the trench.

Examination of the profiles of the trench revealed the same general stratigraphy as observed at the other Loma Duran sites. The present-day ground surface is covered by 5-12 cm of loose eolian sand, except along unpaved 28th Avenue, where as much as 60 cm of recent historic sand has accumulated on a roadside berm. A red paleosol with an underlying weak calcic horizon occurs at the surface just beneath the loose sand. The red paleosol follows the gentle relief of the present-day topography. Although the paleosol and modern surface coincide, indicating that little geomorphic change has occurred since the stability of the surface and soil development, the top of the paleosol is missing due to erosion. The potential for features was known to be associated with the top of a red paleosol that is developed in 120 cm of eolian sand. In the north area of the site, the red paleosol and 120 cm of eolian sand overlie the eroded surface of a late Pleistocene paleosol that has a stage II calcic horizon (Figure 6.8).

![Figure 6.8: Sketch of the stratigraphy of LA 126408; all of the archaeological remains and features occur at the top of the red paleosol; the surface is covered by several centimeters of historic loose eolian sand that is not shown here](image)

**Mechanical Stripping**

Identification of the red paleosol at LA 126408 in BHT 1 suggested the need for mechanical stripping to expose the old surface to determine whether buried cultural deposits were present at the site. Thus, a 40 x 15 m area (600 sq. m or 6455 sq. ft) was stripped, centered on BHT 1. The stripping revealed six stains, three lithic artifacts, and one piece of fire-cracked rock, all situated at the top surface of and/or intruding into the red paleosol. Prehistoric cultural features were not found buried within the eolian sand.

Investigation of the stains showed that three were the product of natural processes such as root burns and rodent burrows. Three stains had more depth and were excavated as features. No artifacts were found in association with any of the features and the fill material did not contain any obvious organic material.
Based on the irregular shapes of the staining and the lack of evidence of cultural activity, all three of these features were determined to be non-cultural. Thus all six stains at LA 126408 exposed by mechanical stripping were determined to be natural phenomena and not the result of human activity.

Materials Collected and Analysis

Three flaked stone artifacts were recovered during mechanical stripping at LA 126408. These consisted of one core, one flake fragment, and one piece of angular debris. All were Pedernales chert. The flake fragment has evidence of secondary stage reduction and a lipped cortical platform. The core had less than 50 percent cortical covering, and three flake scars spaced along a single platform. The assemblage is too small to draw meaningful conclusions regarding site function or technological strategies. No ceramics were observed at the site.

Summary and Management Recommendation

The buried paleosol observed at all of the Loma Duran sites in the west portion of the project area was also present at LA 126408. In addition to a trench across the construction area, a large area near 28th Avenue was mechanically stripped to test for the presence of buried cultural deposits. However, only three artifacts and one piece of FCR were present on the paleosol. Six stains that were exposed by the stripping were determined to non-cultural. The subsurface material at LA 126408 lacks important information to address the research issues in the data recovery plan. Therefore, LA 126408 was determined “not eligible” for inclusion on the NRHP. No further archaeological investigations were completed at the site.

Eligible Sites

LA 55507

Previous Work

LA 55507 was originally recorded during an archaeological survey in 1986 (Hogan 1986). The site measured 200 m by 410 m (656 ft by 1345 ft) and consisted of a series of ridges and knolls with extensive outcroppings of Santa Fe gravels and cobble-sized fragments of various materials suitable for tool-making. The nature of the lithic assemblage indicated extensive lithic procurement and testing activities. At that time, one hundred percent of the observed artifacts (n=75) were analyzed and diagnostic materials were collected.

LA 55507 was not relocated during the 1999 survey of the Paseo del Volcan corridor (Parsons Brinckerhoff 1999); however, in 2005, PB relocated LA 55507 during a survey for right-of-way expansion beyond the previously surveyed corridor. The site consists of a continuous scatter of prehistoric flaked-stone artifacts and five rock concentrations of unknown function. The Santa Fe gravel outcrop covers much of the site. The artifacts are located on the slopes of a group of low knolls northeast of Arroyo de la Baranca. The rock concentrations are associated with the northernmost knoll. The site boundaries were changed to 260 m (853 ft) north-south by 190 m (623 ft) east-west to encompass the artifact distribution. Fire-cracked rock identified in the 1986 survey was not relocated.
Physical Setting
LA 55507 occurs on the on the top and slopes of two knolls and ridges that have outcroppings of gravels of the upper Santa Fe Group. The site has some limited disturbance caused by off-road vehicular traffic, as well as wind erosion and significant erosion from sheet wash. Artifacts occur on the eroded surface of the hill slope and are shallowly buried in eolian-colluvial sediment near the base of the slope. Shallow drainages also contain occasional surface artifacts. The gravels include vesicular basalt, red granite, fossiliferous gray-brown limestone, yellow sandstone, red sandstone, quartz, quartzite, white and brown chalcedony (Pedernales chert), gray chert, petrified wood, ironstone, and jasper, ranging in size to approximately 45 cm in diameter.

Arroyo de la Baranca is oriented northwest-southeast and is about 1,500 ft (457 m) to the east. The site overlooks a broad, open valley to the west, south, and east. From the northernmost knoll there is a clear view of the mesa area to the north, and a broad, open valley to the southeast and northwest. The area supports desert grassland vegetation including sagebrush, cholla, narrow-leaf yucca, fourwing saltbush, Indian rice grass, snakeweed, grama grasses, prickly pear yucca, ground cholla, tumbleweed, scorpion weed, and other forbs. Surface vegetation covers approximately 25-50 percent of the site. Most of the vegetation is located within pockets of sediments on the hill slopes and in the drainages.

Investigation Strategy
All subsurface testing and data recovery activities at LA 55507 were conducted within the limits of the construction zone and right-of-way for the proposed Paseo del Volcan project on the north side of 28th Avenue. The testing and data recovery strategy consisted of surface survey and collecting, mechanical excavation of trenches, and hand excavation of test units.

Site Survey and Surface Collection
The initial activities consisted of re-surveying the entire site to determine the extent of the artifact distribution and to identify any previously unrecorded features. More artifacts were observed than originally described in the initial site recording and the five rock concentrations were relocated. No additional features were identified.

Because of the artifact density at this site, surface collection procedures were determined according to two criteria. Artifacts located individually or in scatters with fewer than ten specimens per 25 sq m were point provenienced and collected. Surface collection units (SCUs) were placed in areas with high artifact densities (> 10/25 sq m) and the artifacts were point located within the individual grid units. In determining the location for the SCU, attention was given to any apparent intrasite differences in lithic distribution patterns, and structural/organizational differences between artifact accumulations. In addition, in order to evaluate the nature and relative frequency of the naturally-occurring lithic material types on the site, two 50-meter linear collection transects were placed on top of the knoll and a sample of 100 unmodified lithic materials was collected at 5-meter intervals.

Twenty three SCUs were used to collect a representative sample of the artifact scatter. The 5 by 5 m SCUs covered 575 sq m total. A total of 535 artifacts were collected from the SCUs, with counts ranging from 2 to 152 lithic pieces, an average of 23.3 artifacts per unit. In addition to the SCU collections, a sample of 157 artifacts was point-provenienced and collected from across the site in small scatters beyond the SCUs.
These collections were generated to provide information on the material types and frequencies of unmodified naturally occurring lithic materials on the site. The prehistoric artifact assemblage was composed primarily of flaked stone debitage, but also included flaked stone tools and cores. Lithic materials noted in the field consisted of chalcedony, chert, quartzite, and silicified wood.

Mechanical Trenching and Site Stratigraphy

Mechanical excavation of trenches was undertaken at LA 55507 to test for subsurface features and cultural deposits, and to expose the site’s stratigraphy. The site was tested with three mechanical backhoe trenches (BHT) that were placed in areas with sediment accumulation and where lithics were observed. The location of the trenches was determined in consultation with the project geologist, Dr. Stephen Hall.

BHT 1 measured 45 m in length and was positioned 8-12 m north of 28th Avenue across a low, artifact-covered knoll. BHTs 2 and 3 were placed parallel and north of BHT 1 across a terrace at the base of the northernmost knoll (see Figure 6.10). The BHTs were spaced 12-15 meters apart. All of the trenches averaged 0.75 m in diameter and were excavated to a depth of approximately 1.5 m (5 ft) in depth. No features or other cultural material was observed in any of the trenches.

The trenching at LA 55507 revealed a stratigraphy (Figure 6.9) unique in the project area. The sediments at the site are dominated by gravels and mudstone of the Santa Fe Group, of Early Pleistocene to Pliocene age. Covering these ancient gravels is a thin mantle of eolian and colluvial sand that covers the gravels in some areas. In much of the area the mantle of sand is not present and the Santa Fe gravels are exposed on the surface. Archaeological remains of any age could be buried in the areas where the eolian and colluvial sands are present; however, no remains were identified in the three backhoe trenches nor in the four tests units. Moreover, the hundreds of artifacts dispersed among the Santa Fe gravels and embedded in the surface of the loose sands indicate that the site is largely a surface manifestation.

![Figure 6.9: Sketch of stratigraphy at LA 55507](image)

Figure 6.9: Sketch of stratigraphy at LA 55507; artifacts occur on the denuded surface of the Santa Fe Group and are buried in shallow eolian-colluvial deposits at the foot of the hillslope; the local deposits are covered by 12 cm of recent eolian sand that is not shown in the diagram.
Figure 6.10: LA 55507 Site Map
Based on the results of the mechanical stripping, the test units, and the stratigraphy at the site, no mechanical surface stripping was conducted.

**Hand Excavation**

Four hand-excavated test units were used to investigate artifact scatters and two rock concentrations. Locations of the test units are shown on Figure 6.10. TU 1 measured 2 by 2 m and was placed over a rock concentration located 51 m south of the site datum. The rock concentration consisted of a cluster of 30-40 chalcedony, quartzite, sandstone, and granite cobbles and small boulders located on the southwestern slope of the knoll. This unit was excavated in three levels to a depth of 30 cm, with artifacts in the upper two levels. Level 1 was a light brown, very fine loose sand with gravels, and contained cores and lithic debitage. Sediments in Level 2 were similar and contained flaked stone debitage. Level 3 contained loose reddish brown fine-grained sand and no artifacts. The rocks within the concentration were point provenienced during mapping, and removed. The origins for the rock concentrations are likely associated with colluvial and alluvial processes.

TU 2 measured 2 by 2 m and was placed over a rock concentration located 15 meters east of TU 1. The rock concentration included a cluster of 40-50 chalcedony, quartzite, sandstone, basalt, limestone, and granite cobbles and small boulders. TU 2 was excavated in three 10 cm levels to 30 cm below the surface. All three levels contained the same type of sediments as seen in TU 1 and contained artifacts including flaked stone cores, a biface, and debitage. Artifacts decreased with depth. The rocks located within the unit were point provenienced during mapping and removed. Like the concentration at TU 1, the origins for the rock concentrations are likely associated with colluvial and alluvial processes.

TU 3 measured 2 by 2 m, and was placed within an area of high artifact density near the top of the knoll, 15 m south of the site datum. This unit was excavated in three 10 cm levels to a 30 cm depth. Levels 1 and 2 contained flaked stone debitage. Level 1 consisted of light brown, very fine loose sand and gravels that included flaked stone debitage. Level 2 contained brown to very pale brown fine-grained loose sand with coarse gravels, with only a few pieces of lithic debitage. No artifacts were identified in Level 3. No subsurface features were identified.

TU 4 measured 2 by 2 m, and was placed within sedimentary deposits with high surface artifact densities along the base of the knoll, 25 m south of the site datum. This unit was excavated in three 10 cm levels to 30 cm below the surface. All of the levels contained flaked-stone debitage. Level 1 consisted of light brown, very fine loose sand and gravels, and contained high quantities of flaked stone debitage. Level 2 contained light brown fine-grained sand with a high percentage of coarse gravels. Very few pieces of flaked stone debitage were derived from the level. Level 3 contained light brown fine-grained loose sand with a high percentage of gravel inclusions. A few pieces of flaked stone debitage were derived from the level. No subsurface features were identified.

**Materials Collected and Analysis**

LA 55507 is a lithic procurement site that consists of a moderately-dense scatter of flaked stone artifacts. A total of 1,440 flaked stone artifacts were recovered from LA 55507, the largest lithic assemblage in the project area. Artifacts consist of 1,264 pieces of debitage, 11 used flakes, 123 cores, 5 core/hammerstones, 1 hammerstone, 30 tested cobbles, 1 uniface, 4 bifaces, and 1 retouched cobble tool. About half of the assemblage was recovered from surface contexts, with the remaining half coming from the uppermost levels of the test units. No other artifacts or samples were recovered from this site.
The lithic assemblage is dominated by debitage, which makes up 88 percent of the sample. Flake fragments outnumber whole flakes only 2-to-1, which is a lower ratio than most of the other sites in the study. The site has high frequencies of early-stage debitage, large debitage size, and relatively high percentages of cores and tested cobbles.

Ninety-six percent of the debitage on the site is Pedernales chert. All of the sites in the project area have high percentages of Pedernales chert, and groups were clearly favoring this material, as it is scattered over the site surface with other raw material types. Microcrystalline granular structure characterizes about 88 percent of the flake debitage, reflecting the quality of the Pedernales material. Other raw materials range in their crystalline quality, but most are not as fine-grained as the Pedernales chert. The next most frequently occurring material, tan chert, amounts to only 1.3 percent of the assemblage, and no other material amounts to one percent of the assemblage. Heat-treatment of raw materials was probably an infrequent occurrence, as only 5.7 percent of the assemblage exhibits clear evidence of thermal alteration.

Eleven used flakes were recovered; all are of Pedernales chert, with the exception of one flake of reddish-brown chert. Two of the used flakes have extensive unimarginal retouch. Scraping and cutting/sawing use was the most common.

One hundred twenty-three cores, 5 core/hammerstones, 1 hammerstone, and 30 tested cobbles were recovered from the site. This represents 11 percent of the flaked stone assemblage, the largest amount and percentage of cores and associated artifacts recovered from the project. Core preparation and reduction does not appear to follow a distinct pattern on LA 55507, with an array of platform types. Heat-treating of cores appears to be rare, with only 2 cores (1.6 percent) exhibiting any thermal alteration. Although the site reflects intensive lithic reduction, most cores were not exhaustively reduced, with almost 44 percent of the cores retain more than half of their cortical covering. Over 85 percent of the cores and core/hammerstones recovered from the site are of excellent microcrystalline quality. Even most of the tested cobbles exhibit good quality, but, predictably, the quality of the tested cobbles lags behind the quality of the cores.

Site inhabitants overwhelmingly selected Pedernales chert for testing and reduction. Of the 123 cores, over 97 percent are Pedernales chert, with the remaining 3 percent split among quartzite, moss agate, and obsidian cores. The obsidian, and possibly the moss agate cores, are non-local. Likewise, most of the tested cobbles are also of Pedernales chert.

Two bifaces, one uniface, and one retouched cobble tool comprise the tools in the flaked stone assemblage. All except one of the bifaces were recovered from the site surface. The uniface and cobble tool are distinctive and are discussed in detail in the lithics chapter of this report.

Raw Material Study

One hundred unmodified Santa Fe gravels were systematically sampled from the surface of LA 55507 in order to investigate prehistoric raw material selection that occurred on the site and the constraints that the materials may have placed on reduction and use strategies. Sampling procedures were detailed previously, which roughly follow those set out by Shelley (1993). The sample reflects that LA 55507 has a broad and diverse range of sedimentary, igneous, and metamorphic raw materials that were available and selected by prehistoric groups visiting the Paseo de Volcan corridor. The most common material is Pedernales chert making up 38 percent of the sample, followed by granite, composing 31 percent of the sample. All other material types amount to 7 percent or less of the sample. The results of the raw material evaluation are presented in Chapter 7 of this report.
Summary and Management Recommendation

LA 55507 primarily functioned as a lithic raw material source for prehistoric groups, where almost any desired material for flaked or ground stone use could be found. The diversity and quality of materials available from the site appears to have placed no constraints or limitations on reduction strategies for the prehistoric inhabitants of the Paseo de Volcan corridor sites. Pedernales chert appears to have been the favored flaked stone raw material. Pedernales chert makes up about 38 percent of the naturally-occurring raw material nodules at the site, but represents about 93 percent of the total lithic assemblage. Additionally, of the Santa Fe nodules that appear at the site, it is the most microcrystalline material available, as about 79 percent of the Pedernales nodules were classified as microcrystalline, while no other material at the site was classified as microcrystalline. Thus, Pedernales nodules were intentionally selected over other materials for lithic production.

Although the site functioned primarily as a place where flaked stone raw materials were collected, tested, and carried away; tools recovered from the site suggests the location may also have functioned as a processing locale. Formal and expedient tools recovered from the site exhibited wear from hammering/battering, cutting/sawing, scraping, and other indeterminate use. The lack of worn out and broken formal tools suggests the site may be the result of small task groups being sent out from a residential location to obtain lithic raw materials and quickly leaving. There were no diagnostic tools found on the site to assign a cultural/temporal affiliation, but the lack of patterned core preparation and reduction suggests the site assemblage may be the sum result of reuse and revisits by different groups employing different raw material reduction strategies through time.

Data recovery of the portion of LA 55507 within the APE site has been completed. Portions of the site extend north and south of the APE and contain hundreds of artifacts. Although some of the research issues for the project were addressed in the current investigation, the portion of the site in the APE did not contain information to address some research issues such as chronology. The remaining portion of the site may contain information to address regional research questions regarding chronology and lithic organization at raw material locations. The remainder of LA 55507 is therefore recommended as eligible to the NRHP under criterion “d”.

LA 55509

Previous Work

LA 55509 was originally recorded during an archaeological survey in 1986 (Hogan 1986). The site measured 40 m (131 ft) by 55 m (180 ft) and consisted of a “cluster of three artifact scatters in deflated areas of a dune” which appeared to be “the remains of one or more Archaic residential camps” (Hogan 1986). At that time, one hundred percent of the surface artifacts were analyzed and diagnostic materials were collected. Because the nature and extent of the subsurface cultural material was not fully evaluated, the site was recommended as having undetermined eligibility for inclusion in the NRHP.

In 1999 PB attempted to relocate LA 55509 during an archaeological survey for the proposed Paseo del Volcan roadway (PB 1999); however, the site was not relocated, likely due to poor locational information. In January 2005 PB relocated LA 55509 during an archaeological reevaluation of a portion of the previously surveyed Paseo del Volcan corridor. Changes in the design plans required drainage improvements where Arroyo de la Baranca crosses the project corridor and the site was identified during the survey for the improvements. It was determined that LA 55509 was plotted on the ARMS Map.
Service approximately 221 m (725 ft) south of the location shown on the site location map in the 1986 report.

As recorded in 2005, the site measures approximately 96 m (315 ft) north-south and 98 m (322 ft) east-west, and the entire site is north of 28th Avenue. During the 2005 site recording thirteen artifacts were identified dispersed across the site, and 22 artifacts were recorded in a concentration immediately south of the right-of-way boundary fence. Surface lithics included a projectile point, cores, core-reduction flakes, biface-thinning flakes, a utilized flake, angular debris, and ground stone. The only ceramic artifact was a Rio Grande Glaze “A” bowl sherd. The projectile point is a Polvadera obsidian San Jose (3200-1500 BC) dart point.

Based on the nature of the lithic debitage assemblage and the San Jose point, LA 55509 was assigned a Middle to Late Archaic (ca. 5500 BC – 1500 BC) cultural/temporal affiliation. The presence of one glazeware sherd was not considered sufficient to assign a later Ancestral Puebloan component to the site. The presence of artifacts and fire-cracked rock in disturbed and eroded areas indicated a high potential for buried cultural deposits with information potential related to prehistoric land use patterns. LA 55509 was determined eligible for inclusion in the National Register under criterion “d”.

Physical Setting
LA 55509 is located on a high bench less than 100 ft west of Arroyo de las Lomotas Negras, which flows intermittently southeast-northwest through the area. LA 55509 is about 500-600 ft west of LA 55507, a large prehistoric quarry site. The topography slopes away from the site in all directions except north, where is gently slopes up. The site is associated with eolian sand that is likely derived from the arroyo. The surface vegetation consists of various types of bunch grass, cholla, snakeweed, prickly pear cactus, fourwing saltbush, chamisa, and sage bushes. The site shows evidence of active eolian erosion along hill slopes and along the graded road cuts of 28th Avenue. The cut-slopes north and south of 28th Avenue have been routinely scraped by road maintenance equipment.

Investigation Strategy
Testing and data recovery activities at LA 55509 incorporated surface collections, mechanical trenching, mechanical surface stripping, and manual excavations using 1 x 1 test units. Surface collections at the site included piece plotting artifacts and the use of five surface collection units. Subsurface testing at the site began with five mechanically excavated trenches totaling 252.5 meters (828.2 ft). Based on the identification of subsurface cultural remains in two of the trenches, four areas were mechanically stripped totaling approximately 326 square meters (3510 square feet). Seven test units were excavated manually, during preliminary testing and in association with feature excavations. Six features were identified and excavated as a result of testing and data recovery excavations at LA 55509.

Surface Survey and Surface Collection
The initial activities consisted of resurveying the entire site. Prior to commencing subsurface investigations, a point provenience was obtained for all observed surface artifacts, and they were then collected. In four areas of high artifact/fire-cracked rock density, 5 m x 5 m (16 ft x 16 ft) grids were used for surface collections, and in one area of high fire-cracked rock density a 10 m x 10 m (33 ft x 33 ft) grid was used. The location of each artifact and piece of fire-cracked rock was plotted on the collection grid. Outside of these units, each artifact was plotted. One hundred ten artifacts were collected from the surface.
Table 6.3: Surface Artifacts at LA 55509

<table>
<thead>
<tr>
<th>Surface Area/Unit</th>
<th>Collection Size (meters)</th>
<th>Assemblage Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>General scatter</td>
<td>All areas not in collection units</td>
<td>61 lithics, including 1 point and FCR</td>
</tr>
<tr>
<td>809</td>
<td>5 x 5</td>
<td>10 - 7 debitage, 2 cores, 1 hammerstone and FCR</td>
</tr>
<tr>
<td>SCU 2</td>
<td>5 x 5</td>
<td>17 - 15 debitage, 1 core, 1 ceramic and FCR</td>
</tr>
<tr>
<td>SCU 3</td>
<td>5 x 5</td>
<td>3 - 2 flakes, 1 core and FCR</td>
</tr>
<tr>
<td>SCU 4</td>
<td>5 x 5</td>
<td>10 - all debitage</td>
</tr>
<tr>
<td>SCU 5</td>
<td>10 x 10</td>
<td>9 - 6 flake-stone, 1 core, 1 hammer-stone, 1 ceramic and FCR</td>
</tr>
</tbody>
</table>

Mechanical Trenching

Subsurface testing at the site began with five mechanically excavated trenches (Figure 6.11). Backhoe Trenches (BHT) 1-4 ranged in length from 60 to 71.5 m (197 to 235 ft), and BHT 5 is 15 m (50 ft) long. The trenches were excavated to a depth of 1.25 to 1.5 m (4 to 5 ft) below the ground surface. Four of the trenches were excavated east-west, perpendicular to the slope of the low hill; one trench was excavated north to south with the slope of the hill. One ash stain (Feature 1) was revealed in BHT 4, and several pieces of fire-cracked rock and one flake were noted in the backdirt of BHT 3, although no feature was observed in that trench profile. Two artifacts and numerous areas of faint charcoal flecking were observed in the other trenches, but no features were identified.

Site stratigraphy at LA 55509 is shown in Figure 6.12. The ground surface at LA 55509 is covered with approximately 10 cm of loose sand, although sheet erosion has removed it at the northern edge of the site, exposing a red paleosol and artifacts at the surface. The red paleosol (Bw) is the same red paleosol that occurs at other sites in the project area, and is associated with a whitened calcic (stage I) horizon (Bk), also present at the other sites. The middle and lower part of the site has been subjected to shallow gully erosion, resulting in the removal of the red paleosol Bw horizon down to the whitened calcic Bk horizon. Prehistoric thermal features intrusive into the eroded Bk surface indicate that it was used as a living surface in the past. Subsequently, the shallow gulley was filled with reddish yellow eolian sand, likely derived from deflation of the top of the adjacent red paleosol. This younger eolian sand buried the occupation surface. Older artifacts from a period pre-dating the gullygling (and coinciding with the occupation surface at the top of the red paleosol) may also have become mixed with the artifacts from the younger occupation. The gullygling appears localized and the location of cultural material and features in the Bk horizon as seen at LA 55509 is the only case observed in the project area.

Two OSL ages provide a useful geochronology of the eolian sand at the site. The older sand in which the red paleosol is formed is dated 15,130 ± 1,070 yrs BP, consistent with the OSL ages of the eolian sand and red paleosol elsewhere in the project. The younger eolian sand that buries archaeological features at the site is dated 1,350 ± 150 yrs BP (= 356 to 956 AD, 2 sigma) (Hall 2006).

Mechanical Surface Stripping

Based on the identification of a feature in BHT 4 and numerous pieces of fire-cracked rock and a flake in BHT 1, the surface of four areas was mechanically stripped to the top of the red paleosol with the assistance of Dr. Stephen Hall, the project geologist. The mechanically stripped areas totaled approximately 326 sq m (3510 sq ft). Three features were exposed by the mechanical surface stripping.
Figure 6.11: LA 55509 Map Showing Excavation Units
Figure 6.12: Sketch of the stratigraphy of LA 55509; the hillside was eroded, mixing the artifacts from the red paleosol with later occupation of the eroded surface; subsequently, the younger surface along with artifacts and features was buried; the red paleosol is developed in late Pleistocene eolian sand.

**Hand Excavation**

Seven test units were hand-excavated at LA 55509 and ranged in size from 1 x 1 m to 3 x 3 m. Four of the test units were used to define the extent of the stains/features exposed in the backhoe trenches and by mechanical surface stripping. After the features were fully exposed in the test unit(s), they were hand-excavated by bisection.

Two test units were used to test for the presence of buried features, one at an artifact concentration on the red paleosol surface (TU 2), and another at a fire-cracked rock concentration (TU 4).

TU 6 was placed within TU 2, a 3 x 3 m unit that was terminated at 30 cm below the surface. TU 6 was excavated to examine the stratigraphy at the highest elevation of the site. The following table presents a summary of the hand-excavated units, the associated feature/cultural manifestation, and the material recovered. Four hundred sixty-one (461) lithic artifacts and 17 ceramic sherds were collected from the subsurface hand excavated test units.

**Table 6.4: LA 55509 Hand-Excavated Test Unit Summary**

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Unit Size (m)</th>
<th>Total Levels</th>
<th>Cultural Material (L=level)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 x 1</td>
<td>5</td>
<td>L4-1 lithics, L5-2 lithics</td>
<td>Placed over Feature 1 exposed in BHT 4</td>
</tr>
<tr>
<td>2</td>
<td>3 x 3</td>
<td>3</td>
<td>L1-162 lithics, 14 sherds</td>
<td>Placed in north area of site where red paleosol and artifacts exposed at surface</td>
</tr>
<tr>
<td>3</td>
<td>2 x 2</td>
<td>5</td>
<td>L1-8 lithics, L2-24 lithics</td>
<td>Adjacent to BHT 3 near where fire-cracked rock observed, Features 2-3 exposed in Level 3</td>
</tr>
<tr>
<td>4</td>
<td>2 x 2</td>
<td>4</td>
<td>L1-2 lithics</td>
<td>Placed in area of fire-cracked rock surface</td>
</tr>
</tbody>
</table>
A total of six ash/charcoal stains/features were exposed at the site and were hand excavated (Photo 6.1). All of the features were less than one meter in diameter, four were less than 20 cm deep, and two were 50-60 cm deep. The stain designated as Feature 1, upon completion of excavation, did not appear to be cultural. It was a badly eroded/disturbed stained area that appeared to be the result of re-deposition, bioturbation, and organic decomposition.

Features 2, 3, 4, and 5 were clustered in a 4 x 4 m area. Features 2 and 3 were exposed in BHT 3, and Features 4 and 5 were exposed by mechanical stripping in an area adjacent to BHT 3 and 4. Feature 6 was exposed in BHT 4, about 18 m south of the feature cluster.

Feature 2 was a circular deposit of brown sediments with charcoal, ash, and fire-cracked rock inclusions in a basin-shaped earthen pit, with 15 associated lithic artifacts in the surrounding sediments of the test unit. Feature 2 appears to represent the basal remnant of an eroded and bioturbated secondary refuse deposit. A juniper wood sample returned a 2-sigma calibrated radiocarbon date of 820 BC – 760 BC, and 620 BC – 590 BC by the Accelerator Mass Spectrometry (AMS) method.

Feature 3 was an irregular shaped thermal feature measuring approximately 80 x 53 cm and about 10 cm deep. This feature was about 30 cm west of Feature 2. Soils were pale brown sandy silt with charcoal flecking. The feature’s integrity had been compromised by eolian and alluvial erosion and bioturbation. Several pieces of fire-cracked rock were found within the feature, and 198 lithic artifacts were found in surrounding sediments of the test unit.

Feature 4 was a circular deposit of dark grayish brown loose sandy loam with yellowish brown mottling, located approximately 60 cm west of Feature 3. The fill included charcoal, ash, and three lithic artifacts.
Feature 5 consisted of an oval-shaped deposit of dark gray silty sandy loam with charcoal and fire-cracked rock inclusions in a basin-shaped earthen pit. The feature was 2 m southwest of Feature 2. One flake, one piece of thermally altered rock, and several pieces of gravel were identified in the south half of the fill. The north half was collected as a bulk soil sample. The feature was interpreted as the basal remnant of a hearth.

Feature 6 consisted of a shallow, ovoid basal remnant of a thermal feature. The feature fill was brown silty sand with ash that included a piece of a burned root and a piece of fire-cracked rock. Excavations within the four square meters adjacent to the feature produced three ceramic sherds, 15 lithics, and several pieces of fire-cracked rock.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Size - L x W x D Dimensions in meters</th>
<th>Plan view shape</th>
<th>Materials Recovered*</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.70 x 0.60 x 0.14</td>
<td>irregular</td>
<td>One lithic</td>
<td>undetermined</td>
</tr>
<tr>
<td>2</td>
<td>0.30 x 0.26 x 0.53</td>
<td>circular</td>
<td>FCR, Groundstone</td>
<td>Secondary ash deposit</td>
</tr>
<tr>
<td>3</td>
<td>0.80 x 0.53 x 0.59</td>
<td>ovoid</td>
<td>FCR, Lithics, charcoal</td>
<td>Hearth</td>
</tr>
<tr>
<td>4</td>
<td>0.24 x 0.17 x 0.18</td>
<td>circular</td>
<td>Lithics</td>
<td>undetermined</td>
</tr>
<tr>
<td>5</td>
<td>0.33 x 0.34 x 0.10</td>
<td>ovoid</td>
<td>Lithics, FCR</td>
<td>Hearth</td>
</tr>
<tr>
<td>6</td>
<td>0.30 x 0.43 x 0.09</td>
<td>ovoid</td>
<td>One lithic, FCR</td>
<td>undetermined</td>
</tr>
</tbody>
</table>

* FCR=Fire-cracked rock

Materials Collected and Analysis

Radiocarbon Dates

One sample of charred wood material was submitted for wood identification and radiocarbon analysis. The sample was collected from the fill of Feature 2, a circular basin-shaped pit. The material was identified as juniper wood, and returned a 2-sigma calibrated radiocarbon date of 820 BC – 760 BC, and 620 BC – 590 BC by the Accelerator Mass Spectrometry (AMS) method. Multiple probability ranges are a result of short-term variations in atmospheric 14C contents at certain time periods. More specific information on the radiocarbon dates is presented in Appendix C.

Botanical Analysis

The botanical samples produced little meaningful data. From the two features at this site for which analysis was conducted, the archaeobotanical remains consisted of juniper wood charcoal with small amounts of sagebrush and unknown non-conifer. More detailed information on the macrobotanical results is presented in Chapter 8.

Lithic Artifacts

The flaked stone assemblage at LA 55509 is the second largest of the project sites and consists of 601 flaked-stone artifacts and eight pieces of ground stone (Table 6.6). The assemblage is dominated by debitage, but also includes cores, used flakes, hammerstones and a core/hammerstone, a tested cobble, and four bifaces, including a projectile point. The dart point is morphologically similar to the San Jose
type cluster, which generally dates from 4500-1500 B.C., during the Middle and Late Archaic periods (Justice 2002:133). The San Jose dart point is complete and made from translucent, non-local obsidian. Eight ground stone items were recovered, including 4 manos, 2 netherstones, and 2 fragments of indeterminate ground stone. Detailed lithic analysis is provided in Chapter 7.

Table 6.6: LA 126409 Lithic Assemblage

<table>
<thead>
<tr>
<th>Debitage</th>
<th>Cores</th>
<th>Used Flakes</th>
<th>Hammerstones, tested cobbles</th>
<th>Formal tools (bifaces)</th>
<th>Ground stone</th>
</tr>
</thead>
<tbody>
<tr>
<td>575</td>
<td>15</td>
<td>3</td>
<td>4</td>
<td>4 (1 dart point)</td>
<td>8</td>
</tr>
</tbody>
</table>

The debitage raw material assemblage is diverse. Over 88% of the debitage is Pedernales chert, with smaller amounts of numerous other locally-available materials. Primarily due to the high frequency of excellent quality Pedernales chert, 87% of the debitage is microcrystalline, while 10.3% is fine-grained, and 2.5% is medium-grained. Fifteen cores, one tested cobble, and one core/hammerstone were recovered from the site.

The presence of both flaked stone artifacts and ground stone suggests a variety of activities took place at the site. Small grinding tools typically associated with Middle to Late Archaic sites are consistent with the radiocarbon date of ca. 820 BC – 760 BC/620 BC – 590 BC on charcoal recovered from a thermal feature. The number of lithics also suggests a variety of activities taking place including tool production (cores and debitage) or retooling (flakes and debitage), as well as activities using the biface tools such as hunting.

Most of the ground stone items exhibit evidence of burning or heat-alteration; seven of the eight specimens are fragments. There is one nearly complete, round one-hand limestone mano. LA 55509 ground stone exhibits the characteristics of a mobile strategy, although the small size of the ground stone assemblage and the fragmentary condition of the specimens makes the conclusion tenuous. Netherstones are thin, the only complete mano is one-handed, and none of the grinding surfaces observed exhibit large pecks or coarse textures. A high frequency of heat-altered materials, hinting at reuse of artifacts as heating stones, and two possible examples of recycling/multiple-use artifacts (battering on the complete mano and possible recycling of an indeterminate ground stone artifact as a scraper plane) suggest that artifacts were curated for more than one task.

Ceramic Artifacts

A total of 26 sherds were recovered from LA 55509, including two from the surface, one from a test trench, four from one of the mechanical stripped areas, and 14 from a test unit placed in the area of the exposed red paleosol. The assemblage contains plain graywares (n=4) and Glaze C, Glaze D-E wares (n=11), indicating Coalition to late Classic Period use of the area. Eleven sherds were of indeterminate type but appear to be from the same vessel as the other Glaze D-E sherds. However, the assemblage is too small to draw any meaningful conclusions regarding site function or subsistence practices.

Summary and Management Recommendations

LA 55509 has two components, an Archaic occupation, possibly dating as early as the Middle Archaic based on the presence of a San Jose point, and a Late Archaic occupation that dates from ca. 820 BC – 760 BC/620 BC – 590 BC based on one AMS C14 date from charcoal at Feature 2. A later, less intensive Puebloan use of the site area is evidenced by a small (n=26) ceramic assemblage that dates to the Coalition-Classic periods based on gray wares and Rio Grande glaze pottery types.
A total of six ash/charcoal stains/features were identified at the site. Two of the features appear to be basin-shaped hearths and both contained very dark fill with some charcoal, and another appears to be a secondary ash deposit. Three of the stains were shallow, badly eroded, and/or disturbed and had indistinct morphology. The hearths and ash deposit indicate the area was used as a campsite, likely for short term logistical forays for targeted resources, including lithic raw material.

The lithic assemblage at the site is relatively large, and the presence of both flaked stone artifacts and ground stone suggests a variety of activities took place at the site. The large number of lithics also indicates multiple activities, including tool production (cores and debitage) or retooling (flakes and debitage), as well as activities using biface tools such as hunting. The small grinding tools are consistent with a Middle to Late Archaic adaptation. There is a high frequency of heat-altered materials, hinting at reuse of artifacts as heating stones, and two possible examples of recycling/multiple-use artifacts (battering on the complete mano and possible recycling of an indeterminate ground stone artifact as a scraper plane) suggest that artifacts were curated for more than one task.

Eighty-three percent of subsurface artifacts were limited to two areas, one upslope and one midslope: 1) TU 2, a 3 x 3 m unit at the top of the slope where the red paleosol is exposed, and 2) TU 3, a 3 x 3 m unit where two features were exposed. TU 2 contained 199 artifacts, including 14 sherds and 185 lithics. TU 3 contained 198 lithic artifacts. The high lithic count is likely related to the proximity of LA 55509 to LA 55507, a lithic quarry about 600 ft to the east. The high count of artifacts at TU 2 is also the result of exposure of the red paleosol at that test location at the top of the slope. Of the 199 artifacts in TU 2, 176 (88 percent) were recovered from Level 1 of the red palesol. The high count of buried artifacts at TU 3 is likely the result of the following processes:

1. Many of the artifacts exposed on the red paleosol were displaced downslope to the part of the site that was subjected to shallow gully erosion (see Hall 2006); and
2. In addition to the secondary deposit of those artifacts, the eroded surface at midslope was occupied and features were dug into the eroded surface and artifacts were deposited; and
3. The eroded midslope occupation surface and the associated cultural deposits, as well as artifacts displaced from upslope, were subsequently covered with a more recent (ca. 1350 BP) eolian sand deposit.

