Excavations along NM 22:
Agricultural Adaptation from AD 500 to 1900 in the Northern Santo Domingo Basin, Sandoval County, New Mexico

compiled by Stephen S. Post and Richard C. Chapman

Volume 1
Introduction to the Peña Blanca Project and Excavation Results from the Small Sites or Small-Scale Investigations

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Eric Blinman, Linda J. Goodman, Jonathan Kaplan,
Leslie D. McFadden, Kenneth L. Peterson,
Stephen S. Post, Jeanne Schutt, John Ware

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Archaeology Notes 385

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Administrative Summary and Acknowledgments

Between September 30, 1996 and January 27, 1997, Sandra Marshall of the New Mexico State Highway and Transportation Department (NMSHTD) conducted a cultural resources survey along a portion of NM 22 between Peña Blanca and Cochiti Dam where NMSHTD planned to replace the bridge over the Santa Fe River, widen the shoulders, flatten the slope, overlay the pavement, and add a deceleration lane . The survey determined that seven sites fell within the project area and NMSHTD requested that OAS prepare a data recovery plan and budget for work at the seven sites.

It was May 14 before the project director, John Ware, was able to meet with Mr. Jacob Pecos of the Cochiti Pueblo Environmental Office to review the project and obtain permission to visit the sites. At that time, Steve Koczan of NMSHTD anticipated that the construction contract would be let in October so there would be no time for a testing phase to determine the nature and extent of the sites within the project area. A data recovery plan was submitted to NMSHTD on August 20, 1997. It was not until December 9, 1997 that a budget for the field phase of the project was approved by NMSHTD. At that time, Governor Herrera of Cochiti Pueblo signed a letter of permission for the work and OAS applied for an ARPA permit to conduct the excavations. Permit number BIA/AAO-98-002, effective January 13, 1998 through January 13, 1999, was issued.

In February 1998, OAS subcontracted with the Office of Contract Archeology (OCA), University of New Mexico, to provide excavation and analysis support for the project. Field laborers were hired from Santo Domingo and Cochiti pueblos. John Ware, Ph.D., from OAS and Richard Chapman, Ph.D., from OCA served as co-principal investigators. OAS crews excavated four sites, LA 6169, LA 6170, LA 6171, and LA 115863 from February to October 1998. OCA crews excavated three sites, LA 249, LA 265, and LA 115862 from February to June 1998.

At the end of the field phase, John Ware resigned from the project and was replaced by Stephen Post as the OAS Principal Investigator. Mr. Post and Dr. Chapman coordinated the analysis, report writing and production, and curation responsibilities. OCA was responsible for the chipped and ground stone analysis, the miscellaneous and mineral artifact analysis, the geomorphological study, provenience database management, writing of the site reports for the sites its crews excavated and the graphic reproduction of site and large feature profiles. OAS was responsible for the ceramic analysis, fauna analysis, human osteology study and human remains reburial, archaeobotanical analysis, ethnohistory, reporting on sites excavated by OAS crews, final report compilation, editing, and preparation for production. Ultimately, curation preparation for all sites was completed by OAS staff.

This report, in six volumes, provides the cultural historical and environmental context and background, the research design, excavation reports on the seven sites, analytical chapters, and a project synthesis. The sum of the report represents the work of many OAS and OCA staff members who are identified on the cover pages of each volume. Principal authors and analysts were assisted by a troop of lab personnel, many of whom no longer work at either institution.

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Volumes in the Collection:

Volume 1. Introduction to the Peña Blanca Project and Excavation Results from the Small Sites or Small-Scale Investigations

Volume 2. Major Site Excavations at LA 265 and LA 6169

Volume 3. Major Site Excavations at LA 6170 and LA 6171

Volume 4. Analytical Studies: Chronology, Ceramics, Stone Tools

Volume 5. Analytical Studies: Fauna and Flora

Volume 6. Site Structure and Conclusions

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VOLUME 1

INTRODUCTION TO THE PEÑA BLANCA PROJECT AND EXCAVATION RESULTS FROM THE SMALL SITES OR SMALL-SCALE INVESTIGATIONS

by Nancy J. Akins, Jessica Badner, Byrd Bargmann, Eric Blinman, Linda J. Goodman, Jonathan Kaplan, Leslie D. McFadden, Kenneth L. Peterson, Stephen S. Post, Jeanne Schutt, John Ware

Contents

PART I. INTRODUCTION TO THE PEÑA BLANCA PROJECT

PART II. EXCAVATION RESULTS FROM THE SMALL SITES OR SMALL-SCALE INVESTIGATIONS

Figures

Tables

Part I

Introduction to the Peña Blanca Project

Chapter 1
Introduction and Project History

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The field project was completed through the combined efforts of the OAS and OCA project directors and crew, as well as,

This report, in six volumes, provides the cultural historical and environmental context and background, the research design, excavation reports on the seven sites, analytical chapters, and a project synthesis. The sum of the report represents the work of many OAS and OCA staff members who are identified on the cover pages of each volume. Principal authors and analysts were assisted by a troop of lab personnel, many of whom no longer work at either institution.