Based on subsurface investigations at eight sites in the project area, LA 55509 is the only site where these processes occurred.

LA 55509 was determined eligible under criterion "d" for its potential to contain buried features and important information on Middle to Late Archaic occupation of the West Mesa. Data recovery efforts at LA 55509 have been completed in accordance with the research design and data recovery plan for the project, and the portion of the site within the Paseo del Volcan construction limits has been removed. The site no longer contains information to address regional research questions, beyond that obtained from this study. LA 55509 is recommended not eligible to the NRHP and no further archaeological investigation is recommended.

**LA 126406**

**Previous Work**

LA 126406 was originally recorded during a 1999 archaeological survey of the Paseo del Volcan roadway corridor conducted by PB (Parsons Brinckerhoff 1999). The site was located along both sides of 28th...
Avenue. It consisted a four ash stain features seen in road cuts along a 70-m stretch of 28th Avenue (Parsons Brinckerhoff 1999). The site was revisited by SWCA, Inc. in 2000 for the purpose of developing a testing plan for the Paseo del Volcan corridor (Phillips 2000). On November 2, 2004 representatives of NMDOT and PB visited the site to assess the potential impact of design changes associated with the proposed Paseo del Volcan roadway project.

Three of the four features (Features 1-3) were located on the north side of the road cut, each approximately 1 m below the modern ground surface. The fourth (Feature 4) was on the south edge of the road cut, about 40 cm below the modern ground surface. All the features appeared to be associated with the same buried surface. One artifact, a basalt metate fragment, was recorded on the surface immediately north of the stains in stabilized eolian deposits that were unaffected by grading of the road.

The site boundaries were established to encompassed the exposed features; however, Phillips (2000:82) stated “…but due to the sand cover the full extent of the remains can only be guessed at.” The 2004 inspection determined that the nature and horizontal extent of any buried cultural remains was unknown beyond that indicated by the four features, but that additional buried remains might be located adjacent to and in approximately the same stratigraphic horizon. At that time, the site was recommended ‘undetermined’ for inclusion in the National Register of Historic Places based on the unknown potential for buried cultural materials. The site was included in the Loma Duran group of sites (Group 2) under the testing program and included in the current testing and data recovery plan based on the potential for buried cultural deposits.

**Physical Setting**

LA 126406 is located 1.5 miles east of Arroyo de la Baranca on the south side of a low hill terrace associated with Loma Duran, located northwest of the site. The site is on a broad, flat slope within the area of active road maintenance associated with 28th Avenue. This location has clear views to the east, south and west. Eolian sands cover the entire site. The hill margins show evidence of active erosion and active eolian erosion persists along hill slopes and along the graded 28th Avenue roadway. The cut-slopes north and south of 28th Avenue are routinely graded by road maintenance equipment.

The surface vegetation consists of various types of bunch grass, cholla, snakeweed, prickly pear cactus, fourwing saltbush, chamisa, and sage bushes. The surface sediments consist of fine eolian sand and sandy loam. Disturbances to the site are the result of erosion and road maintenance activities.

**Investigation Strategy**

All subsurface testing and data recovery activities at LA 126406 were conducted within the limits of the construction zone and right-of-way for the proposed Paseo del Volcan project on the north side of 28th Avenue. The testing and data recovery strategy consisted of surface survey and collecting, mechanical excavation of trenches, mechanical surface stripping, and hand excavation of test units and features.

**Site Survey and Collection**

The initial activities consisted of re-surveying the entire site to relocate the four features previously recorded, and to identify any additional unrecorded surface artifacts and features. None of the original features was relocated, likely as a result of erosion or road maintenance activities. No additional features were identified. Two cores were found on the surface and collected.
Mechanical Trenching and Site Stratigraphy

Mechanical excavation of trenches was undertaken at LA 126406 to test for subsurface features and cultural deposits, and to expose the site’s stratigraphy. The site was tested with three mechanical backhoe trenches (BHT), and three Test Units (TU).

Three backhoe trenches (BHT 1-3) were initiated within one meter of the estimated location of the features designed 1-3 during the 1999 survey, and were extended north across the site boundary to the northern edge of the construction limits (Figure 6.13). The trenches were approximately 45 m (148 ft) long and excavated to an average depth of 1.5 m (4.9 ft) below the ground surface. Representative sample profiles were recorded, and identified features were mapped in profile and photographed. All features were subsequently exposed in plan view during mechanical stripping.

Feature 1, which was not relocated during the re-survey, was exposed in BHT 1; however, Feature 1 was determined to be non-cultural and was not investigated further. Features 2-4 were not relocated during trenching. BHT 1 also exposed a new feature, Feature 5, in the north end of the west wall. Feature 5 was a moderately dark stain and basin- or slightly bell-shaped in profile. BHT 2 did not expose any features, but BHT 3 exposed Feature 6, a shallow thermal feature in the east wall of the trench about 34-38 cm below the surface.

LA 126406 occurs on the south-facing slope of a low hill. The surface of the site is mantled by loose eolian sand. Just below the loose sand is the eroded top of the red paleosol and accompanying stage I calcic horizon; the paleosol follows the contour of the present-day surface (Figure 6.14). The red paleosol is developed at the top of an eolian sand body that is greater than 170 cm thick; the two older calcic paleosols observed elsewhere in the project are not exposed in the three trenches that dissect the site. The eolian sand with its red paleosol is late Pleistocene in age. Archaeological features occur at the top of the eroded red paleosol and eolian sand unit similar to other sites in the area.

Hand Excavation

Three 1 x 1 m TUs were employed to investigate the stains revealed by trenching. All units were hand excavated to expose the top of the features in plan view.

Test Unit 1

TU 1 was placed 5.5 meters south and 17.5 meters east of site datum, over an irregular charcoal stain on the north shoulder of 28th Avenue to examine the nature and extent of the stain. The unit was excavated through a brown, sandy loam in two arbitrary levels to a depth of about 25 cm below surface, at which depth the staining was no longer observed. No artifacts were recovered. The charcoal staining observed on the road cut slope was determined to have been caused by burned brush that was unrelated to the prehistoric occupation of the site. Thus, no feature number assigned to this stain.

Test Unit 2

TU 2 was placed 34 m north and 0.5 m west of site datum, adjacent to the north end of Trench 1 on the west side over Feature 5. It was excavated through a brown sandy loam in three arbitrary levels to a depth of about 23 cm below the surface. One piece of angular debris was recovered from Level 2. Excavation of Level 3 was halted when, after 6-8 cm, the entire feature was exposed in plan view. Further excavation of the feature was conducted after surface stripping.
Figure 6.13: LA 126406 Site Map
Figure 6.13: LA 126406 Site Map continued
Figure 6.14: Sketch of the stratigraphy of LA 126406; the subsurface stratigraphy is uniform throughout the site area; the entire sequence of eolian sand correlates with the sequences dated 15,000-10,000 yrs BP nearby; the red paleosol and its stage I carbonate horizon formed after 10,000 yrs BP; the older late Pleistocene calcic paleosol is not exposed at 170 cm depth; historic loose eolian sand covers the site but is not shown in the diagram.

Test Unit 3

TU 3 was placed adjacent to Trench 3 at the north end over Feature 6, a carbon stain located about 30 cm below the surface. The TU was excavated in three arbitrary levels to a depth of about 34 cm. A slightly compact reddish brown silty sand was encountered in Level 2, but no cultural materials were noted in Levels 1 or 2. The top of Feature 6 was exposed in plan view in Level 3, a compact silty sand, identified as a paleosol, which contained three chalcedony flake fragments, 4 pieces of possible granitic fire-cracked rock, gravels, and two pieces of calcined bone. Feature 6 measured approximately 80 x 82 cm in plan view. Excavation also revealed that the feature consisted of two separate components, subsequently designated Features 6A and 6B. Further excavation of the feature was conducted after surface stripping.

Mechanical Surface Stripping

Based on the features exposed in BHTs 1 and 3, an area measuring 55 m E-W and 58 m N-S and totaling approximately 1800m² (19,365 ft²), was mechanically stripped to the level of the features observed in the trenches, i.e., approximately 35 cm below the modern ground surface. Generally, the stripped area was between BHTs 1 and 3, and extended north of the trenches (see Figure 6.13). The stripped area was expanded as additional ash stains were exposed. A total of 24 new stain features were identified in these stripped areas. All 24 were generally small and shallow, ranging from 29 to 150 cm (11 to 59 in) in diameter and from 5 to 34 cm (2 to 13 in) in depth. Associated cultural material was sparse and there was a noticeable lack of fire-cracked rock at all but a few of the features.

Some of the features exposed by stripping were found clustered into two concentrations. One concentration contained 11 features (Features 6 (later 6A, 6B), 7, 10, 11, 12, 17, 18, 19, 23, 25, and 26). The second concentration contained three features (Features 13, 14, 15). The remaining 10 features (8, 9, 16, 20, 21, 22, 24, 27, 28, and 29) were scattered within the two stripped areas.
Feature Excavations

Two Study Units (SU) were used to investigate the feature concentrations exposed in the stripped area, as the concentrations held the potential to be a living floor, or a structure with associated features. The investigation examined both the feature concentrations and the more isolated features. SU 1 measured 5 sq. m and was placed 29 m north and 10 m east of datum and encompassed three clustered features (Features 13, 14, and 15, Photo 6.2). SU 2 also measured 5 sq. m and was placed over the second cluster, Features 6, 7, 10, 11, 12, 17, 18, 19, 23, 25, and 26.

Photo 6.2: LA 126406, Study Unit 1 (pre-excavation)

Of the 29 features identified within the APE, 26 were determined to be relatively intact cultural features and were excavated, including Feature 6, which was later considered to be two separate features (Features 6A and 6B). Features 2-4 were not relocated, and Feature 1 was found to be non-cultural. All were identified by carbon residue staining and all were investigated by bisection. All the features identified at LA 126406 are listed in tables below. Table 6.7 lists features that were not excavated.

Table 6.8 lists the excavated features with a maximum dimension of less than one meter and summarizes the results of excavation in terms of size, morphology, and cultural remains, if any. Table 6.9 provides the same data with regard to features with a maximum dimension of greater than one meter. Photo 6.3 illustrates a sample small (<1 m) thermal feature at the site.

Photo 6.3: LA 126409, small feature morphology (Feature 29)
Table 6.7: Features at LA 126406 that were not excavated

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Cultural Remains Recovered and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>North side of road cut - not relocated on re-survey. A stain assumed to be Feature 1 was observed in BHT 3, but was found to be non-cultural</td>
</tr>
<tr>
<td>2</td>
<td>North side of road cut - Not relocated</td>
</tr>
<tr>
<td>3</td>
<td>North side of road cut -Not relocated</td>
</tr>
<tr>
<td>4</td>
<td>South edge of road cut-Not relocated</td>
</tr>
</tbody>
</table>

Table 6.8: Features at LA 126406 with maximum dimension of one meter or less

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Size (L x W x D) m</th>
<th>Morphology</th>
<th>Cultural Material Recovered and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.64 x 0.60 x 0.18</td>
<td>Basin/Bell/T/O/SubR</td>
<td>None, BHT 1, TU 2, possible hearth</td>
</tr>
<tr>
<td>6A</td>
<td>0.57 x 0.50 x 0.15</td>
<td>Basin/Cir</td>
<td>L(11), BrB, BS, BHT 3, TU 3, SU 2, probable hearth</td>
</tr>
<tr>
<td>6B</td>
<td>0.57 x 0.64 x 0.24</td>
<td>Basin/Cir</td>
<td>C, BrB, BHT 3, TU 3, SU 2, probable hearth</td>
</tr>
<tr>
<td>7</td>
<td>0.59 x 0.48 x 0.34</td>
<td>Basin/O</td>
<td>L (3), F, C, FCR, SU 2, possible roasting pit</td>
</tr>
<tr>
<td>9</td>
<td>0.51 x 0.48 x 0.33</td>
<td>Basin/Cir</td>
<td>F (3), C, possible hearth</td>
</tr>
<tr>
<td>10</td>
<td>0.47 x 0.30 x 0.31</td>
<td>Bell/O</td>
<td>BrB, GSU 2, SU 2, possible storage pit</td>
</tr>
<tr>
<td>11</td>
<td>0.57 x 0.45 x 0.11</td>
<td>Basin/O</td>
<td>C, L (1), SU 2, possible hearth</td>
</tr>
<tr>
<td>12</td>
<td>0.55 x 0.45 x 0.29</td>
<td>Bell/Basin/O</td>
<td>C, L (1), BrB (1), V, FCR, SU 2, possible roasting pit</td>
</tr>
<tr>
<td>13</td>
<td>0.90 x 0.86 x 0.07</td>
<td>Basin/Cir</td>
<td>Cer (5), C, SU 1, hearth</td>
</tr>
<tr>
<td>14</td>
<td>&lt;1.0 (?) x 0.94 x 0.07</td>
<td>Basin/Irr</td>
<td>C, SU 1; hearth</td>
</tr>
<tr>
<td>15</td>
<td>0.77 x 0.74 x 0.14</td>
<td>Basin/O</td>
<td>C, SU 1, hearth</td>
</tr>
<tr>
<td>17</td>
<td>0.14 x 0.18 x 0.17</td>
<td>Basin/O</td>
<td>F, C, SU 2, possible post hole</td>
</tr>
<tr>
<td>18</td>
<td>0.43 x 0.49 x 0.06</td>
<td>Basin/Cir</td>
<td>C, FCR, SU 2, questionable feature, possible hearth</td>
</tr>
<tr>
<td>19</td>
<td>0.42 x 0.28 x 0.21</td>
<td>Bell/Cir</td>
<td>C (flecking), SU 2, possible secondary deposit</td>
</tr>
<tr>
<td>20</td>
<td>0.35 x 0.31 x 0.14</td>
<td>Basin/Cir</td>
<td>None, possible severely eroded hearth or non-cultural</td>
</tr>
<tr>
<td>21</td>
<td>&lt;1.0 (?) x 0.49 x 0.26</td>
<td>Basin/Bell/Cir</td>
<td>None, very dark fill, possible pit or hearth</td>
</tr>
<tr>
<td>22</td>
<td>0.82 x 0.92 x 0.12</td>
<td>Basin/O/Irr</td>
<td>None, dark gray fill, possible hearth or non-cultural</td>
</tr>
<tr>
<td>23</td>
<td>0.31 x 0.41 x 0.13</td>
<td>Basin/Bell/O</td>
<td>FCR, C, dark gray mixed fill, SU 2, indeterminate, possible storage pit</td>
</tr>
<tr>
<td>24</td>
<td>0.50 x 0.60 x 0.50</td>
<td>Bell/Cir</td>
<td>C, dark gray fill, indeterminate</td>
</tr>
<tr>
<td>25</td>
<td>0.29 x 0.31 x 0.10</td>
<td>Basin/Bell/Cir</td>
<td>None, slight C, dark fill, SU 2, possible hearth</td>
</tr>
<tr>
<td>26</td>
<td>0.30 x 0.29 x 0.14</td>
<td>Basin/Cir</td>
<td>L(1), C, very dark fill, SU 2, possible 'early' hearth</td>
</tr>
<tr>
<td>27</td>
<td>0.63 x 0.60 x 0.7</td>
<td>Basin/O</td>
<td>None, sampled only, possible hearth</td>
</tr>
<tr>
<td>28</td>
<td>0.42 x 0.42 x 0.9</td>
<td>Basin/ Cir</td>
<td>Light C, possible hearth</td>
</tr>
<tr>
<td>29</td>
<td>0.88 x 0.70 x 0.22</td>
<td>Basin/Cir</td>
<td>Light C, possible roasting pit or hearth</td>
</tr>
</tbody>
</table>
Table 6.9: Features at LA 126406 with maximum dimension of one meter or more

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Size (L x W x D) m</th>
<th>Morphology</th>
<th>Cultural material recovered and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1.30 x 1.10 x 0.13</td>
<td>Basin/Irr</td>
<td>None, small core frag nearby, possible hearth</td>
</tr>
<tr>
<td>16</td>
<td>1.35 x 0.82 x 0.05</td>
<td>Basin/O</td>
<td>L (1), C, possible hearth</td>
</tr>
</tbody>
</table>

While all the features had dark soils stained with carbon residue that appeared to be the result of thermal activity, others did not contain clear evidence of thermal use. Seven did not contain any artifacts. Most had been impacted to some extent by rodent activity and other bioturbation, and the edges were not typically well-defined due to mottling of the soils on the feature edges.

As discussed in Chapter 2, it is geologically evident that erosional events truncated the upper portion of the prehistoric living surface, either during and/or after occupation. Based on soil composition of the paleosol, Dr. Hall estimates that approximately 30 cm of the paleosol was truncated through erosion, although the amount would vary across the site and among sites. Because all the features are intrusive into the paleosol, the upper portions of all the features have been truncated and only some portion of the basal remnants of the features remain. Thus, the original depths and profile shapes of the features are not known. It is not feasible, therefore, to draw definitive conclusions regarding the morphology and function of these features. The erosion that removed the upper portions of the features also explains the general paucity of associated cultural material and the noticeable lack of fire-cracked rock.

The above limits notwithstanding, the descriptions allow some general conclusions to be drawn regarding these features. The basal remains of the features were generally small and shallow, with 24 of the 26 measuring less than one meter at their maximum dimension. Only two (Features 8 and 16) measured greater than one meter in diameter in their maximum dimension, and neither exceeded 1.35 meters. Feature depths ranged from 6 cm to 0.5 m (2 inches to 20 inches).

Generally, cultural material associated with the features was sparse. Of the 26 features investigated, 20 (77%) contained some cultural material (charcoal, artifacts, faunal, lithics, ceramics, ground stone or FCR). Of those 20, however, charcoal was the only cultural material in six (30%). Only five ceramics were recovered, all of which were of gray utility ware, and all were recovered from the upper portion of Feature 13. Fifty lithics were recovered from the entire site, but only 18 were found in the feature fill. Fire-cracked rock was noticeably sparse as well. It was present in only four of the 26 features (15%), and when present, numbered only a few pieces.

The clustering of features in SU 2 indicates an area of intense use, but the nature of the activities is not clear. These 12 features (Features 6A, 6B, 7, 10, 11, 12, 17, 18, 19, 23, 25, and 26) display a wide range of horizontal and verticals shapes and depths (Table 6.10).

Table 6.10. SU 2 Feature Descriptions

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Horizontal Shape</th>
<th>Vertical Shape</th>
<th>Max Depth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A</td>
<td>Circular</td>
<td>Basin</td>
<td>15</td>
</tr>
<tr>
<td>6B</td>
<td>Circular</td>
<td>Basin</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>Ovoid</td>
<td>Basin</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>Ovoid</td>
<td>Bell</td>
<td>31</td>
</tr>
<tr>
<td>11</td>
<td>Ovoid</td>
<td>Basin</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>Ovoid</td>
<td>Bell or basin</td>
<td>29</td>
</tr>
<tr>
<td>17</td>
<td>Ovoid</td>
<td>Basin</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>Circular</td>
<td>Basin</td>
<td>6</td>
</tr>
<tr>
<td>19</td>
<td>Circular</td>
<td>Bell</td>
<td>21</td>
</tr>
</tbody>
</table>
There is no clear evidence that the SU 2 concentration of features represents a habitation structure, as all of the features are small and appear to be discrete (Photo 6.4). There also does not appear to be any consistent relationships between the three variables measured. Thus, an alternative interpretation of this concentration is that the features represent a location where a variety of related activities took place, perhaps by a group of people engaged in a task or tasks requiring several features in order to accomplish the end result(s). Heating stones in one pit, then placing them in a second pit for boiling, and later storing the product in a bell shaped pit, is an example of one possible series of activities. Repeated use of the area over time could also explain this concentration of potentially multi-purpose features. Unfortunately, it is not feasible to draw any definitive conclusions, because of the history of erosion at the site and the lack of precise dating of all of the individual features.

Based on the presence of the carbon residues, the general morphology, the cultural contents, and the association with other features containing artifacts and/or charcoal or FCR, most features at LA 126406 appear to have been hearths, roasting pits or storage pits. Features 8 and 16 were interpreted as hearths despite their larger size, but this is most likely due to differential erosion within the site.

**Materials Collected and Analysis**

**Radiocarbon Dates**

Six charcoal samples were submitted for C14 analysis from five features at the site. The results of the C14 analysis are shown in Table 6.11. More detailed information on the radiocarbon dates is presented in Appendix C.
Table 6.11: Radiocarbon Dates at LA 126406

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Provenience</th>
<th>Wood ID</th>
<th>14C Analysis Method</th>
<th>Calibrated Date Range(s), 2-sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-219096</td>
<td>Feature 6B, North ½ (hearth)</td>
<td>Juniper seeds</td>
<td>AMS</td>
<td>1380 – 1100 BC</td>
</tr>
<tr>
<td>Beta-219097</td>
<td>Feature 7, East ½ (roasting pit)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>1390 – 1120 BC</td>
</tr>
<tr>
<td>Beta-219099</td>
<td>Feature 13 (hearth)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>AD 1040 - 1260</td>
</tr>
<tr>
<td>Beta-219100</td>
<td>Feature 12, South ½ (roasting pit)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>1400 – 1140 BC</td>
</tr>
<tr>
<td>Beta-219102</td>
<td>Feature 13 (hearth)</td>
<td>Not submitted for analysis</td>
<td>AMS</td>
<td>AD 1020 - 1210</td>
</tr>
<tr>
<td>Beta-219104</td>
<td>Feature 16, East ½ (oval pit)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>AD 1020- 1200</td>
</tr>
</tbody>
</table>

The radiocarbon dates reflect a Late Archaic occupation from about 1400 BC to 1100 BC, and a ceramic period occupation from AD 1020 to AD 1260 during the late part of the Developmental period. The five undifferentiated gray utility ware sherds recovered from Feature 13 are consistent with the Developmental Period radiocarbon dates. The range of dates and features cutting into one another suggest reuse of the site by Archaic and Puebloan groups over hundreds of years.

Botanical Analysis

The botanical samples produced little meaningful data. Juniper seeds were identified in macrobotanical samples from Feature 6B (hearth) and from the north half of Study Unit 2 at LA 126406. Although juniper cones were used for emergency food or seasoning, the resinous quality of the cones renders them unpalatable enough to preclude their widespread use. The fleshy cones (commonly called berries) can still be attached to branches and burn along with the wood and the seeds inside the cones inadvertently become part of the record. The balance of archaeobotanical remains consisted primarily of juniper wood charcoal with small amounts of sagebrush and unknown non-conifer. Macrobotanical wood samples were 94% juniper and 6% sagebrush, with traces of unknown conifer and saltbush/greasewood. Considering that today, the nearest juniper is two to five miles away, either juniper was more prevalent in the immediate prehistoric site environs or inhabitants made a point of traveling the distance to gather wood.

In sum, evidence of plant resources that could have been processed using the ground stone artifacts found at LA 126406 was absent from the flotation samples. The most that can be said about plant exploitation at this site is that local wood resources were used for fuel. More detailed information on the macrobotanical analysis is presented in Chapter 8.

Lithics

A total of 50 lithic artifacts were recovered from the site, including 36 pieces of flaked stone debitage, three cores, five manos, 1 disk-shaped sandstone artifact and five fragments of indeterminate ground stone. None of these artifacts was diagnostic, making it impossible to assign a cultural/temporal affiliation to the assemblage. Chapter 7 presents detailed information and analyses of the assemblage.

As suggested by the variety of features in SU 2, the presence of flaked stone artifacts and ground stone also suggests a variety of activities took place at LA 126406. Likewise, the relatively small number of
flaked stone artifacts includes evidence of a variety of reduction strategies, including tool production (cores and debitage) and retooling (flakes and debitage).

The site contained more ground stone artifacts (n=11), and a higher percentage (22 percent) of ground stone artifacts than any other site in the project area. The high ratio of ground stone-to-flaked stone may suggest food processing was the primary activity conducted on site. The size and condition of the ground stone tool kit suggests it was used for plant processing. Both these suggestions accord well with the proposed interpretation of the features (see above), although macrobotanical evidence for food processing was lacking. Of the 39 flaked stone artifacts, all but three are pieces of debitage; the other three are cores. These cores were probably gathered from the surface at nearby LA 55507, brought back to the site, and reduced. The flaked stone assemblage, then, indicates that the site also functioned as a lithic reduction locale.

The sandstone disk-shaped artifact was shaped by pecking and flaking into a circle. Its use could not be determined as the only evidence of wear was traces of grinding on the surfaces before shaping. It may be some kind of recycled tool.

**Summary and Management Recommendations**

LA 126406 appears to have been used periodically during the Late Archaic and the Developmental Period. Aside from three possible bell-shaped pits (Feature 10, 19 and 24) that may have functioned as storage pits, the other features at the site appear to be the result of thermal activities. With the exception of Features 8 and 16, they are small (less than one meter in the longest dimension). The larger size of Features 8 and 16 may be a function of differential erosion or they may represent roasting pits. The horizontal and vertical shapes of the features vary, and lack any clear correlation with depth across the site, or within either study unit (SU 1 or SU 2), except that those in SU 1 tended to be more consistently shallow. There is no clear evidence that SU 2 is a habitation location, despite the concentration of 12 features within it. More likely, the features represent a location where a variety of related activities took place, or an area that was used repeatedly over time.

The lithic assemblage suggests the site functioned as both a plant processing locale and as a lithic reduction site. Unfortunately, the lack of botanical evidence from the features does not allow identification of the targeted plant resources, or allow inferences as to seasonal use of the site. Lithic analyses suggest the on-site reduction of cores gathered from the surface of LA 55507. These two activities are characteristic of a mobile strategy; although the small number of artifacts precluded inferences regarding the nature of the lithic technology.

The stratigraphy at this site is similar to other Loma Duran sites and is uniform across the site. The prehistoric living surface appears to have been the red paleosol horizon formed after 10,000 yrs BP. The paleosol has a geologic unconformity along its top and the A soil horizon is no longer present. This unconformity, together with the paucity of artifacts and the substantial number of features with widely varying depths, suggests that post depositional processes have truncated the features and the paucity of artifacts indicates that most of the artifacts have been displaced, limiting the information potential of the site. The information obtained at the site has been used, to the extent possible, to address the research questions posed in the data recovery plan, however, the information was limited due to the site formation processes. This is true of all the Loma Duran sites in the project area. A more detailed discussion of LA 146406 in terms of the specific research questions posed in the research design is included in the Summary Chapter.
Data recovery at the site has been completed. One thermal feature south of 28th Avenue and beyond the APE was not investigated. Although other buried features are likely present south of 28th Avenue, the geoarchaeological conditions are similar to the excavated portion of the site and the remaining portion of the site does not likely contain information to address regional research questions beyond that obtained from this study. The remainder of LA 126406 is therefore recommended as not eligible and no further archaeological investigation is recommended.

**LA 126409**

*Previous Work*

LA 126409 was originally recorded during the 1999 archaeological survey of the Paseo del Volcan roadway corridor (Parsons Brinckerhoff 1999) and consisted of seven charcoal stains. The site is the westernmost of the Loma Duran group of sites. Six of the stains were identified in the profiles of the road cuts along both sides of a 70-m stretch of 28th Avenue and one was exposed in plan view in the roadbed. No surface artifacts were observed and the site was assigned an unknown cultural/temporal affiliation. Because the nature and extent of the subsurface cultural material was not fully evaluated, the site was recommended as having undetermined eligibility for inclusion in the NRHP.

LA 126409 was revisited by SWCA, Inc. in 2000 for the purpose of developing a testing plan for 25 sites along the Paseo del Volcan corridor, and was included in the Loma Duran group of sites under the testing program (Phillips 2000). On November 2, 2004 the site was revisited by representatives of NMDOT and PB to assess the impact of design changes associated with the proposed Paseo del Volcan roadway project. The site was included in the current testing and data recovery plan based on the potential for buried cultural deposits.

*Physical Setting*

LA 126409 is located approximately 1.7 mi west of Arroyo de la Baranca and about 0.8 mi east of Arroyo de los Montoyas. This is the western-most site in the APE and is situated on a west-facing slope just below the crest of a low hill. The north edge of the site occurs in a topographically low swale or closed depression. The ground surface is mantled by several centimeters of recent loose eolian sand that obscures underlying deposits and archaeological features. The site has clear views to the east, south and west.

The surface vegetation consists of various types of bunch grass, cholla, snakeweed, prickly pear cactus, fourwing saltbush, chamisa, and sage bushes. The site shows evidence of active eolian erosion along hill slopes and along the graded road cuts of 28th Avenue. The cut-slopes north and south of 28th Avenue have been routinely scraped by road maintenance equipment.

*Investigation Strategy*

All subsurface testing and data recovery activities at LA 126409 were conducted within the limits of the construction zone and right-of-way for the proposed Paseo del Volcan project on the north side of 28th Avenue. The testing and data recovery strategy consisted of surface survey and collecting, mechanical excavation of trenches, mechanical surface stripping, and hand excavation of test units and features.
Site Survey and Surface Collection

The initial activities consisted of resurveying the entire site to relocate the seven previously recorded features, and to identify any additional unrecorded features and surface artifacts. All seven features were relocated. Previously recorded Features 2, 3, and 4 are located on the south side of 28th Avenue and were not investigated as they are beyond the APE of the undertaking. During the site survey, several pieces of fire-cracked rock and three new features were identified on the south side of 28th Avenue. These newly identified features were designated as Features 9, 10, and 11. Because the newly identified surface artifacts and features are on the south side of 28th Avenue and beyond the APE of the project, the material and features were recorded and mapped for inclusion on the updated LA Form, but they were not further investigated.

Features 1, 5, 6, were relocated on the north side of 28th Avenue, while Feature 7 was relocated in the roadbed of 28th Avenue. Initial testing of these features clearly reflected that they had been largely destroyed by the road maintenance activities and by the vehicular traffic on 28th Avenue and they all lacked integrity, and no further investigation of those features was conducted. Also during the site survey, one newly identified feature, designated Feature 8, was identified within the portion of the site north of 28th Avenue and within the APE, and was included in the data recovery efforts.

Mechanical Trenching and Site Stratigraphy

Mechanical excavation of trenches was undertaken at LA 126409 to test for subsurface features and cultural deposits and to reveal the site’s stratigraphy. Three trenches were placed across the site, each running north from 28th Avenue (Figure 6.15). Two of the trenches (BHT 1 and 2) were 75 m (246 ft) long, while the third was approximately 42 m (138 ft) long. A fourth trench (BHT 4) was excavated in a westerly direction from BHT 1 in order to define the site boundary to the west. All four trenches were approximately 75 cm wide, and each was excavated to a maximum depth of 1.5 m (5 ft) below the ground surface.

BHT 1 and 2 were excavated to sufficient depth to expose the culturally sterile caliche and compacted sand horizon. A thermal feature (Feature 12) was exposed in the trench profile about 15 m from the southern end of BHT 1. The stain was located about 15-20 cm below the surface and consisted of a dark stained sediments with numerous pieces of fire-cracked rock.

BHT 2 exposed a layer of large cobbles near the northern end of the trench, about 1.5 m below the modern ground surface. A rectangular area measuring 6 x 8 m (20 x 26 ft [BHT 2a]) was mechanically excavated along the northeastern edge of BHT 2 to further examine the nature the cobble feature. Additional cobbles were encountered in BHT 2a at a depth of 1.4-1.5 m below the surface.

The cobbles were located at the interface between the bottom of the red paleosol and a sterile soil with large quantities of calcium carbonate (Photo 6.5). No artifacts were observed during the mechanical excavation and the depth and location of the cobbles at the bottom of the red paleosol was unique compared to observations in other trenches at LA 126409, and at the other Loma Duran sites. A 3 x 3 m hand excavated test unit (TU 3) was placed to encompass the cobbles and a single 10-cm thick arbitrary level was hand excavated. The fill matrix was brown colored sandy loam with no artifacts and the cobbles showed no modification or associated charcoal flecking or staining. No patterning in the cobbles was discerned and it was determined that the cobble concentration was a natural phenomenon.
Representative profiles of the trenches were subsequently recorded and Feature 12 was mapped and photographed prior to excavation. No stains or other cultural deposits were identified in BHT 3 or BHT 4.

The stratigraphic sequence exposed in the four trenches was similar across the site and is summarized below. The stratigraphy is similar to the other Loma Duran sites, although more erosion appears to have occurred on the south side of 28th Avenue than on the north side of the road and has exposed the red paleosol in some areas.

The entire portion of the site north of 28th Avenue is mantled by a thin (approximately 10-15 cm) layer of loose eolian sand (Figure 6.16). Directly below the loose blow sand is a 90-120 cm thick unit of eolian sand, marked by a red paleosol (Bw) with a weak calcic horizon at the surface. The parent material (C horizon) of the eolian sand unit rests directly on the eroded top of a late Pleistocene calcic paleosol (2Bw) that has stage II carbonate development. In the swale at the north end of the site, the eolian sand is partly reworked as colluvium, and the red paleosol is less developed than on the hillside. Five OSL dates provide the late Pleistocene age of the red paleosol. The OSL age of eolian sand beneath the stage II calcic paleosol is ~130,000 ± 30,000 yrs BP (an estimate only).

The archaeology at LA 126409 is restricted to the upper surface of the eolian sand unit and red paleosol (Bw soil horizon). Features intrude into the Bw red paleosol, but artifacts and features were not found buried within the late Pleistocene eolian sand.

**Mechanical Surface Stripping**

Due to the presence of stains in the road cut and the identification of the feature-bearing paleosol in both BHT 1 and BHT 2, mechanical stripping was initiated near the stain (Feature 12) exposed in BHT 1. The eolian overburden was stripped to the top of the red paleosol, with constant monitoring of the overburden for the presence of cultural material. Stripping expanded along 28th Avenue as stains were exposed and covered a total of 1710 sq. m (18,397 sq. ft) with a total of 31 stains exposed in the stripped area. Another feature (Feature 35) was later designated within Feature 12.

**Hand Excavation**

All stain features were hand excavated using a bisection method, except at two locations. Test Unit 1 and Test Unit 2 were used after stains were revealed by surface stripping, where the stains were partially cut or sufficiently close to the road cut that a test unit was used to prevent further loss of feature material during excavation.
Figure 6.16: Stratigraphic sketch of LA 126409 with location of six OSL ages; the archaeology is restricted to the top of the red paleosol; several centimeters of historic loose eolian sand covers the red paleosol but is not shown here. The deeper mechanical excavation at the north end extends to approximately 2.4 m below the top of the red paleosol, and is not shown to scale.

Test Unit 1

TU 1 consists of a 1 by 2 m unit located over Features 15, 16, and 17, which were exposed by surface stripping near the 28th Avenue north road cut. Three arbitrary 10-cm levels were excavated to a depth of 37 cm below datum, or 30 cm below the surface. The grayish brown fill was identified as associated with mixed natural sediments and charcoal stained sediments, however, no artifacts were identified in any of the levels or features. All fill from the 1 x 2 m unit was screened through 1/8-inch wire mesh. The fill from each of the three features within the test unit was assigned a separate provenience numbers by level and the fill material from each was screened separately.

Test Unit 2

TU 2 consists of a 1 by 1 m unit placed over a charcoal stain located on the north cut-bank and designated as Feature 20. One 10 cm level of TU 1 was excavated to define the extent of the feature. At the completion of Level 1, the feature was well defined and only the feature was excavated from this point, and excavations of the test unit were terminated. The fill consisted of dark yellowish brown sandy loam that was rich in organics and small pieces of charcoal. No artifacts were identified in Level 1 of the test unit or in the feature fill. All fill from the 1 x 1 m unit and the feature fill was screened through 1/8-inch wire mesh.

Feature Excavations

Thirty-two features within the APE were determined to be relatively intact cultural features and were excavated, including a fire-cracked rock concentration within Feature 12 that was designated as a separate feature (Feature 35). Other than Features 15, 16, 17, and 20 discussed above, and Feature 35—the fire-cracked rock concentration in Feature 12—the remaining 27 stains were investigated by the bisection of the feature. In general, the features were small and shallow. Most (n=27) were less than one meter in
diameter. Four features were more than one meter in diameter, with two exceeding two meters. Feature
depths ranged from 3 cm to 52 cm (1 inch to 20 inches). All the features identified at LA 126409 are
listed in the tables below.

Table 6.12 presents the 10 features at LA 126409 that were not excavated because they were either not in
the APE (i.e. south of 28th Avenue) or because they lacked integrity.

Table 6.12: Non-excavated Features at LA 126409

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Size L x W x D meters</th>
<th>Morphology</th>
<th>Cultural Material Recovered and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n/a</td>
<td>n/a</td>
<td>No integrity</td>
</tr>
<tr>
<td>2</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
<tr>
<td>3</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
<tr>
<td>4</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
<tr>
<td>5</td>
<td>n/a</td>
<td>n/a</td>
<td>No integrity</td>
</tr>
<tr>
<td>6</td>
<td>n/a</td>
<td>n/a</td>
<td>No integrity</td>
</tr>
<tr>
<td>7</td>
<td>n/a</td>
<td>n/a</td>
<td>In 28th Ave. roadway, lacks integrity</td>
</tr>
<tr>
<td>9</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
<tr>
<td>10</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
<tr>
<td>11</td>
<td>n/a</td>
<td>n/a</td>
<td>South of 28th Ave.-not investigated</td>
</tr>
</tbody>
</table>

Table 6.13 presents the 27 stains and the fire-cracked rock concentration whose maximum dimension was
one meter or less; Table 6.14 presents the four features that have a maximum dimension of more than one
meter. The tables present the size and shape of the features, as well as the associated materials recovered
from each feature.