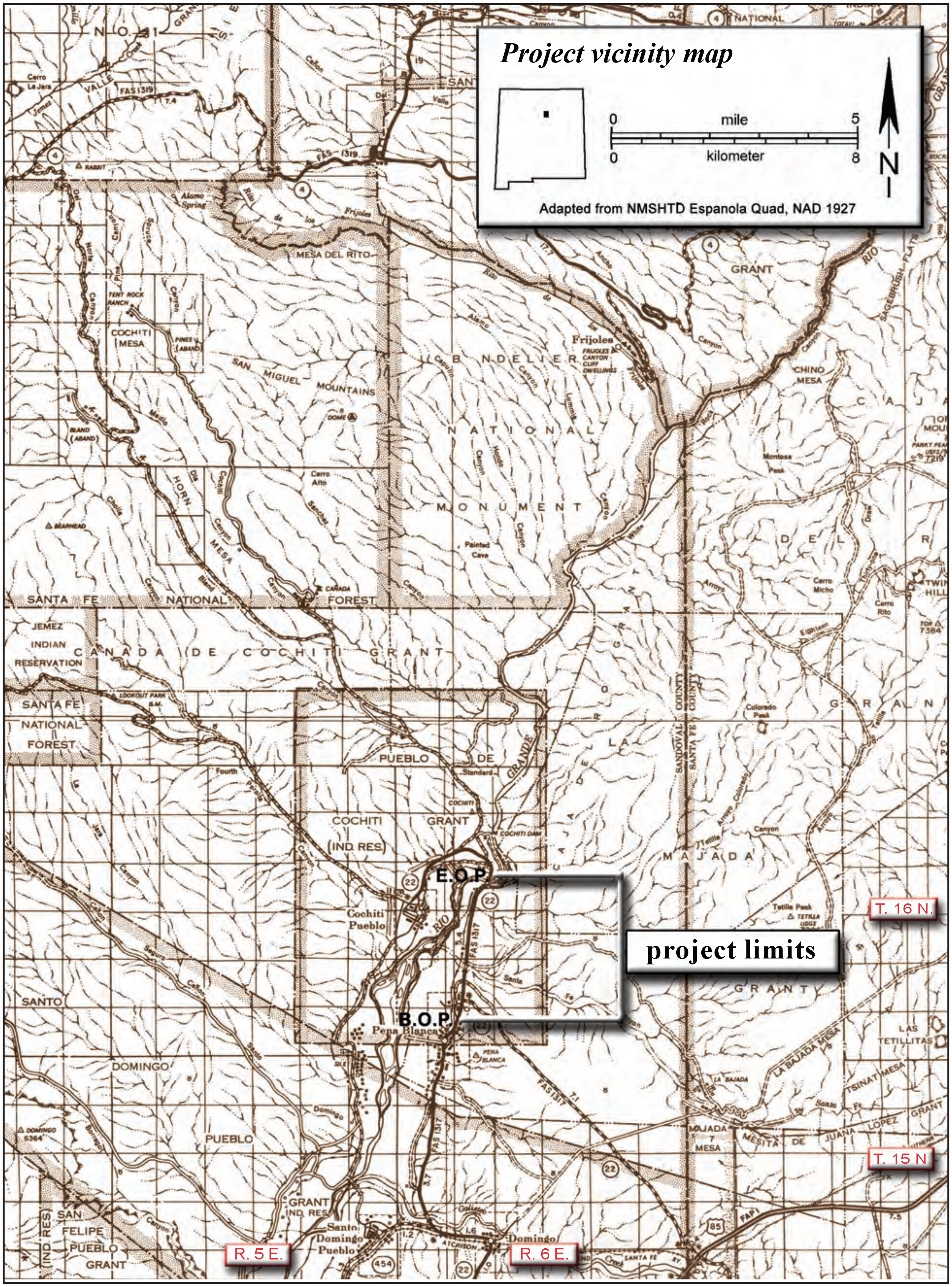

Figure 1.1. Project vicinity map.

Chapter 2
Prehistoric Cultural Background

Nancy J. Akins and Stephen S. Post

Archaeological and ethnological research in the Cochiti area dates back to the work of such well-known pioneers as Adolf Bandelier, Charles F. Lummis, Edgar L. Hewett, Nels C. Nelson, H. P. Mera, Leslie White, Ruth Benedict, and W. W. Hill. Much of the excavation and testing took place on the Pajarito Plateau and at Bandelier National Monument until the 1960s when survey and excavations associated with the construction of Cochiti Dam and the eventual floodpool brought research into the Peña Blanca project area (Biella 1977:105–106).

This section builds on the work of Biella (1977a:105–149; 1979:103–144), Chapman (1979:61–73), and Chapman and Biella (1979:385–406), adding some of what we have learned about Rio Grande prehistory in the intervening time. Biella's site distribution data include information collected before 1975 from nine USGS topographical quadrants, which are discussed as five districts reflecting major geological or physiographic features (Cochiti project study). The most pertinent for this project is the Cochiti District, which is comprised of the area along the Rio Grande below the mouth of White Rock Canyon (Biella 1977:106). In addition, Dickson's (1979) survey of a transect of land from Arroyo Hondo Pueblo to Cochiti Pueblo on the west side of the Rio Grande encompassed the Peña Blanca project area. A historic period overview can be found in the ethnohistory section of this report, prepared by Linda Goodman.

Paleoindian (9200–5500 BC)

Paleoindians are viewed as big-game hunters, although some researchers believe the earliest or Clovis (9200–8900 BC) and latest or Late Paleoindian (8000–7000 BC) groups were unspecialized hunter-gatherers and that only Folsom (8900–8000 BC) groups specialized in hunting migratory big game (Moore et al. 2002:11). Low population, the highly mobile nature of the subsistence strategy, relative scarcity of diagnostic tools, and soil accumulation all contribute to the paucity of evidence for Paleoindian use of much of the Upper and Middle Rio Grande area (Cordell 1978). Most of the evidence is in the form of diagnostic projectile points found on the surface. These provide information on the range of environments used but little about subsistence, group size, type of mobility, or organization.