Table 6.13: Features at LA 126409, maximum dimension-one meter or less

<table>
<thead>
<tr>
<th>Feature No.</th>
<th>Size L x W x D meters</th>
<th>Morphology</th>
<th>Cultural Material Recovered and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0.46 x 0.30 x 0.09</td>
<td>Basin/Ci</td>
<td>V-1 BS, C, RCD 590</td>
</tr>
<tr>
<td>13</td>
<td>0.50 x 0.48 x 0.12</td>
<td>Basin/O</td>
<td>San Jose projectile point-1, RCD 4485</td>
</tr>
<tr>
<td>14</td>
<td>0.42 x 0.36 x 0.12</td>
<td>Basin/Ci/Irr</td>
<td>None</td>
</tr>
<tr>
<td>15</td>
<td>0.75 x 0.40 x 0.13</td>
<td>Irregular/Irr</td>
<td>None, TU 1</td>
</tr>
<tr>
<td>16</td>
<td>0.40 x 0.35 x 0.08</td>
<td>Basin/Ci</td>
<td>None, TU 1</td>
</tr>
<tr>
<td>17</td>
<td>0.15 x 0.15 x 0.50</td>
<td>Irregular/Irr</td>
<td>None, TU 1</td>
</tr>
<tr>
<td>18</td>
<td>0.40 x 0.34 x 0.20</td>
<td>Basin/O</td>
<td>FCR (1)</td>
</tr>
<tr>
<td>19</td>
<td>1.00 x 0.85 x 0.17</td>
<td>Basin/Irr</td>
<td>C</td>
</tr>
<tr>
<td>20</td>
<td>0.50 x 0.40 x 0.52</td>
<td>Cylinder/Ci</td>
<td>None, TU 2</td>
</tr>
<tr>
<td>22</td>
<td>0.57 x 0.38 x 0.16</td>
<td>Basin/O</td>
<td>None</td>
</tr>
<tr>
<td>23</td>
<td>0.76 x 0.75 x 0.08</td>
<td>Basin/Ci</td>
<td>FCR (1)</td>
</tr>
<tr>
<td>24</td>
<td>0.56 x 0.46 x 0.03</td>
<td>Basin/Ci</td>
<td>None</td>
</tr>
<tr>
<td>25</td>
<td>0.79 x 0.78 x 0.12</td>
<td>Basin/O</td>
<td>FCR (2)</td>
</tr>
<tr>
<td>26</td>
<td>0.81 x 0.76 x 0.14</td>
<td>Basin/O</td>
<td>FCR (2), C</td>
</tr>
<tr>
<td>27A</td>
<td>0.55 x 0.33 x 0.25</td>
<td>Basin Ci</td>
<td>None</td>
</tr>
<tr>
<td>28</td>
<td>0.62 x 0.60 x 0.29</td>
<td>Basin/O</td>
<td>FCR (1)</td>
</tr>
<tr>
<td>29</td>
<td>0.50 x 0.49 x 0.18</td>
<td>Basin/O</td>
<td>FCR (1)</td>
</tr>
<tr>
<td>30</td>
<td>0.63 x 0.41 x 0.04</td>
<td>Basin/O</td>
<td>None</td>
</tr>
<tr>
<td>31</td>
<td>0.54 x 0.46 x 0.17</td>
<td>Basin/Ci</td>
<td>FCR (1), F</td>
</tr>
<tr>
<td>32</td>
<td>0.60 x 0.45 x 0.33</td>
<td>Basin/Ci</td>
<td>L (1)</td>
</tr>
<tr>
<td>33</td>
<td>0.53 x 0.50 x 0.26</td>
<td>Basin/Ci</td>
<td>L-1, FCR-1, F-1BrB, RCD 4330</td>
</tr>
<tr>
<td>35</td>
<td>0.52 x 0.47 x 0.15</td>
<td>Ci</td>
<td>FCR concentration within Feature 12.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L-1, FCR-14, V-1, RCD 5185</td>
</tr>
</tbody>
</table>
Excavation Results

A total of 31 stains and one fire-cracked rock concentration were excavated, all of which were identified by the carbon residue staining (Photo 6.6). Although many of the stains appeared to be the result of thermal activity, others did not contain clear evidence of thermal alteration. Twenty-four of 32 features did not contain any artifacts, although seven of those did contain one or two pieces of fire-cracked rock.

As discussed in Chapter 2, it is geologically evident (i.e. the A horizon is not present and an unconformity exists at the top of the red paleosol) that erosional events truncated the upper portion of the prehistoric living surface either during and/or after occupation. Based on soil composition of the paleosol, Dr. Hall estimates that approximately 30 cm of the paleosol was truncated through erosion, although the amount would vary across a site and among the sites. Because all the features are intrusive into the paleosol, the upper portions of all the features have been truncated and only the basal remnants of the features remain. Thus the original depths and profile shape of the features are not known and it is,
therefore, not feasible to draw definitive conclusions regarding the morphology and function of the features. The erosion that removed the tops of the features also explains the general paucity of associated cultural material, and the noticeable lack of fire-cracked rock.

Notwithstanding the above limitations, some basic descriptions are presented that allow some general conclusions regarding the features. The basal remnants of the features were generally small and shallow, with 28 of the 32 measuring less than one meter at their maximum dimension. Four were over a meter at their maximum dimension, with two measuring over two meters, including one that was 2.8 x 2.7 m. Depths ranged from 3 cm to 52 cm (1 to 20 inches), and most (n=21) measured 20 cm or less in depth. Most of the features (n=29) were basin shaped, and circular (n=14) or oval (n=13) in plan view.

Of the 32 features investigated, 18 (56 percent) contain cultural materials (charcoal, artifacts, faunal, vegetal or fire-cracked rock), including all four features greater than 1 m in diameter. Generally, however, associated cultural material was sparse and there was a noticeable lack of fire-cracked rock. Fire-cracked rock was present at only 12 of the 32 features (37.5 percent) and when present there were only a few pieces. Ten of the 12 features with fire-cracked rock had one or two pieces, and only two had 8 or more pieces, with 14 pieces of fire-cracked rock the highest count at any feature (Feature 21). Associated artifacts were relatively rare, with artifacts at only eight of the features, and only one feature (Feature 12) with more than 10 artifacts. Feature 12, a large (2.8 x 2.7 m) oval basin, contained 59 of the 82 (72 percent) flaked-stone lithics, and also contained four of 10 pieces of ground stone. No sherds were recovered from any of the features.

Based upon the presence of the carbon residue, the general morphology, the cultural contents, and association with other features containing artifacts and/or fire-cracked rock, most of the features appear to have been hearths or roasting pits. The size of Feature 12 and the associated lithic assemblage indicates that this basin-shaped feature may have been a habitation structure (Photo 6.7).

![Photo 6.7: LA 126409 Feature 12, Possible Habitation Structure](image)

**Materials Collected and Analysis**

**Radiocarbon Dates**

Six charcoal samples were submitted for C14 analysis from six features at the site. The results of the C14 analysis are shown in Table 6.15. At least three of the C14 dates are on Juniper wood, and the “old wood” problem should be considered when interpreting the radiocarbon dates. More detailed information on the radiocarbon dates is presented in Appendix C.
Table 6.15: LA 126409 Radiocarbon Dates

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Provenience</th>
<th>Wood ID</th>
<th>14C Analysis Method</th>
<th>Calibrated Date Range(s), 2-sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-219098</td>
<td>Feature 8, South ½ (hearth)</td>
<td>Juniper seeds</td>
<td>AMS</td>
<td>AD 1300 – 1420</td>
</tr>
<tr>
<td>Beta-219101</td>
<td>Feature 12, South ½ (roasting pit or habitation)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>3510 – 3420 BC, 3390 – 3320 BC, 3220 – 3120 BC</td>
</tr>
<tr>
<td>Beta-219103</td>
<td>Feature 13 (hearth)</td>
<td>Unknown seed</td>
<td>AMS</td>
<td>2600 – 2460 BC</td>
</tr>
<tr>
<td>Beta-219105</td>
<td>Feature 33 (roasting pit)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>2480 – 2280 BC</td>
</tr>
<tr>
<td>Beta-219106</td>
<td>Feature 27, East ½ (roasting pit)</td>
<td>Juniper wood</td>
<td>AMS</td>
<td>2850 – 2820 BC, 2670 – 2470 BC</td>
</tr>
<tr>
<td>Beta-219107</td>
<td>Feature 35 (hearth)</td>
<td>Not submitted for botanical analysis</td>
<td>AMS</td>
<td>3340 – 3200 BC, 3200 – 2920 BC</td>
</tr>
</tbody>
</table>

A San Jose projectile point (indicative of a Middle to Late Archaic occupation) at Feature 13 is consistent with the radiocarbon date from the feature. One additional date (AD 1300 – 1420) from juniper seeds in Feature 8 indicates use of the site during the Classic Period (ca. A.D. 1325–1600) as well. However, no ceramic sherds were identified at the site, although this may be due to the erosional processes that truncated the red paleosol of the old living surface. Thus the Classic Period date may be an anomaly derived from intrusive seeds. On the other hand, three Puebloan period radiocarbon dates were obtained from LA 126406, located about one-quarter mile to the east.

Macrobotanical Remains

The botanical samples produced little meaningful data. All but two of the nine samples that yielded non-wood plant remains (Features 8 and 12) from LA 126409 were composed entirely of modern intrusive plant material. Unburned plant parts included goosefoot, purslane, spurge, dropseed grass, and hedgehog cactus seeds. Weedy annuals like goosefoot and purslane proliferate in disturbed ground and produce innumerable seeds that can easily be dispersed by insects, wind, or rodents. The sweet fruits of cacti are a source of food for rodents and the numerous small seeds can find their way into the soil horizon either during or after consumption of the fruits. A monocot stem was recovered from Feature 8 and one-seed juniper seeds from Feature 12.Juniper seeds were also identified in macrobotanical samples from these same two features. Macrobotanical wood samples were 94% juniper and 6% sagebrush, with traces of unknown conifer and saltbush/greasewood. More detailed information on the macrobotanical results is presented in Chapter 8.

Lithics

A total of 82 flake stone and 10 pieces of ground stone were recovered from the site, all from subsurface contexts. Of this assemblage, 57 pieces of flake stone and four pieces of ground stone were recovered from Feature 12, the largest feature at the site. Table 6.16 summarizes the general nature of the lithic assemblage.
Table 6.16: LA 126409 Lithic Assemblage

<table>
<thead>
<tr>
<th>Debitage</th>
<th>Cores</th>
<th>Formal tools</th>
<th>Ground stone</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>5</td>
<td>1 (dart point)</td>
<td>10</td>
</tr>
</tbody>
</table>

The presence of both flaked stone artifacts and ground stone suggests a variety of activities took place at the site. Small grinding tools typically associated with Middle to Late Archaic sites and the association with radiocarbon dates around 5100 BP is consistent with the presence and nature of the ground stone assemblage. The number of lithics, though relatively small compared to some other sites in the project area, also suggests a variety of activities taking place including tool production (cores and debitage) or retooling (flakes and debitage), as well as activities using the tools such as hunting (a point). Detailed lithic analysis is provided in Chapter 7.

Summary and Management Recommendations

LA 126409 appears to have been used periodically during the Middle Archaic to Late Archaic periods, with possible use during the Classic period. Most of the features at the site are the result of thermal activity and are generally characterized as small (less than 1 m in diameter), oval or circular basin hearths or roasting pits. The presence of these feature types suggests short-term use of the area, while targeted resources were gathered. Feature 12, however, is much larger (2.8 x 2.7 m) than most of the features at this site, and most of the lithic artifacts at the site are from this feature. Ground stone is also present at Feature 12, which indicates that a wider range of activities occurred at this location than at most features. The size of Feature 12 suggests a habitation location, although there is no supporting evidence that a structure was present. Unfortunately, the paucity of botanical evidence from the features does not allow identification of the targeted plant resources or inferences as to seasonal use of the site.

The lithic assemblage suggests the site was used as a seasonal short-term hunting, plant-processing, and raw material reduction location for mobile Archaic foragers. Flaked stone debitage patterns and size, core reduction patterns and size, and the lack of expedient flaked stone tools are suggestive of a mobile Archaic affiliation. A relatively high percentage of ground stone artifacts indicates food processing was an important site function.

The stratigraphy at this site is similar to the other Loma Duran sites. The prehistoric living surface appears to have been the red paleosol horizon that is of Late Pleistocene age. The paleosol has a geologic unconformity along its top and the A soil horizon is no longer present. This unconformity at the top of the old living surface, along with the paucity of artifacts (n=92) in an area where numerous features are present (n=32) is evidence that erosional processes have truncated the features and displaced most of the artifacts. This situation is found at all of the Loma Duran sites in the project area and explains the lack of associated artifacts at the features and limits the information potential of the sites in this geoarchaeological context. The specific research questions posed in the research design will be addressed in the Summary Chapter.

LA 126409 was determined eligible under criterion “d” for its potential to contain buried features and important information on Middle to Late Archaic occupation of the West Mesa. Data recovery efforts at LA 126409 have been completed in accordance with the research design and data recovery plan for the project, and the portion of the site within the Paseo del Volcan construction limits has been removed.

Previously recorded Features 2, 3, and 4 are located on the south side of 28th Avenue and were not investigated as they are beyond the APE of the undertaking. Although other buried features are likely present south of 28th Avenue, the geoarchaeological conditions are similar to the excavated portion of the
sit and the remainder of the site does not likely contain information to address regional research questions beyond that obtained from this study. Therefore, LA 126409 is recommended as not eligible to the NRHP and no further archaeological investigation is recommended.
Lithic artifacts were recovered from seven sites along the Paseo del Volcan corridor during testing and data recovery. Fieldwork at the seven sites (LA 55503, LA 55507, LA 55509, LA 126405, LA 126406, LA 126408, and LA 126409) resulted in the recovery of 2207 flaked stone artifacts (Table 7.1). No lithic artifacts were recovered from LA 126407. Twenty-nine ground stone items were recovered from three sites (Table 7.2): LA 55509, LA 126406, and LA 126409.

Research Questions

The lithic analysis was designed and conducted to address the research questions outlined in the Testing and Data Recovery Plan developed for the project. These questions involved the organization of lithic technology, site function, and the subsistence/mobility strategies employed by the inhabitants of the eight sites along the corridor. These research questions are interdependent, in that it is necessary to understand site function in order to understand the range of subsistence and mobility strategies employed by the prehistoric inhabitants. Lithic artifacts, specifically the organization of lithic technology, provide one line of evidence to test hypotheses regarding site function. The specific research questions and data expectations for each site are described more fully in Campbell (2005) and Raymond (2005), and are summarized in Chapter 4 of this report.

The research questions regarding the organization of lithic technology are derived from models of curated versus expedient organizational strategies (Binford 1973, 1977, 1979). Generally, prepared core technologies and retouched formal tools are assumed to indicate a curated technology, and that the lack of extensive core preparation (see Nash 1996) and unretouched tools indicate an expedient technology. Of course, it is recognized that prehistoric groups employ both strategies depending on other aspects of their economic and settlement strategies, and the organization of their lithic technology will exist along a continuum of curated-expedient strategies.

The goals of the research were different for each group of sites. At LA 55507, the lithic quarry site, the hypothesis was that there is high quality, accessible lithic material available at LA 55507, and that the procurement and testing activities and core-reduction technology at the site will reflect a curated lithic strategy, in which cores and core-reduction flakes were transported off-site. It is expected that the (rejected) cores and tested cobbles and discarded flakes at this site will be dominated by prepared platforms.

At the Group 2 sites, LA 126406 and LA 126409, the hypothesis was that, as seasonally-occupied residential sites, the flaked-stone technology would reflect an expedient lithic strategy due to the availability of local lithic material. It was expected that the flaked-stone tool assemblage at the Group 2 sites would be dominated by utilized, unretouched, core reduction flakes made from locally available silicate materials. However, it was also expected that formal, curated tools would be present in the lithic assemblage and that these tools were associated with the logistical component of the subsistence-settlement system. It was also expected that the flaked-stone assemblage at the Group 2 sites would have a low percentage of cores, but those present would have prepared platforms and a low percentage of cortical material.
The hypothesis for the lithic technology at the Group 3 site (LA 55509) was that as activity-specific logistical sites, the assemblage would reflect a curated lithic strategy, although local lithic material is available nearby. The assumption is that these sites were logistical sites used for periodic forays for targeted resources and therefore, tool reliability is the critical organizational strategy. It was expected that the flaked-stone tool assemblage at LA 55509 would be dominated by formal tools and non-cortical flakes with prepared platforms. It was also expected that the flaked-stone assemblage would have a higher percentage of non-local material than Group 2 sites.

**Methods, Definitions, and Analytical Types**

At least thirteen variables were recorded on each artifact for the flaked stone analysis. Analysis variables included morphological type, material type, grain size, reduction stage (debitage and used flakes only) or percentage of cortex (cores), remnant platform surface (debitage and flake tools only), platform lipping (debitage and flake tools only), artifact size, presence and degree of thermal alteration, facial evaluation (tools only), tool condition, use-wear extent and type, weight, maximum measurements (cores and complete tools only), core type, and a comments section in which miscellaneous attributes could be described. The attributes selected for the analysis were chosen to produce data applicable for answering research goals as outlined above and in the Paseo de Volcan Testing and Data Recovery Plan (Campbell 2005, Raymond 2005).

**Table 7.1: Flaked Stone Artifact Types by Site**

<table>
<thead>
<tr>
<th>Artifact Type</th>
<th>Site Number (LA)</th>
<th>126405</th>
<th>126406</th>
<th>126408</th>
<th>126409</th>
<th>55503</th>
<th>55507</th>
<th>55509</th>
<th>Total</th>
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<tbody>
<tr>
<td>Debitage</td>
<td></td>
<td>4</td>
<td>36</td>
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<td>76</td>
<td>36</td>
<td>1264</td>
<td>575</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>80.0*</td>
<td>92.3</td>
<td>66.7</td>
<td>92.7</td>
<td>97.3</td>
<td>87.8</td>
<td>95.7</td>
<td>90.3*</td>
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<tr>
<td>Used Flakes</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>3</td>
<td>0.5</td>
<td>14</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Tested Cobble</td>
<td></td>
<td>30</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>0.2</td>
<td>1.4</td>
<td>31</td>
</tr>
<tr>
<td>Core</td>
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</tr>
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<td></td>
<td>7.7</td>
<td>33.3</td>
<td>6.1</td>
<td></td>
<td>0.3</td>
<td>8.5</td>
<td>2.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Core/Hammerstone</td>
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<td></td>
<td>1</td>
<td></td>
<td>6</td>
<td>0.3</td>
<td></td>
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<td>0.2</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Hammerstone</td>
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<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
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<td></td>
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<td></td>
<td></td>
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<td>0.1</td>
</tr>
<tr>
<td>Cobble Uniface</td>
<td></td>
<td>1</td>
<td></td>
<td>3</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>0.1</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Flake Biface</td>
<td></td>
<td>3</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Biface</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Projectile Point</td>
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<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>20.0</td>
<td></td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Other Tool</td>
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<td></td>
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<td></td>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>39</td>
<td>3</td>
<td>82</td>
<td>37</td>
<td>1440</td>
<td>601</td>
<td>2207</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2**</td>
<td>1.8</td>
<td>0.1</td>
<td>3.7</td>
<td>1.7</td>
<td>65.2</td>
<td>27.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Column percent; **Row percent; tr = trace
Table 7.2: Ground Stone Artifact Type by Site

<table>
<thead>
<tr>
<th>Artifact Type</th>
<th>Site Number (LA)</th>
<th>126406</th>
<th>126409</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-Hand Mano</td>
<td>55509</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>One-Hand Mano/Pestle</td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Indet. Mano</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Indet. Netherstone</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Shaped Disk/Blank</td>
<td></td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Indet. Ground Stone</td>
<td></td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Morphological Types

The morphological type variable provides information on artifact form and often function. Following Andrefsky (1998), artifacts were categorized according to debitage, cores and related items, and tools. These categories were further subdivided into more discrete types.

Debitage

Debitage is defined in this analysis as the discarded and unused pieces of lithic material resulting from the reduction of raw material or a stone artifact. Seven categories of debitage are defined for this analysis, including six flake debitage categories and one non-flake debris type. The definition of each category of debitage follows.

Angular debris is non-flake debitage that lacks a recognizable dorsal and ventral surface. It is generally produced during core reduction and is unintentional.

Flakes contain evidence of a dorsal and ventral surface. They are the by-products of lithic reduction. Six types of flakes were classified in the analysis: whole flakes, proximal flake fragments, distal flake fragments, flake fragments, bifacial-thinning flakes, and bipolar flakes. Whole flakes have a recognizable platform or point-of-force location, with maximum width and length intact. Proximal flake fragments contain a platform or point-of-force location, but are missing a distal termination. Distal flake fragments have intact terminations, but are lacking a platform or point-of-force location. Flake fragments lack proximal or distal ends, but have flake morphology. Bifacial thinning flakes exhibit most of the following variables: bidirectional dorsal flake scars, a curvate longitudinal cross-section, feathered flake terminations, a lipped platform, little or no cortex, and a generally diffuse bulb-of-force. Bifacial thinning flakes have been associated with biface production, a technology often related to Archaic mobility patterns (Kelly 1988). Bipolar flakes are recognized by crushed or sheared platforms on both ends. They lack bulbs-of-force and may exhibit compression rings that originate from opposite ends that meet near the center of the flake. Bipolar technology has been argued as a method of reduction used to maximize lithic raw materials (Andrefsky 1994) and is often used to reduce small cores such as obsidian merikanites or Apache Tears. No bipolar flakes were identified in this collection.

Cores, Hammerstones, and Tested Cobbles

For this study, a core is defined as a mass of lithic material that has evidence of three or more detached flakes. Five types of cores were recognized in the analysis: unidirectional, bidirectional, parallel, multidirectional, and bifacial. As defined for the purposes of this analysis, a unidirectional core has evidence of detached flakes along a single platform. Bidirectional cores contain two platforms that are not oriented opposite each other. Parallel/Opposed-Platform cores have two platforms that are
oriented/parallel to each other. Multidirectional cores have evidence of detached flakes removed in random directions from three or more platforms. Bifacial cores contain evidence of detached flakes from a single margin and removed from two surfaces.

Two types of core tools are recognized. A core tool is a core with use wear other than battering/hammering. A core/hammerstone is a core that exhibits evidence of battering/hammering. A hammerstone is an unprepared lithic mass, such as a natural stream cobble, used to detach flakes. A tested cobble is a lithic mass that exhibits evidence of one or two detached flakes.

Flaked Tools

Flaked stone tools are categorized by function and technology. Ten categories of flaked stone tools were recognized in the analysis; any other tool in the analysis that did not fit the above categories was classified as either other tool or indeterminate tool.

Functional flaked tool categories include: used flakes, retouched flakes, projectile points and drills. Used flake are unmodified flake debitage that exhibit use wear damage. A retouched flake exhibits consistent retouch flaking along one or more margins. It is presumed that flakes exhibiting retouched edges were utilized. A projectile point is a finished biface (exhibits flake-removal scars on both surfaces) with lateral edges that converge to a point. Projectile points served as the tip of an arrow, spear or atlatl dart. A drill is a functional category used for specialized tools with a narrow or elongated blade that is used for puncturing by twisting.

Technological flake tool categories used for this analysis are unifaces and bifaces. A uniface is a tool that exhibits flaking on only one face. Three types of unifaces were recorded based on their parent form: cobble, flake, and indeterminate. A cobble uniface is manufactured from a cobble, a flake uniface is made from a flake, and a uniface from an unidentified parent form was recorded as an indeterminate uniface. Bifaces exhibit flaking on both faces and are also categorized by parent form. The three biface categories are cobble bifaces, flake bifaces, and indeterminate bifaces.

Material Type and Grain Size

Artifact material type was determined by both macroscopic and microscopic (20X) examination. When specific material types could not be determined, material was classified as one of three general geologic types -- igneous, sedimentary, or metamorphic -- or categorized as unidentified. Artifacts were then grouped into four categories (microcrystalline, fine, medium, or course) according to raw material grain size. Grain size is a relative measure of raw material structure and flaking characteristics. Microcrystalline materials have no macroscopically visible granular structure, and are characterized by excellent flaking qualities that include conchoidal fractures. Fine-grained materials have small visible grains but still provide good flaking characteristics. Medium-grained materials show a dense and uneven surface, and flake morphology is less discernable. Course-grained materials contain large vesicles and/or crystals and have unclear flake morphology. These materials have poor lithic reduction qualities.

A broad variety of materials were available and used by the prehistoric inhabitants of the West Mesa along the Paseo de Volcan corridor. The stratigraphic geology of the area consists of Santa Fe Group deposits that filled the Albuquerque Basin from adjacent uplifts. The upper deposits of the Santa Fe Group are defined by the onset of the through-going axial-fluvial drainage (ancestral Rio Grande) that linked the previously separate basins of the Rio Grande rift (Connell 2008). Later Quaternary fluvial secondary deposits of the Rio Grande contained a large variety of clasts that reflect the diverse geology of
the drainage basin (Cole et al. 2007). Cole and his colleagues (2007) have identified clasts of quartzite, granite, Pedernales chert, aphanitic chert, basalt, sandstone, limestone, granite, obsidian, schist, and petrified wood in the Quaternary deposits in the fluvial terrace fill deposits of the Rio Grande. Some of the hilltops and rises in and adjacent to the project area are covered in surface exposures of clasts from the Santa Fe Group or later Quaternary deposits. In the project area, LA 55507 is located on such a surface exposure.

Within the abundant variety of available raw materials, Pedernales chert was overwhelmingly selected for flaked stone tool production by the prehistoric inhabitants of the project area (Table 7.3). Pedernales chert is exposed in nodule form on the surface of LA 55507 and is of generally excellent microcrystalline quality. It fractures predictably, is usually homogenous in structure, and is abundantly available on LA 55507. The majority of Pedernales chert in this study is translucent when in flake form, often has a waxy appearance, and occurs in white, gray, brown, and mixed colors. It is nearly identical to chalcedony, but does not have a fibrous structure. Other cherts are found in the project’s site assemblages, but in small percentages. Some of these cherts may have been exposed on the surface of LA 55507, or were available along the Rio Grande River. These include unknown chert types of reddish-brown, white, tan, and other colors. Additionally, banded chert and oolithic chert are present in some of the assemblages. Other local raw materials were rarely used for flaked stone production in the project area. Quartzite, which was favored for hammerstone use, occurs in most of the flaked stone assemblages, but usually in very small percentages. Even rarer in the Paseo de Volcan study are flaked stone artifacts of basalt, petrified wood, moss agate, and fossiliferous limestone.

### Table 7.3: Flaked Stone Material Type by Site

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Site Number (LA)</th>
<th>126405</th>
<th>126406</th>
<th>126408</th>
<th>126409</th>
<th>55503</th>
<th>55507</th>
<th>55509</th>
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</thead>
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<tr>
<td>Quartz</td>
<td></td>
<td>5</td>
<td>0.3*</td>
<td>5</td>
<td>0.2</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Red-Brown Chert</td>
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<td>2.6</td>
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<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indet. Chert</td>
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<td>0.4</td>
<td></td>
<td></td>
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</tr>
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<tr>
<td>Limey Chert</td>
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<td></td>
<td></td>
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<tr>
<td>Metasediment</td>
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<td>0.0</td>
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<td></td>
<td></td>
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<tr>
<td>White Chalcedony/Pedernales Chert</td>
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<td>168</td>
<td>377</td>
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<td></td>
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<tr>
<td>Basalt</td>
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<td>0.2</td>
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<td>2.3</td>
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<td>Gray Chalcedony/Pedernales Chert</td>
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<td>738</td>
<td>1012</td>
<td></td>
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</tbody>
</table>

**Lithics**

Chapter 7 - 5
Ground stone artifacts were made from a broad variety of raw materials. The majority recovered from the project is of locally available sandstone, but ground stone items of limestone, quartzite, granite, and schist are also present. All of the ground stone materials are available on the surface of LA 55507.

Due to the diverse variety of locally-available lithic raw materials, nonlocal materials were difficult to identify in the study. With the exception of a few artifacts of untyped obsidian, all the other artifacts in the assemblage appear to have been locally available.

A 100-piece sample of Santa Fe gravels and cobbles was collected from LA 55507 in order to identify the extant and quality of raw materials available on the site. These lithic materials appear to have been used by the inhabitants of the Paseo de Volcan corridor sites, and sampling the variation in the gravels was expected to shed light on prehistoric raw material choice. Sampling and analysis of the site’s gravels was conducted according to procedures set out by Shelley (1993). Briefly, a portion of the site was selected that appeared to have a representative scatter of gravels across its surface. Two 50-meter tapes were placed side-by-side, 1 meter apart, over the site surface. From each 1-meter portion of the taped grid, one random gravel/cobble item was collected. The only limitation that was placed on the sample was that gravels that measured less than 2 cm were discarded, and another gravel from the 1 × 1-m unit was re-sampled. Results from the surface collection are described in the site summary section.

**Cortex**

Cortex amount is used as a measure of reduction for all debitage except angular debris. Flakes with 80 percent or more of their dorsal surface covered with cortex are considered primary flakes; secondary flakes have between 0 percent and 80 percent of the dorsal surface covered in cortex, and tertiary flakes have no cortex on the dorsal surface. The percentage of cortex retained on cores was also gathered as a relative measure of lithic reduction.

**Platform Remnant Surface**

For flakes with an intact platform, the platform preparation variable indicates the type of treatment exhibited on the platform. Variability in platforms on debitage has been used to determine the type of hammer used, method of reduction (core reduction or bifacial reduction), and stage of biface reduction (Andrefsky 1998, 2001). Generally, in bifacial production, the later the biface is in the reduction sequence, the greater the amount of platform preparation. Five categories of platform type are measured: indeterminate and/or point-of-force, cortical or natural platform surface, a single flake scar, multi-faceted...
platform, and abraded platform; all flake debitage for which a platform was not present was categorized as Not Applicable (Phagan 1976). Cortical and single-facet platforms are generally considered to be unprepared striking surfaces. A cortical striking platform is composed of the unmodified cortical (natural) surface of the objective flake. A single-facet platform is a non-cortical platform with a single flat surface on the objective flake. An indeterminate/point-of-force platform is a flake with what appears to be a striking platform, but, other than the identification of the point of force, the characteristics of the platform could not be determined. Multi-faceted and abraded platforms are indicative of planned platform preparation or modification. A multi-faceted platform has an angular surface created by removal of several striking platform preparation flakes. In some cases the combination of flake scares creates a rounded or convex appearance, rather than an angular appearance. An abraded platform is usually a multi-faceted platform that has also been smoothed by abrasion or rubbing.

**Platform Lipping**

A platform lip is a discernable “hook” just distal to the striking platform. On whole and proximal flakes, a relative present/absent category is used to measure platform lipping. A platform lip is labeled as “present” if the lip would catch or stop a fingernail passing over it. Platform lipping is often caused by soft-hammer percussion (Crabtree 1970:150; Whittaker 1994:187) and correlated with bifacial thinning technology (Kooymant 2000).

**Size**

All debitage and used flakes were measured using a series of graduated circles at 1-cm intervals, to provide an ordinal measure of dimensions (see Patterson 1982). For example, a “Size-1” flake fits into the first size interval of 0.0 cm and 1.0 cm; a “Size-2” flake has maximum dimensions between 1.0 cm and 2.0 cm; and so on. All other tools and cores are measured for maximum length, width, and thickness to the nearest millimeter.

**Thermal Alteration**

Artifacts are grouped under three relative measures of thermal alteration: unknown, heated/oxidized, and heat-damaged. Lithic materials were often heated in an effort to make them flake in a more predictable manner. An artifact that exhibits potlids is considered heat-damaged. A waxy, crazed, or oxidized surface indicates the presence of thermal alteration, while artifacts lacking any of the above variables were given an “unknown” designation.

**Face Evaluation**

Bifaces and formal tools are coded according to a ranked evaluation of energy investment into facial regularization or flattening (Phagan 1976). Facial evaluation of retouched tools can provide data for assessing technological stage of production and the amount of energy invested in tool production. Following Phagan (1976), seven categories of ranking, from facially unworked with cortex to an artifact with a highly stylized face, are defined and implemented. Both faces of the artifact are evaluated.

**Tool Condition**

Tools are ranked according to completeness, from less than 25 percent complete to complete or nearly complete. Tool condition can correlate with retooling behavior. Groups “retool” when they replace exhausted and broken hafted bifacial tools with new bifacial tools. Sites that contain a high percentage of
basal portions from hafted bifaces and/or exhausted hafted bifaces may have functioned as a retooling locality.

**Use Wear**

All artifacts in the analysis are evaluated for evidence of use wear under 20x magnification. Different types of artifact damage can be a useful indicator as to how a tool was used. As evidence of use wear can sometimes be problematic (see Eisele et al. 1995; Fiedel 1996; Newcomer et al. 1986), artifacts had to exhibit a clear and consistent pattern of microchipping, micropolish, or striations to be classified under one or more of the use wear categories. Neusius’s (1988) descriptions of use-wear patterning are used to determine wear type.

**Weight**

All artifacts are weighed to the nearest tenth of a gram on a digital scale with a 500-g capacity. For artifacts weighing over 500 grams, a triple-beam balance scale was used.

**Site Lithic Assemblage Descriptions**

Analytical results are presented below. Flaked and ground stone artifacts are grouped into general categories and summarized by site.

**LA 55503**

LA 55503 is a prehistoric and historic artifact scatter. Flaked stone artifacts recovered from the site include 36 pieces of flaked stone debitage and a core.

**Debitage**

The debitage (n=36) is composed of 75.0 percent flake fragments, 11.1 percent whole flakes, and 13.9 percent angular debris (Table 7.4). The site has a high flake fragment-to-whole flake ratio (6.75 to 1), and there are no bifacial thinning flakes. One of the six flakes with platforms exhibits lipping. Pedernales chert accounts for 100 percent of the raw material, and 91.9 percent of the material is microcrystalline. The assemblage is dominated by tertiary flakes (67.7 percent), followed by secondary flakes (25.8 percent), and primary flakes (6.5 percent) (Table 7.5). Overall, flake size is small, with 61.1 percent of the debitage Size 1 and 2 (Table 7.6). Nine pieces of the debitage (25 percent) exhibit evidence of thermal alteration.

**Cores**

One core was recovered from the site, which represents 2.7 percent of the site’s flaked stone assemblage. The core is of Pedernales chert, has multidirectional platforms, and retains less than 50 percent cortex. The core has at least eight visible flake scars and an additional surface from which flakes could be removed. The core weight is 394 g, and it does not exhibit heat treatment.

**Site Summary**

The recovery of a core among the 37 flaked-stone artifacts at LA 55503 suggests that initial-stage core reduction occurred at the site. The low percentage of primary (6.5 percent) and secondary (25.8 percent) flakes, and the high number of small, tertiary flakes (67.7 percent) indicates that later stage reduction also
occurred, although the later stage reduction does not appear to be the result of bifacial reduction as no bifacial thinning flakes or bifaces were recovered. Due to the small assemblage (n=37), any conclusions regarding the lithic strategy is tenuous, and the small size of the assemblage may indicate an opportunistic limited lithic activity, rather than an area used repeatedly. However, the small assemblage size may also be due to post-occupational erosion, as recorded in the geologic record. Due to the lack of diagnostic artifacts recovered from the site, a cultural/temporal affiliation cannot be made on the basis of the lithic assemblage.

Table 7.4: Debitage Type by Site

<table>
<thead>
<tr>
<th>Debitage Type</th>
<th>Site Number (LA)</th>
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<th>126406</th>
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<th>126409</th>
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<th>55507</th>
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<tr>
<td>Angular Debris</td>
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<td>4</td>
<td>1.8*</td>
<td>1.1**</td>
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<td>0.4</td>
<td>8.0</td>
<td>2.2</td>
<td>5</td>
</tr>
<tr>
<td>Flake Fragments</td>
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<td>1</td>
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<td>17</td>
<td>17</td>
</tr>
<tr>
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<td>2.7</td>
<td>0.9</td>
<td>0.6</td>
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<td>8</td>
<td>1.7</td>
</tr>
<tr>
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<td>1.8</td>
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<td>2.2</td>
<td>4</td>
<td>0.8</td>
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<tr>
<td>Bifacial Thinning Flakes</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
<td>36</td>
<td>2</td>
<td>76</td>
<td>36</td>
<td>1264</td>
<td>575</td>
<td>1993</td>
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</tbody>
</table>

* Row percent; ** Column percent

Table 7.5: Flake Reduction Stage by Site

<table>
<thead>
<tr>
<th>Flake Reduction Stage</th>
<th>Site Number (LA)</th>
<th>126405</th>
<th>126406</th>
<th>126408</th>
<th>126409</th>
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<td>59</td>
<td>31</td>
<td>1124</td>
<td>545</td>
<td>1797</td>
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</tbody>
</table>

Does not include indeterminate cases; *Column percent.
LA 55507

LA 55507 is a lithic procurement site that consists of a moderately-dense scatter of flaked stone artifacts. A total of 1,440 flaked stone artifacts were recovered from LA 55507, the largest lithic assemblage in the project area (Table 7.1). Artifacts consist of 1,264 pieces of debitage, 11 used flakes, 123 cores, 5 core/hammerstones, 1 hammerstone, 30 tested cobbles, 1 uniface, 4 bifaces, and 1 retouched cobble tool. The majority of the assemblage was recovered from surface contexts, with the remaining small quantity coming from non-feature, test-unit contexts.

Debitage

Almost 88 percent of the flaked stone on the site consists of debitage. Debitage is divided between 59.8 percent flake fragments, 28.1 percent whole flakes, and 11.9 percent angular debris. Flake fragments outnumber whole flakes only 2-to-1 (Table 7.4), which is a lower ratio than most of the other sites in the study. The site has high frequencies of early-stage debitage, large debitage size, and relatively high percentages of cores and tested cobbles. Debitage reduction stages are divided between 14.2 percent primary, 50.7 percent secondary, and 35.1 percent tertiary. Two bifacial thinning flakes were recovered. Average flake size is the largest in the project area (Table 7.6), with nearly half (46 percent) of the debitage being Size 4 and larger, and only 3.1 percent of the assemblage falling into the Size 1 category.