The Cochiti project study reports eight Paleoindian sites in their study area. All are in Upper Sonoran juniper or juniper-related ecological communities and mainly in or just downstream from Bland Canyon (Biella 1977:113, 118–119). Isolated Clovis, Folsom, Agate Basin, Milnesand, and Scottsbluff points have been found on the Pajarito Plateau (Powers and Van Zandt 1999:21). At the Caja del Rio Canyon site (LA 112527) north of White Rock Canyon, Clovis, Plainview, Angostura, Midland, and Folsom components were represented by one or more complete or broken spear points and other tools. The site is on top of a butte overlooking the Cañada Ancha drainage 2 km from its confluence with the Rio Grande. The site may reflect repeated, short-term, possibly ritual visits to this location. Contemporaneity of associated rock features has not been determined. Little or no debris from tool production and maintenance have been observed, further supporting the hypothesis that the spear points were deposited as part of a seasonal ritual. The full Paleoindian time range is represented by the points suggesting a long-lived practice and occupation by one kin-related group or band. Farther north in the Jemez Mountains, a Clovis point found at a multicomponent site located in a saddle overlooking an intermittent drainage indicates use of high-altitude environments (Evaskovich et al. 1997:418, 438–439). Late Paleoindian finds consisting of Cody Complex artifacts have been reported from the Galisteo Basin (Post 1996:11).

Little evidence of Paleoindian use or occupation has been found within a 10-km radius of the Peña Blanca project area. No sites have been recorded, but two Cody Complex artifacts, an Eden point fragment, and a Cody scraper were identified in the South Caja del Rio area (Doleman 1996:60). Substantial soil deposition may account for the apparent absence of lower elevation sites rather than indicating these groups found the floodplain and adjacent terraces unattractive to their subsistence regime.

Archaic (5500 BC–AD 600)

Archaic groups are characterized as highly mobile hunter-gatherers who relied on a broad spectrum of plant and animal resources. Because of the time span involved and differences in mobility and subsistence, the period is generally subdivided into the Early, Middle, and Late Archaic as well as by the Oshara Tradition phases defined by Irwin-Williams (1973). Early Archaic or Jay (5500 to 4800 BC) and Bajada (4800 to 3200 BC) phase sites are usually small camps that were probably occupied by highly mobile families or extended family groups for short periods of time. Middle Archaic San José (3200 to 1800 BC) and Armijo (1800 to 800 BC) phase sites are more numerous, are larger, and have more ground stone tools. Environmental conditions appear to have worsened reducing the number of exploitable plants and animals. Corn was probably introduced some time in the Late Archaic. Late Archaic or En Medio phase (800 BC to AD 400 or 600) populations were less mobile and had a greater reliance on corn, although this sequence is less evident in the Northern Rio Grande (Post 2002). Population increased with more diverse locations being occupied along with more evidence of seasonal aggregation. Cool, dry conditions prevailed during much of this phase (Anschuetz et al. 1997:85–87; Moore et al. 2002:12–13).

A total of 59 Archaic sites, most dating to the latest phase, are located within the Cochiti project study area (Biella 1977:113). The Cochiti Reservoir survey of the permanent and flood control pools recorded 90 nonstructural sites, some with artifacts suggesting Archaic period occupations (Biella and Chapman 1977a:201). Subsequent excavations at six of these sites were aimed at defining the Archaic adaptation in the project locale. While the absence of datable charcoal precluded refining the Oshara Tradition phases in the Cochiti area and very little evidence of the fauna and flora used was preserved, these researchers noted a pattern of hearths, fire-cracked rock scatters, and grinding tools that indicated seeds were ground. Pieces of mussel shell in the hearths that suggested use of riverine resources. Sites did not appear to be located with respect to environmental diversity nor did the intensity of use of a particular site area depend on environmental diversity. The project area, in and around White Rock Canyon, appears to have been seasonally occupied by small groups with a much larger territorial range (Chapman and Biella 1979:386–393).

On the Caja del Rio Plateau, Irwin-Williams (1973) recorded a large multicomponent lithic artifact scatter. The Bajada type site overlooks the broad Santo Domingo Basin to the west and provides access to the upper elevation grasslands to the south and east. The site covers 300,000 sq m exhibiting a wide array of tools and manufacturing debris. The accumulated artifact distribution suggests a repeatedly occupied hunting camp, perhaps geared to summer exploitation of large game herds and June maturation of Indian ricegrass (Hicks 1982).

Other Early Archaic sites were identified in the South Caja del Rio area (Doleman 1996). While not as extensive as the Bajada site, these locations suggest that seasonal camps and hunting or resource extraction areas were widespread and focused on the upland juniper-grasslands.

Few Middle Archaic period sites (3300 to 1800 BC), as defined by San José-style points, have been identified in the Cochiti and surrounding areas. San José-style points were recovered from the Bajada site investigations suggesting continuity in seasonal movement along the Rio Grande from the Early to Middle

Archaic periods (Hicks 1982). In the South Caja del Rio area, no Middle Archaic components were found during the inventory (Doleman 1996). This apparent absence of San José phase sites may reflect a change in base camp locations and the effect that unsystematic surface collecting had on projectile point distributions within the Caja del Rio area. Excavated Middle Archaic period sites in the Santa Fe area reflect a focus on seasonal foraging and plant processing. Shallow housepit foundations combined with a wide range of thermal and processing pits suggest that Middle Archaic populations moved into piñon-juniper settings adjacent to primary tributaries of the Santa Fe River (Post 2005). These sites were buried, suggesting that Middle Archaic components in other areas are buried or have been removed by geomorphological processes.