Ninety-six percent of the debitage on the site is Pedernales chert. All of the sites have high percentages of Pedernales chert (Table 7.3), and groups were clearly favoring this material, as it is scattered over the site.
surface with other raw material types. Other raw materials in the assemblage include quartz, chalcedony, petrified wood, moss agate, tan chert, red-brown chert, banded chert, quartzite, and basalt; however the next most frequently occurring material (tan chert) amounts to only 1.3 percent of the assemblage, and all other materials are less than one percent of the assemblage. Microcrystalline granular structure characterizes about 88 percent of the flake debitage. Heat-treatment of raw materials was probably an infrequent occurrence, as only 5.7 percent of the assemblage exhibits clear evidence of thermal alteration.

**Used Flakes**

Eleven used flakes were recovered; three of which were from Level 2 of Test Unit 2, and one from Level 3. The used flakes range from Size 3 to Size 7; two are primary flakes, six are secondary flakes, and three are tertiary flakes. All of the flakes are Pedernales chert, with the exception of one flake of reddish-brown chert. Three of the flakes exhibit scraping use, with two having extensive unimarginal retouch. Six other flakes have wear from cutting/sawing, with two of these exhibiting extensive use damage. Another flake has both scraping use and wear from cutting/sawing. The remaining flake has wear damage of an indeterminate type.

**Cores, Hammerstones, and Tested Cobbles**

One hundred twenty-three cores, 5 core/hammerstones, 1 hammerstone, and 30 tested cobbles were recovered from the site. This represents 11 percent of the flaked stone assemblage, the largest amount and percentage of cores and associated artifacts recovered from the project (Table 7.1). Core preparation and reduction does not appear to follow a distinct pattern on LA 55507. Of the 123 cores, 27.9 have multidirectional platforms, 26.2 percent have bifacial platforms, 20.5 percent have single unidirectional platforms, 18.8 percent have parallel/opposing platforms, and 6.5 percent have bidirectional platforms. Additionally, heat-treating of cores appears to be rare, with only 2 cores (1.6 percent) exhibiting any thermal alteration. Although the site reflects intensive lithic reduction, most cores were not exhaustively reduced. Almost 44 percent of the cores retain more than half of their cortical covering. Over 85 percent of the cores and core/hammerstones recovered from the site are of excellent microcrystalline quality. Even most of the tested cobbles exhibit good quality, but, predictably, the quality of the tested cobbles lags behind the quality of the cores, with 66.7 percent of the tested cobbles exhibiting microcrystalline granular structure compared to 85.4 percent of the cores and core/hammerstones.

Site inhabitants overwhelmingly selected Pedernales chert for testing and reduction and tended to use quartzite hammerstones in the reduction process. Of the 123 cores, over 97 percent are Pedernales chert, with the remaining 3 percent split among quartzite, moss agate, and obsidian cores. The obsidian, and possibly the moss agate cores, are nonlocal. Twenty-six of the 30 tested cobbles are Pedernales chert, followed by 2 quartzite, 1 tan chert, and 1 banded chert core. There are 4 Pedernales chert core/hammerstones and 1 quartzite core/hammerstone, and the 1 hammerstone is quartzite. The site’s mean core weight is the second largest in the project, and the weight range the second broadest. Core weight ranges from 27.2 g to 713.6 g, with a mean weight of 165.2 g. Tested cobbles have a mean weight of 157.26 g, and range of 22.1 g to 771.4 g. The five core/hammerstones range in weight from 91.6 g to 1260.5 g and have a mean weight of 387.1 g. The single hammerstone weighs 672.1 g.

**Retouched Tools**

Two bifaces, one uniface, and one retouched cobble tool comprise the tools in the flaked stone assemblage. All except one of the bifaces were recovered from the site surface. The uniface and cobble tool are distinctive. The uniface is manufactured from heat-treated basalt and is Size 11. It appears to be
complete and has hammering/battering scars along its margins. The retouched cobble tool is made on a cobble of metasediment that has been flaked along one margin. It weighs 387.6 g and has an indeterminate wear pattern along its flaked edge. It is the only metasediment flake stone artifact recovered in the project. One biface is an early-stage flake biface fragment made on untreated Pedernales chert, measuring 4.5 × 4.5 × 1.6 cm, and appears to have fractured during manufacture. No use wear is evident. Another biface was recovered from level 1 of a test unit. This is another early-stage biface, but appears to be in complete condition and measures 6.1 × 3.2 × 2.0 cm. It does not exhibit evidence of use wear or heat-treatment.

Raw Material Sample

One hundred unmodified Santa Fe gravels were systematically sampled from the surface of LA 55507 in order to help understand prehistoric raw material selection that occurred on the site and the constraints that the materials may have placed on reduction and use strategies. Sampling procedures were detailed previously, which roughly follow those set out by Shelley (1993). The sample contains a wide range of sedimentary, igneous, and metamorphic materials (Table 7.7). Materials consist of Pedernales chert (38 percent), granite (31 percent), quartzite (7 percent), limey chert (6 percent), tan chert (5 percent), limestone (3 percent), sandstone (2 percent), conglomerate (2 percent), schist (1 percent), chalcedony (1 percent), indeterminate igneous (1 percent), indeterminate sedimentary (1 percent), and unidentified (2 percent). The weight of the samples ranged from 1.1 g to 1783.3 g, with a mean weight of 173.3 g. Gravel/cobble sizes ranged from Size 2 to Size 17, with an average of Size 7. The sample’s grain size/quality is distributed among microcrystalline (25 percent), fine (11 percent), medium (22 percent), coarse (17 percent), and indeterminate (25 percent) (Table 7.8).

Almost all of the materials from the unmodified raw material sample are found in the Paseo de Volcan corridor site artifact assemblages. Pedernales chert, the most common and best quality material found in the site assemblages (Table 7.8), is also the most common material in the sample. The Pedernales chert sample has a weight range of 1.1 g to 1437.5 g, with a mean weight of 98.9 g. Its size ranges from Size 2 to Size 15, with an average of Size 6. Overwhelmingly, the Pedernales chert sample exhibits the best quality of all the sampled raw materials. Without considering the indeterminate cobbles, over 83 percent of the Pedernales chert has a microcrystalline granular structure, with the remaining percentage having a fine-grained structure. No other material in the sample exhibits a microcrystalline granular structure. The next best quality raw material in the sample is the tan chert, with all five cobbles possessing fine-grained structure. The remaining raw materials exhibit medium- or coarse-grained structures, with the exception of one fine-grained quartzite cobble.

Granite is the second-most abundant material in the sample. It is found as ground stone on two sites in the study and is some of the largest and heaviest material in the sample. Granite samples range from 5.9 g to 1098.3 g in weight, with a mean weight of 187.4 g. The average granite sample is a Size 7 (7.8), with a size range from Size 3 to Size 16.

Quartzite, limey chert, tan chert, limestone, sandstone, conglomerate, schist, chalcedony, indeterminate igneous, indeterminate sedimentary, and an unidentified cobble complete the raw material sample. All of these materials, with the possible exception of the indeterminate materials, are found as artifacts on sites in the Paseo de Volcan corridor. Quartzite, which was favored for hammerstone use, was also used for flaked and ground stone artifacts. Flaked limey and tan cherts are found in small percentages on many of the project sites. Limestone is found in both flaked and ground stone forms. A trace of flaked chalcedony was identified among the Paseo de Volcan sites. In addition to quartzite and limestone,
sandstone and schist were also used for ground stone artifacts in project assemblages. Indeed, among the raw material sample, only the conglomerate and possibly the untyped materials are not found in the Paseo de Volcan assemblages.

The surface of LA 55507 has a broad and diverse range of sedimentary, igneous, and metamorphic raw materials that were available and selected by prehistoric groups visiting the Paseo de Volcan corridor. Large-sized clasts of microcrystalline Pedernales chert are abundant and were the primary choice for flaked stone tools among the Paseo de Volcan groups. Less common and lower quality materials such as tan chert, limey chert, quartzite, sandstone, granite, and schist are found on the site surface and occur in artifact form over the project site assemblages. LA 55507 may have functioned as a lithic raw material source, where there was an ample supply of microcrystalline Pedernales chert for flaked stone tools and supplies of granite, quartzite, sandstone, and limestone for ground stone tools and hammerstones. The sheer diverse quantity and quality of materials available from the site appears to have placed no constraints or limitations on reduction strategies for the prehistoric inhabitants of the Paseo de Volcan corridor sites.

**Summary**

LA 55507 primarily functioned as a lithic raw material source for prehistoric groups. Lithic raw material from the Santa Fe Formation is present in abundance over the site, with Pedernales chert being the favored flaked stone raw material. The Pedernales chert makes up about 38 percent of the naturally occurring raw material nodules at the site, but represents about 93 percent of the total lithic assemblage. Additionally, of the Santa Fe nodules that appear at the site, it is the most microcrystalline material available, as about 79 percent of the Pedernales nodules were classified as microcrystalline. No other material at the site was classified as microcrystalline. Thus, Pedernales nodules were intentionally selected over other materials for lithic production.

Raw materials such as sandstone, granite, schist, and quartzite, that were used for ground stone tools on the Paseo de Volcan corridor sites, are also found on LA 55507. Although the site functioned primarily as a place where flaked stone raw materials were collected, tested, and carried away, tools recovered from the site suggests the location also functioned as a processing locale. Formal and expedient tools recovered from the site exhibited wear from hammering/battering, cutting/sawing, scraping, and other indeterminate use. The lack of worn out and broken formal tools suggests the site may be the result of small task groups being sent out from a residential location to obtain lithic raw materials and quickly leaving. There were no diagnostic tools found on the site to assign a cultural/temporal affiliation, but the
Table 7.7: Cross-tabulation of Material Type by Size, LA 55507 Raw Material Sample

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*Column percent of total recorded.
lack of patterned core preparation and reduction suggests the site assemblage may be the sum result of reuse and revisits by different groups employing different raw material reduction strategies through time.

**LA 55509**

LA 55509 is a moderate-sized Archaic site, with various hearths and secondary refuse pit features. The flaked stone assemblage, the second largest of the project’s sites (Tables 7.1 and 7.2), consists of 601 artifacts: 575 pieces of flaked stone debitage, 3 used flakes, 15 cores, 1 core/hammerstone, 1 tested cobbles, 2 hammerstones, 3 bifaces, and 1 projectile point. Eight ground stone items were recovered, including 4 manos, 2 netherstones, and 2 fragments of indeterminate ground stone.

**Debitage**

Debitage is composed of 71.7 percent flake fragments, 21.2 percent whole flakes, 6.8 percent angular debris, and 0.5 percent bifacial thinning flakes. A 3.4-to-1 flake fragment-to-whole flake ratio is high among project sites. The debitage raw material assemblage is diverse. Over 88 percent of the debitage is Pedernales chert, followed by quartzite (2.5 percent), basalt (2.3 percent), white chert (2.0 percent), petrified wood (1.3 percent), indeterminate chert (1.0 percent), obsidian (0.8 percent), limestone (0.7...
percent), red-brown chert (0.5 percent), tan chert (0.3 percent), and limestone/chert (0.2 percent).

Primarily due to the high frequency of excellent quality Pedernales chert, 87.0 percent of the debitage is microcrystalline, while 10.3 percent is fine-grained, and 2.5 percent is medium-grained. The majority of the debitage is Size 2 (42.9 percent), but 34.2 percent is Size 3 and larger (Table 7.6); Size 1 debitage accounts for 22.8 percent of the category. Most of the flakes are tertiary (70.2 percent), although all reduction stages are present. Single-flake scar platforms account for 67.7 percent of the flakes with intact platforms, although all other platform types are present. A full 24.0 percent of the debitage exhibits a waxy, crazed, and oxidized heat-altered surface, suggesting heat treatment, while 4.2 percent of the debitage was heat-damaged (potlids).

Used Flakes

Three utilized flakes with cutting/sawing use-damage were collected from the site. One used flake, recovered from the general site surface, is a complete, Size 4 tertiary flake of reddish-brown chert that exhibits continuous wear along one lateral margin. Another reddish-brown chert, Size 5 secondary flake was collected from Test Trench 3 and exhibits wear along one margin. The third used flake was recovered from 42-44 cmbd at the mechanically scraped area adjacent to Feature 6, which was exposed near the south end of BHT 4. It is a Size-8, whole tertiary flake of Pedernales chert, with use-damage along two margins.

Cores

Fifteen cores, one tested cobble, and one core/hammerstone were recovered from the site. All but six of the cores were recovered from non-feature surface contexts. Of the remaining six cores, two were discovered during excavation of Test Trench 3, and four cores were recovered in Backhoe Scrape 4. Microcrystalline and fine-grained Pedernales chert account for all but two (1 basalt, 1 white chert) of the site’s cores. The tested cobble is quartzite. The core/hammerstone is Pedernales chert, weighs 875.5 g, and retains less than 75 percent cortical covering. On average, the cores exhibit at least seven visible flake scars, and range in weight from 18.4 g to 1154.4 g, with a mean weight of 217.6 g. This is the widest weight range and heaviest mean core weight in the project area. Removal of the heaviest core as an outlier results in a mean weight of 150.7 g for the cores, comparable to the mean weight of 165.2 g for cores at LA 55507. Thirteen of the fifteen cores retain 50 percent or less cortex. Core platform patterns are diverse and include the following: 2 single, 3 parallel/opposed, 7 multidirectional, and 4 bifacial.

Hammerstones

Two hammerstones were recovered from collection units. Both are quartzite and large in size. A lightly battered quartzite hammerstone, weighing 740.2 g, was found on the surface of Collection Unit 1. The second quartzite hammerstone was located on the surface of Collection Unit 2 and weighs 880.0 g.

Retouched Tools

Four retouched tools were recovered from the site. They consist of three flake bifaces and one projectile point. The flake bifaces, from Test Unit 2, Test Unit 3, and the south half of Feature 4, are complete specimens, with mean measurements of $5.1 \times 3.8 \times 1.3$ cm (length × width × thickness). The bifaces are of microcrystalline gray Pedernales chert and range from the first stage of facial regularization to a secondarily flattened face. Two do not exhibit any use wear; the third has evidence of shaving/planing and grinding.
One projectile point, a dart point, was recovered from the general site surface. The dart point is morphologically similar to the San Jose type cluster, which generally dates from 4500-1500 B.C., during the Middle and Late Archaic periods (Justice 2002:133). The San Jose dart point is complete and made from translucent, non-local obsidian. It has straight, non-serrated blades and a concave base, with slightly flaring basal ears. The hafting area exhibits grinding.

Ground Stone

Eight ground stone artifacts were recovered from LA 55509. Most exhibit evidence of burning or heat-alteration; seven are fragments. The only nearly complete artifact, an approximately round one-hand mano of limestone, was discovered in Backhoe Scrape Unit 1. It is plano-convex in cross-section and, although both surfaces are ground, the convex surface is the most intensively ground surface and the only grinding surface prepared by pecking. Secondary use from battering is evident on one broken end, also spalled from heat. The mano measures 8.7 cm in length, 8.4 cm in width, and 4.3 cm in thickness.

Three indeterminate mano fragments, two of quartzite and one of granite, came from Test Trench 4 (29 cmbgs), the north half of Feature 2, and Level 4 (48-58 cmbd) of Test Unit 3. Grain sizes on the quartzite specimens are indeterminate, and the granite mano is fine-grained. All three are burned fragments and could not be evaluated for production criteria.

Of two netherstone fragments, a pink sandstone specimen was recovered from the surface and a limestone specimen was found in Level 3 of Test Unit 2. Both are relatively thin (1.6 cm and 1.3 cm, respectively) with flat grinding surfaces; however, the sandstone netherstone has small, narrow pecks and unidirectional striae on the grinding surface, and the limestone fragment shows no evidence of production or use-wear pattern.

Two fragments of indeterminate ground stone were found in Level 5 of Test Unit 1 and Level 1 of Test Unit 2. The latter fragment is a light orange sandstone artifact with a flat grinding surface; however, exposure to heat has compromised the stability of the material, and it retains little surface integrity. The former indeterminate ground stone artifact is a thick wedge-shaped fragment of schist that is caliche-encrusted on the largest intact grinding surface, which is flat-to-slightly concave. The opposite surface appears to be well ground to the degree of polish on an area closest to the acute angle of the wedge. This edge is flaked and may have use wear, although caliche masks any traces. This artifact may be a scraper plane or possibly recycled as a scraper plane after its original form was broken.

LA 55509 ground stone exhibits the characteristics of a mobile strategy, although the assemblage is too small and fragmentary to be certain. Netherstones are thin, the only complete mano is one-handed, and grinding surfaces on all artifacts lack coarse textures. A high frequency of heat-altered materials, hinting at reuse of artifacts as heating stones, and two possible examples of recycling/multiple-use artifacts (battering on the complete mano and possibly recycling of an indeterminate ground stone artifact as a scraper plane) suggest that artifacts were curated for more than one task.

Site Summary

The lithic assemblage recovered from LA 55509 is diverse and moderately large. The San Jose-style point suggests that this site was occupied during the Middle Archaic to Late Archaic periods, between 4500-1500 B.C. (Justice 2002:133). This date is earlier than an AMS radiocarbon date from juniper wood that returned a 2-sigma calibrated date of 820 BC – 760 BC, and 620 BC – 590 BC. No definitive flaked stone artifacts styles from other temporal/cultural periods were identified; however, the site contains Classic period ceramics (A.D. 1325 - 1500) that suggest a portion of the lithic assemblage may be
associated with a Classic period occupation. Nevertheless, the majority of flaked and ground stone patterns from LA 55509 suggest the site is the result of a longer-term, multi-activity Archaic occupation. More formal tools (one projectile point and three bifaces) were recovered from LA 55509 than from any other site in the study. The projectile point suggests general hunting, and one of the bifaces, as well as the utilized flakes, indicate evidence of processing. The ground stone assemblage produced evidence of food processing and exhibits evidence of multiple uses and recycling of material for other functions, including use as heating stones. Core reduction does not appear to have been as large a component on LA 55509 as on some of the other sites in the area, but a variety of evidence suggests it was more systematic and organized. The high ratio of flake fragments-to-whole flakes and a high percentage of lipped debitage are suggestive of an Archaic bifacial reduction pattern. The site has low percentages of primary flakes and flakes with intact cortical platforms, but it has a high frequency of tertiary flakes and flakes with a single flake scar remnant platform. Additionally, most of the cores on the site have low percentages of intact cortical surfaces. The site also contains a high percentage of heat-treated artifacts. These patterns suggest initial core reduction took place off-site, possibly on LA 55507, where raw materials may have been obtained. Cores were then brought back to LA 55509, sometimes heat-treated, and further, more intensively, reduced.

**LA 126405**

This site consists of a scatter of a few flaked stone artifacts associated with one thermal feature. A limited flaked stone assemblage of four flakes and one projectile point fragment was recovered from test unit contexts on this site. One gray Pedernales chert distal flake fragment was recovered in the second level of Test Unit 1. Another gray Pedernales chert flake fragment was discovered in Level 2 of Test Unit 3. Two artifacts were found in the first level of Test Unit 4. A distal fragment of a projectile point made from brown Pedernales chert exhibits a well-shaped face, but no clear evidence of use wear. From the same level is a whole flake of brown Pedernales chert. The fifth and last artifact from the site is another whole flake of white Pedernales chert.

The assemblage from LA 126405 has no diagnostic artifacts and is associated with an unknown cultural/temporal affiliation. The assemblage is too small to make any but the most general observations. The site may be the residue of a fleeting visit to gather resources. As few as a single person may have occupied the site as a task-specific locale where one stopped for a day or two, gathered lithic raw material and/or seasonal foods, hunted to procure food, and left to return to a base camp. However, given the geological context of this and the other Loma Duran sites, the small assemblage is most likely the result of post-occupational erosion and is not a true representation of site activities.

**LA 126406**

LA 126406 consists of a relatively small number of flaked and ground stone artifacts associated with numerous shallow features of unknown function. Fifty lithic artifacts were recovered from the site, including 36 pieces of flaked stone debitage, 3 cores, 5 manos, 1 shaped disk/blank, and 5 fragments of indeterminate ground stone.

**Debitage**

The debitage consists of 63.9 percent flake fragments, 25.0 percent whole flakes, and 11.1 percent angular debris. There are no bifacial thinning flakes in the assemblage. The majority of the raw material is Pedernales chert (88.9 percent) of various colors (Table 7.3). The other raw materials in the assemblage
are quartzite (5.6 percent), banded chert (2.8 percent), and undifferentiated chert (2.6 percent). Over 80.0 percent of the debitage is microcrystalline, 11.1 percent is of fine granular structure, and 8.3 percent is medium-grained. A majority of the debitage is in the Size 1 category (52.8 percent). Size 2 debitage consists of 36.1 percent of the assemblage, and Size 3 and larger debitage accounts for 11.2 percent. Over 44.0 percent of the flakes are tertiary, 30.5 percent are secondary, and the remaining 16.7 percent of the flakes are primary-stage flakes. Eleven flakes have remnant platform surfaces that are fairly evenly distributed by preparation type. Platform surfaces include 18.2 percent indeterminate or point-of-force, 18.2 percent cortical or natural surface, 18.2 percent single flake scar, 9.1 percent two-to-three flake scars, 18.2 percent having a series of flake scars, 9.1 percent with a mass of flake scars, and 9.1 percent has a ground platform surface. Only one of the eleven flakes that have intact proximal ends exhibits lipping. One piece of debitage has evidence of being heat-treated, while four others contain potlids. All of the potlidded, heat-damaged debitage were recovered from feature contexts.

Cores

There are three cores from the site. Two were recovered from the surface of the site, and a third core was uncovered in the mechanical stripping area. One core from the site surface has multidirectional platforms and is of microcrystalline-quality gray Pedernales chert, with less than 50 percent remnant cortex; the core weighs 274.6 g. The second core from the site surface has bidirectional platforms and is a limey chert. Less than 25.0 percent of the cortex remains on the core, and it weighs 34.5 g. The third core is quartzite, has bidirectional platforms, retains no cortical covering, and weighs 47.6 g.

Ground Stone

Eleven ground stone artifacts were recovered from LA 126406: three one-hand manos, one shaped disk/blank, and five indeterminate ground stone pieces. Most artifacts show evidence of intense heat alteration.

One-hand manos are represented by one whole artifact, one broken artifact, and three fragments that fit together as one nearly complete mano. The whole mano is an oval sandstone cobb that measures 11.7 × 7.5 × 4.5 cm (length × width × thickness). It was recovered from the west half of Feature 10 (14 cmbd) and appears to have been ground on a flat/slab metate or grinding slab. Although it is plano-convex in cross-section, reflecting opposing grinding surfaces, it also exhibits a small, third ground surface on one side or mano edge that is 3.2 cm in length. The flat grinding surface is slightly faceted from use and has perpendicular, bidirectional grinding straie, and the convex grinding surface has small, narrow pecks, indicating production efforts to roughen the surface. Battering use wear on one of the tool ends provides evidence of secondary use. The second one-hand mano is a heat-altered sandstone fragment that is extremely blackened and friable. Although the fragment represents more than half of the original form, providing morphological information such as oval shape and bi-convex cross-section, production and use attributes are not obtainable. The grinding surface is fine-textured, and the tool measures approximately 9.1 × 6.9 × 4.8 cm. The third one-hand mano is composed of three granite fragments that fit together, each from a different vertical provenience (18-21 cmbd, 20-27 cmbd, and 28-33 cmbd) from the north half of Feature 35. When the fragments are joined, they form an oval sandstone mano that is 12.5 × 8.5 × 6.1 cm in size, oval in shape, and bi-planar in cross-section. Grinding surfaces are pecked (small and narrow) and medium-textured.

A sandstone disk-shaped artifact was found in the south half of Feature 35, at 19-27 cmbd. It was shaped by flaking and pecking into an almost perfect circle (9.6 - 9.7 cm diameter range; 4.1 - 4.3 cm width
range), but the only evidence of use wear is a small trace of grinding on the surfaces prior to shaping into the disk form, suggesting that the artifact is a recycled tool.

Three indeterminate ground stone fragments were recovered from the base of mechanical stripping at LA 126406. One of these is a quartzite cobble, approximately 12 cm in length and 7 cm in width and thickness that may have been used as a hammerstone or pestle; however, heat spalling impedes determination of function. Two indeterminate fragments of schist may have originated from the same artifact. Although they do not fit together, both fragments share similar characteristics, such as material, thickness (1.0 cm and 0.8 cm), and treatment (flat-to-slightly concave surface, with pecking).

Two indeterminate ground stone fragments, one sandstone and one granite, came from TU 2. The sandstone specimen exhibits a convex, pecked grinding surface, and the granite fragment has a flat grinding surface. Both artifacts were too small for type identification.

LA 126406 ground stone represents activities such as food processing and tool production and exhibits the characteristics of a mobile strategy. Manos are one-handed, produced grinding surfaces do not exhibit large pecks or coarse textures, and there appears to be a relatively high frequency of recycling for such a small assemblage. A high frequency of heat-altered materials, hinting at reuse of artifacts as heating stones, and one example of recycling (shaped disk/blank) suggest that artifacts were curated for more than one task.

Site Summary

The lithic assemblage recovered from LA 126406 amounts to only 50 artifacts; therefore, trying to define activity and occupation based on such a small assemblage will be problematic. Additionally, none of the lithic artifacts recovered from the site were diagnostic, so no cultural/temporal affiliation can be made on the basis of the lithic assemblage. However, this site contains more ground stone artifacts (n=11) and a higher percentage (22 percent) than any other site in the study. The high ratio of ground stone-to-flaked stone artifacts suggests food processing was the primary activity conducted on the site. Indeed, the size and condition of the ground stone tool kit suggests that processing plants was an important function at the site. The flaked stone assemblage appears to represent a secondary function as a lithic reduction locale. Of the 39 flaked stone artifacts recovered from the site, all but three are pieces of debitage. The three other artifacts are cores. These cores may have been gathered from the surface exposure on LA 55507, brought back to the site, and reduced. Indeed, the lithic assemblage suggests the site primarily functioned as a seasonal food-processing locale for a mobile task-group, with flaked stone core reduction serving as a secondary function. However, as with all of the Loma Duran sites, post-occupational erosion likely removed some unknown portion of the artifact assemblage. It is not known if the remaining assemblage is representative of past site activities.

LA 126408

LA 126408 consists of a few flaked stone artifacts associated with what were initially believed to be cultural features, but were later found to be non-cultural. This site’s flaked stone assemblage consists of only three flaked stone artifacts: one secondary proximal flake fragment of mixed-color Pedernales chert with a lipped cortical platform, one fragment of gray Pedernales chert angular debris, and a gray Pedernales chert core with three flake scars along a single platform. The core weighs 79.1 g, and has less than 50 percent cortical covering. All of the artifacts were recovered in general contexts during mechanical surface stripping. The assemblage is too diminutive to draw any conclusions regarding site
activities. The small assemblage size may also be a product of post-occupation erosion that occurred at all Loma Duran sites.

LA 126409

LA 126409 consists of a relatively small assemblage of flaked stone, ground stone, with numerous carbon-stained features. The flaked stone assemblage consists of 82 items including debitage, cores, and a projectile point. The ground stone assemblage consists of 10 artifacts, including 5 manos, 1 mano/pestle, 2 netherstones, and 2 pieces of indeterminate ground stone.

Debitage

There are seventy-six pieces of debitage in the assemblage. Of this number, flake fragments account for 61.8 percent, while whole flakes account for just 14.5 percent. A large portion of the debitage is angular debris (23.7 percent). Debitage raw material consists of 71.1 percent Pedernales chert, 21.1 percent homogeneous tan chert, 6.6 percent quartzite, and 1.3 percent limey chert. This is the lowest percentage of Pedernales chert artifacts in the study. Additionally, the high percentages of tan chert and quartzite stand out among project sites (Table 7.3); hence, debitage raw materials do not possess the microcrystalline quality as found at the other sites in the study. Microcrystalline materials account for 57.9 percent of the debitage, while 35.5 percent is fine-grained and 6.6 percent is medium-grained. Tertiary flakes outnumber secondary flakes by more than 3-to-1 and outnumber primary flakes by more than 4-to-1. Platform preparation appears to have been relatively consistent, with 47 percent of the remnant platform surfaces consisting of a single flake scar. Other platform surfaces include cortical, 2-3 flake scars, ground, and point-of-force. Twenty-five percent of the intact platforms exhibit a pronounced lip.

Cores

Five cores were found on the site, which account for 6.1 percent of the flaked stone assemblage. All of the cores are of generally small size and retain relatively little cortex. Three of the cores are core fragments and appear to have come from the same parent core. Recovered from the mechanically excavated surface stripping area, the core fragments are gray Pedernales chert and range in weight from 7.0 g to 21.2 g. The fragments have bidirectional platforms and less than 25 percent cortical covering. Two other cores were excavated from Feature 12. One of these is of mixed-color Pedernales chert, has a single unidirectional platform, weighs 50.1g, and retains less than 50 percent cortical covering. The other core is also of Pedernales chert, has two bidirectional platforms, weighs 15.1 g, and retains less than 25 percent of its cortex. No tested cobbles or hammerstones were found on the site.

Retouched Tools

One retouched tool was found on the site, a complete projectile point. The point is similar to San Jose dart points that are indicative of a Middle to Late Archaic occupation, between 4500-1500 B.C. (Justice 2002:133). The point is complete and manufactured from microcrystalline white Pedernales chert, has excursive retouched blade edges, grinding along its hafting area, and exhibits possible cutting/sawing use wear.
Ground Stone

Ten ground stone artifacts were analyzed from LA 126409. Included are 2 one-hand manos, 1 one-hand mano/pestle, 3 indeterminate mano fragments, 2 netherstone fragments, and 2 fragments of indeterminate ground stone. As with artifacts from LA 55509 and LA 126406, artifacts from LA 126409 exhibit various characteristics of heat alteration, such as discoloration, spalling, crazing, and fracturing.

Two complete one-hand manos were found in Features 12 and 27. The specimen from Feature 12 is an oval tool of plano-convex cross-section that is a natural limestone cobble, measuring 10.5 × 8.6 × 4.1 cm, with a fine-grained texture. Although both surfaces have been ground, the convex surface has been more intensively ground and exhibits multidirectional straie. The second mano is also a natural oval shape, but is made of sandstone and is bi-convex in cross-section. It measures 9.3 × 7.8 × 5.6 cm and exhibits small, black adhesions on one ground surface; battering use wear is visible on one tool end.

A one-hand mano from the scraped surface has pestle wear on its constricted, pointed end. Approximately oval, this sandstone mano contains three ground surfaces as well. The third grinding surface consists of a tool edge/side. The mano is plano-convex in cross-section, with grinding surfaces exhibiting multidirectional straie and the flat surface exhibiting small black adherants (with some red spots, possibly hematite) and polish. Based on the use wear and adherants, this tool may have been used for the processing of nonfood substances, possibly pigment.

Three sandstone mano fragments were recovered from the scraped surface (n=2) and Feature 27. Although these specimens were too fragmentary to determine mano type, one mano from the scraped surface has at least two opposing grinding surfaces, with a possible third grinding surface on the side, similar to one of the complete manos, described above.

Indeterminate netherstone fragments, one of sandstone and one of limestone, were found in Features 12 and 27. The limestone tool has a flat-to-slightly concave surface, with a rounded lip, and is either a grinding slab or a narrow slab metate (at least 23 cm wide); it is medium-textured. The sandstone netherstone was a small fragment, also with a flat-to-slightly concave surface. It has unidirectional grinding straie on the use surface.

Finally, two indeterminate ground stone fragments were recovered from Feature 12. Both are made of sandstone.

Ground stone artifacts from LA 126409 depict a relatively varied assemblage, compared with other sites, reflective of food-processing and, possibly, pigment-processing tasks. In addition to grinding activities, hammerstone and pestle/pounding activities are also represented. Mano size, multiple use surfaces and multi-task tools, and a high frequency of heat-alteration of tools suggest a curation strategy by site occupants.

Site Summary

The only diagnostic artifact recovered from the site is a San Jose dart point that places the site occupation between ca. 4500-1500 B.C., during the Middle to Late Archaic periods. The flaked stone assemblage recovered from LA 126409 is relatively small, so broad patterns derived from the assemblage must be treated with some caution and the post-occupational erosion known to have occurred at the site may affected the recovered assemblage. However, most of the trends and patterns exhibited by the assemblage suggest the site was used as a seasonal short-term hunting, plant-processing, and raw material reduction location for mobile Archaic foragers. Flaked stone debitage patterns and size, core reduction patterns and size, and the lack of expedient flaked stone tools are suggestive of a mobile Archaic affiliation. A
relatively high percentage (10.9 percent) of ground stone artifacts indicates food processing was an important site function. The large percentage of interior, tertiary flakes, the small numbers of primary and secondary flakes, and the high frequency of angular debris are indicative of later stages of core reduction; cores appear to have been initially reduced off-site. The site has a high ratio of flake fragments-to-whole flakes that has been considered an Archaic indicator (Sullivan and Rozen 1985), due to trampling, recycling, and reuse. Although there are only a small number of cores, they are smaller-sized and retain little cortex. Small, light cores are easily transportable and may have been favored by Archaic groups (Kelly 1988). Of flake debitage that retain intact platforms, almost 50 percent have a single-flake scar platform, suggesting a more patterned reduction technique than found in any of the other sites in the study. A large percentage of flakes have lipped platforms, again suggesting Archaic reduction patterns, although no bifacial thinning flakes were identified in the assemblage.

**Chronology, Site Function, Subsistence, and Mobility**

Four research issues were proposed for the Paseo de Volcan lithic analysis: site chronology and stratigraphy, site function, subsistence and mobility strategies, and technological organization (Raymond 2005). Three types of sites were hypothesized by Phillips (2000) to be present in the Paseo de Volcan project corridor. The following is a short summary of the three site groups, their characteristics, and the Paseo de Volcan project sites that are hypothesized to be within each group, taken primarily from Phillips (2000), Campbell (2005), and Raymond (2005). A set of lithic criteria expectations is presented for each group site type. Then, each site is analyzed according to the expectations set forth within each site type. A discussion is presented to consider broader patterns among the project sites. First, a short review of the proposed mobility model Raymond (2005) derived from Binford (1980) to be used in the Paseo de Volcan lithic analysis is presented.

**The Foraging and Collecting Settlement Subsistence Model**

Hunter-gatherers employ a number of approaches in order to gain access to and obtain resources. The lithic assemblages from the Paseo de Volcan sites are evaluated based upon Binford’s (1980) hunter-gatherer mobility model of foraging and collecting. Following Binford, hunter-gatherers are said to operate along a continuum of mobility tactics in order to obtain resources. The form of mobility and tactics is tied to how resources are distributed over the landscape. On one end of the mobility continuum are foragers. Foragers are said to move as a residential group to the resource they wish to exploit. This is the mobility tactic employed to procure predictable resources, such as nodules of chert from lithic outcrops or seasonal plants. On the other end of the continuum are collectors. Collectors are said to exploit unpredictable, mobile, and patchy resources, such as deer, by sending logistical groups to secure the resource. These logistical collectors obtain the resource and transport it back to the group, which is said to be established at a relatively central location. Overall, it is believed most hunter-gatherer groups use a combination of these mobility tactics to gain access to and procure resources.

**Proposed Paseo de Volcan Corridor Site Types and Results**

**Group 1: Lithic Procurement Sites (LA 55507)**

Lithic Procurement sites are described by Phillips (2000) as being located in hilly areas that have natural exposures of cobbles and pebbles on the surface. According to Phillips (2000), traits are said to include larger site size, low artifact density, and artifacts from local deposits. These sites are hypothesized to be limited-activity locations for the procurement and reduction of local resources. If LA 55507 is a lithic
procurement site, it is expected to have the following assemblage criteria: an assemblage with a relatively high frequency of tested cobbles and early-stage cores compared to non-procurement sites, as cores carried to non-procurement areas will undergo further reduction; early-stage reduction flakes and angular debris, as cores are initially tested and reduced before being carried off; cores weighing more than those on non-procurement sites, reflecting the larger mass of a primary-material origin; flake platforms with little-to-no platform preparation, reflecting early-stage core reduction; and a narrow range of activities other than procurement and primary reduction.

Most of the lithic trends from LA 55507 confirm the hypothesis that the site was a limited-activity location for the procurement and reduction of local lithic raw materials. As previously elaborated, excellent quality Santa Fe gravels and cobbles are in abundance over the site surface, with 90 percent of the flakes of microcrystalline quality. The high quality of material explains its popularity with prehistoric knappers and the large amount of cultural material documented at the site, 65.2 percent of all flaked stone artifacts recovered from the project area. As expected, the site has a high frequency of tested cobbles, cores, early-stage reduction flakes, and angular debris, 61.3 of all artifacts, and little evidence of late stage reduction, including bifacial reduction (Table 7.9). Compared with other project area sites, LA 55507 has the highest core mean weight, with the exception of LA 55509 that has a single high outlier; without the outlier, the mean core weight at LA 55509 would also be lower than the core weight at LA 55507. A relatively low percentage of flake tools (0.8 percent) and formal flake stone tools (0.2 percent) and no ground stone artifacts in the assemblage indicates that the range of activities was limited and did not include general food-processing activities.