The low frequency, low visibility pattern observed for the Middle Archaic changes somewhat in the Armijo phase (1800 to 800 BC) when small structures and abundant and diverse artifacts and features indicate the use and reuse of sites as base or residential camps, probably on a seasonal basis to exploit plant resources. Sites cluster, suggesting a water source may have contributed to their placement. Late Archaic or En Medio phase sites are more abundant and occur in a greater range of locations from repeatedly occupied riverine and lowland locations to the foothills of the Sangre de Cristo Mountains. Most are limited activity or short-term bases but some have structures and higher densities of artifacts indicating longer use or reoccupation. Evidence for the use of corn is virtually absent (Moore et al. 2002:13–15; Post 1996:11-2, 2004; Schmader 1994a).

Specific seasonal movements have been proposed for some areas. Late Archaic foragers in the area just north of Albuquerque appear to have located their winter residential camps in foothill rockshelters where shelter, fuel wood, and water were available. With spring, groups moved down into areas where they could forage for early season plants then shifted to higher elevations following the availability food plant resources. By summer, these groups had moved into the Jemez Mountains to forage and hunt. Resources stored for winter use would have been processed during summer (Dello-Russo 1999:202–203).

Archaic sites cluster in areas to the north and east of the Peña Blanca project area (Post 2002). The absence in the general vicinity may have more to do with a lack of survey, the general poverty of seasonal plant and animal life on the gravel terraces, later occupations at terrace ends, and soil accumulations in the valley and tributary bottoms.

Pueblo Period

A shift from a more mobile hunting and gathering economy to one based on corn farming and appearance of ceramics generally marks the beginning of the Pueblo era, around AD 600. Few sites date to the early transitional period making it difficult to characterize its exact nature. Corn was present in the area in the Late Archaic but either the climate, short growing season, or abundance of natural resources may have delayed the advent of full-scale farming until it was forced by demographic pressure (Ware 1997:8–9).

Dissatisfied with the Pecos Classification scheme based on the sequence found in the Four Corners area, Wendorf and Reed (1955) proposed a framework more suited to the patterns observed at sites in the Rio Grande region. Most researchers use this reconstruction of the cultural sequence, some with subdivisions and refinements (e.g., Boyer and Lakatos 2000:61–67; Dickson 1979:10).

Developmental Period

The Developmental period is commonly divided into the Early Developmental (AD 600 to 900), Middle Developmental (or Red Mesa) (AD 900 to1000 or 1100), and Late Developmental (or Tesuque) (AD 1000 or 1100 to 1200) phases or periods (e.g., Dickson 1979:10), or into the Early Developmental (AD 600 to 900) and Late Developmental (AD 900 to 1200) (e.g., Boyer and Lakatos 2000:71).

Early Developmental. Surveys have recorded relatively few Early Developmental sites. Those found tend to be situated on low terraces overlooking primary and secondary tributaries of the Rio Grande with most found south of La Bajada Mesa. Residential sites generally have between one and three shallow circular pit structures and ceramic assemblages comprised of plain gray and brown wares, red slipped brown wares, and San Marcial Black-on-white (Boyer and Lakatos 2000:15–16). In the Santa Fe area, sites dating before AD 800 are mainly low frequency artifact scatters with enough hunting-related implements to suggest they could be logistic camps left by agricultural populations living at lower elevations. After AD 800, small family groups may have begun farming at lower elevations along the Tesuque and Nambé rivers (Post 1996:21, 1998, 2002).

Several sites in the Albuquerque area have structures dating to this period (Schmader 1994b). Earlier excavations found sites located along intermittent tributaries of the Rio Grande on gravel bluffs, low terraces, sandy hills, and hill tops. These sites had one to a few pit structures, outside activity areas with storage pits and fire pits, corn and corn grinding tools, and evidence for the use of mainly rabbits but some artiodactyls (Cordell 1989:304–305). More recent excavations at River's Edge on the west mesa of Albuquerque documents a pattern of residential sites containing between 2 and 12 pit structures as well as smaller sites with few artifacts and lacking permanent shelters (Schmader 1994b). Architecture was not particularly uniform with houses ranging from round to oval to rectangular with entrances through the roof, entry ramp, or a side door. Size and depth varied considerably as does the amount of interior and exterior storage. The settlement pattern is viewed as spatially extensive and not particularly intensive and that structures were mainly occupied during the winter. Subsistence depended heavily on hunting and gathering as well as growing corn. Fauna recovered from these sites was largely small mammals such as rabbits and mice, some birds, and few large mammal bones were found. Both males and females were robust suggesting they remained mobile (Schmader 1994b:320, 489–502). Dello-Russo's analysis of climatic conditions for this area indicates that precipitation levels were very low but predictable between AD 300 and 395 and again between AD 419 and 489, and improved as did predictability from AD 490 to 520. Precipitation levels were high and favorable and year-to-year predictability increased from AD 570 until at least AD 660 (Dello-Russo 1999:53–54). Improved conditions, from an agricultural perspective, may have helped set the stage for greater investment in agricultural resources and establishment of a more sedentary settlement pattern.