LA 55507, the single Group 1 site, met the data expectations for Phillip’s model of Lithic Procurement Sites. His traits of larger site size and locally derived artifact materials were met. While LA 55507 did not have a low artifact density as suggested by Phillips, this was more of an observation by Phillips than a data expectation per se. LA 55507 contained dense artifacts of numerous types, many of which are associated with testing of nodules and early stage reduction associated with core preparation for later, off-site reduction and use. The density of artifacts may be a factor influenced by resource quality, accessibility, extent, and period of use. The characteristics of the lithic assemblage at LA 55507 relative to the material available at the site provide some insight as to the procurement and use of exposed raw material deposits at the site.

Another hypothesis, under the domain of Chronology and Stratigraphy, states that LA 55507 was used from the Archaic period through Puebloan times. This hypothesis could not be addressed adequately given the data. The lithic profile of the site is dominated by initial core reduction attributes, masking any characteristics that might suggest either bifacial reduction technology or core reduction technology, or a mixing of those strategies as separate or prevalent, either spatially or temporally. The only noticeable difference at this site was a larger-than-average flake size, but this attribute may also be related to initial core reduction and the larger size of the exploited resource on-site. The maximum size of source material collected from the site was variable, ranging between 2 cm and 17 cm, with 42 percent ranging between Sizes 5 and 7. Debitage flake size ranged between 1 cm and 12 cm, with 47.8 percent ranging between Sizes 3 and 4, and 25 percent above size 4.

**Group 2: Early Intensively Used Sites of the Loma Duran Cluster (LA 126405, LA 126406, LA 126408, LA 126409)**

Phillips (2000) describes these sites as being located on ridges and should predate the Late Archaic based upon stratigraphy. Following Binford (1980), these sites are hypothesized to be residential foraging sites,
where plant and animal resources were exploited during the summer. Occupation length on these sites is believed to be longer-term (weeks) and the artifact assemblages are expected to reflect a broad range of activities. If sites LA 126406, LA 126408, and LA 126409 are residential foraging sites, there should be evidence of multiple activities, including food processing. Evidence can be in the form of multiple artifact types and/or use-wear patterns. As an indication of an early temporal assignment, technologically the assemblage should reflect a curation behavior strategy and mobility. This would be expressed as a relatively high ratio of retouched tools-to-used flakes, evidence of bifacial reduction technology (bifacial thinning flakes, many small, internal flakes, lipping on flakes, bifacial reduction of cores and bifacially produced tools), relatively low core weight and cores with little cortex, relatively small ground stone tools in both total mass and surface area, evidence of reuse and retooling, high platform preparation values, high tool production values, and the possible presence of exotic materials.

**LA 126405**

Only five lithic artifacts (four debitage and one projectile point fragment) were recovered from LA 126405. The lack of artifacts in the geomorphological setting of this site precludes meaningful conclusions regarding the lithic assemblage.

**LA 126406**

The small assemblage from LA 126406 provides conflicting evidence for our model of the residential foraging site pre-dating the Late Archaic. On one hand, there is evidence of multiple activities, though limited, including food processing, and the assemblage appears to be adapted to a mobile settlement strategy, with a low mean core weight and little cortex, small manos, and a high degree of recycling. On the other hand, there is little evidence of a bifacial reduction technology. No flake tools or bifacial thinning flakes were recovered, lipping is exhibited on a single flake, there is a relatively high frequency of primary flakes; however, this site has the highest frequency of Size-1 (small) flakes.

The small number of artifacts (n=47) suggests mobility and short-term use; however, the small assemblage may be the result of erosion. The fact that not a single flaked stone tool was recovered suggests that tools were carried off-site, reinforcing the presumption that site inhabitants practiced curation behavior. That flake tools were produced on-site must be deduced from the high frequency of small (Size 1) debitage remaining. Cores were reduced on-site as well, manifesting as primary flakes and three cores with little-to-no cortex. The site has a relatively large (n=8) ground stone assemblage and indicates that plant processing occurred at the site. The patterns from LA 126406 suggest that it functioned as a short-term plant processing location occupied by mobile task groups.

**LA 126408**

Only three lithic artifacts (two debitage and one small core) were recovered from LA 126408. The lack of artifacts in the geomorphological setting of this site precludes meaningful conclusions regarding the lithic assemblage.
### Table 7.9: Selected Flaked Stone Criteria by Site

<table>
<thead>
<tr>
<th>Flaked Stone Criteria</th>
<th>55503</th>
<th>55507</th>
<th>55509</th>
<th>126405</th>
<th>126406</th>
<th>126408</th>
<th>126409</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Tested Cobbles, Primary Flakes, Secondary Flakes and Angular Debris</td>
<td>40.5</td>
<td>61.8</td>
<td>27.1</td>
<td>0</td>
<td>53.8</td>
<td>66.6</td>
<td>47.6</td>
</tr>
<tr>
<td>% Microcrystalline Quality Flakes</td>
<td>47.1</td>
<td>88.4</td>
<td>87.5</td>
<td>100.0</td>
<td>84.4</td>
<td>0</td>
<td>60.3</td>
</tr>
<tr>
<td>% Flakes with Prepared Platforms</td>
<td>35.3</td>
<td>46.4</td>
<td>75.5</td>
<td>50.0</td>
<td>63.6</td>
<td>--</td>
<td>70.6</td>
</tr>
<tr>
<td>% Flake Tools</td>
<td>0</td>
<td>0.8</td>
<td>0.05</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% Formal Tools</td>
<td>0</td>
<td>0.2</td>
<td>0.07</td>
<td>20.0</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>% Cores</td>
<td>2.7</td>
<td>8.5</td>
<td>2.7</td>
<td>0</td>
<td>7.7</td>
<td>33.3</td>
<td>6.1</td>
</tr>
<tr>
<td>% Cores with 50% or Less Cortex</td>
<td>100.0</td>
<td>71.1</td>
<td>75.0</td>
<td>---</td>
<td>100.0</td>
<td>100.0</td>
<td>100</td>
</tr>
<tr>
<td>% Cores with Bifacial and Parallel Platforms</td>
<td>0</td>
<td>45.3</td>
<td>44.0</td>
<td>---</td>
<td>33.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% Tools</td>
<td>0</td>
<td>1.6</td>
<td>2.5</td>
<td>20.0</td>
<td>22.0</td>
<td>0</td>
<td>12.0</td>
</tr>
<tr>
<td>% of Flakes with Lipping</td>
<td>16.6</td>
<td>7.9</td>
<td>30.3</td>
<td>0</td>
<td>9.1</td>
<td>0</td>
<td>25.0</td>
</tr>
<tr>
<td>% Bifacial-Thinning Flakes</td>
<td>0</td>
<td>0.2</td>
<td>0.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1 Percent of all artifacts; 2 Percent of flake debitage; 3 Percent of flakes with platforms; 4 Percent of total artifacts; 5 Percent of total artifacts; 6 Percent of total artifacts. Does not include tested cobbles; 7 Percent of cores, core tools, core/hammerstones; 8 Percent of cores, core tools, core/hammerstones; 9 Includes both flaked and ground stone, does not include cores or tested cobbles; 10 Percent of lipping on number of proximal flake fragments plus whole flakes; 11 Percent of flakes.
LA 126409

The data from LA 126409 are slightly more consistent with Group 2 site predictions than LA 126406. Although the assemblage has only a single flaked stone tool, the San Jose projectile point fits into the temporal range expected. Technological indicators for a bifacial technology include a high frequency of tertiary flakes, a relatively high frequency of flake platform preparation, a high frequency of small debitage (78.9 percent of sizes 1 and 2), and a high frequency of pronounced lipping. A variety of ground stone artifacts reflect food processing and the processing of non-food substances, possibly pigment, and are represented by three different forms – manos, netherstones, and a combined pestle form. The lithic trends observed on LA 126409 suggest it was a short-term, multi-task locale primarily used for processing plants that was inhabited by groups practicing curation behavior.

Group 3: Camp Sites Along Arroyos of the West Mesa (LA 55503, LA 55509)

These sites are said to be located near arroyos and are hypothesized to represent campsites left by groups traveling between the Rio Grande River and the West Mesa in search of natural resources (Phillips 2000). Based upon diagnostic artifacts identified during earlier site recording, LA 55503 is expected to have a Developmental Period (A.D. 600-1200) cultural/temporal affiliation. LA 55509 is hypothesized to be the result of a Middle to Late Archaic (4500-1500 B.C.) occupation and a later Classic Period (A.D. 1325-1500) occupation. The sites are believed to be limited-activity, task-specific logistical sites, where small groups camped during forays to gather resources. These sites are believed to be short-term (days) camps that may have been used on several occasions. Artifacts are expected to reflect a narrow range of activities. If sites LA 55503 and LA 55509 functioned as logistical sites, the assemblage should be limited in types, and tools should reflect collecting and processing activities associated with resource procurement.

LA 55503

The recovery of a core among the 37 flaked-stone artifacts at LA 55503 suggests that initial-stage core reduction occurred at the site. The low percentage of primary (6.5 percent) and secondary (25.8 percent) flakes, and the high number of small, tertiary flakes (67.7 percent) indicates that later stage reduction also occurred, although the later stage reduction does not appear to be the result of bifacial reduction as no bifacial thinning flakes or bifaces were recovered. Due to the small assemblage (n=37), any conclusion regarding the lithic strategy is tenuous; however, the small size of the assemblage, most concentrated in a small area, and the lack of any tools suggests an opportunistic limited lithic activity, and there is no evidence of extended use of the site. This assemblage does not appear to reflect a subsistence strategy of “days” in duration.

LA 55509

The diversity of artifacts recovered from this site does not support its categorization as a limited-activity, task-specific logistical site. A total of 601 lithic artifacts were recovered, composed of a wide variety of types. Activities reflected in tool form and use-wear patterns include animal hunting, food processing, core reduction, and tool production. Tool types include projectile point, hammerstones, manos, netherstones, and scraper planes, as well as used flakes and bifaces with no apparent use wear. The broad range of lithic artifacts reflects a wider, rather than narrow range of activities. Additionally, the frequency of flake tools on the site is higher than any of the proposed residential sites. The site’s
assemblage is the second-largest in the study and may be more reflective of a more intensively used site, rather than one of short, logistical duration.

While the lithic assemblage at LA 55509 suggests that that several activities occurred at the site, the assemblage should be considered in the context of the site’s proximity to the lithic quarry site about 600 ft to the east (LA 55507). The proximity to material source, the presence of numerous cores of Pedernales chert, and a debitage assemblage dominated by Pedernales chert suggest that the adjacent lithic raw material was the targeted resource for the campsite. The large debitage assemblage (n=575) at LA 55509 is likely related to further reduction of cores obtained from LA 55507, as well as bifacial reduction to produce tools. Thus it is likely that the primary activity at the site was related to the procurement of lithic raw material and the production of stone tools, and that other secondary activities such as plant processing and hunting were performed in association with the primary activity.

Discussion

Phillips (2000) suggests prehistoric groups were traveling back and forth between the Rio Grande and the West Mesa searching for natural resources. The general patterns derived from the lithic data indicate prehistoric groups appeared to have been mainly using the Paseo de Volcan corridor as a predictable place to procure, test and reduce lithic raw materials, and to process seasonal plants.

Lithic patterns from the Paseo de Volcan corridor suggest the area was favored by Archaic groups. Two sites, LA 55509 and LA 126409, had diagnostic tools that place them into the Middle to Late Archaic temporal/cultural affiliation, and radiocarbon dates from thermal features reflect a Middle Archaic occupation at LA 55509, and a Late Archaic occupation at LA 126406. Based on radiocarbon dates, both appear to also have a ceramic period occupation. While there are no diagnostic artifacts at LA 126406, the ground stone assemblage is similar to assemblages recovered from LA 55509 and LA 126409. The temporal/cultural affiliation for LA 55507 is unclear. The assemblages from sites LA 126405 and LA 126408 were too small to indicate temporal/cultural affiliation.

The abundance and diversity of lithic raw material available on LA 55507 suggests this location was a one-stop “supermarket” where high quality raw materials for both flaked and ground stone tools could be replenished. This site may have been a primary draw to the West Mesa and may have been visited by many of the prehistoric inhabitants of the Paseo de Volcan corridor.

Hunting and animal processing appears to have played a very minimal role among project site occupants. Only three projectile points were analyzed in the entire assemblage, and almost as rare were bifaces, unifaces and flake tools. Indeed, the flaked stone patterns suggest the prehistoric groups that were occupying the Paseo de Volcan corridor viewed hunting more as an opportunistic activity and less as a planned primary goal. This pattern is also verified by the ground stone assemblages from sites LA 55509, LA 126406, and LA 126409. Unlike the majority of flaked stone assemblages in the project, the ground stone assemblages from these sites exhibit evidence of re-use and curation behavior. This is additional evidence of a more intensive plant processing focus than animal processing focus.

The primary goals of the Paseo de Volcan site inhabitants appear to have been the replenishing of lithic raw materials for tool kits and accessing and processing seasonal plants for food. The general lack of formal, exhausted, and broken flaked stone tools suggests the inhabitants were not occupying the area long enough or hunting intensively enough to wear tools out. Similarly, there is little to no evidence of retooling or discard in the Paseo de Volcan sites.
Of the seven sites in the Paseo de Volcan analysis, two fit the hypothesized site models (LA 55507 and LA 126409), four sites did not exhibit data consistent with the site model (LA 55503, LA 55509, LA 126405, and LA 126408), and one site had mixed results (LA 126406). However, many sites produced small overall assemblages where little interpretation could be made. All results must be interpreted in light of the erosion that is known to have occurred either during and/or after occupation of the Paseo del Volcan corridor. On the Loma Duran sites particularly, this erosion likely removed a significant portion of the sites’ artifact assemblages as well as features and living surfaces. Recovered assemblages are likely not representative of past site activities and should be interpreted with caution.

**Summary and Future Research**

The Paseo de Volcan testing and data recovery project resulted in the recovery of 2207 flaked stone and ground stone artifacts from seven sites: LA 55503, LA 55507, LA 55509, LA 126405, LA 126406, LA 126408, and LA 126409. No artifacts were recovered at LA 126407, and LA 126405 and LA 126408 each had fewer than 10 artifacts and no meaningful inferences could be drawn from the lithic assemblages and are not considered further. Analytical criteria were selected that would provide data applicable to addressing research questions concerning site function, subsistence and mobility, technological organization, and chronology. Site assemblages were described by artifact type. An unmodified raw material lithic sample from LA 55507 was described to provide information on the variety of raw material types available, and if these raw materials placed any restrictions on reduction strategies or raw material choice to the prehistoric inhabitants of the Paseo de Volcan corridor.

Research questions were organized under three types of site clusters that were proposed for the Paseo de Volcan project corridor (Phillips 2000): Group 1, Lithic Procurement Sites (LA 55507), Group 2, Early Intensively Used Sites of the Loma Duran Cluster (LA 126406, LA 126408, and LA 126409), and Group 3, Camp Sites Along Arroyos of the West Mesa (LA 55503, and 55509). LA 55507 was hypothesized to be a limited-activity locale for the procurement and reduction of local raw materials, utilized from the Archaic through to the Formative Period. LA 126406, LA 126408, and LA 126409 were expected to be pre-Late Archaic residential foraging locations. LA 55503 and LA 55509 were hypothesized to be limited-activity task specific logistical sites. LA 55503 was inferred to be a Development period site (AD 600-1200), and LA 55509 was expected to be the result of two occupations: an Early to Middle Archaic (4500-1500 B.C.) occupation, and a Classic Period (A.D.1325 -1500) occupation. The data recovery plan (Campbell 2005, Raymond 2005) proposed that the three types of sites be tested under a cultural ecology approach drawing from Binford’s (1980) foraging and collecting site settlement model.

The results obtained from the excavations at the Paseo del Volcan sites show, most importantly, that site formation processes have affected the integrity of the sites, including their artifact assemblages. Particularly in the Loma Duran vicinity, erosional events in the past have removed some portion of the prehistoric living surface(s) and the associated artifacts. This is likely the major contributing factor to the small artifact assemblages recovered at these sites.

Differential preservation makes interpretation of lithic data difficult. In general, the lithic pattern from LA 126409 fits the proposed model and supports the interpretation of the site as a short-term, multi-task locale. Two sites, LA 55503 and LA 55509, did not produce assemblages in support of the proposed site models, although the small size of the assemblage at LA 55503 precludes any robust interpretations. The patterns at LA 55509 suggest the site was not a limited-activity camp, but a multi-activity location where hunting, food processing, core reduction, and tool manufacture took place. However, its proximity to a lithic quarry (LA 55507) and core reduction and tool production activities may reflect activities organized
around the procurement and preparation of curated cores. The last two sites, LA 55507 and LA 126406, had mixed results. LA 55507 is a lithic procurement locale where materials were selected and initially reduced, but the site’s temporal/cultural affiliation could not be deduced given the data. LA 126406 exhibited some limited evidence of multiple activities, but had relatively little lithic data that could confirm the hypothesized Archaic affiliation. However, a radiocarbon date from the site indicates a Late Archaic occupation.

The majority of the lithic trends from the Paseo de Volcan corridor sites suggest the area was primarily used by Archaic task-groups visiting the West Mesa for two primary purposes: to replenish their lithic raw material supply for their flaked stone and ground stone tool kits, and to access and process plant foods.

The characteristics of the lithic assemblage at LA 55507 relative to the material available at the site provide some insight as to the procurement and use of exposed deposits of the Santa Group and later Quaternary fluvial deposits on the West Mesa. One aspect of raw material availability that has been understudied is the complex nature of the stratigraphy of the Albuquerque Basin and the secondary deposits of cryptocrystalline material from upstream regional sources. Recent geological studies of these issues provide a baseline to begin integrating data into the archaeological literature. Cole and his colleagues (2007) have noted the diverse and complex geology of the Rio Grande drainage basin and have shown that Quaternary fluvial terrace-fill deposits of the river contain a wide variety of clasts and also reflect the recycling of material from the Tertiary Santa Fe Group deposits. They have identified the nature of deposits at several locations along the river by rock type, size, and shape and have noted the likely source of certain materials. For example, they identify “Pedernal chert” as a possible silicified calcrete eroded from the Pedernal Chert Member of the Abiquiu Formation north of the Jemez Mountains. They observed that Pedernal chert, petrified wood, and quartzose sandstone are more common on the west side of the Rio Grande valley. They conclude that this observation is consistent with the widespread presence of quartzose sandstone and petrified wood in the Cretaceous and Jurassic rocks of the Colorado Plateau west of the Albuquerque basin; and the source of the Pedernal chert as north of the Jemez Mountains. They propose that early Cenozoic drainage appears to have transported these clasts westward into the San Juan Basin, from which they were recycled southeastward into the Rio Grande rift of the Albuquerque valley. Rather than the generalized assumptions of the homogeneous distribution of Pedernal chert and obsidian along the Rio Grande valley, the integration of geological studies will allow more analytical and systematic methods to identify locations of lithic source material and make inferences as to how the West Mesa landscape was used to procure the available material.

More in depth and sophisticated research that examines the relationship between raw material availability, mobility, and technological organization is necessary to begin to construct meaningful models of lithic procurement behavior in the area. Models and methodological approaches offered by Bamforth (1990), Andrefsky (1994), and Parry and Kelly (1987), provide a basis for further examination of raw material availability and the organization of technology and mobility patterns. These studies also develop attributes that can be measured to make inferences as to material quality as well as procurement behavior. For example, rather than qualitative evaluation of grain size, Bamforth (1990) proposes the use of the number of certain types of material flaws to measure material quality. Andrefsky (1994a, 1994b) has shown how the quality, size and shape of lithic raw materials affects both the structure and organization of lithic assemblages and how the geological occurrence of raw material availability is related to tool morphological variability and technological variability. Parry and Kelly (1987) have examined the relationship between the availability of raw material and mobility patterns. These approaches will
provide a basis to examine lithic procurement behavior in the area and explain the variation in lithic raw material among archaeological sites on the West Mesa.
Fifteen flotation samples and fifteen wood charcoal samples were examined from pits and thermal feature remnants at three sites within the limits of the construction zone for the Paseo del Volcan project. The sites consist of clusters of thermal features and pits, where charcoal concentrations or lenses, as well as lithic, groundstone, and fire-cracked rock artifacts represent the remains of activities that are somewhat obscure at least as far as what can be interpreted from archaeobotanical analysis results.

Sites are located to the east (LA 126406) and west (LA 126409) of Arroyo de la Baranca and on the top and eastern slope of a low dunal ridge (LA 55509) on Albuquerque’s West Mesa. Vegetation is typical of Plains Grassland (Brown 1994) that has been overgrazed where snakeweed (Gutierrezia sarothrae) and sand sage (Artemisia filifolia) are the most conspicuous plants on the landscape. Four-wing saltbush (Atriplex canescens) and rabbitbrush (Chrysothamnus spp.) are two other prevalent shrubs that occur in this biotic community. Cholla (Opuntia imbricata) and prickly pear cactus and grasses such as grama grasses (Bouteloua curtipendula, B. gracilis, B. eriopoda), Indian rice grass (Achnatherum hymenoides), and alkali sacaton (Sporobolus airoides) commonly occur. Small stands of one-seed juniper (Juniperus monosperma) can be found 2-5 miles west of the project area at slightly higher elevations along a ridge that overlooks the Rio Puerco drainage.

Methods

Archaeobotanical analysis of material from the project involved wood sample analysis, flotation processing, and flotation full-sort analysis as described below. Identification was aided by the use of a modern comparative collection. Scientific nomenclature and common names followed those presented in Martin and Hutchins (1980). Identifications were made to genus (e.g., Chenopodium) and species (Juniperus monosperma).

Flotation Samples

Flotation Processing

The fifteen flotation samples were processed using a standard decant flotation system as described by Hammett and McBride (1993). Flotation samples were processed in volumes of 2.0 liters unless the sample was less than 2.0 liters, in which case the entire sample was processed. Each flotation sample was poured into a bucket of water, agitated gently until the botanical material floated to the surface, and then decanted onto a clean piece of chiffon material to dry. The residue at the bottom of the bucket (called the heavy fraction) was rinsed to eliminate soil matrix, dried, and examined by Parsons Brinkerhoff personnel in order to recover lithic, ceramic, and bone material.

Flotation Full-Sort Analysis

The floated material was passed through a series of graduated screens (U.S. Standard Sieves with 4mm, 2mm, 1mm, and .5mm mesh sizes). The material from each screen size was then examined using a binocular microscope at a magnification of 7x to 45x. Charred reproductive plant parts like seeds and fruits were identified and counted. Charred non-reproductive plant parts (stems) and uncharred plant parts were also identified and quantified as an estimate of abundance/liter.
If more than 20 pieces of wood charcoal were present in a sample, then 20 pieces (selected randomly from the 4mm and 2mm screens) were identified, separated by taxon, counted, and weighed. Then the remainder of each fraction was scanned to identify any taxa that might have been missed. Otherwise, all identifiable wood charcoal from a sample was analyzed. Weights of <0.1g indicate specimens were too small to register on the scale. Wood specimens submitted for identification prior to submission to a radiocarbon dating laboratory were treated the same as wood charcoal from flotation samples, with the exception that every fragment was identified from a given sample. Each taxon was placed in an appropriate container such as a foil packet or polypropylene vial.

Several problems that arise consistently during wood identification in the southwest are addressed by placing specimens in more general categories. The identification of unknown conifer is used when a specimen is too fragmentary or the presence of root holes precludes differentiation between juniper and other conifers such as piñon or fir. Finally, several species of shrubs that are in the Chenopodiaceae (goosefoot) family are impossible to distinguish from each other (four-wing saltbush, greasewood, winterfat, etc.). For this reason, identification to species is impossible and specimens are placed in the combined saltbush/greasewood taxon.

**Results of Analysis**

The following section describes the results of analysis of charred and uncharred plant remains from flotation and wood samples.

**Charred and Uncharred Plant Remains**

Archaeobotanists have struggled with the interpretation of uncharred seeds recovered from subsurface samples. The uncertainty as to whether uncharred seeds were deposited because of cultural activity, from rodent and insect activity, or from seed rain, precludes their clear interpretation. Minnis (1981) discusses problems inherent in interpreting uncharred seeds recovered from open-air sites. He tested a modern facsimile of an archaeological site to compare the presence of taxa known to have been used to the number of contaminants. Three economic taxa were recovered, as well as 16 taxa that had been deposited by non-human processes such as seed rain or rodent movement. Because of these kinds of questions about the origins of uncharred plant materials found in open-air sites, this report will focus on charred plant remains. Therefore, when present, uncharred remains were recorded, but were considered to be more of a representation of the local vegetation than a reflection of cultural activities.

All but two of the nine samples that yielded non-wood plant remains (PD 49 and PD 56 from LA 126409) were composed entirely of modern intrusive plant material. Unburned plant parts included goosefoot, purslane, spurge, dropseed grass, and hedgehog cactus seeds. Weedy annuals like goosefoot and purslane proliferate in disturbed ground and produce innumerable seeds that can easily be dispersed by insects, wind, or rodents. The sweet fruits of cacti are a delectable source of food for rodents and the numerous small seeds can find their way into the soil horizon either during or after consumption of the fruits.

A monocot stem was recovered from the thermal feature (Feature 8) and one-seed juniper seeds from the roasting pit (Feature 12) at LA 126409 (Table 8.1). Juniper seeds were also identified in macrobotanical samples from these same two features and from Feature 6B (hearth) and from the north half of Study Unit 2 at LA 126406 (Table 8.4). Although the mealy cones were used for emergency food or seasoning, the resinous quality of the cones renders them unpalatable enough to preclude their widespread use. The fleshy cones (commonly called berries) can still be attached to branches and burn along with the wood and the seeds inside the cones inadvertently become part of the record. The balance of archaeobotanical
remains consisted primarily of juniper wood charcoal with small amounts of sagebrush and unknown non-conifer (Table 8.2 and Table 8.3). Macrobotanical wood samples were 94% juniper and 6% sagebrush, with traces of unknown conifer and saltbush/greasewood (Tables 8.4 and 8.5). Considering that today, the nearest juniper is two to five miles away, either juniper was more prevalent in the immediate prehistoric site environs or inhabitants made a point of traveling the distance to gather wood.

With the lack of clear evidence of structures, the location of LA 55509 just downhill from an obvious lithic procurement area, and LA 126406 and LA 126409 situated on a high flat spot with a good overview of the terrain below, it would appear that the primary function of these sites was for lithic procurement and tool manufacturing and/or as hunting camps. The presence of a possible San Jose point and biface reduction debitage at LA 55509 and a San Jose point at LA 126409 help support this interpretation. Evidence of plant resources that could have been processed using the ground stone artifacts found at LA 126406 and LA 126409 was absent from flotation samples. The most that can be said about plant exploitation at these sites is that local wood resources were used for fuel.

Table 8.1: LA 55509, LA 126406, and LA 126409 flotation sample plant remains, counts and abundance per liter.

<table>
<thead>
<tr>
<th>Site</th>
<th>LA 55509</th>
<th>LA 126406</th>
<th>LA 126409</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD No.</td>
<td>34</td>
<td>79-1</td>
<td>82</td>
</tr>
<tr>
<td>Context</td>
<td>F. 2 Basin-shaped pit</td>
<td>F. 13 Hearth</td>
<td>F. 14, N/2 Hearth</td>
</tr>
<tr>
<td>Cultural Other: Monocot</td>
<td>+ stem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perennials: Juniperus monosperma One-seed juniper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Cultural Annuals: Chenopodium Goosefoot</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Portulaca Purslane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasses: Sporobolus Dropseed grass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: Euphorbia Spurge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perennials: Echinocereus Hedgehog cactus</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number in () represents minimum number of individuals; + 1-10/liter.
Table 8.2: LA 55509 and LA 126406 flotation sample wood charcoal taxa, by count and weight in grams.

<table>
<thead>
<tr>
<th>Site</th>
<th>55509</th>
<th>126406</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD No.</td>
<td>34</td>
<td>54</td>
</tr>
<tr>
<td>Context</td>
<td>F. 2 Basin-shaped pit</td>
<td>F. 4, S/2 Base, secondary refuse deposit</td>
</tr>
<tr>
<td></td>
<td>F. 17 Post mould</td>
<td>F. 10, W/2 Basal remnant, Storage pit</td>
</tr>
<tr>
<td></td>
<td>F. 13 Hearth</td>
<td>F. 14, N/2 Hearth</td>
</tr>
<tr>
<td></td>
<td>F. 15, N/2 Hearth</td>
<td>F. 16, E/2 Ovoid pit</td>
</tr>
<tr>
<td></td>
<td>F. 29, S/2 Hearth</td>
<td></td>
</tr>
<tr>
<td>Conifers:</td>
<td>Juniperus Juniper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/&lt;0.1g</td>
<td>6/&lt;0.1g</td>
</tr>
<tr>
<td></td>
<td>2/&lt;0.1g</td>
<td>1/&lt;0.1g</td>
</tr>
<tr>
<td></td>
<td>19/0.4g</td>
<td>20/0.3g</td>
</tr>
<tr>
<td></td>
<td>17/0.3g</td>
<td>7/0.1g</td>
</tr>
<tr>
<td></td>
<td>10/0.1g</td>
<td></td>
</tr>
<tr>
<td>Non-Conifers:</td>
<td>Artemisia cf. Sagebrush</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/&lt;0.1g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/&lt;0.1g</td>
<td></td>
</tr>
<tr>
<td>Unknown non-conifer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>5/&lt;0.1g</td>
<td>6/&lt;0.1g</td>
</tr>
<tr>
<td></td>
<td>2/&lt;0.1g</td>
<td>1/&lt;0.1g</td>
</tr>
<tr>
<td></td>
<td>20/0.4g</td>
<td>20/0.3g</td>
</tr>
<tr>
<td></td>
<td>20/0.3g</td>
<td>8/0.1g</td>
</tr>
<tr>
<td></td>
<td>10/0.1g</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.3: LA 126409 flotation sample wood charcoal taxa, by count and weight in grams.

<table>
<thead>
<tr>
<th>PD No.</th>
<th>49</th>
<th>101</th>
<th>102</th>
<th>105</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>F. 8, N/2 Thermal feature</td>
<td>F. 36, S/2 Thermal feature</td>
<td>F. 37, East side Circular basin</td>
<td>F. 33 Thermal feature</td>
</tr>
<tr>
<td>Conifers: Juniperus Juniper</td>
<td>9/0.1g</td>
<td>5/0.1g</td>
<td>8/0.1g</td>
<td>2/&lt;0.1g</td>
</tr>
<tr>
<td>Non-Conifers: Artemisia Sagebrush</td>
<td>11/0.1g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>20/0.2g</td>
<td>5/0.1g</td>
<td>8/0.1g</td>
<td>2/&lt;0.1g</td>
</tr>
</tbody>
</table>

Table 8.4: LA 126406, macrobotanical wood and plant remains by count and weight in grams.

<table>
<thead>
<tr>
<th>PD No.</th>
<th>20-3</th>
<th>24-2</th>
<th>58-2</th>
<th>67-2</th>
<th>77</th>
<th>84</th>
<th>117-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature</td>
<td>6B, N ½ Hearth</td>
<td>7, E ½ Roasting pit</td>
<td>12, S ½ Roasting pit</td>
<td>16, W ½ Hearth</td>
<td>13, S ½ Hearth</td>
<td>15, N ½ Thermal feature</td>
<td>SU 2, N ½</td>
</tr>
<tr>
<td>Non-Wood Seeds: Juniperus monosperma one-seed juniper</td>
<td>3(2)/&lt;0.1g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Conifers: Juniperus</td>
<td>5/&lt;0.1g</td>
<td>10/&lt;0.1g</td>
<td>44/0.8g</td>
<td>106/2.5g</td>
<td>55/1.5g</td>
<td>1/&lt;0.1g</td>
<td></td>
</tr>
<tr>
<td>Non-Conifers: Artemisia sagebrush</td>
<td></td>
<td>7/&lt;0.1g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atriplex/Sarcobatus saltbush/greasewood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2/&lt;0.1g</td>
<td></td>
</tr>
<tr>
<td>cf. Cylindropuntia cholla</td>
<td></td>
<td></td>
<td>6/&lt;0.1g</td>
<td></td>
<td></td>
<td></td>
<td>20/0.5g</td>
</tr>
<tr>
<td>Totals</td>
<td>3(2)/&lt;0.1g</td>
<td>5/&lt;0.1g</td>
<td>10/&lt;0.1g</td>
<td>51/0.8g</td>
<td>112/2.5g</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numbers in ( ) represent minimum number of individuals.
Table 8.5: LA 126409, macrobotanical wood and plant remains by count and weight in grams.

<table>
<thead>
<tr>
<th>PD No.</th>
<th>47-1</th>
<th>47-2</th>
<th>57</th>
<th>93</th>
<th>66</th>
<th>72-2</th>
<th>86-1</th>
<th>97-1</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature</td>
<td>8, S ½ Hearth</td>
<td>12, N ½ Roasting pit</td>
<td>12, S ½ Roasting pit</td>
<td>27, E ½ Roasting pit</td>
<td>28, N ½ Hearth</td>
<td>33, S ½ Roasting pit</td>
<td>36, S ½ Hearth</td>
<td>Weight</td>
<td>%</td>
</tr>
<tr>
<td>Non-Wood Seeds:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juniperus monosperma juniper</td>
<td>2(0)/&lt;0.1g</td>
<td>4(0)/&lt;0.1g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.1g</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Wood Conifers:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juniperus juniper</td>
<td>36/1.3g</td>
<td>6/0.1g</td>
<td>21/0.4g</td>
<td>22/0.8g</td>
<td>31/0.5g</td>
<td>54/1.6g</td>
<td>4.7g</td>
<td>94%</td>
<td></td>
</tr>
<tr>
<td>Unknown Conifer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/&lt;0.1g</td>
<td>&lt;0.1g</td>
</tr>
<tr>
<td>Non-Conifers:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artemisia sagebrush</td>
<td>9/0.3g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3g</td>
<td>6%</td>
</tr>
<tr>
<td>Atriplex/Sarcobatus saltbush/greasewood</td>
<td>1/&lt;0.1g</td>
<td></td>
<td></td>
<td>1/&lt;0.1g</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.1g</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Totals</td>
<td>46/1.6g</td>
<td>2(0)/&lt;0.1g</td>
<td>4(0)/&lt;0.1g</td>
<td>6/0.1g</td>
<td>21/0.4g</td>
<td>23/0.8g</td>
<td>32/0.5g</td>
<td>54/1.6g</td>
<td>5.0g</td>
</tr>
</tbody>
</table>

Numbers in ( ) represent minimum number of individuals.
CHAPTER 9
SUMMARY AND CONCLUSIONS

From August 8, 2005 through October 15, 2005, Parsons Brinckerhoff (PB) completed archaeological testing and/or data recovery at eight sites along a segment of the proposed Paseo del Volcan roadway in the City of Rio Rancho, Sandoval County, New Mexico. The investigations were conducted at the request of the NMDOT and the City of Rio Rancho prior to the initiation of construction of a 6.8-km (4.2-mi) segment of the proposed corridor between Unser Boulevard and Iris Road. The new asphalt paved 2-lane roadway has now been completed and is open to traffic. The testing and data recovery activities represent the final stage of cultural resource investigations for this segment of Paseo del Volcan.

This report documents the findings from the testing and data recovery activities, and meets the research goals of the fieldwork as defined in the data recovery plan dated March 2005 and addendum (Campbell 2005, Raymond 2005). Excavation activities were carried out under New Mexico Archaeological Excavation Permit Number SE-229 and New Mexico State Land Office Archaeological Permit No. 113. Data recovery was completed at four sites—LA 55507, LA 55509, LA 126406, and LA 126409—in the Paseo del Volcan project area. Testing at four additional sites—LA 55503, LA 126405, LA 126407, and LA 126408—resulted in those sites being determined not eligible for nomination to the NRHP and no further archaeological investigations were conducted.

Research Design

The research design for this project was developed within the framework of the models proposed by David Phillips (2000) for study of sites along the Paseo del Volcan corridor, and within a cultural ecology theoretical perspective. Phillips (2000) identified three distinct clusters among the sites in the Paseo del Volcan corridor. Specific research contexts were developed for each cluster, based on spatial patterning, site attributes, and some basic assumptions linking site attributes and past activity. These three clusters included:

- Group 1: Lithic Procurement Sites of the Arroyo Venada Site Cluster
- Group 2: Early Intensively Used Sites of the Loma Duran Site Cluster
- Group 3: Campsites Along Arroyos of the West Mesa

More detailed descriptions of these groups as described by Phillips (2000) are presented in Chapter 4.

Research Domains

In the research design and data recovery plan, several research domains were identified to test the Phillips (2000) models of the sites. The research domains included topics related to chronology to address the culture history of the West Mesa and as well as larger issues of systemic adaptations to the local environment. The research domains are:

- chronology and stratigraphy,
- site function,
- subsistence and mobility strategies, and
- technological organization.

The following sections describe the results of the project in terms of the defined research domains.
Geoarchaeology and Chronology

Of the four eligible sites, none were assigned a temporal or cultural affiliation during the original surveys, although LA 55509 was thought to be Archaic based on the lithic assemblage and the lack of ceramics. LA 55507 was thought to have been used from Archaic through Puebloan times as a source of lithic raw material.

A comprehensive study of the geology of the area, using optically-stimulated luminescence (OSL) dating of the sediments combined with the radiocarbon dates acquired from thermal features, allowed a chronometric evaluation of identified paleosols and cultural deposits. The study also identified site formation processes that affected the archaeological record and the information available at the sites to address other research domains.

In developing a testing plan for sites in the Paseo del Volcan corridor, Phillips (2000) had posited that “an older red sand is capped by a younger tan sand; the known remains occur on the older sand and are entirely capped by the younger sand. It is not yet possible to date the sand strata bracketing the archaeological remains – indeed, this should be one goal of the testing program (emphasis added) – but the following sequence can be tentatively described for the area. First, the older red sand formed; then, a period of nondeposition/erosion ensued, during which the prehistoric occupation took place; finally, the younger tan sand was deposited over the archaeological remains, creating today’s ground surface. Given this sequence, the archaeological remains seem likely to predate the Late Archaic, and could conceivably be as old as Paleoindian”.