The Cochiti project study reports only a few Developmental period (AD 900–1200) sites recorded in the study area by 1975. These were mainly adjacent to or in the modern floodplain of the Rio Grande and Santa Fe drainages and most date to the latest part of the period (Biella 1977:117). The Cochiti Reservoir survey found 12 sites with depressions that could date to the Early Developmental period. These generally lacked lithic and ceramic artifact debris so were only tentatively assigned to this period because of the depressions (Biella and Chapman 1977a:203). These were all below the mouth of White Rock Canyon and along the Santa Fe River drainage (Biella and Chapman 1979:393). Based on these findings, evidence for a continuous occupation of the Cochiti area during the Early Developmental period was said to be entirely lacking. Instead, use of the region was believed to be one of occasional forays into an agriculturally marginal region (Biella 1979:142).

Dickson's survey of a transect between Arroyo Hondo and Cochiti Pueblo (including all of the Peña Blanca project area) highlights the problems encountered in recognizing sites from this time period. The survey recorded eleven Early Developmental period sites, eight on the Rio Grande floodplain or terrace and three from the Santa Fe River canyon area. These appeared to be small isolated settlements with only three having discernible pit structure depressions (1979:30). It is noteworthy that the Arroyo Hondo survey recognized Early Developmental period components at only two of the six Peña Blanca project sites with structures dating to this period. LA 249 is noted as seeming to have an Early Developmental component (Dickson 1979:30). LA 265 is listed as an Early to Middle Coalition sherd scatter, but the portions of this site that were originally designated LA 6172 and LA 6173 and lumped into LA 265 by Marshall (1997), were recorded as a site with three pit structures (LA 6172) and a sherd scatter (LA 6173). LA 6169 was recorded as a Late Developmental period site with 15 to 20 rooms and a kiva and one historic structure; LA 6170 as a Coalition site with 10 to 12 rooms, 1 to 2 kivas, and two historic structures; and LA 6171 as a Coalition site with 20 to 30 rooms and 2 to 3 kivas. LA 115862 was not recorded at all (Dickson 1979:88–91).

Marshall's (1997) survey in preparation for this project recognized Early and Middle Developmental period components and the possibility of structures at LA 265. Late Developmental components were noted at LA 6169 and LA 6171, a Middle Developmental camp at LA 115862, and a Middle Developmental component at LA 115853.

Without testing to confirm the time periods represented at the sites, the research design for this project (Ware 1997) anticipated finding Early Developmental period deposits at LA 265, LA 6169, LA 6170, LA 115862, and possibly at LA 6171 and LA 115863 (Ware 1997:21–38). Excavations at all of these sites, except LA 115863, plus those at LA 249, ultimately revealed substantial pit structures occupied year-round and evidence of a well-developed farming economy. The earliest evidence of corn agriculture and storage may date as early as AD 435 and was demonstrably present by at least the early AD 500s, a period of increasing and more predictable precipitation (Dello-Russo 1999:54, 86).

Middle Developmental. As discussed by Dickson (1979:11), this middle period (AD 900–1100) marks the transition from pit structures to contiguous-walled adobe surface structures with Red Mesa Black-on-white as the predominant painted ware. In the Arroyo Hondo survey, he notes that three sites occupied at the early end of the period were abandoned but eleven new sites were established. Sites continued to be concentrated on the floodplain and the terraces along the Rio Grande and Santa Fe River. Several (including the Peña Blanca project site LA 265) were recorded as no more than sherd and lithic scatters but at least two had one or more pit structures and eight (including Peña Blanca project site LA 249) have contiguous-walled structures (Dickson 1979:30–31).

In the Santa Fe area, Middle Developmental (defined as AD 900–1000) site frequencies increase but do not necessarily indicate an increase in population. Instead, a change to a more sedentary lifestyle may have made these sites more visible (Post 1996:21). The Red Mesa component at the Tesuque By-Pass site consisted of a jumble of features including the remains of several adobe and slab-based structures, sections of floors, and a semisubterranean circular structure with a ventilator to the southeast (McNutt 1969:51). At least part of LA 835 with its 20 to 22 residential units, each comprised of 10 to 20 adobe surface rooms and one or more kivas and a great kiva, dates to this period (Boyer and Lakatos 2000:72). Red Mesa sites are decidedly rare in the Galisteo Basin (Ware 1997:10).

In the Cochiti area, the excavated site of LA 272, which probably dates between 950 and 1050 (Wilson, Chapter 16), provides our closest information on this time period. The site consists of three pit structures, at least two surface structures, exterior work areas or remnants of additional surface rooms, a storage pit, and a diversion wall, situated on a narrow mesa overlooking the Santa Fe River near its confluence with the Rio Grande. The pit structures were circular, 5.2, 4.0, and 5.0 m in diameter and 1.4, 1.3, and 1.9 m deep, unplastered, and with vent openings to the southeast. Four-post roof support systems were found in two structures and the third and deepest structure had only a burned spot on a floor that was virtually indistinguishable from the fill. Because the mesa was narrow, the structures were to the east on a line with the pit structures rather than in front of them. One of the surface structures was probably built of adobe and was a single row of nine rooms. Foundations were basalt slabs and cobbles. Three rooms had hearths. The second surface structure was not completely excavated and may have been one large or two smaller rooms (Snow 1971:5–8). Most of the ceramics were gray utility wares, some with neck bands. Decorated wares include Piedra Black-on-white and Red Mesa Black-on-white. Metates are troughs and manos are both two and one-hand (Honea 1971a:10–14). The relatively small number of artifacts and lack of burials was interpreted as indicating a relatively short-term occupation (Snow 1971:21).