The current research has confirmed Phillips’ “tentative” sequence of the stratigraphic and site formation processes; and based on OSL dates from an identified red paleosol (Phillips’ older red sand) and C14 dates from thermal features, the archaeological remains do predate the Late Archaic, but do not date to the Paleoindian period. The red paleosol identified during this investigation stretches across the 4 miles in the project area, and is absent only in isolated areas, such as at LA 55507, where there are much older Pleistocene Santa Fe gravel outcrops.

Wherever the late Pleistocene eolian sand containing the red paleosol occurs in the project area, OSL dating methods consistently date the sand to 10,000-15,000 BP. Towards the end of the Pleistocene (between about 10,000-15,000 BP) homogenous layers of eolian sand were deposited on top of earlier eroded surfaces. After this depositional process, the topography has remained similar to today, evidenced by the undulations of stratigraphy in the trenches, which follow the modern-day topography. Then around 9,000-10,000 BP, the area stabilized, eolian deposition ceased, and a red paleosol formed at the top of the eolian sand. It is possible that this stabilization of the landscape corresponded with the Pleistocene-Holocene transition. It is not entirely clear, however, when and how quickly this paleosol developed, although extrapolation of OSL dates suggests it may have formed by ca. 9000 BP.

Sometimes after this period of stability, the paleosol began to erode, with as much of 30 cm of it eventually being removed. Again, how quickly this process occurred is unclear, but erosion likely took place after 9000 B.P. Radiocarbon dates from truncated features intrusive into the red paleosol reflect Middle Archaic, Late Archaic, and Puebloan occupations on the red paleosol. The radiocarbon dates are consistent with the two San Jose points found at two sites, and the limited ceramic assemblages. Although the use of other areas of the West Mesa by Paleoindian and Early Archaic groups has been clearly established (Huckell 2000), there is no evidence of those groups in the Paseo del Volcan area.
Site Formation Processes

As stated above, sometime after about ca. 9000 BP, erosion of the top portion of the red paleosol occurred, which is identified geologically by an unconformity. Based on the paucity of artifacts at the Loma Duran sites (LA 126405-126409) in association with the thermal features, it appears that erosional processes displaced most of the artifacts and fire-cracked rock on the original prehistoric living surface and truncated features that were dug into the red paleosol. Of the five Loma Duran sites (including those determined not eligible), the largest artifact assemblage contained 92 artifacts, with the next largest containing 47 artifacts, although numerous thermal features were present at each. Two sites had fewer than 10 artifacts and another had none. The truncation of the features is inferred from the paucity of artifacts and fire-cracked rock, and is confirmed by observations of the unconformity at the tops of the features.

Thus at all sites at which the unconformity exists (all of the Loma Duran sites), the sites generally lack sufficient artifact assemblages to test many of the hypotheses presented in the research program. Likewise, the truncation of the thermal features limited the information that could be derived from those features. The high number of basal remnants of thermal features indicates that prehistoric groups frequently camped in the area, likely to exploit seasonal resources and to procure the Pedernales chert material available at LA 55507. However, because the top portions of the features appear to have been removed, it was not feasible to determine the original depth, shape, or sequence of construction of the features. Almost all fire-cracked rock also has been removed and inferences as to the function of the features were not feasible. Further, based on the recovered material from light fractions, preservation of botanical material recovered from the thermal features was poor. Little in the way of archeobotanical material was recovered, and the erosion had also removed almost all faunal remains that may have been present.

While some of the sites contain many thermal features, their eroded condition does not allow robust tests of hypotheses regarding technological organization, site function, subsistence, or seasonality. It is clear that the erosional activities that occurred in the project area severely impacted the information that may have existed at these sites. It is suggested that for future projects in this area, geological studies should first establish whether the unconformity in the red paleosol is present, and if so, the research design should take into account the effects of the erosion on the cultural deposits.

Site Function

Lithic Procurement Site (Group 1, LA 55507)

Phillips had proposed that the primary function of Group 1 sites (LA 55507) was for the procurement and initial reduction of flaked stone. The lithic assemblage at LA 55507 in association with the raw material available at the site supports that hypothesis. LA 55507, east of the Loma Duran sites, and just west of Arroyo de la Baranca, contained extensive outcroppings of Santa Fe gravels, including Pedernales chert. The knoll on which the gravels are located contained thousands of pieces of lithic debitage, as well as numerous cores, tested cobbles and associated artifacts. The site has a different geoarchaeological setting than other sites in the area, with the cultural deposits largely exposed on the Pleistocene surface. Other dispersed nodules were observed in the four mile-long corridor, but no other concentrated source of lithic raw material as seen at LA 55507 was observed in the project area.

Most of the lithic patterns at LA 55507 support the hypothesis that the site was a limited-activity location for the procurement and reduction of local lithic raw materials. In order the understand the nature of the
raw material deposits, 100 unmodified Santa Fe gravels were systematically sampled from the surface of LA 55507. The sample contained a wide range of sedimentary, igneous, and metamorphic materials, including Pedernales chert (38 percent), granite (31 percent), quartzite (7 percent), limey chert (6 percent), tan chert (5 percent), and lesser amounts of limestone, sandstone, conglomerate, schist, chalcedony, and indeterminate materials. Almost all of the materials from the unmodified raw material sample are found in the Paseo de Volcan corridor site artifact assemblages, but those assemblages were dominated by Pedernales chert.

Not only was the Pedernales chert the most common type of material at the site, it clearly exhibits the best quality of all the sampled raw materials. About 80 percent of the Pedernales chert has a microcrystalline granular structure, with the remainder having a fine-grained structure. No other material in the sample exhibits a microcrystalline granular structure. The next best quality raw material in the sample is the tan chert, with all those cobbles possessing fine-grained structure. The remaining raw materials exhibit medium- or coarse-grained structures, with the exception of one fine-grained quartzite cobble.

That the Pedernales material was being selected is clear. The Pedernales chert makes up about 38 percent of the naturally occurring raw material nodules at the site, but represents about 93 percent of the total lithic assemblage. Raw materials such as sandstone, granite, schist, and quartzite that were used for ground stone tools on the Paseo de Volcan corridor sites, are also found on LA 55507. Although the site functioned primarily as a place where flaked stone raw materials were tested and carried away, tools recovered from the site suggest the location also functioned as a processing locale. Formal and expedient tools recovered from the site exhibited wear from hammering/battering, cutting/sawing, scraping, and other use. The lack of worn out and broken formal tools suggests the site may be the result of small task groups being sent out from a residential location to obtain lithic raw materials and quickly leaving. There are no thermal features at the site, but there are several at the nearby LA 55509, and there are numerous thermal features at two (LA 126406 and LA 126409) of the Loma Duran sites, both of which are within 1.5 miles of LA 55507.

There were no diagnostic tools found on the site to assign a cultural/temporal affiliation, but the lack of patterned core preparation and reduction suggests the site assemblage may be the sum result of reuse and revisits by different groups employing different raw material reduction strategies through time. However, the palimpsest nature of the surface assemblage at LA 55507 precluded distinguishing these differences, and there were no temporal controls. A future avenue of research may be a landscape approach to the location of lithic raw materials on the West Mesa and their association with nearby sites. Applying patch models from foraging theory to determine which raw material sources are used across the landscape may give insights as to how prehistoric groups organized their technological behavior.

Early Intensively Used Sites of the Loma Duran Site Cluster (Group 2, LA 126406 and LA 126409)

Phillips (2000) proposed that the Loma Duran cluster represents “an early, intensive, and often-repeated occupation of a ridge top on the West Mesa”. As he states, this ridge top may have been a seasonal base camp for a single group, which varied the exact location of the camp from time to time.

As previously discussed, site formation processes severely impacted the information available to address the research domains that inform the hypotheses. Radiocarbon dates confirm Phillips assertion that the area was used prior to the Late Archaic (ca. 1400-100 BC) and also has a late Development Period occupation (ca. 1020-1260 AD), LA 126409
has several dates from the Middle Archaic (ca. 3510-3120 BC) consistent with the San Jose point at the site.

That both sites were intensively used is indicated by the high number of thermal features found at each. However, whether habitation structures were present is unclear, and the artifact assemblages were too small to make more than tenuous inferences as to the range of activities at each site.

There are numerous features at LA 126406; however, all appear to be small thermal features suggesting short-term use of the area; none are indicative of a habitation structure. The lithic assemblage at LA 126406 suggests the site functioned as both a plant processing locale and as a lithic reduction site. Unfortunately, the lack of botanical evidence from the features does not allow identification of the targeted plant resources, or allow inferences as to seasonal use of the site. Lithic analyses suggest the on-site reduction of cores gathered from the surface of LA 55507. These two activities are characteristic of a mobile strategy.

At LA 126409, the small size of most of the features suggests short-term use of the area, while targeted resources were gathered from the surrounding environment. One feature, however, is much larger (2.8 x 2.7 m), and most of the lithic artifacts at the site are from this feature. Ground stone is also present at the feature indicating that a wider range of activities occurred at this location. The size of the feature suggests a habitation location, although there is no supporting evidence that a structure was present, and the feature may be the result of a palimpsest of thermal activities. Again, the paucity of botanical evidence from the features does not allow identification of the targeted plant resources or inferences as to seasonal use of the site. The lithic assemblage suggests the site was used as a seasonal short-term hunting, plant-processing, and raw material reduction location for mobile Archaic foragers. Flaked stone debitage patterns and size, core reduction patterns and size, and the lack of expedient flaked stone tools are suggestive of a mobile Archaic affiliation. A relatively high percentage of ground stone artifacts indicates food processing was an important site function. However, due to the erosion that affected the site, the small, remaining assemblage may not be representative.

Camp Sites Along Arroyos of the West Mesa (Group 3 site, LA 55509)

These sites were proposed as a series of spatially disparate sites located along the various arroyos in the project area representing campsites of people traveling from the Rio Grande to the West Mesa in search of natural resources. LA 55509, due to its location near an arroyo, was evaluated as a logistical campsites used to procure targeted resources.

This site is only a few hundred feet west of the lithic procurement site (LA 55507) and contains six ash/charcoal stains/features, none of which suggest habitation structures. The hearths and ash deposit indicate area was used as a campsite, likely for episodic logistical forays for targeted resources, including lithic material. This site has two components, an Archaic occupation, possibly dating as early as the Middle Archaic based on the presence of a San Jose point, and a Late Archaic occupancy that dates from ca. 820 BC – 760 BC, and 620 BC – 590 BC based on one radiocarbon date. A later, less intensive Puebloan use of the site area is indicated by a small (n=25) ceramic assemblage that dates to the Coalition to the Classic periods based on pottery types.

While the features indicate a campsite for logistical forays, the lithic assemblage suggests the site is the result of a longer-term, multi-activity Archaic occupation. More formal tools were recovered from LA 55509 than from any other site in the study. The projectile point suggests general hunting, and one of the bifaces, as well as the utilized flakes, indicate evidence of processing. The ground stone assemblage
produced evidence of food processing and exhibits evidence of multiple uses and recycling of material for other functions. Core reduction does not appear to have been as large a component on LA 55509 as on some of the other sites in the area, but a variety of evidence suggests it was more systematic and organized. These patterns suggest initial core reduction took place off-site, possibly on LA 55507, where raw materials may have been obtained. Cores were then brought back to LA 55509, sometimes heat-treated, and further, more intensively, reduced.

Summary

The research design prepared for the Paseo del Volcan testing and data recovery project was developed under a cultural ecological approach and focused on four primary research questions: chronology and stratigraphy, site function, subsistence and mobility, and technological organization. Hypotheses were developed based on Phillips’ (2000) testing plan for the Paseo del Volcan corridor as well as Binford’s (1980) collector-forager model of subsistence. The data collected at the eight sites in the project area contributed differentially to testing these hypotheses. Only four sites produced sufficient data to address research issues at all; one Group 1 site (LA 55507), two Group 2 sites (LA 126406 and LA 126409), and one Group 3 site (LA 55509), and these sites varied in terms of the number of artifacts and features represented. Macrobotanical and faunal information were absent and affected interpretations of subsistence and seasonality at all sites. In addition, geological information indicated that major erosional events in the past had likely removed a portion of most if not all of the sites, also affecting overall interpretations. The geoarchaeological study was productive and explained the site formation processes that limited information obtained from these sites. While most of the research issues were addressed to some degree, many sites produced mixed results and suggest the need to further refine these issues for future projects, especially taking into account the geoarchaeological conditions that exist in the general area.

The investigations discussed in this report represent the final phase of archaeological investigations along the portion of Paseo del Volcan between Unser Boulevard and Iris Road. This report completes the responsibilities of the NMDOT, City of Rio Rancho, and FHWA under Section 106 of the National Historic Preservation Act.
CHAPTER 10
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APPENDIX A

GEOLOGICAL REPORT
GEOMORPHOLOGY AND ARCHAEOLOGICAL GEOLOGY
ALONG PASEO DEL VOLCAN CORRIDOR,
RIO RANCHO, SANDOVAL CO., NM

---Preliminary Final Report ---
with Appendix A

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April 25, 2006
GEOMORPHOLOGY AND ARCHAEOLOGICAL GEOLOGY
ALONG PASEO DEL VOLCAN CORRIDOR,
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Geomorphology and Archaeological Geology
Along Paseo del Volcan Corridor,  
Rio Rancho, Sandoval Co., NM  

--Preliminary Final Report--  
with Appendix A  

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EXECUTIVE SUMMARY  
The topography and ground surface along the Paseo del Volcan corridor is marked by the presence of three to five feet of wind-deposited sand that accumulated about 15,000 to 10,000 years ago. After the sand was deposited, the topographic surface stabilized and a red soil formed in the sand. Archaeological sites occur at the top of the sand and its red soil and in many cases prehistoric cultural features, such as hearths and storage pits, intrude into the sand/red soil. The wind-deposited (or eolian) sand pre-dates the archaeological record, and buried sites will not be found in the sand. The sand was dated by optically stimulated luminescence (OSL), a new technique that is used to date sediments that would be difficult to date by radiocarbon or other means. The red soil that formed in the eolian sand is distinctive. Wherever it occurs in the area, its presence is an indication that the associated sediments are too old to contain archaeology, and any sites that are present in those circumstances will be found at the modern-day surface. Conversely, if sites are not observed, they are not present. Recent disturbance of the local rangeland along with strong winds have resulted in the covering of the ground surface with two to five inches of wind-blown sand, making it difficult to see archaeological remains and the makeup of the local surficial geology. Numerous backhoe trenches dug along the Paseo corridor proved valuable to the deciphering of the local landforms and associated archaeology. The results of this thorough field study are applicable to nearby areas and provide valuable insights to cultural resource management for the region.  

INTRODUCTION  
The project occurs along 28th Avenue NE in Rio Rancho near the center of Loma Machete 7.5-minute quadrangle, Sandoval County. The landscape is desert shrub grassland that consists of low rolling hills sloping to the southwest toward the Rio Grande valley. Small- to moderate-size washes flow southwesterly across the area. Bedrock geology is composed of gravel and sand and mudstone of the Santa Fe Group (lower Pleistocene to Miocene) (Personius et al., 2000). These sediments are components of the thick sequence of fluvial deposits that fill the Rio Grande valley. Following their deposition, the sediments were eroded during the past million years, forming the present-day topography. Today, the eroded landscape is mantled by late Pleistocene eolian sand. Archaeological sites are associated with the eolian sand cover. The present
investigation is focused on the eolian sand and associated soils and their relationship to the archaeological record.

**Surficial Geology**
Poorly consolidated sediments of the upper Santa Fe Group form the bedrock surface throughout the area. The Santa Fe Group is divided into five separate formations and unnamed units by Personius et al. (2000); the stratigraphy is presently in revision along with an updated geologic map of the area (Connell, personal com.). The upper-most, youngest unit is a 5-10 meter thick sandy gravel that consists of vesicular basalt, pink granite, red and yellow sandstone, fossiliferous limestone, quartz, quartzite, chalcedony (white, gray and brown Pedernales chert), ironstone, jasper, and petrified wood. The clasts are coated by secondary carbonate. The gravels are derived by stream transport from the northwest (Sierra Nacimiento and vicinity) and today form a cap on some hilltops. The clasts are lithic resources for prehistoric tools and hearthstones and show up in local archaeological sites.

During the early and middle Pleistocene, the sands, mudstones and gravels of the Santa Fe Group were eroded, forming two or more surfaces that grade east and southeast towards the Rio Grande valley. The surfaces are defined largely by the presence of well-developed calcic paleosols, indicating that the landscape was stable for long periods of time. During the late Pleistocene, erosion by streams and wind continued, further modifying the rolling-hill topography and low escarpments formed by resistant calcic paleosols and gravels.

**General Geomorphology**
The physical landscape of the project area is a direct consequence of eolian sand deposition on a late Pleistocene eroded surface. The present-day topography is underlain by 50 to 150 cm of eolian sand that overlies an eroded late Pleistocene calcic paleosol. The eolian sand is also late Pleistocene in age, deposited approximately 15,000 to 10,000 years ago. A red paleosol with a weak calcic horizon is present at the top of the eolian sand; pedogenesis occurred sometime during the past 10,000 years. The depth of the paleosol horizons conforms to the undulation of the present-day topography indicating that the deposition of the thin sand sheet during the last episode of the Pleistocene and subsequent development of the red soil are the most recent preserved geomorphic events on these upland surfaces.

More recently, however, during historic time, the top of the red paleosol was everywhere truncated by erosion and later buried by 6-12 cm of loose eolian sand. The mantle of loose sand masks all underlying deposits and soils drastically reduces the visibility of archaeological sites.

**STRATIGRAPHY**

**Historic and Late Pleistocene Eolian Sand and Red Paleosol**
Eolian sand dominates the surficial geology at the project. The quartz sand is coarse to fine and generally poorly sorted, especially for wind-transported sand. Deposits of eolian sand require only strong winds and a supply of sand. Long periods of eolian deposition are indicators of this set of conditions and that can in turn provide some paleo-environmental information. The eolian deposits at the project are discussed below, most recent to oldest.
**Recent loose sand.** The recent loose sand covers almost every surface, masking virtually all underlying geologic deposits and archaeological sites. The sand is 8 to 12 centimeters thick although it is 30 cm thick and exhibits thin bedding in a low berm along unpaved 28th Avenue. The loose sand is generally strong brown in color (7.5YR 5/6) and is composed of quartz with minor amounts of feldspar, chert, muscovite, and calcite. The sand texture is very coarse to very fine and poorly sorted and the grains are rounded. The sand is not calcareous and grains lack secondary carbonate coats. However, the sand is effervescent in hydrochloric acid due to the reaction of rare calcite grains that are derived from erosion of calcic paleosols in the watershed. The recent loose sand is derived from historic deflation of modern arroyos where sand supply is abundant (Fig. 1)

**Figure 1.** Historic eolian sand overlying the Holocene red paleosol at the low berm that formed recently along the unpaved 24th Avenue; a stage I calcic horizon occurs beneath the red Bt horizon; red paleosol and calcic horizon are formed in the prominent eolian sand body that occurs throughout the project; GEO-1, LA 126408, south end of trench TT-1; meter scale in 10-cm increments

**Recent loose red sand.** Beneath the recent loose brown sand that occurs everywhere and is described above occurs recent loose red sand. The loose red sand is yellowish red in color (5YR 5/6). The grains are mostly quartz with rare calcite grains derived from erosion of calcic paleosols. The sand is coarse to very fine and poorly sorted; grains are rounded to subrounded. The loose red sand lacks secondary carbonates although rare calcite grains effervesce in acid. The grains exhibit a very weak coat of iron oxide that produces its yellowish red color. While the yellowish red color keys out to the same color as the underlying red paleosol, the color of the loose red sand is actually less stronger red than the paleosol. The loose red sand deposit is 11 to 22 cm thick and occurs only in the low
berm along the unpaved 28th Avenue. Elsewhere the loose red sand was either not deposited or was deposited and subsequently deflated. Regardless, it occurs only in the roadway berm. The loose red sand is derived from deflation of the underlying red paleosol; the top of the paleosol is missing due to erosion.

**Historic A horizon soil.** A recent A horizon soil about 10 to 12 cm thick occurs immediately on top of the red paleosol and, at the roadway berm, just below the loose red sand (Figs 1, 2). The A horizon sand is brown to dark brown in color (7.5YR 4/4) and is developed in very coarse to very fine quartz sand. The grains are rounded and poorly sorted. The sand is noncalcareous and reworked carbonate clasts are absent.

The weak soil formed in a landscape dominated by grassland. The vegetation may have been desert shrub grassland somewhat similar to today. The weak soil is formed in eolian sand but is not related to the underlying red paleosol. The soil may have formed during early historic time, perhaps 100 to 200 years ago. Today the soil is gone due to disturbance and erosion; at the project, it is observed only in the roadway berm along 28th Avenue where it has been protected by more recent eolian deposits of historic loose sand.

**Late Pleistocene eolian sand.** The project landscape is dominated by a 50 to 150 centimeter thick mantle of eolian sand that accumulated during the period between about 15,000 and 10,000 years ago. The sand is light brown (7.5YR 6/4) and composed of quartz grains, fine to medium, poorly sorted, grains subrounded to rounded. The sand is massive, lacking any bedding whatsoever. The sand has been severely bioturbated by insects that produce burrow fills about 12 mm in diameter. Rodent activity has also disturbed the eolian sand, although most visible burrows are associated with more recent overlying sand deposits. The late Pleistocene eolian sand...
sand body rests directly on the eroded surface of an older late Pleistocene calcic paleosol (Figs. 3, 4) that itself may have formed in eolian sand. The local archaeological record is restricted to the top of the younger late Pleistocene sand, and prehistoric cultural features intrude into it.

**Red paleosol.** The most conspicuous aspect of the eolian sand is the red paleosol that occurs everywhere at the top of the late Pleistocene sand unit (Fig. 5). The paleosol has a yellowish red (5YR 4/6) Bt horizon, 10-15% clay, with a whitened Btk/Bk calcic horizon (2-7% carbonates) with stage I carbonate morphology. The red color is clay and iron coats on the quartz sand grains. The paleosol appears structureless; however, in large areas where the top of the paleosol has been scrapped away, etching of the paleosol surface by wind-carried sand shows that weak ped structures are present (Fig. 6).

**Pleistocene and Older Deposits and Paleosols**
The late Pleistocene eolian sand and its red paleosol and stage I calcic horizon rest unconformable on the eroded surface of older Pleistocene paleosols and associated deposits. The older Pleistocene deposits are poorly exposed in the shallow trenches although in some cases these older sediments are close to the present-day surface and are not buried deeply by the late Pleistocene eolian sand.

**Late Pleistocene Paleosol.** Directly beneath the latest Pleistocene eolian sand that mantles the landscape is the eroded remnant of a stage II calcic paleosol (Figs. 3, 4). The calcic horizon is about 60 to 80 cm thick and where measured has 5-23% carbonates. The dominant carbonates occur as pod-like casts of insect burrow-fills about 10 to 15 mm diameter in which carbonates line burrow-fills and break out as elongated masses; the degree of cementation is weak; the upper 10 to 15 cm is weathered with less carbonate but with rare weak carbonate filaments; the sediment matrix is fine sand pink in color; pebbles are absent. The A horizon and red B horizons (Bw or Bt) are largely gone due to erosion.

The sediment above the calcic horizon is fine to coarse yellowish red sand (5YR 5/6) that may represent the lower part of the original paleosol Bt horizon. It is massive without bedding and is noncalcareous except for rare carbonate filaments. The sediment below the calcic horizon is strong brown quartz sand (7.5YR5/6), coarse to fine textured. It is massive without bedding and largely noncalcareous. The original deposit in which the late Pleistocene paleosol is developed may be eolian sand although the extent of the deposit is incompletely exposed in only a few the project trenches. A single OSL age on fine eolian sand below the stage II calcic horizon is ca. 130,000 ± 30,000 yrs BP (Table 3). The age is an estimate only and may be a minimum value for the age of the sand.

The late Pleistocene paleosol represents an old surface from a former paleo-topography that differs from that of the present-day topography as indicated by the absence of the paleosol in some 2-meter deep trenches and the presence in others close to the surface.
Figure 3. Late Pleistocene eolian sand unit with red paleosol at the top, overlying eroded surface of a late Pleistocene paleosol stage II calcic horizon; the horizontal dotted line marks the local erosional unconformity; GEO-10, LA 126409, trench TT-2, north end; OSL samples collected in the shadow just left of the photographed section; 1-meter scale with 10-cm increments
Figure 4. LA 126409, south end of trench 1, GEO-13; locality with four OSL dates (Fig. 19); deposits are eolian sand with red paleosol and its stage I calcic horizon overlying eroded late Pleistocene paleosol with a stage II calcic horizon; the eolian sand containing the red paleosol was deposited ca. 15,000 to 10,000 yrs BP; the top of the late Pleistocene eolian sand has an historic A horizon soil that is overlain here by historic eolian sand (and spoil pile from backhoe); the sample hole to the right of the second-down age position was not completed; laboratory data indicate that the red “Bw” horizon has a significant clay content (11-14%) and is best classified a “Bt” horizon; 1-meter scale with 10 cm increments
Figure 5. Red paleosol with whitened stage I calcic horizon overlain by 6 cm of historic loose sand and spoil pile from backhoe at LA 126407 (Figs. 6, 12, 19); the red paleosol with calcic horizon formed during the Holocene in late Pleistocene eolian sand; three OSL ages of eolian sand were collected just to the right of the meter scale and are shown below in Fig. 6; GEO-16; 1-meter scale with 10-cm increments

Figure 6. Soil profile in eolian sand at LA 126407, Trench 1, GEO-16, shown in Figs. 5, 19; sediment data in Table 4; soil characterized by stage I carbonate morphology; top of red paleosol truncated by natural erosion during an undetermined period in the past
Figure 7. Very weak ped structure of the red paleosol; peds are about 10 to 14 cm in diameter; exposed upon removing overlying sand and subsequent wind-sand abrasion at LA 126408

Figure 8. Percentage of very fine sand vs. percentage soil carbonates in Btk and Bk horizons; the data points are labeled with the stage of carbonate morphology (I, II, III) as determined in the field; soils with stage I carbonate morphology generally have less carbonate than stage II and III soils although overlapping somewhat with stage II soils (data from Table 4); textural data also show that the younger eolian sand (with stage I soil carbonate morphology) is generally coarser grained than the older eolian deposits.
Figure 9. Miocene-Pliocene calcic paleosol with stage III carbonate morphology (but only 18.0% carbonate content; Table 4); located at LA 126405, GEO-16; the calcic paleosol may have formed on the Rincones surface during the Miocene-Pliocene (Connell and Smith, 2005); close-up of weak laminar structure in the upper part of the calcic horizon; vertical distance is 40 cm; US cent for scale in upper right corner

Miocene-Pliocene Paleosol. A much older paleosol with a calcic horizon about 80 to 100 cm thick is exposed in trenches at LA 126405 and LA 55503. The upper part of the ancient soil is missing due to erosion and only a rare remnant of the Bw or Bt horizon is present. The calcic horizon has stage III carbonate morphology yet has only 18.0% carbonates (Table 4). The upper 25 cm is characterized by weak laminar structure (Fig. 9); nodule-like structures are carbonate-lined casts of insect burrows, the same as occurs in the younger stage II paleosol. The degree of cementation is weak to strong. Carbonate filaments are generally absent although are present along laminar structures when cracked open. The sediment matrix is coarse to fine quartz sand with numerous small unsorted pebbles. The common presence of small pebbles scattered throughout the calcic horizon indicates that the sediment in which the ancient soil developed is colluvium. The colluvium in turn was likely overlying a weathered surface of sedimentary deposits of the Santa Fe Group. The base of the thick calcic horizon is not well exposed in the trenches, leaving uncertain the nature of the original sediments in which the soil formed in this area. The calcic paleosol matches the soil morphology and topographic position of the Rincones surface in the northwestern Albuquerque basin placing it stratigraphically below and older than the Llano de Albuquerque surface (ca. 2.0-2.5 Ma); the Rincones erosional surface is Miocene-Pliocene (Connell and Smith, 2005).
Solution pipes in the Miocene-Pliocene stage III calcic horizon at LA 126405 (GEO-18); late Pleistocene eolian sand overlying calcic horizon and pipe has been removed, revealing pipe’s circular plan view; luminescence age from the fill of the large pipe is 19,780 ± 1,960 yrs BP; 1-meter scale with 10-cm increments

Solution pipes in calcic horizon. The interesting discovery of solution pipes in the stage III calcic paleosol at two localities was not anticipated (LA 125405 and LA 55503, GEO-18,-23) (Fig. 10). The pipes occur only in the stage III paleosol, not in the younger stage II paleosol. The pipes formed at some time after the period of soil-forming processes that led to the development of the paleosol. The age of the paleosol may be greater than 300,000 years; the pipes may represent groundwater solution of the carbonates during a period of wetter climate such as during one of the major periods of glaciation. The material that fills the pipes is loose, brown pebbly unsorted sand; the pebbles are quartz and feldspar and are coated with carbonates; small chunks of the paleosol carbonates also occur in the fill deposits. The pipes may be of different ages, representing multiple discrete periods of solution and filling. The pipes are common, and their resemblance to prehistoric pit features could be a source of speculation by the field worker. A single OSL age from the fill of a larger pipe is 19,780 ± 1,960 yrs BP (Table 3) (Fig. 10).

Pleistocene & Holocene paleosols: carbonate content and stages of carbonate morphology. Although not a focus of this investigation, routine measurements of the texture and carbonate content of the Pleistocene-Holocene paleosols show some interesting relationships. First, the texture of the sediments in which the two Pleistocene soils are developed is finer-grained than that of the younger Pleistocene eolian sediments and its Holocene red paleosol (Table 4). The older sediments are very fine-fine sand with a comparatively high clay content. The younger
Pleistocene eolian sediments are generally fine-medium sand. All of these deposits are eolian in origin.

The carbonate content of the calcic horizon of the Holocene red paleosol with a stage I carbonate morphology ranges from 1.6 to 6.7% and averages 3.7% from three separate localities (Table 4) (Figs. 6, 8). These values are consistent with those from stage I calcic horizons in south-central New Mexico (Gile et al. 1995) and in the Albuquerque basin (Machette et al., 1997). Birkeland (1999, p. 357) also observes that stage I soils generally contain <10% carbonates.

The carbonate content of three samples from stage II calcic horizon of the paleosol beneath the prominent younger late Pleistocene eolian sand is 5.5 and 5.6% (GEO-13) and 23.2% (GEO-10) (Fig. 8). These values may not be representative; the low ones are within the range of stage I calcic soils, and the high one is greater than the carbonate content of the stage III paleosols. Birkeland (1999, p. 357) summarizes that stage II whole-soil carbonates are 10-15%. The two stage III calcic paleosol localities (LA 55503 and LA 126405) have carbonate content 14.4 and 18.0% (Table 4). Birkeland (1999) indicates that stage III carbonates are generally 20 to >40%. The variability of laboratory determinations of carbonate content in stage II and III calcic horizons at Paseo del Volcan is matched, however, by similar variability of stage II and III paleosols throughout the Albuquerque area (Machette et al., 1997).

**Figure 11.** Composite stratigraphy of the surficial geology along 28th Avenue NE, Rio Rancho, Sandoval Co., New Mexico, based on 32 stratigraphic sections from more than 30 backhoe trenches; no single stratigraphic section includes all of these units together; all of the archaeological sites at the project occur
at the top of and are intrusive into the late Pleistocene eolian sand and red paleosol; no vertical scale although each stratigraphic section is generally no more than 1.5 meters thick

**SUMMARY OF STRATIGRAPHIC AND GEOMORPHIC HISTORY**
The overall recent geologic history of the project is dominated by eolian sand deposition, soil formation, and erosion. The most recent time period encompassing the archaeological record during the past 10,000 years is characterized by landscape stability and development of the red paleosol. The complete sequence of geologic events revealed in the project area is outlined below, earliest to latest:

1. Erosion of the Rincones surface in the northwestern Albuquerque basin >2.5 million years ago
2. Stage III calcic paleosol development on Rincones surface >2.5 million years ago (observed at LA 55503, LA 126405)
3. Erosion of the stage III calcic paleosol and formation of solution pipes < 2.5 million years ago (observed at LA 55503, LA 126405); solution-pipe fill at LA 126405 has a luminescence age of 19,780 ± 1,960 yrs BP
4. Eolian sand deposition during late Pleistocene ca. >100,000 years ago (eolian sand at north end of LA 126409 dated ca. 130,000 ± 30,000 yrs BP)
5. Surface stability and stage II calcic paleosol development on late Pleistocene eolian sand broadly between 15,000 and 100,000 years ago
6. Erosion of late Pleistocene stage II paleosol sometime before ca. 15,000 years ago
7. Eolian sand deposition from ca. 15,000 to 10,000 years ago
8. Landscape stability and red paleosol development after ca. 10,000 years ago
9. Prehistoric occupation of the eolian sand deposits with a red paleosol at the top of the sequence after the development of the red paleosol
10. Deflation of the top of the red paleosol; erosion may have occurred before, during, or after prehistoric occupation
11. Short-lived stability of the sand sheet and development of weak A horizon soil during past 200 years
12. Erosion of the recent A horizon soil and accumulation of mantle of loose eolian sand in the past 50 years

**CORRELATION OF PASEO DEL VOLCAN GEOMORPHOLOGY**

**Eolian Records**
While a number of regional geomorphic studies have focused on older geologic history, only a few investigations of late Quaternary-age eolian deposits are reported from northern New Mexico. The Chaco dune field of the San Juan Basin is the most thoroughly documented although the geochronology of the eolian sand is based entirely on radiocarbon ages from
archaeological sites, indicating that Holocene eolian sand deposition occurred between about 6000 and 2000 years ago. In the past 2000 years, the sand sheet was primarily stable and vegetated by desert shrub grassland, resulting in the formation of a red desert soil (Hall, 1983, 1990; Schultz, 1983; Wells et al., 1990).

More recently, geoarchaeological investigation of the Mariposa Ranch area just north of the Paseo del Volcan project has produced a geomorphic record of eolian sand deposition somewhat similar to that of the San Juan Basin. At Mariposa Ranch, the Holocene and archaeological record prior to 4000 years ago is missing due to erosion. The Mariposa sequence of eolian sand deposition began about 4000 years and lasted until about 2000 years ago (Hall, 2004).

The above two investigations (there are no others from the region) do not parallel the Paseo del Volcan sequence where a Holocene eolian component is missing from the record. The period of eolian sand deposition between about 15,000 to 10,000 years ago at Paseo del Volcan is yet undocumented from other studies in the region.

**Paleoclimate: Eolian Records, Soil Development**
Landscape development is not random but is related to climate and climate change. The period of eolian sand deposition at Paseo del Volcan about 15,000 to 10,000 years ago corresponds to the late-glacial climate during the transition from glacial to postglacial conditions. This period of time is poorly documented in the Southwest. However, in general it was a time of change from sagebrush grassland to desert-shrub grassland vegetation (Hall, 2005). The change in climate and vegetation may have resulted in down cutting of local streams, making new sand available for wind transport and deposition. How representative or widespread this may have been must await new geochronologic investigations of eolian sand sheets in the Southwest.

The red paleosol formed during the Holocene after the deposition of the eolian sand. Whether soil development continued for 10,000 years or occurred during only a portion of that time is not known. Nevertheless, the red paleosol has a weak Bt horizon and a weak Bk horizon with stage I carbonate morphology and formed during a comparatively hot, dry Holocene climate in an eolian sand landscape dominated by desert-shrub grassland vegetation.

**OPTICALLY STIMULATED LUMINESCENCE (OSL) ANALYSIS**
OSL ages fill the gap in geochronology of deposits not readily dateable by radiocarbon. Eolian sand is especially suitable for luminescence analysis. It has provided conclusive evidence that the thin sand sheet along this area of Paseo del Volcan is too old to have buried archaeology. It would be difficult to draw this conclusion without the benefit of OSL ages.

OSL is a new adaptation of thermoluminescence dating. In OSL, laser light (instead of heat) is used to stimulate the sand grains. The amount of light given off is directly related to the time the sample has been buried (or the age of the sample); the greater amount of light emitted during the analysis, the older the sample. Ages determined by OSL are in calendar years.

The OSL ages from Paseo del Volcan were produced by standard OSL methodology (Table 3; Fig. 12). The following paragraphs describe the laboratory technique and are written by Dr.
Sample Preparation/Dose-Rate Determination
Sample preparation were carried out under amber-light conditions. Samples were wet sieved to extract the 90–150 µm fractions, and then treated with 1 N HCl to remove carbonates. Quartz and feldspar grains were extracted by flotation using a 2.7 gm cm\(^{-3}\) sodium polytungstate solution, then treated for 75 minutes in 48% HF, followed by 30 minutes in 47% HCl. The sample was then resieved and the <90 µm fraction discarded to remove residual feldspar grains. The etched quartz grains were mounted on the innermost 2 mm of 1 cm aluminum disks using Silkospray.

Chemical analyses were carried out by Chemex Labs, Inc., Sparks, NV, using a combination of ICP-MS and ICP-AES. Dose-rates were calculated using the method of Aitken (1998) and Adamiec and Aitken (1998). The cosmic contribution to the dose-rate was determined using the techniques of Prescott and Hutton (1994).