Late Developmental. Population and site size increased during the Late Developmental period. Locations include low terraces overlooking primary and secondary tributaries but more are found at higher elevations than in the previous period. Sites from this period range from those with pit structures, sometimes associated with 5 to 20 room surface structures, often sometimes in community-like clusters to coursed-adobe pueblos with over 100 rooms. Architectural forms are varied and are more elaborate than before. The predominant decorated ceramic type was Kwahe'e Black-on-white (Moore et al. 2002:16–17; Ware 1997:10). Cordell sees this period as one of low settlement density, a great deal of experimentation, and continued residential mobility in a time of relatively high effective moisture rather than a general highland adaptation (Cordell 1989:311).

Late Developmental sites are more common than Early Developmental sites in the Cochiti Reservoir area. Again these are situated mainly below the mouth of White Rock Canyon. The exceptions are mainly multicomponent sites where the Developmental components could not be clearly defined by survey (Chapman and Biella 1979:393). Use of the Cochiti Reservoir area during this time was believed to be similar to the previous period, that is, an extremely ephemeral and intermittent use of the Cochiti area (Biella 1979:142).

The Arroyo Hondo transect survey located 3 sherd scatters and 21 structural sites dating to this period. One site was a rockshelter, three had pit structures, and one also had a small masonry surface room. New site locations seemed to indicate a trend toward settlement outside the major river valleys. Late Developmental components were recognized at the Peña Blanca project sites of LA 249 and LA 6169 (Dickson 1979:31, 99), but not at LA 6170.

Two of the excavated Cochiti Dam sites have components dating to this period. LA 6461, the Red Snake Hill site, is situated just north of Cochiti Pueblo on a low terrace on the west bank of the Rio Grande. At least two pit structures at this site date to late in this period. No surface rooms were found. The pit structures were 3.3 to 3.6 m in diameter and 4.0 to 4.6 m in diameter and 2.4 m deep. Ventilator tunnel and shafts were oriented to just south of east and southeast. Neither had four-post roof systems (Bussey 1968a:7–11). North Bank (LA 6462), also north of Cochiti Pueblo and on the west bank of the Rio Grande, was a multicomponent site. The seven completed pit structures with Kwahe'e ceramics ranged from 3.1 to 4.5 m in diameter and from 0.5 to 2.3 m deep. Ventilators were oriented east (n = 2), southeast (n = 3), or south (n = 1). One had no ventilator. Features varied considerably. Some had bench-like features, some had large storage pits, and roof-support postholes ranged from absent to four. Two unfinished structures were also attributed to this period. Two of the pit structures fronted adobe room blocks dating to a later period that could overlie or have been built during the Late Developmental period (Bussey 1968b:13–62).

In contrast, north of Santa Fe at the Tesuque By-Pass site, the Kwahe'e component consists of an L-shaped room block, kiva, and exterior pits. Rooms are arranged in pairs on a north-south axis with other rooms appended on the north end. Floors were clay or cobbles and two of the rooms had hearths. The kiva was circular, 6.4 m in diameter, with unshaped stone walls and a ventilator in the eastern wall (McNutt 1969:37). Southwest of Santa Fe, two jacal structures, one semisubterranean with a shallow depression used as a hearth, were found beneath Pindi Pueblo (Stubbs and Stallings 1953:24–25).

These sites demonstrate the architectural variability but none provide much in the way of information on subsistence or mobility. Results of the Peña Blanca project, as well as ongoing studies of sites north of Santa Fe, indicate that the population retained a good deal of mobility and may have actually increased their dependence on wild resources, especially hunting artiodactyls.

Coalition Period

After AD 1200, sites again increased in size and number, pit structures were largely replaced by surface rooms, and Santa Fe Black-on-white became the predominant painted ware (Ware 1997:12). Upland areas were occupied with the first good evidence of agricultural features. The typical architectural layout was a 13- to 30-room village with one or two tiers of rooms facing a plaza with a kiva. Larger sites with more than 100 rooms are also found (Cordell 1989:314–315). Population growth was more apparent in areas like the Pajarito Plateau and Galisteo Basin while the Tewa Basin maintained or experienced some decrease in population, suggesting a shift in location rather than a uniform increase throughout the Northern Rio Grande area. Some areas were populated through interregional population shifts and others may have been populated by migrating populations from the west and south. Architectural forms remain variable with surface rooms constructed of adobe, of masonry, and combinations of the two. Rooms are usually rectangular or subrectangular with some that are D-shaped. Pit structures are circular or subrectangular and range from shallow to deep. Floor features vary and ventilators continue to be oriented to the east or southeast (Moore et al. 2002:18–19).

The Cochiti project study notes a dramatic increase in the number of sites, especially on the Pajarito Plateau (Biella 1977:117). Survey of the Cochiti Reservoir flood pool located 11 single-component sites ranging from single rooms to a 12- to 17-room pueblo and an isolated kiva or shrine (Biella and Chapman 1977a:203). Summarizing the excavation data for the excavated Coalition sites in the vicinity of Cochiti Reservoir, Biella divides the sites into three basic types of sites: one-room sites, small sites (four to eight rooms), and larger sites. One-room sites had well-constructed surface or semisubterranean structures with plastered floors and mortared walls. Most had hearths and some had small bins and cists. The small sites had seven or eight room contiguous room blocks and often a kiva. Rooms were arranged in a double row with the front rooms equipped with hearths. Building materials and construction techniques varied. The larger sites were groups of two or more of the small room block units. None of the site types have indications of restricted or seasonal use, but rather appear to reflect the size of the groups occupying the sites. Project researchers felt this seemingly sudden occupation with redundant residential patterns implied a substantial and rapid colonization of the area, which up until this period had only been intermittently occupied. Yet, they also acknowledged that the ceramics suggest continuity within the area, leaving open an alternative interpretation (Biella 1979:110–121, 142–143).