Optical Measurements
Optically stimulated luminescence measurements were carried out on a Riso Automated OSL Dating System Model TL/OSL-DA-15B/C, equipped with blue and infrared diodes, using the Single Aliquot Regenerative Dose (SAR) technique (Murray and Wintle, 2000). A preheat of 220ºC for 10 seconds was used, with a cutheat of 160ºC, based upon a preheat plateau test between 180 and 280ºC on UNL 1292. A dose-recovery test (Murray and Wintle, 2003) on UNL 1292 recovered 40.45 ± 0.59 Gy from an applied dose of 39.52 Gy. Thermap transfer for the same sample was 0.14 ± 0.01 Gy. Examination of the growth curves for the samples showed the samples to be well below saturation. Optical ages are based upon a minimum of 14 aliquots. Individual aliquots were monitored for insufficient count-rate, poor quality fits (i.e. large error in the equivalent dose, \(D_e\)), poor recycling ratio, strong medium vs fast component, and detectable feldspar. Aliquots deemed unacceptable based upon these criteria were discarded from the data set before averaging.

Results
Optical ages range from 1.35 ± 0.15 to 19.78 ± 1.96 ka, with 1-sigma errors. With the exception of UNL 1285 (Volcan 1), the samples appear well suited for optical dating, with good dose-recovery and low thermal transfer and recuperation. There is no indication of partial bleaching. UNL 1285 is close to saturation on the growth curve and unsuitable for optical dating for that reason. The age quoted for this sample should be regarded as an estimate only.

by
Ronald J. Goble, Ph.D.
Department of Geosciences, University of Nebraska-Lincoln

Ronald J. Goble, Department of Geosciences, University of Nebraska-Lincoln who did the analysis.
DISCUSSION OF OSL AGES
Late Pleistocene Eolian Sand
The OSL ages of the eolian sand along Paseo del Volcan are consistent and show that the sand was deposited ca. 15,000 to 10,000 years ago (Fig. 12). The upper OSL age from LA 126407 is statistically younger than the lower two ages that are similar at 2-sigma standard deviation. At LA 126409, the upper 4 OSL ages are likewise similar at 2-sigma although sample 8 from the north end of the site where the eolian sand is thicker is significantly older. The oldest OSL age from the eolian sand unit was determined at LA 55509 below the red paleosol and is 15,130 ± 1,070 yrs BP (Fig. 16).

Sedimentation rate. A linear regression of the depth versus OSL age (mid-point value) from both both LA 126407 and LA 126409 gives a correlation coefficient of 0.83% ($r^2$, 0.69%). The amalgam of data from the two sites may be more representative than if each site were looked at separately. Regression indicates a net sedimentation rate of 10 cm of eolian sand deposition every 370 years or 0.27 mm of sand net deposition per year. The very slow net sedimentation-rate values suggest that, during the period of 15,000 to 10,000 years ago, sand was deposited slowly and continuously as eolian particle fallout on dense sagebrush grass vegetation. The absence of soils within the sand body, that would indicate episodes of local landscape stability, supports the interpretation of slow-continuous eolian sedimentation.

Age and geomorphology of the surface. Extrapolation of the regression line to the present-day surface of the red paleosol indicates that the age of the top of the stratigraphic section is 10,185 years BP. Field and laboratory soil data from LA 126407 indicate that the top of the red paleosol is eroded. The A horizon is missing, and the clay-rich Bt horizon is truncated (Fig. 6).
amount of soil profile that is missing is estimated a minimum of 30 cm. Applying the 10 cm per 370 year relationship, this would mean that the terminal age of deposition of the original eolian sand deposit is ca. 9,000 years BP. However, a number of uncertainties apply. Although the period of red soil pedogenesis is the past 10,000 years, it is not known if the red soil formed throughout or only during a part of the Holocene. The fact that erosion definitely occurred after the development of the red soil (it’s A and upper part of Bt horizons are missing) suggests that the red soil may have formed early or mid-Holocene and that the period of erosion may have occurred in late Holocene time prior to the occupation of the surface by prehistoric inhabitants.

ARCHAEOLOGICAL GEOLOGY
Geomorphic Description of Archaeological Sites
The archaeological sites and their features in the project generally at the present-day surface. Most of the site areas, however, are obscured by 10 cm or more of loose eolian sand that mantles the entire landscape. Successful scraping away of the loose sand at the sites revealed features that in many cases were not visible at the surface. Numerous exploratory trenches were dug in areas where no indications of sites were present; sites were not discovered although the trenches provided geomorphic information that proved useful in interpreting the geology of the archaeological sites elsewhere. The general location of sites and non-site trenching localities are shown in Fig. 13, and a list of the geomorphic-stratigraphic localities is provided in Table 1.

Figure 13. Topographic profile along the right-of-way centerline of proposed Paseo del Volcan along 24th Avenue NE, Rio Rancho, Sandoval Co.; from Loma Machete 7.5 minute quadrangle (US Geol. Survey); stratigraphic sections from these sites and non-sites are listed in Tables 1 & 2

Table 1. Archaeological sites and accompanying stratigraphic sections and luminescence samples, Paseo del Volcan, Rio Rancho (see Table 2, Appendix A)

<table>
<thead>
<tr>
<th>Archaeological site</th>
<th>Geologic section</th>
<th>Luminescence sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA 55503</td>
<td>GEO-23</td>
<td>---</td>
</tr>
<tr>
<td>LA 55507</td>
<td>GEO-24</td>
<td>---</td>
</tr>
<tr>
<td>LA 55509</td>
<td>GEO-20,-21,-22,-25</td>
<td>OSL-11,-12</td>
</tr>
<tr>
<td>LA 126405</td>
<td>GEO-18</td>
<td>OSL-10</td>
</tr>
<tr>
<td>LA 126406</td>
<td>GEO-4,-5,-6</td>
<td>---</td>
</tr>
<tr>
<td>LA 126407</td>
<td>GEO-15,-16</td>
<td>OSL-6,-7,-9</td>
</tr>
<tr>
<td>LA 126408</td>
<td>GEO-1,-3</td>
<td></td>
</tr>
<tr>
<td>LA 126409</td>
<td>GEO-2,-12,-13; (north end) -10</td>
<td>OSL-2,-3,-4,-5; (north end) -1,-8</td>
</tr>
</tbody>
</table>
LA 55503. The site occurs on a low-gradient slope with a low hill rising about 1.5 mile to the NNW; the surface at the site slopes gradually to the SE. The site occurs about 550 feet NE of a small unnamed wash. The site and adjacent surfaces are covered by 10 cm of loose eolian sand. Beneath the loose sand are three separate thin eolian sand units that overlie an ancient calcic paleosol. In some sections occurs a coarse yellowish brown eolian sand 30-cm thick with a yellowish red paleosol at the top that likely correlates with the late Holocene red paleosol documented elsewhere in the project. In places at the site, the coarse eolian sand with its red paleosol is missing and a brown fine silty eolian sand that contains small carbonate nodules is present; the fine eolian sand and carbonate nodules likely represent an eroded, weathered remnant of the late Pleistocene stage II calcic paleosol. Also at the site is a yellow eolian sand that underlies the late Pleistocene paleosol. The yellow sand rests directly on a weathered Miocene-Pliocene stage III calcic paleosol. In places the yellow sand occurs at the surface and elsewhere at the site it is entirely missing and the weathered stage II paleosol rests directly on the older stage III calcic horizon (Fig. 14). The laterally discontinuity of the three units indicates a history of active sheet erosion at various times at this locality.

The Miocene-Pliocene stage III calcic horizon dominates the near-surface geology. Common solution pipes characterize the stage III calcic paleosol. The age of the pipe fill is uncertain although both the yellow sand and the brown fine sand with carbonate nodules occur as pipe fill sediments. The carbonate-cemented sediment is unsorted gravelly sand, indicating that the material in which the soil formed is colluvium derived from sediments of the underlying Santa Fe Group.

The archaeology at LA 55503 occurs at the upper surface of the various sediments that mantle the Miocene-Pliocene calcic horizon. The potential for buried sites is largely non-existent although young features can be intrusive into the older pre-site units.

Figure 14. Stratigraphy at site LA 55503; artifacts occur on the present-day surface at the top of the paleosol; archaeology is not present in the subsurface; these paleosols are likely the same ones observed at other sites; a thin layer of loose eolian sand covers the area and is not shown here
**Figure 15.** Sketch of stratigraphy at LA 55507; artifacts occur on the denuded surface of the Santa Fe Group and are buried in shallow eolian-colluvial deposits at the foot of the hillslope; the local deposits are covered by 12 cm of recent eolian sand that are not shown in the diagram.

**LA 55507.** The site occurs on the steep SW slope of a prominent hill formed by erosion-resistant gravels of the upper Santa Fe Group. Artifacts occur on the eroded surface of the steep hillslope and are shallowly buried in eolian-colluvial sediment near the base of the hillslope. The gravels include vesicular basalt, red granite, fossiliferous gray-brown limestone, yellow sandstone, red sandstone, quartz, quartzite, white and brown chalcedony (= Pedernales chert), gray chert, petrified wood, ironstone, and jasper, ranging in size to 45 cm in diameter. The sandy gravel is called “Upper sandstone and conglomerate (lower Pleistocene(?) to Pliocene)” and is mapped as the youngest member of the Santa Fe Group on the Loma Machete quadrangle (Personius et al, 2000).

Artifacts at LA 55507 occur mainly at the surface of the eroded slopes of the hilltop gravel outcrop. Downslope, a few artifacts occur at shallow depth in slope-wash eolian-colluvial sand deposits. The deposits are generally no more than 40 cm thick and lie directly on the eroded surface of gravels, sand, and mudstone of the Santa Fe Group. Closer to the hillslope, Santa Fe Group gravels are at the surface and younger deposits are absent (Fig. 15).
LA 55509. The site occurs on a high bench just east of Arroyo de la Baranca, an ephemeral wash that flows southwesterly across the project. The topography slopes away from the site in all directions except north where it gently slopes up. The site is associated with eolian sand that is likely derived from the wash. The ground surface is covered with 10 cm of loose sand although sheet erosion has removed it at the northern edge of the site, exposing a red paleosol and artifacts at the surface. The red paleosol with an associated whitened calcic horizon (stage I) is the same red paleosol that occurs at other sites in the project. The middle and lower part of the site has been subjected to shallow gully erosion, resulting in the removal of the red paleosol Bw/Bt horizon down to the whitened calcic horizon. Prehistoric features on the eroded surface indicate that it was used as a campsite in the past. Subsequently, the shallow gully was filled with reddish yellow eolian sand, likely derived from deflation of the top of the adjacent red paleosol (Fig. 16). The young eolian sand buried the occupation surface. Older artifacts from a period of time pre-dating the gullying (and coinciding with the occupation surface at the top of the red paleosol) may also have become mixed with the artifacts from the younger occupation. The erosion and burial of sites is uncommon in the project area; this is the only case. Two OSL ages provide a useful geochronology of the eolian sand at the site. The older sand in which the red paleosol is formed is dated 15,130 ± 1,070 yrs BP, consistent with the OSL ages of the eolian sand and red paleosol elsewhere in the project. The younger eolian sand that buries archaeological features at the site is dated 1,350 ± 150 yrs BP (= 356 to 956 AD, 2 sigma).
Figure 17. Sketch of stratigraphy at LA 126405 with a Miocene-Pliocene calcic paleosol (stage III); the calcic paleosol has numerous pipes; an OSL age of pipe fill is 19,780 ± 1,960 yrs BP; archaeological features occur at the top of the red paleosol; recent loose eolian sand covers the site but is not shown here.

LA 126405. The site occurs on the east-facing low-gradient slope of a mile-long hillside that rises to the west and descends eastward and slopes gently to the northeast at the site. The surface is covered by several centimeters of loose eolian sand. Beneath the loose sand is an eolian sand unit with a yellowish red paleosol at the top; a stage I calcic horizon occurs with the paleosol. In the south end of the site, the red paleosol rests directly on a Miocene-Pliocene stage III calcic paleosol. At the north end of the site, the stage III paleosol drops in depth and disappears below the base of the trench. The red paleosol persists at the top of the eolian sand, and a stage II calcic paleosol grades into the thickened section below the red paleosol (Fig. 17). The Miocene-Pliocene stage III calcic paleosol dominates the south portion of the site. The paleosol is about a meter thick and has weak laminar structure in the upper 25 cm (Fig. 7). The paleosol also exhibits solution pipes (Fig. 8). The pipe fill is a mixture of loose sand and pebbles. The OSL age of a large pipe fill is 19,780 ± 1,960 yrs BP. The locality was inspected by S. Connell who identified the paleosol as characteristic of the Rincones surface that is in excess of 2.5 million years in age (Connell and Smith, 2005). Archaeology occurs at the top of and intrusive into the upper eolian sand and red paleosol.
LA 126406. The site occurs on a low topographic high just below the crest of a low hill on a south-facing slope; the topography slopes gently down southwards. The surface of the site is mantled by loose eolian sand. Just below the loose sand is the eroded top of the red paleosol and accompanying stage I calcic horizon; the paleosol follows the contour of the present-day surface (Fig. 18). The red paleosol is developed at the top of an eolian sand body that is greater than 170 cm thick; the two older calcic paleosols observed elsewhere in the project are not exposed in the three trenches that dissect the site. The eolian sand with its red paleosol is late Pleistocene in age. Archaeological features occur at the top of the eroded red paleosol and eolian sand unit similar to other sites in the area.

LA 126407. The site occurs on a quasi-flat area of a low hilltop with a slight topographic rise to the north; the site is on a gentle south-facing slope. The surface is mantled by 6 to 12 cm of loose eolian sand. The site occurs on an eroded red paleosol with weak calcic horizon that is developed in 90 cm of eolian sand. Three OSL ages of the eolian sand are 13,110 ± 690, 13,890 ± 840, and 11,210 ± 770 yrs BP, base to top, respectively (Figs. 5, 6, 12, 19). An eroded late Pleistocene stage II calcic paleosol occurs beneath the eolian sand at the north end of the site (Fig. 19). Archaeological features at the site are at the surface at the top of the eolian sand unit and its red paleosol. Features intrude into the red paleosol. Artifact and features were not observed at depth in the late Pleistocene eolian sand.
Figure 19. Sketch of the stratigraphy of LA 126407 with OSL ages; recent loose eolian sand covers the site but is not shown here.

LA 126408. The site occurs on the first crest of a series of low hills along 28th Avenue east of Unser Blvd. The broad topography grades south and west into Arroyo de los Montoyas, a moderately large wash that drains the area. The north edge of the site occurs on the edge of a low swale or closed depression. The present-day ground surface is covered by 5-12 cm of loose eolian sand, and though along unpaved 28th Avenue as much as 60 cm of recent historic sand has accumulated on a roadside berm (Fig. 1). A red paleosol with an underlying weak calcic horizon occurs at the surface just beneath the loose sand. The red paleosol follows the gentle relief of the present-day topography. Although the paleosol and modern surface coincide, indicating that little geomorphic change has occurred since the stability of the surface and soil development, the top of the paleosol is missing due to deflation. The site occurs on the eroded top of a red paleosol that is developed in 120 cm of eolian sand. In the north area of the site, the red paleosol...
and 120 cm of eolian sand overlie the eroded surface of a late Pleistocene paleosol that has a stage II calcic horizon (Fig. 20).

The archaeology at LA 126408 is entirely at the top surface of the red paleosol. Burned rock, artifacts, and features rest on the top of the red paleosol or are intrusive into the paleosol and late Pleistocene eolian sand unit. Prehistoric cultural features were not found buried within the eolian sand.

**Figure 21.** Geomorphic sketch of LA 126409 with location of six OSL ages; the archaeology is restricted to the top of the red paleosol; several centimeters of historic loose eolian sand covers the red paleosol but is not shown here; the deeper excavation extends to approx. 2.4 m below the top of the red paleosol and is not shown to scale

**LA 126409.** This site is the western-most of the project and occurs on a west-facing slope just below the crest of a low hill. The north edge of the site occurs in a topographically low swale or closed depression. The ground surface everywhere is mantled by several centimeters of recent loose eolian sand that obscures underlying deposits and archaeological features. Directly below the loose sand is a 90 to 120 cm thick unit of eolian sand marked by a red paleosol with a weak calcic horizon at the surface. The eolian sand rests directly on the eroded top of a late Pleistocene calcic paleosol that has stage II carbonate morphology (Figs. 3, 4). In the swale at the north end of the site, the eolian sand is partly reworked as colluvium, and the red paleosol is less red than on the hillside (Fig. 3). Five OSL ages provide the late Pleistocene age of the upper eolian sand (Fig. 21). The OSL age of eolian sand beneath the stage II calcic paleosol is ~130,000 ± 30,000 yrs BP (an estimate only).

The archaeology at LA 126409 is restricted to the upper surface of the eolian sand unit and red paleosol. Features intrude into the sand and red paleosol, but artifacts and features were not found buried within the late Pleistocene eolian sand.
Summary of the Geomorphology of the Archaeological Sites

All of the sites have some commonalities in relation to the physical landscape and the surficial geology. First, all of the sites are covered by several centimeters of recent loose eolian sand, making it difficult to see cultural materials and features. Only by careful inspection of small-eroded places on the ground surface can charcoal concentrations be discovered before scraping with machinery.

Second and most important, all of the sites occur at the present-day surface immediately beneath the loose cover sand. The artifacts, heated stones, and features are all at or intruded into the truncated top of the red paleosol. The eolian sand in which the red paleosol is formed accumulated ca. 15,000 to 10,000 years ago based on OSL analysis. The red paleosol formed in the sand on the stable surface during the past 10,000 years. The upland landscape has not changed much since the deposition of the eolian sand and red soil formation; in trench after trench, the top of the paleosol follows the rise and fall of the present-day topography. In principle, prehistoric sites of all and every age could be represented on the old surface; sites may intrude the late Pleistocene sand and its red paleosol but will not be found buried within it.

One site with a buried cultural horizon is an exception. The north edge of site LA 55509 has artifacts on the present-day surface of the red paleosol, similar to the other sites. However, within the past 2000 years, gullying on the hillside eroded the red paleosol down to the underlying whitened calcic horizon. The erosional surface was occupied prehistorically. Subsequently, the erosional surface and its cultural features and artifacts were buried by 30 cm of eolian sand that is dated 1,350 ± 150 yrs BP (Fig. 16).

At site LA 55507, most of the artifacts are found on the denuded surface of a hillside capped by abundant gravels with some stones of moderate quality for tool making. At the toe of the slope, however, and in eolian-colluvial deposits in an old gully, an occasional artifact was observed that had become buried by shallow recent deposits of eolian-colluvial sand (Fig. 15).

Also, the presence of basalt cobbles and boulders at the erosional contact of the base of the eolian sand and underlying late Pleistocene paleosol at the north edge of LA 126409 seems geologically anomalous. The OSL age of eolian sand that caps the cobble-boulder horizon is 14,690 ± 850 yrs BP (Table 3, Fig. 3), consistent with other ages from the site and much too old to support a cultural origin for the stones. The stone line is natural in origin.

ADDITIONAL ASPECTS OF THE ARCHAEOLOGICAL GEOLOGY

Bioturbation of Sediments at Sites and Elsewhere Through Time

Bioturbation refers to the movement of particles in a sedimentary deposit by the burrowing activity of animals. Plant roots also affect the integrity of sediments, but disturbance by plant roots is not as thorough as the disturbance that comes from burrowing animals such as mammals, insects, and earthworms. In the project, all of the eolian deposits show evidence of having been disturbed by rodents and insects (earthworms are rare or absent in arid upland habitats). At archaeological sites, prehistoric features with black charcoal particles in the eolian sand exhibit small burrow fills of yellow sand with the charcoal-blackened feature and black burrow fills in adjacent yellow sand (Figs. 22, 23). Without the color difference, it would be difficult to tell if
burrowing had occurred or not. However, all of the prehistoric eolian sand lacks stratification and bedding, indicative of post-depositional disturbance.

Further, both the late Pleistocene stage II calcic paleosol and the Miocene-Pliocene stage III calcic paleosol exhibit carbonate-filled casts of small burrows. The burrow fills are about 9 to 16 mm diameter and about 20 to 50 mm long, similar in size to the burrows left behind by cicada insect larvae. In the United States, cicadas live underground as juveniles for 13 to 17 years and feed on juices from plant roots, emerging for a 6-8 week period as adults to breed and lay eggs for the next cycle. The presence of cicada-like burrows in all of the deposits and paleosols at the project indicate that local burrowing activity has been ongoing for a million or more years. Cicada-like burrows were also documented in deposits containing late Archaic sites at Mariposa Ranch (Hall, 2004).

Rodent burrowing activity seems to be restricted to the soft loose eolian sand associated with the roadside berm along 28th Avenue and to the locally thicker accumulations of soft loose eolian sand that mantles the landscape. The comparatively large burrows and burrow fills produced by rodents are much less pervasive than the bioturbation by cicadas.

Significant to archaeological sites, the degree of disturbance by burrowing animals is directly related to the size of the burrower. Although cicadas may completely 100% disturb a sedimentary deposit, the degree of particle movement in each burrow is much less than that that occurs with the occasional rodent burrow.

Figure 22. Prehistoric hearth at LA 126409 (Feature 28); vast amounts of fine charred particles were removed from the circular feature; cicada-like burrows are visible in the cleaned wall (see Fig. 21); 10-cm scale increments
SUMMARY OF GEOMORPHOLOGY AND ARCHAEOLOGICAL GEOLOGY
The Paseo del Volcan corridor passes through desert shrub grassland of the northwestern Albuquerque basin. Local bedrock consists of eroded Santa Fe Group gravels and mudstones that fill much of the Rio Grande rift valley. During the late Pleistocene calcic soils developed on stable eolian sand deposits throughout the landscape, followed by widespread erosion. During the transition from glacial-age to postglacial conditions about 15,000 to 10,000 years ago, three to five feet of eolian sand was slowly deposited as a veneer over the eroded hillsides. Subsequently a red soil formed on the stable sand surface. Later, perhaps during the mid-Holocene about 6000 to 5000 years ago, the surface was further eroded, removing the upper part of the red soil. Prehistoric people camped on the eroded surface, and their hearths and storage pits are dug into the old red soil. Today the landscape is mantled with 4 to 6 inches of recent wind-deposited sand, obscuring the presence of archaeological sites on the old red soil.

The geochronology of the eolian sand and associated soils is provided by optically stimulated luminescence dating, a comparatively new technique that provides ages of sand. The presence of archaeological sites and features at the surface of the eolian sand is consistent with the late Pleistocene age of the sand. The results from the investigation also tell us that the sand deposits are too old to contain archaeology; buried sites are not present in the upland study area.
Table 2. Location of geomorphic-stratigraphic sections (GEO-) and luminescence (V-, OSL) sample localities along 28th Avenue NE, Paseo del Volcan, Sandoval Co., NM; NST = non-site trench; map datum NAD 27

<table>
<thead>
<tr>
<th>GEO- Locality</th>
<th>Trench</th>
<th>UTM Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 LA126408</td>
<td>1, south end</td>
<td>13 346055E 3908136N</td>
</tr>
<tr>
<td>2 LA126409</td>
<td>1, north end</td>
<td>13 345899E 3908195N</td>
</tr>
<tr>
<td>3 LA126408</td>
<td>1, north end</td>
<td>13 346073E 3908205N</td>
</tr>
<tr>
<td>4 LA126406</td>
<td>3, middle</td>
<td>13 346397E 3908140N</td>
</tr>
<tr>
<td>5 LA126406</td>
<td>2, north end</td>
<td>13 346374E 3908147N</td>
</tr>
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<td>6 LA126406</td>
<td>1, north end</td>
<td>13 346373E 3908166N</td>
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<td>7 NST-5</td>
<td>1, near north end</td>
<td>13 346579E 3908155N</td>
</tr>
<tr>
<td>8 NST-5</td>
<td>1, near south end</td>
<td>13 346575E 3908132N</td>
</tr>
<tr>
<td>9 NST-1</td>
<td>1, west end</td>
<td>13 345779E 3908380N</td>
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<tr>
<td>10 LA126409</td>
<td>2, north end, deep site</td>
<td>13 345873E 3908202N</td>
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<td>V-1,-8 (OSL) from below and above buried stones., respectively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 NST-2</td>
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<td>13 345954E 3908168N</td>
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<tr>
<td>12 LA126409</td>
<td>2, S end of N segment</td>
<td>13 345860E 3908161N</td>
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<tr>
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<td>1, south end</td>
<td>13 345889E 3908148N</td>
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<td></td>
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<tr>
<td>14 NST-3</td>
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<td>13 347995E 3908158N</td>
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<tr>
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<td>13 346219E 3908174N</td>
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<td>16 LA126407</td>
<td>2, N end of S segment</td>
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<td>V-6,-7,-9 (OSL) from red paleosol and underlying eolian sand</td>
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<td></td>
</tr>
<tr>
<td>17 NST-4</td>
<td>1, north end</td>
<td>13 346271E 3908173N</td>
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<tr>
<td>18 LA126405</td>
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<td>V-10 (OSL) from solution pipe</td>
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<td>19 NST-6</td>
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<td>20 LA55509</td>
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<td>23 LA55503</td>
<td>3, middle</td>
<td>13 351153E 3908200N</td>
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<td>24 LA55507</td>
<td>2, west end</td>
<td>13 348971E 3908112N</td>
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<tr>
<td>25 LA55509</td>
<td>3E, middle</td>
<td>13 348837E 3908124N</td>
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<td>V-11,-12,-13 (OSL) from eolian sand</td>
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<td></td>
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Table 3. OSL analyses and ages of eolian sand deposits along Paseo del Volcan, Rio Rancho, Sandoval Co., NM

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<th>Sample No.</th>
<th>Field No.</th>
<th>Burial Depth (m)</th>
<th>H₂O (%)*</th>
<th>K₂O (%)</th>
<th>U (ppm)</th>
<th>Th (ppm)</th>
<th>Cosmic Ray (Gy)</th>
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<td>UNL-1285</td>
<td>Volcan-1</td>
<td>2.34</td>
<td>5.25</td>
<td>2.45</td>
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<td>Volcan-8</td>
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<td>7.8</td>
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<td>UNL-1286</td>
<td>Volcan-2</td>
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<td>2.26</td>
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<td>Volcan-3</td>
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<td>0.91</td>
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<td>0.81</td>
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<th>UNL No. (cont.)</th>
<th>Dose Rate (Gy/ka)</th>
<th>Dₑ (Gy)**</th>
<th>Recuperation (%)</th>
<th>No. of Aliquots</th>
<th>Age (ka)***</th>
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<td>UNL-1291</td>
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<td>2.81 ± 0.11</td>
<td>3.79 ± 0.39</td>
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</table>

Analysis by Dr. Ronald J. Goble, Department of Geosciences, University of Nebraska-Lincoln; samples collected by S. A. Hall in August-September 2005; OSL analysis completed in 2006
*In-situ moisture content
**Error on Dₑ is 1 standard error
***Error on Age includes random and systematic errors calculated in quadrature

Table 4. Sediment data from deposits and soils at Paseo del Volcan, Rio Rancho, Sandoval Co., NM; samples are in centimeters depth; numbers are percentages; Wentworth scale.
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<th>Bt</th>
<th>0-10 cm</th>
<th>1.6%</th>
<th>12.3</th>
<th>28.7</th>
<th>36.6</th>
<th>20.8</th>
<th>74</th>
<th>12</th>
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<th>0.32</th>
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<tbody>
<tr>
<td>10-20</td>
<td>2.1</td>
<td>13.4</td>
<td>27.5</td>
<td>36.5</td>
<td>20.5</td>
<td>78</td>
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<td>20-30</td>
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<td>Btk</td>
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<td>5.4</td>
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<td>C</td>
<td>60-70</td>
<td>11.6</td>
<td>40.0</td>
<td>25.0</td>
<td>14.9</td>
<td>8.5</td>
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<td>25.1</td>
<td>12.9</td>
<td>91</td>
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<td>0.02</td>
<td>2.3</td>
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<td>2.5</td>
<td>25.2</td>
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<td>91</td>
<td>6</td>
<td>3</td>
<td>0.01</td>
<td>2.2</td>
<td>-</td>
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<tr>
<td>90-100</td>
<td>2.3</td>
<td>21.3</td>
<td>32.9</td>
<td>29.5</td>
<td>14.0</td>
<td>91</td>
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<td>4</td>
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<tr>
<td>100-110</td>
<td>1.5</td>
<td>19.0</td>
<td>32.4</td>
<td>31.2</td>
<td>15.9</td>
<td>89</td>
<td>8</td>
<td>3</td>
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<td>1.0</td>
<td>11.9</td>
<td>28.7</td>
<td>36.7</td>
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<td>3</td>
<td>0.03</td>
<td>2.6</td>
<td>-</td>
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</tbody>
</table>

| LA 126409, Trench 1, GEO-13, Locality of OSL samples 2-5; Eolian sand with red paleosol |
| Bt   | 0-10 cm | 0.8  | 8.7  | 33.2 | 40.4 | 16.9 | 77 | 10 | 13 | 0.29 | 1.9 | 0.02 |
| 10-20| 0.8     | 9.3  | 32.4 | 40.5 | 17.0 | 81 | 8 | 11 | 0.20 | 1.4 | 0.02 |
| 20-30| 1.1     | 9.9  | 32.9 | 40.3 | 15.8 | 84 | 7  | 9  | 0.17 | 1.2 | 0.02 |
| Btk  | 30-40   | 1.0  | 10.3 | 33.0 | 39.9 | 15.8 | 86 | 6  | 8  | 0.11 | 2.0 | 0.01 |
| 40-50| 1.1     | 9.0  | 32.7 | 41.1 | 16.1 | 88 | 5  | 7  | 0.07 | 2.0 | -    |
| 50-60| 1.0     | 6.8  | 29.4 | 43.0 | 19.8 | 89 | 4  | 7  | 0.04 | 1.6 | -    |
| C    | 60-70   | 0.6  | 5.8  | 28.5 | 44.5 | 20.6 | 92 | 5  | 3  | 0.02 | 1.3 | -    |
| 70-80| 0.2     | 5.2  | 28.6 | 44.5 | 21.5 | 92 | 5  | 3  | 0.02 | 1.0 | -    |
| 80-90| 0.3     | 5.2  | 28.1 | 41.9 | 24.5 | 89 | 7  | 4  | 0.03 | 1.6 | -    |
| 2Bk  | 90-100  | 0.8  | 8.1  | 21.3 | 29.5 | 40.3 | 61 | 29 | 10 | 0.08 | 5.5 | -    |
| 100-110| 0.3   | 7.1  | 21.2 | 30.3 | 41.1 | 59 | 30 | 11 | 0.09 | 5.6 | -    |

| LA 55509, Trench 3E, GEO-25, Locality of OSL samples 11, 12; Eolian sand with eroded/buried red paleosol |
| Bw   | 15-25 cm | 0.1  | 3.1  | 25.0 | 42.8 | 29.0 | 85 | 9  | 6  | 0.14 | 2.6 | -    |
| Bk   | 40-50    | 0.1  | 2.0  | 25.4 | 45.6 | 26.9 | 77 | 17 | 6  | 0.15 | 4.6 | -    |
| C    | 60-70    | 0.1  | 2.9  | 31.6 | 47.9 | 17.5 | 88 | 8  | 4  | 0.06 | 3.4 | -    |
| 2Bk  | 100-110  | 0.3  | 0.7  | 4.7  | 26.0 | 68.3 | 56 | 40 | 4  | 0.09 | 5.2 | -    |

| LA 126409, Trench 2, deep cut at north end, GEO-10, Locality of OSL samples 1, 8; Buried calcic soil |
| Bt   | 130-140 cm | 1.8  | 7.8  | 20.9 | 36.8 | 32.7 | 73 | 12 | 15 | 0.11 | 2.4 | 0.02 |
| Bk   | 170-180   | 1.3  | 6.2  | 16.1 | 33.8 | 42.6 | 47 | 31 | 22 | 0.10 | 23.2 | -    |
| C    | 230-240   | 1.2  | 11.9 | 17.2 | 36.1 | 33.6 | 89 | 7  | 4  | 0.01 | 3.0 | -    |

| LA 55503, Trench 3, stage III calcic paleosol, GEO-23 |
| Bk   | 100-110 cm | 1.0  | 2.7  | 13.9 | 38.1 | 44.3 | 64 | 18 | 18 | 0.04 | 14.4 | -    |

| LA 126405, Trench 1, stage III calcic paleosol, GEO-18; Locality of OSL sample 10 from pipe fill in caliche |
| Bk   | 130-140 cm | 6.0  | 8.1  | 16.0 | 32.8 | 37.1 | 84 | 13 | 3  | 0.07 | 18.0 | -    |

“---” = not measured; OM = estimated organic matter (organic carbon, Walkley-Black); carbonates determined by chittick method; analysis by Milwaukee Soil Laboratory, 6917 W. Oklahoma Ave., Milwaukee, Wisconsin 53219

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Schultz, J. D.

Wells, S. G., McFadden, L. D., and Schultz, J. D.
Appendix A. Stratigraphic sections from backhoe trenches along 28th Avenue NE, Paseo del Volcan, Rio Rancho, Sandoval Co., New Mexico; measurements in centimeters except where noted; textures of sediments and soils from Wentworth scale; colors of sediments and soils from Munsell Soil Color Charts; stages of carbonate morphology from P. W. Birkeland, 1999, *Soils and Geomorphology*, 3rd edition, p. 357; UTM coordinates (map datum NAD 27) in parentheses

**GEO-1. LA 126408, south end of TT-1 (13 346055E 3908136N)**

0-23 cm Historic eolian sand, very pale brown sand, coarse to fine, poorly sorted, weakly laminar to massive, calcareous but no visible carbonates, no pebbles, sand is loose with thin slightly indurated crusts at top and buried throughout (each crust representing a surface), numerous rootlets, sharp basal contact; aluminum soda pop can with .22 bullet holes buried 10 cm within unit; unit sand is derived from recent disturbance along adjacent unpaved 28th Avenue; unit occurs only at the top of the berm formed by road grading; unit parallels road but thins to zero within 10 meters away from road; unit probably formed within the past 20 years

23-47 Historic eolian sand, light reddish brown sand, fine to coarse, poorly sorted, weakly laminar to massive, calcareous but no visible carbonates, no pebbles, sharp and irregular basal contact; sand unit occurs only in roadcut berm and represents reworked red sand from the underlying older red paleosol that occurs near the modern surface throughout the western third of the project area; this unit thins to zero within 10 meters of the roadcut berm

47-58 Historic A horizon soil, light grayish brown sand, fine to coarse, massive, soft, calcareous but no visible carbonates, no pebbles, soil weakly developed, base sharp and irregular on underlying eroded surface of red paleosol; A horizon soil preserved only in roadcut berm; elsewhere the soil has been eroded and is missing except in rare cases of preservation where it has been buried by younger eolian sand; the A horizon soil may represent early historic landscape stability

58-100 Red paleosol, yellowish red (5YR 4/6) coarse to fine sand, poorly sorted, massive, hard, noncalcareous but with faint carbonate filaments, absence of soil structure, color grades to reddish yellow (7.5YR 6/6) at paleosol base, paleosol formed in eolian sand; basal contact gradational

100-148 Eolian sand, reddish yellow (7.5YR 6/6) fine to coarse sand, massive, hard, strongly calcareous with carbonate filaments, occas. isolated pellets of carbonate-cemented sand that may be reworked from underlying unit, no pebbles

148-270+ Eolian sand and carbonates, light brown (7.5YR 6/4) fine silty sand, massive, soft, no pebbles, strongly calcareous with weak carbonate filaments, occas. soft nodules of carbonate-cemented sand; stage II carbonate morphology

**GEO-2. LA126409, deep excavated place near north end of TT-1 (13 345899E 3908195N)**

0-16 cm Historic loose surficial sand, light brown, fine to coarse, poorly sorted, massive, no pebbles, numerous rootlets, colluvial component where it has washed into a low area, absence of A horizon development, sharp irregular basal contact with red paleosol
16-60  Red paleosol, light reddish brown coarse to fine sand, massive, hard, noncalcareous with no carbonate filaments, no pebbles; this locality is in a swale and paleosol is less red than characteristic of adjacent hillslopes

60-112  Eolian sand, medium brown sand, very fine to coarse, poorly sorted, hard, massive, calcareous with moderate number of carbonate filaments, no pebbles

112-168+  Eolian sand and carbonates, pink-reddish yellow sand, very fine-coarse, poorly sorted, hard, massive, calcareous, rare weak carbonate filaments, dense pod-like masses of carbonate-cemented sand that formed in insect burrow fills, small moderately hard carbonate pellets 10 mm dia. in upper part of unit; stage II carbonate morphology

GEO-3.  LA126408, north end of TT-1 (13 346073E 3908205N)
0-5 cm  Historic loose eolian sand that mantles local landscape and covers red paleosol

5-37  Red paleosol, yellowish red sand, coarse to fine sand, poorly sorted, massive, absence of soil structure, hard, noncalcareous with no visible carbonates; paleosol continues laterally throughout length of trench paralleling local topography

37-80  Eolian sand, reddish yellow to light brown, coarse to fine, poorly sorted, massive, calcareous, faint trace of secondary carbonates on sand grains giving the sand a whitened color, absence of carbonate filaments, no pebbles; elsewhere in trench occurs a weak calcic zone in upper 30 cm of unit and with occas. soft carbonate nodules <5 mm dia.; stage I carbonate morphology in upper 30 cm

80-145+  Eolian sand and carbonates, pink-reddish yellow, fine to coarse, poorly sorted, soft to hard, massive, occas. isolated quartz and chert granules, pod-like carbonate masses accumulated in insect burrow fills, upper contact sharp but not distinct; stage II carbonate morphology; this pink sand-carbonate unit is exposed only at the north end of trench TT-1 indicating that the unit does not parallel the red paleosol or the modern topography

GEO-4.  LA126406, about 1/3 of the way from the south end of TT-3; roadcut berm at south end of TT-3 has same sequence of historic eolian sand observed at GEO-1 (13 346397E 3908140N)
0-10 cm  Historic loose eolian sand

10-58  Red paleosol, yellowish red sand, fine to coarse, massive, hard, sharp upper contact, noncalcareous with rare weak carbonate filaments, rare isolated quartz-chert pebbles 2-15 mm dia., absence of soil structures, paleosol developed in eolian sand, lower paleosol grades into underlying eolian sand; weathered platy structure at surface at contact with overlying loose sand

58-74  Reddish yellow eolian sand, fine to coarse, massive without bedding, no pebbles, hard, infrequent visible carbonates

74-106  Reddish yellow eolian sand, fine to coarse, massive, hard, no pebbles, weak to moderate development of carbonate filaments, absence of carbonate nodules; stage I carbonate morphology; possible weak Bk horizon and faint whitening from carbonate-coated sand
106-170+ Reddish yellow eolian sand, coarse to fine, massive, soft, no pebbles, absence of carbonate filaments, rare isolated soft carbonate pellets <15 mm dia. that are reworked from older stage II calcic horizon that underlies this unit and is not exposed in the trench at this locality

**GEO-5. LA126406, middle of trench TT-2 (13 346374E 3908147N)**

0-12 cm Historic loose eolian sand

12-53 Red paleosol, yellowish red eolian sand, fine to coarse, massive, sharp upper contact with 4-cm platy weathered zone, gradational lower boundary, hard, slightly calcareous with sparse weak carbonate filaments, absence of pebbles, absence of soil structures

53-77 Reddish yellow eolian sand, fine to coarse, massive without bedding, no visible carbonates, no pebbles, moderately hard

77-115 Reddish yellow eolian sand, fine to coarse, massive, sparse weak carbonate filaments, weak carbonate coats on sand grains with faint whitening of sediment, occas. rare soft pellet of carbonate cemented sand reworked from older calcic horizon (not exposed in trench); stage I carbonate morphology

115-145+ Yellowish brown eolian sand, fine to coarse, massive, soft, no pebbles, no visible carbonates

**GEO-6. LA126406, north end of trench TT-1 (13 346373E 3908166N)**

0-12 cm Historic loose sand, light yellowish brown, coarse to fine, thin crust on undisturbed surface

12-44 Red paleosol, yellowish red sand, coarse to fine, massive, without soil structure, absence of bedding, no pebbles, sharp upper contact and gradational lower boundary, noncalcareous and without carbonate filaments, moderately hard, occasional insect burrow fills ca. 7 mm dia.; paleosol follows the modern surface topography as exposed in the trench

44-154+ Reddish yellow eolian sand, coarse to fine, massive, soft to moderately hard, no pebbles, no visible carbonates, occas. rare isolated carbonate pellets <10 mm dia.

Stage II calcic horizon not exposed in this trench.

**GEO-7. Non-Site Trench (NST)- 5, north end of trench 1 (13 346579E 3908155N)**

0-5 cm Historic loose eolian sand; insect burrow fills

5-42 Red paleosol, yellowish red sand, fine to coarse quartz sand, clayey, massive, hard, no pebbles, no soil structures, insect burrow fills, weak carbonate filaments in lower 10 cm of paleosol

42-57 Eolian sand, reddish yellow, fine to coarse, massive, hard, no pebbles, insect burrow fills, weak carbonate filaments

57-81 Eolian sand and carbonates, light brown, fine quartz sand, massive, no pebbles, insect burrow fills, hard, carbonate-cemented sand, carbonate filaments, isolated carbonate pellets 10 mm dia.
reworked from older calcic horizon, sharp contact with underlying pink calcic unit; stage II carbonate morphology

81-154+ Calcic horizon, pink (5YR 7/4) fine quartz sand, massive, hard, common soft carbonate nodules <25 mm dia. throughout, platy structure, lacks laminar structure, sand-grain matrix has thin carbonate coats resulting in a whitened color; vertical solution pipes 15 to 60 cm wide at top of horizon; pipe fill is a loose brown fine pebbly unsorted sand that lacks secondary carbonates; stage III carbonate morphology

| GEO-8, Non-Site Trench (NST)-5, near south end of trench 1 (13 346575E 3908132N) |
|---------------------------------|---------------------------------|
| 0-4 cm Historic loose sand |
| 4-34 Red paleosol, yellowish red eolian sand, fine to medium, clayey, massive, hard, absence of pebbles, no carbonate filaments; small burrow fills contain carbonate filaments (while matrix does not) |
| 34-66 Eolian sand and calcic horizon (stage I), fine to medium quartz sand, hard, whitened color due to carbonates, no carbonate filaments, isolated soft carbonate nodules |
| 66-76/86 Eolian sand, yellowish brown, fine to medium, well sorted, massive, occas. soft carbonate nodules (probably carbonate-filled cicada burrows) |
| 86-150+ Eolian sand with calcic horizon (stage II), fine to very fine quartz sand, massive, well sorted, occas. soft carbonate nodules (insect burrow fills) |

| GEO-9, Non-Site Trench (NST)-1, west end, trench through low swale or topographic depression (13 345779E 3908381N) |
|---------------------------------|---------------------------------|
| 0-14 cm Loose eolian sand, historic |
| 14-56 Red paleosol, medium brown, medium to fine quartz sand, massive, no visible carbonates, soft, no pebbles; paleosol lacks red color here due to partial cumulic soil/sediment origins |
| 56-84 Eolian sand, light brown, medium to fine quartz sand, massive, moderately hard, very weak carbonate filaments |
| 84-123 Eolian sand, pale brown, fine to medium quartz sand, massive, whitened color due to carbonate coats on sand grains, no carbonate filaments, small isolated nodule-like (10 mm dia.) occurrence of partial cemented cicada insect burrow fills |
| 123-153+ Eolian sand, yellowish brown, fine to medium quartz sand, massive, soft, no visible carbonates, no visible bedding |

| GEO-10, LA 126409, trench 2, north end, deep excavation, middle of low swale; OSL 1, 8, Fig. 3 (13 345873E 3908202N) |
|---------------------------------|---------------------------------|
| 0-6 cm Loose eolian sand, historic |
| 6-80 Red paleosol, reddish brown, eolian sand, fine to very fine quartz sand, well sorted, massive, no pebbles, hard, occas. weak carbonate filaments (but no discernable Bk horizon), equivalent to |
red paleosol elsewhere in same trench at this site but less red color due to slope wash of sediments into low swale

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<th>Depth</th>
<th>Description</th>
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<tbody>
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<td>80-128</td>
<td>Eolian sand, medium brown, fine to very fine quartz sand, well sorted, massive, no pebbles, soft, no visible carbonate or carbonate filaments; OSL age at 125 cm depth (below top of red paleosol), 14,690 ± 850 yr BP (#8)</td>
</tr>
<tr>
<td>128-150</td>
<td>Eolian sand, fine to very fine quartz sand, clayey and silty, massive, poorly sorted, unit contains small pebbles &lt; 10 mm dia. and cobbles to 19 cm dia.; sharp basal contact on underlying caliche; clayey fine sand with pebbles may be slope wash/colluvial in origin; unit may also be a buried Bt horizon of the underlying Bk calcic paleosol</td>
</tr>
<tr>
<td>150-228</td>
<td>Calcic paleosol, stage II (23% carbonates), very fine to fine quartz sand, silty and clayey, upper 12 cm weathered and has less carbonate or carbonate filaments, carbonate filaments densest in middle of calcic horizon, pod-like accumulation of carbonates on walls of insect burrow fills and rootlets, not a dense/indurated Bk</td>
</tr>
<tr>
<td>228-248+</td>
<td>Yellowish brown eolian sand, fine to very fine, massive, soft, occas. carbonate filaments in upper 5 cm; OSL age at 234 cm depth, ~130,000 ± 30,000 yrs BP (#!), age is estimate only and may be a minimum age for the sand</td>
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GEO-11, Non-Site Trench (NST)-2, north end (13 345954E 3908168N)

<table>
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<tr>
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<th>Description</th>
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<tr>
<td>0-8 cm</td>
<td>Modern loose eolian sand</td>
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<tr>
<td>8-52</td>
<td>Red paleosol in eolian sand, reddish brown, fine to medium quartz sand, clayey, massive, hard, well sorted, no pebbles, no visible carbonates, lower boundary gradational, absence of soil structures, lower part hard</td>
</tr>
<tr>
<td>52-106</td>
<td>Eolian sand, yellowish brown, medium to fine quartz sand, poorly sorted, massive, soft to moderately hard, faint/weak carbonate filaments, weakly developed Bk horizon (stage I), basal contact with underlying caliche is sharp; carbonate zone observed only in north end of trench, not present in south end; isolated small pebbles</td>
</tr>
<tr>
<td>106-145+</td>
<td>Light brown eolian sand, weak calcic horizon (stage II), isolated hard carbonate pellets 10-15 mm dia., 10-12 mm dia. burrow fills lined with carbonate—these break out of sand into elongated pellets, carbonate pellets are soft and can be broken by hand</td>
</tr>
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GEO-12, LA 126409, TT-2, south end of north trench segment (13 345860E 3908161N)

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>0-12 cm</td>
<td>Loose eolian sand, historic</td>
</tr>
<tr>
<td>12-69</td>
<td>Red paleosol, reddish brown eolian sand, fine to medium quartz sand, clayey, poorly sorted, moderately hard, massive, isolated pebbles &lt;4 mm dia., no soil structure although paleosol continuous along upper part of trench exposure, no visible carbonates; upper 8 cm of paleosol is weather and bioturbated</td>
</tr>
<tr>
<td>69-83</td>
<td>Eolian sand, yellowish brown, fine to coarse sand, massive, faint carbonate filaments (weak stage I), slight whitening due to carbonate coats on sand grains</td>
</tr>
</tbody>
</table>
83-124  Eolian sand, weak calcic horizon (stage II), yellowish brown, fine to very fine quartz sand, numerous cicada burrow fills 10-12 mm dia., carbonate lines the burrow fills, soft, absence of carbonate filaments

124-142+ Eolian sand, light brown, fine to very fine, massive, soft, no visible carbonates

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**GEO-13**, LA 126409, TT-1 (1st trench of project), S end (Figs. 4, 12, 21); four OSL ages #2, 3, 4, 5 that document the late Pleistocene age of the eolian sand (13 345889E 3908148N)

0-8 cm  Loose eolian sand, historic

8-54  Red paleosol, reddish brown eolian sand, fine to medium quartz sand, upper 30 cm clayey, poorly sorted, massive, hard, upper 6 cm soft and bioturbated, isolate pebbles to 12 mm dia., weak carbonate filaments in lower 25 cm (stage I), numerous elongated burrow fills 15 mm dia. in sand at base of paleosol; OSL age at 27 cm depth (below top of red paleosol), 11,550 ± 680 yrs BP (#5)

54-88  Eolian sand, light brown, fine to medium quartz sand, well sorted, massive, hard, bioturbated with numerous insect burrow fills, carbonate filaments and carbonate-coated sand grains, no carbonate pellets or nodules; OSL age at 47 cm depth (below top of red paleosol), 12,710 ± 770 yrs BP (#4), OSL age at 67 cm depth (below top of red paleosol), 12,910 ± 790 yrs BP (#3)

88-120+ Eolian sand, light brown, fine to medium quartz sand, massive, moderately sorted, soft, occas. isolated small pebble of poorly indurated carbonate cemented sand (probably bioturbated from underlying stage II calcic horizon; OSL age at 92 cm depth (below top of red paleosol), 12,820 ± 720 yrs BP (#2)

The above eolian sand rests unconformably on the eroded surface of a late Pleistocene stage II calcic paleosol that is better exposed at the north end of the trench

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**GEO-14**, Non-Site Trench (NST)-3, north area of mid-trench (13 347995E 3908158N)

0-18 cm  Loose eolian sand, historic

18-80  Red paleosol, reddish brown eolian sand, fine to medium quartz sand, clayey upper 30 cm, poorly sorted, massive, absence of pebbles, no visible carbonates

80-102  Eolian sand, light brown, fine to medium, massive, soft, absence of pebbles, no visible carbonates

102-124  Eolian sand, weak calcic horizon (stage I), pale brown, fine to medium/coarse sand, some carbonate filaments, whitened sand due to carbonate coats

124-155+  Eolian sand, yellowish brown, fine to coarse sand, massive, poorly sorted, soft, absence of pebbles, no visible carbonates

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**GEO-15**, LA 126407, TT-1, S end of N segment, red paleosol with weak Bk exposed throughout trench and with a stage II calcic paleosol at the base (13 346219E 3980174N)

0-12 cm  Loose eolian sand, historic
**GEO-16**, LA 126407, trench 2, N end of S segment, locality of three OSL ages (# 6, 7, 9) that document the late Pleistocene age of the eolian sand (Figs. 5, 6, 12, 19); (13 346233E 3908159N)

<table>
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>0-6 cm</td>
<td>Historic loose eolian sand</td>
</tr>
<tr>
<td>6-48</td>
<td>Red paleosol, reddish brown, fine to medium and very fine quartz sand, clayey, massive, no visible carbonates, hard, no pebbles, lower 6-9 cm transition with underlying calcic horizon; OSL age at 27 cm depth (below top of red paleosol) is $11,210 \pm 770$ yrs BP (# 9)</td>
</tr>
<tr>
<td>48-86</td>
<td>Calcic horizon (stage I), light brown coarse to medium quartz sand, massive, weak carbonate filaments, soft; OSL age at 73 cm depth (below top of red paleosol) is $13,890 \pm 840$ yrs BP (# 7)</td>
</tr>
<tr>
<td>86-145+</td>
<td>Eolian sand, light brown, medium to fine quartz sand, massive, no pebbles, occas. isolated carbonate-cemented mass of quartz sand (pebble-sized); OSL age at 113 cm depth (below top of red paleosol) is $13,110 \pm 690$ yrs BP (# 6)</td>
</tr>
</tbody>
</table>

The stage II calcic paleosol underlies the above eolian sand farther north in trenches at LA 126407 but is not present at this specific locality

**GEO-17**, Non-site Trench (NST) 4, trench 1, north end (13 346271E 3908173N)

<table>
<thead>
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<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>0-10 cm</td>
<td>Historic loose eolian sand</td>
</tr>
<tr>
<td>10-66</td>
<td>Red paleosol, reddish brown, fine to medium quartz sand, massive, most of reddish color confined to upper 30 cm; no pebbles, very weak carbonate filaments</td>
</tr>
<tr>
<td>66-86</td>
<td>Eolian sand, light brown, fine to medium, quartz sand, massive, no bedding, no pebbles, very weak carbonate filaments; irregular basal contact with underlying calcic paleosol</td>
</tr>
<tr>
<td>86-145+</td>
<td>Calcic paleosol (stage II), pale brown, fine to very fine quartz sand, soft, strong development of carbonate filaments, pod-like accumulations of carbonate (coats on wall of cicada insect burrow fills)</td>
</tr>
</tbody>
</table>
burrow fills) that are soft and easily break out by hand; the calcic horizon of the red paleosol may be merged with the stage II paleosol carbonates

**GEO-18, LA 126405, TT-1** (only 1 trench at this site), middle of trench (Figs. 9, 10, 17); one OSL age from this locality from fill sediment of solution pipe in stage III calcic paleosol, age is 19,780 ± 1,960 yrs BP (# 10); stage III calcic paleosol may be Miocene-Pliocene paleosol on the Rincones surface that is in excess of 2.5 million years in age

- **0-10 cm** Historic loose eolian sand
- **10-40 cm** Red paleosol, yellow reddish brown, medium to fine quartz sand, massive, no visible carbonates, soft; red paleosol extends across and is developed in fill sediment in the solution pipe; strong bioturbation; the red color of the paleosol is not as red here as it is farther west
- **40-66 cm** Calcic horizon (stage I), light brown eolian sand, fine to medium, massive, soft masses of carbonate-cemented sand but an absence of carbonate filaments; strong bioturbation
- **66-84 cm** Eolian sand, light reddish brown, medium to fine quartz sand, soft but with hard masses of carbonate cemented sand
- **84-190+ cm** Calcic horizon (stage III), strongly cemented sand (18% calcium carbonate), platy irregular surface (weathered) with weak laminar structure upper 25 cm; sandy, some pebbles, cicada insect burrows fills lined with carbonates producing rounded nodular appearance, platy-weak laminar structure absent below 25 cm; lower 10 of caliche is sandy with less carbonates; solution pipes in caliche are filled with loose sand, light brown, fine to medium texture, massive, numerous pebbles of caliche and quartz other lithology, absence of soils, no secondary carbonates, no fossils; OSL age from pipe fill approx. 70 cm below top of caliche is 19,780 ± 1,960 yrs BP (# 10); the stage III caliche dips below the floor of the trench at the north end, and eolian sand with a stage II calcic paleosol is present; the upper eolian sand and red paleosol persist at the top of the sequence

**GEO-19, Non-Site Trench (NST) 6, trench 1, about one-third length N from S end (13 348437E 3908100N)**

- **0-12 cm** Historic loose eolian-colluvial sand, light grayish brown, with small pebbles
- **12-52 cm** Red paleosol, reddish brown quartz eolian sand, medium to fine, massive, no bedding, no visible carbonates, no pebbles; the red paleosol thins northward in trench and rests directly on eroded surface of Santa Fe Group sediments
- **52-68 cm** Eolian sand, light yellowish brown, medium to fine texture, massive, hard, occas. carbonate filaments; this unit thins northward in trench and disappears
- **68-135+ cm** Santa Fe Group, light brown coarse to medium sand, numerous isolated gravels (granite, basalt, chalcedony, pink feldspar) <40 mm dia., sediment has vertical and horizontal fractures filled with secondary carbonates, sediment very hard, sediment at this locality may be colluvial in origin

**GEO-20, LA 55509, trench 4, south end (13 348818E 3908101N)**

- **0-20 cm** Loose eolian sand, historic, faint bioturbation, mixing with underlying sand
20-56  Eolian sand, light brown to light reddish brown, fine to very fine quartz sand, massive without bedding (quasi-bedding due to insect bioturbation zone), no pebbles, no visible carbonates, moderately hard, slight coloration in upper 30 cm (possible weak soil development); base of unit rests on erosional unconformity with underlying calcic horizon

56-108  Eolian sand, light yellowish brown, very fine quartz sand, silty, massive, cemented with carbonates, hard, numerous carbonate filaments, small masses of carbonate-cemented sand <30 mm dia., stage I calcic horizon

108-140+ Eolian sand, light brown, fine to medium quartz sand, massive, soft, carbonate-cemented pods (carbonate coated cicada insect burrow fills), no carbonate filaments, no pebbles

A fragment of a polished stone (mano) occurs near this locality within the upper part of the 20-56 cm unit.

**GEO-21, LA 55509, trench 1E, east end (13 348849E 3908104N)**

0-33 cm  Eolian sand, light brown quartz sand, fine to very fine, loose, massive, numerous rootlets and burrow fills, rodent fecal pellets, recent strong bioturbation, no pebbles, no visible carbonates

33-60  Eolian sand, light brown, fine to very fine, quartz sand, massive, no visible secondary carbonates, no pebbles, soft; may be a weak soil Bw horizon

60-71  Eolian sand, pale brown, fine to very fine, quartz sand, massive, soft, rodent burrow fills to this depth, no visible carbonates, no pebbles; base at erosional unconformity with underlying calcic horizon

71-129  Calcic paleosol (stage I), light yellowish brown, quartz sand, fine to medium, massive, moderately hard, carbonate filaments, pod-like burrow fills partly cemented with carbonates that break out in cylindrical shapes, no carbonate nodules or concretions, small masses of sand cemented by carbonates easily crushed between fingers

129-154+  Light brown, eolian sand, fine to medium, massive, loose and soft, some pod-like carbonate cemented cicada insect burrows, carbonate filaments (stage I carbonate morphology)

**GEO-22, LA 55509, trench 5, west end (13 348804E 3908136N)**

0-18/24 cm  Historic eolian sand, light yellowish brown, fine to medium, massive but with faint lamellae preserved where not turbated; irregular thickness

24-36/46  Eolian sand, light yellowish brown, fine to medium, massive, soft, numerous burrow fills, no visible carbonates; irregular thickness, base of unit rests on erosional unconformity on underlying weak calcic horizon

46-86  Eolian sand, pale brown, fine to medium quartz sand, soft, massive, carbonate filaments, soft masses of cemented sand (stage I carbonates)

86-151  Eolian sand, light reddish brown, medium to fine quartz sand, massive, no visible carbonates, numerous burrow fills
151-180+ Eolian sand, light brown, fine to medium quartz sand, massive, well sorted, numerous burrow fills

**GEO-23, LA 55503, trench 3, middle (Fig.14) (13 351153E 3908200N)**

0-10 cm Uppermost loose sand, platy, weathered top of underlying unit

10-38 Medium brown fine sand, silty, massive, rounded pellet-like carbonate cemented masses 10-12 mm dia. (cicada insect burrow fills with carbonate coats), hard, easily crushed with hammer, no carbonate filaments (eroded stage II calcic paleosol)

38-74 Yellow reddish brown sand, fine to medium, massive, noncalcareous but with occas. reworked caliche nodules, hard, sediment fills solution pipes in underlying caliche; sand thins and is absent in other trenches

74-150+ Calcic horizon (stage III, 14 % calcium carbonate), irregular-weathered top, hard, densely cemented coarse sand with pebbles, upper weakly laminar zone, nodular-like appearance is formed by carbonate-cemented cicada insect burrow fills

**GEO-24, LA 55507, trench 2, west end (Fig. 15); area of thickest development of Holocene deposits that overlie Santa Fe Group sediments (13 348971E 3908112N)**

0-15 cm Upper loose sand, eolian and colluvial, light brown, fine to medium, soft, massive, numerous burrow fills, historic

15-51 Light brown, eolian-colluvial sand, fine to medium, massive, soft, numerous burrow fills, occas. isolated pebble, no visible carbonates; this unit pinches out laterally; it occupies a small gully that is eroded into underlying Santa Fe Group sediments

51-85 Light brown, eolian-colluvial sand, coarse-medium sand, massive, numerous pebbles both isolated and in small lenses, no visible carbonates, numerous burrow fills and root molds; this unit fills the small gully referred to above; upper 15 cm may be a weak A horizon soil that formed in the gully before it was buried by half a meter of additional sand

85-130+ Santa Fe Group, sand and gravels with locally reworked gravels; elsewhere in trench, the Santa Fe Group sediments occur within 40 cm of the surface

**GEO-25, LA 55509, trench 3E, middle (Fig. 16); location of two OSL ages from eolian sand (13 348837E 3908124N)**

0-5 cm Light brown loose sand, eolian, historic

5-33 Eolian sand, yellowish brown, fine to very fine quartz sand, massive, moderately hard, weak platy structure top 10 cm, slightly darker color that underlying eolian sand (may be a weak Bw soil horizon), occas. rare isolated pebble, no visible carbonates (2.6% calcium carbonate), numerous cicada
insect burrow fills 11-12 mm dia., rodent burrow fills 4 cm dia., numerous rootlets, artifacts occur at base of this unit; OSL age (# 12) from 16 cm depth (below top of this unit) is 1,350 ± 160 yrs BP (= 356 to 956 AD, 2 sigma)

33-56 Eolian sand, pale brown, fine to very fine quartz sand, silty, massive, whitening due to thin carbonate coats on sand grains (stage I calcic horizon, 4.6% calcium carbonate), no carbonate filaments or nodules, sediment harder than other units in this section, numerous cicada insect burrow fills 10-12 mm dia., base of weak calcic horizon irregular with underlying sand

56-89 Eolian sand, pale brown, fine to medium quartz sand, massive, soft, occas. rare carbonate filaments (3.4% calcium carbonate), many rootlets, base of unit irregular with underlying eroded surface of calcic paleosol; OSL age (# 11) from 67 cm depth (below top of 5-33 cm unit is 15,130 ± 1,070 yrs BP; this is the earliest age from the upland eolian sand sheet

89-140+ Eolian sand, pale brown, very fine to fine quartz sand, silty (40%), massive, soft, whitening due to carbonate coats on sand grains (stage II calcic horizon, 5.2% calcium carbonate), weak carbonate filaments; in adjacent trench this calcic horizon has dense filaments and carbonate-cemented masses of sand around cicada insect burrow fills; top of this unit is eroded and irregular with overlying eolian sand

GEO-26, Non-Site Trench (NTS) 12, trench 1, middle; locality is broad low-gradient surface with red paleosol (13 348137E 3908103N)

0-12 cm Historic loose eolian sand

12-44 Red paleosol, reddish brown, fine to medium quartz sand, eolian, massive, well sorted, upper half soft with no visible carbonates, lower half hard with weak carbonate filaments, gradational contact with underlying eolian sand and calcic horizon

44-66 Eolian sand, pale brown, medium to fine quartz sand, massive, whitening due to carbonate coats on sand grains (stage I calcic horizon), irregular occurrence of partly cemented cicada insect burrow fills

66-106+ Eolian sand, yellowish brown, medium to fine quartz sand, soft, small masses of carbonate-cemented sand in upper 25 cm

GEO-27, Non-Site Trench (NST) 11, trench 1, middle low gradient surface with red paleosol; uncommon case of alluvium beneath eolian sand (13 347951E 3908114N)

0-12 cm Historic loose eolian sand

12-66 Red paleosol, yellow reddish brown, medium to fine quartz sand, massive, eolian sand, upper 15 cm soft, lower part hard with carbonate-cemented cicada insect burrow fills and faint carbonate filaments

66-87 Eolian sand, yellowish brown, medium to fine quartz sand, eolian, massive, hard, weak cicada insect burrow fill casts cemented with carbonates, calcic horizon (stage II); absence of stage I
calcic horizon association with red paleosol; Bk assoc. with red paleosol may be merged with this stage II calcic horizon

87-122+ Alluvium, light brown, fine sand with rounded pebbles, weakly bedded, sand is massive with some carbonate-cemented cicada burrow fills

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**GEO-28**, Non-Site Trench (NST) 10, trench 1, middle, topography slopes gently eastward (13 347773E 3908120N)

0-10 cm Historic loose eolian sand

10-55 Red paleosol, reddish brown, fine to medium quartz sand, eolian, massive, no pebbles, lower 20 cm has rare faint carbonate filaments, no pebbles

55-97+ Eolian sand, pale brown, fine to medium quartz sand, whitened color due to carbonate coats on sand grains, rare weak carbonate filaments, occas. carbonate-cemented casts of cicada insect burrow fills, no pebbles; calcic horizon (stage I) thicker here than at GEO-26 and GEO-27

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**GEO-29**, Non-Site Trench (NTS) 8, trench 1, middle, shallow trench down to caliche, nearly flat topography sloping gently to northeast (13 347592E 3908132N)

0-10 cm Historic loose eolian sand

10-30/35 Red paleosol, reddish brown, medium to fine quartz sand, eolian, massive, occas. pebbles and large gravels in lower 10 cm of paleosol that are probably lag gravels at unconformity; rests unconformably on eroded surface of stage III calcic horizon

35-70+ Caliche, stage III, weathered, with coarse sand, pebbles, carbonate-cemented casts of cicada burrow fills, absence of laminar structure, presence of small solution pipes 20-30 cm dia.

Absence of stage I and stage II calcic horizons in this trench.

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**GEO-30**, Non-Site Trench (NST) 9, trench 1, middle, topography locally flat with slight slope to southeast (13 347693E 3908120N)

0-8 cm Historic loose eolian sand

8-31 Red paleosol, reddish brown, medium to fine quartz sand, massive, eolian sand, no visible carbonates; paleosol follows topography

31-67 Eolian sand, pale brown, medium to fine quartz sand, massive, whitened color due to carbonate coats on sand grains (stage I), no carbonate filaments, soft, occas. carbonate-cemented casts of cicada burrow fills

67-89 Eolian sand, yellowish brown, medium to fine quartz sand, massive, soft, slightly
calcareous, no filaments

89-105+ Caliche, eroded top of stage III calcic horizon, reddish yellow sand matrix, soft, crumbles between fingers, carbonate-cemented cicada insect burrow fills; caliche does not follow topography nor the overlying red paleosol

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**GEO-31**, Non-Site Trench (NST) 13, trench 1, middle; low gradient slope to ENE towards Arroyo de la Baranca (13 348315E 3908109N)

0-12 cm Historic loose reddish brown eolian sand, derived from nearby deflation of red paleosol

12-17 Historic loose light brown eolian sand

17-39 Red paleosol, reddish brown, medium-fine quartz sand, massive, hard, no visible carbonates, no filaments, paleosol comparatively thin here; sharp lower boundary with underlying stage II caliche

39-77 Caliche (stage II), hard, massive, no pebbles, no laminar or platy structure, cemented cicada burrow molds

77-102+ Yellow sand, fine to very fine, massive, eolian, soft, cicada insect burrow fills are partly cemented by carbonates; unit becomes more calcareous laterally

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**GEO-32**, Non-Site Trench (NST) 14, trench 1, middle, shallow trench located on high bench west of and above Arroyo de la Baranca; the sediments exposed in the trench are alluvial sands and gravels mantled by a thin cover of eolian sand that is bioturbated and mixed with the underlying gravels (13 348493E 3908120N)

0-5/10 cm Light brown sand, eolian, loose, strongly bioturbated with underlying gravels

10-75+ Gravels that include discontinuous zones of carbonate-coated clasts, weakly sorted gravels, some colluvial-mix of clasts; lithology of local origin including basalt, chalcedony, sandstone, granite up to 25 cm dia.; the gravels may be Santa Fe Group sediments or derived from nearby Santa Fe Group deposits.
APPENDIX B

SITE LOCATION MAP
APPENDIX C

RADIOCARBON DATING SHEETS
<table>
<thead>
<tr>
<th>Sample Data</th>
<th>Measured Radiocarbon Age</th>
<th>13C/12C Ratio</th>
<th>Conventional Radiocarbon Age(*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta - 219095</td>
<td>2510 +/- 40 BP</td>
<td>-20.8 o/oo</td>
<td>2580 +/- 40 BP</td>
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<td>SAMPLE : 55509-34-2F2</td>
<td>ANALYSIS : AMS-Standard delivery</td>
<td>MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid</td>
<td>2 SIGMA CALIBRATION : Cal BC 820 to 760 (Cal BP 2760 to 2710) AND Cal BC 620 to 590 (Cal BP 2560 to 2540)</td>
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<td>Beta - 219096</td>
<td>2880 +/- 40 BP</td>
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<td>Beta - 219097</td>
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<td>13C/12C Ratio</td>
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-20.8; lab. mult=1)

Laboratory number: Beta-219095

Conventional radiocarbon age: 2580±40 BP

2 Sigma calibrated results: Cal BC 820 to 760 (Cal BP 2760 to 2710) and
(95% probability) Cal BC 620 to 590 (Cal BP 2560 to 2540)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 790 (Cal BP 2740)

1 Sigma calibrated result: Cal BC 800 to 780 (Cal BP 2750 to 2730)
(68% probability)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

INTCAL98 Radiocarbon Age Calibration

Mathematics
A Simplified Approach to Calibrating C14 Dates
Laboratory number: Beta-219096
Conventional radiocarbon age: 2990±40 BP
2 Sigma calibrated result: Cal BC 1380 to 1100 (Cal BP 3320 to 3050)

 Intercept data
Intercept of radiocarbon age with calibration curve: Cal BC 1250 (Cal BP 3200)
1 Sigma calibrated result: Cal BC 1290 to 1140 (Cal BP 3240 to 3090)

References:
Database used
INTCAL98
Calibration Database
Editorial Comment
INTCAL98 Radiocarbon Age Calibration
Mathematics
A Simplified Approach to Calibrating C14 Dates

Beta Analytic Radiocarbon Dating Laboratory
4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.1:lab. mult=1)

Laboratory number: Beta-219097

Conventional radiocarbon age: 3010±40 BP

2 Sigma calibrated result: Cal BC 1390 to 1120 (Cal BP 3340 to 3070)

(95% probability)

Intercept data

Intercept of radiocarbon age

with calibration curve: Cal BC 1270 (Cal BP 3220)

1 Sigma calibrated result: Cal BC 1310 to 1200 (Cal BP 3260 to 3150)

(68% probability)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

INTCAL98 Radiocarbon Age Calibration

Mathematics
A Simplified Approach to Calibrating C14 Dates
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-12.7; lab. mult=1)

Laboratory number: Beta-219098

Conventional radiocarbon age: 580±40 BP

2 Sigma calibrated result: Cal AD 1300 to 1420 (Cal BP 650 to 530)

(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1400 (Cal BP 550)

1 Sigma calibrated results: Cal AD 1310 to 1360 (Cal BP 640 to 590) and Cal AD 1390 to 1410 (Cal BP 560 to 540)

References:

Database used
IN TCAL98

Calibration Database

Editorial Comment

INTCAL98 Radiocarbon Age Calibration

Mathematics
A Simplified Approach to Calibrating C14 Dates

Beta Analytic Radiocarbon Dating Laboratory
4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.9: lab. mult=1)

Laboratory number: Beta-219099

Conventional radiocarbon age: 870±40 BP

2 Sigma calibrated result: Cal AD 1040 to 1260 (Cal BP 910 to 690)
(95% probability)

Intercept data
Intercept of radiocarbon age with calibration curve: Cal AD 1180 (Cal BP 760)

1 Sigma calibrated result: Cal AD 1160 to 1220 (Cal BP 790 to 730)
(68% probability)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

INTCAL98 Radiocarbon Age Calibration

Mathematics
A Simplified Approach to Calibrating C14 Dates

Beta Analytic Radiocarbon Dating Laboratory
4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.3: lab. mult=1)

Laboratory number: Beta-219100

Conventional radiocarbon age: 3030±40 BP

2 Sigma calibrated result: Cal BC 1400 to 1140 (Cal BP 3350 to 3090)

(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 1290 (Cal BP 3240)

1 Sigma calibrated result: Cal BC 1380 to 1250 (Cal BP 3320 to 3200)

(68% probability)

References:

Database used
INTCAL98

Calibration Database

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21:lab. mult=1)

Laboratory number: Beta-219101

Conventional radiocarbon age: 4600±50 BP

2 Sigma calibrated results: Cal BC 3510 to 3420 (Cal BP 5460 to 5370) and Cal BC 3390 to 3320 (Cal BP 5340 to 5270) and Cal BC 3220 to 3120 (Cal BP 5170 to 5070)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 3360 (Cal BP 5310)

1 Sigma calibrated results: Cal BC 3490 to 3460 (Cal BP 5440 to 5410) and Cal BC 3370 to 3350 (Cal BP 5320 to 5300)

References:

Database used
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Calibration Database
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-10.6; lab. mult=1)

Laboratory number: Beta-219102

Conventional radiocarbon age: 920±40 BP

2 Sigma calibrated result: Cal AD 1020 to 1210 (Cal BP 930 to 740)

(95% probability)

Intercept data

Intercepts of radiocarbon age with calibration curve:
- Cal AD 1060 (Cal BP 890) and
- Cal AD 1080 (Cal BP 860) and
- Cal AD 1150 (Cal BP 800)

1 Sigma calibrated result: Cal AD 1030 to 1180 (Cal BP 920 to 780)

(68% probability)

References:

Database used
INTCAL98

Calibration Database

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-20.3:lab. mult=1)

Laboratory number: Beta-219103

Conventional radiocarbon age: 4010±40 BP

2 Sigma calibrated result: Cal BC 2600 to 2460 (Cal BP 4560 to 4410)
(95% probability)

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal BC 2550 (Cal BP 4500) and
Cal BC 2540 (Cal BP 4480) and
Cal BC 2490 (Cal BP 4440)

1 Sigma calibrated result: Cal BC 2580 to 2470 (Cal BP 4520 to 4420)
(68% probability)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.7:lab. mult=1)

Laboratory number: Beta-219104

Conventional radiocarbon age: 930±40 BP

2 Sigma calibrated result: Cal AD 1020 to 1200 (Cal BP 930 to 750)
(95% probability)

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1050 (Cal BP 900) and
Cal AD 1100 (Cal BP 850) and
Cal AD 1140 (Cal BP 810)

1 Sigma calibrated result: Cal AD 1030 to 1170 (Cal BP 920 to 780)
(68% probability)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.5:lab. mult=1)

Laboratory number: Beta-219105

Conventional radiocarbon age: 3900±40 BP

2 Sigma calibrated result: Cal BC 2480 to 2280 (Cal BP 4430 to 4230) (95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2430 (Cal BP 4380)

1 Sigma calibrated result: Cal BC 2460 to 2310 (Cal BP 4410 to 4260) (68% probability)

References:

Database used
INTCAL98
Calibration Database
Editorial Comment

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-21:lab. mult=1)

Laboratory number: Beta-219106

Conventional radiocarbon age: 4050±40 BP

2 Sigma calibrated results: Cal BC 2850 to 2820 (Cal BP 4800 to 4770) and Cal BC 2670 to 2470 (Cal BP 4620 to 4420)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2580 (Cal BP 4520)

1 Sigma calibrated results: Cal BC 2600 to 2550 (Cal BP 4560 to 4500) and Cal BC 2540 to 2490 (Cal BP 4480 to 4440)

References:

Database used
INTCAL98
Calibration Database
Editorial Comment
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-20: lab. mult=1)

Laboratory number: Beta-219107

Conventional radiocarbon age: 4440±40 BP

2 Sigma calibrated results: Cal BC 3340 to 3200 (Cal BP 5290 to 5150) and Cal BC 3200 to 2920 (Cal BP 5150 to 4870)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 3090 (Cal BP 5040)

1 Sigma calibrated results: Cal BC 3270 to 3240 (Cal BP 5220 to 5190) and Cal BC 3110 to 3020 (Cal BP 5060 to 4970)

References:

Database used
INTCAL98

Calibration Database

Editorial Comment

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APPENDIX D

ARTIFACT CURATION RECEIPT