The Arroyo Hondo survey divides the Coalition period into three phases. Early sites (n = 29) include a sherd scatter (the Peña Blanca site of LA 265) and structural sites ranging from fewer than 10 rooms and no kivas to one with over 500 rooms with four kivas. In the Middle Coalition, four of the Early Coalition sites were abandoned and four new ones were built. By the end of this phase, eleven sites were abandoned. Six new sites were established in the Late Coalition, including Arroyo Hondo Pueblo. The Peña Blanca project sites of LA 6170 and LA 6171 were recorded as Coalition period sites by this survey (Dickson 1979:32–33, 90–91).

Variability within this period is well illustrated by a number of sites. Excavations at the Early Coalition period site of LA 3333 (circa AD 1200–1225) in the northern Galisteo Basin found 15 small, shallow, oval pit structures, most with hearths and internal storage features, two kivas, and a large assortment of storage pits, extramural hearths, and other pits. The structures were expediently constructed, occupied for a brief time, abandoned, and filled with trash. This intermittent and possibly seasonal occupation by a fairly mobile group continued for over two decades. Corn was present but may not have been grown there and may not have contributed as much to the diet as is generally assumed given the lack of weedy annuals in the macrobotanical samples and paucity of metates at the site. Pronghorn were the most important animal resource with less use of small mammals and birds than at most contemporary sites (Ware and Akins 1992).

The Cochiti Dam site of North Bank (LA 6462) has the more typical small room block and kiva arrangement. Unit III at North Bank had eight rooms, four with hearths. Walls were adobe and some had stone or cobble foundations. The rooms were irregular in size but appear to have been constructed as a single unit. The kiva was circular, 3.4 m in diameter and 1.4 m deep. Walls were coursed adobe, the vent was oriented southeast. Another room block (Unit IV) had at least seven rooms and evidence for two more added to the west end. Again, about half of the rooms had hearths. The kiva, located east of the rooms, was 3.7 m in diameter, 1.7 m deep and had plastered soil walls. The vent was almost northeast. Northeast of the room block was a small subrectanglar pit room, 3.1 by 2.2 m in size, and 1.4 m deep. It had a ventilator in the east wall, a hearth and ashpit, four postholes, and a storage cist. Ceramics found on the floor suggest the pit room dates earlier than other structures from this component. The largest of the room blocks (Unit VI) was poorly preserved but probably had 18 or 19 rooms, mainly in a double row. Rooms in the front had hearths. The kiva was circular and 4.2 m in diameter and 1.4 m deep with walls of plastered adobe. The vent was to the east and the only floor features were the hearth and deflector complex. The kiva and a pit room were located east of the room block. Rectangular and 2.9-by-2.4 m in size and 2.4 m deep, the pit room had an east-facing ventilator and a hearth and deflector complex. An adobe bin or altar was built against the south wall and there was a niche in the east wall. Unit VII had a block of eight rooms, three with hearths and all built as a unit. The kiva fronting the rooms lacked Santa Fe Black-on-white ceramics. It was 3.2 m diameter and 1.9 m below the surface and had a wall of coursed adobe. The vent was to the southeast and it had four roof supports (Bussey 1968b:29–32, 38–42, 53–59, 62–68).

The large pueblo portion of Pindi, located on the north side of the Santa Fe River just below Santa Fe, began as an irregular L-shaped room block fronted by three or four subterranean kivas. The principal room block was a long, narrow series of about 40 rooms, in rows two or three rooms wide. This initial construction was followed by a marked expansion and radical changes in building plan. Some of the older rooms were reused and others were built over. Many rooms were added creating a large and a small enclosed plaza along with two surface kivas. After this episode of building activity, rooms were abandoned, rehabilitated, and new rooms constructed. The site was abandoned around AD 1350 when the population moved across the river (Stubbs and Stallings 1953:9–10, 155).

Other large sites like Arroyo Hondo Pueblo were founded in the middle of the Coalition period and grew rapidly. Much of the site was cooperatively constructed between about AD 1315 and 1330, largely as four room blocks around a central plaza. A few rooms were added through accretion or as individual rooms. Construction began with a double line of rooms then additional rows of rooms were added to either side. By the time construction was complete, room blocks ranged from two to five rooms wide with second-story rooms built over the center rooms in many room blocks. Habitation rooms were either plaza-facing rooms or second-story rooms. Between 1,300 and 2,700 individuals could have occupied the site during the peak of the Coalition period, far more than could be supported by the surrounding environment (Creamer 1993:134, 140, 153). More conservative estimates suggest 400 people lived at the site during its peak, which is more in line with the environmental carrying capacity (Wetterstrom 1986).

Aggregation into large sites (50 or more rooms) between AD 1250 and 1350 occurred throughout the Northern Rio Grande. Population peaked earlier on the Pajarito Plateau, at about AD 1270 to 1300 and later in the Chama area, after AD 1350. Crown et al. (1996) suggest some of this is related to changing environmental conditions. Moderately severe drought conditions between AD 1250 and 1300 correspond with population increases as people moved into higher elevations on the Pajarito Plateau or occupied areas near perennial water sources in the Santa Fe area. More favorable precipitation paired with a lowering of the water table from AD 1300 to 1335 may have caused people to begin abandoning the Pajarito Plateau. Some of these movements may account for increases in the population of the Santa Fe area (Cochiti and Arroyo Hondo). Aggregation is explained as growing out of preexisting patterns of indigenous populations in some areas and resulting from the movement of aggregated communities into others. Once aggregation began, it encouraged aggregation elsewhere and may have been an invasion strategy used to overwhelm more dispersed local populations (Crown et al. 1996:190, 199–201).

Aggregation is socially difficult, economically inefficient, and detrimental to health due to poor sanitary conditions and epidemic diseases. According to locational geographers, the conditions under which aggregation occurs include when farmers must cultivate more than one type of field and these are dispersed irregularly on the landscape, when a key resource is highly localized and requires a great investment in labor, as in irrigation, or when it is for defensive purposes (Cordell 1996:230–231).

Classic Period

After about AD 1325, occupation shifted away from upland areas to along the Rio Grande, Chama, Ojo Caliente, and Santa Cruz rivers, and the Galisteo Basin. Upland areas remained occupied at lower population levels. The population was concentrated in large villages, often with multiple room blocks and plazas. These villages were typically accompanied by large-scale agricultural and water-control features including dams, reservoirs, and terrace grid gardens. Black-on-white ceramics evolved into Biscuit Wares in the northern part of the region while distinctive red-slipped glaze wares were produced south of Santa Fe (Moore et al. 2002:19; Ware 1997:14). With drier conditions, those remaining in less populated upland areas such as the Pajarito Plateau aggregated even more and exploited canyon bottom areas for agriculture. Dependence on agriculture appears to level off or decrease only slightly (Powers and Orcutt 1999:566).

The Cochiti project study notes a tendency for aggregation along major drainages as the primary settlement strategy. Other sites are small, one- to three-room sites, possibly fieldhouses that suggest intensified land use by the aggregated villages (Biella 1977:117). Survey of the Cochiti Reservoir flood pool identified 89 site locations with 104 provenience locales. Of these, 12 are nonstructural locations that could suggest increasing procurement of nonagricultural resources, 44 are single room structures, 24 have 2 rooms, 6 have 3 rooms, and 4 have 4 or more rooms. Other feature types include terraces, rubble mounds, isolated walls, slab foundations, and rockshelters (Biella and Chapman 1977a:305–307).

Examining the extant information on the 322 known Classic sites, Biella places them into three types: open camps, small one- to three-room sites, and villages of up to 800 rooms (Biella 1979:122–144). One proposed explanation for the change in settlement pattern is that aggregation in lowland areas actually expanded the food resource base. Movement to lower elevations would have freed the uplands of permanent occupants and made these areas accessible for hunting and gathering (Chapman and Biella 1979:396–397).

Dickson's Arroyo Hondo survey found that 9 of the previously occupied sites were abandoned but 14 new ones were founded in the Early Classic period (AD 1325–1400) resulting in a net increase in sites. Arroyo Hondo Pueblo was virtually abandoned at this time, reoccupied at a much lower population level, then completely abandoned early in the Middle Classic period (AD 1400–1542). By the end of the Middle Classic period only nine sites continued to be occupied. Late Classic period (AD 1542–1610) sites were located in two riverine areas. One of the remaining sites had about 500 rooms while four others had between 100 and 200 rooms (Dickson 1979:34–35).

Excavated sites from this time period in the Cochiti area include examples of all three site types identified by Biella. The nonarchitectural sites are generally small but dense scatters, at least some with fire pits. The 15 one-room sites vary considerably in size and shape. Most are masonry surface rooms but others are pit rooms. Half have hearths, some formal, and others are burned areas on floors. Two- and three-room sites often incorporate boulders into the walls. However, for each room block there is also a tendency for at least one room to have a greater labor investment. These, too, are extremely variable. Hearths and bins are found in some. Large sites are quite variable and range from single room blocks with one or two kivas to sites comprised of several plazas fully enclosed by room blocks containing several kivas (Biella 1979:124–131).

No large sites were excavated as part of the Cochiti Reservoir project, but three were investigated during the Cochiti Dam project. The Alfred Herrera site (LA 6455), located on the second terrace on the west side of the Rio Grande, had two distinct architectural complexes or sectors, one earlier and less complex. The earlier eastern sector had an east-west trending double row of at least nine surface rooms fronted by a row of three (one unfinished) pit rooms, a kiva south of the rooms, and a row of six pit rooms to the west. The western sector had a 3- to 4-room-deep room block of 27 or more rooms with coursed adobe walls, two kivas, and a single pit room (Lange 1968a:73–110).

LA 9154, located on the north bank of the Santa Fe River, had a fairly brief occupation. It was comprised of three noncontiguous coursed adobe room blocks forming a U, open to the south and containing two kivas. Beneath and adjacent to the western rooms are at least five pit rooms. At least the west and north original room blocks were two tiers with later rooms added to the inside of the plaza, reflooring the older rooms to eliminate hearths and other features (Snow 1971:32–42).

The largest excavated site, LA 70, had in excess of 195 rooms, 9 kivas, evidence for 10 or more ramada structures, and a variety of extramural pits outside the pueblo plaza. Up to four main temporal components were identified spanning AD 1325 to 1520. The pueblo had an intensive residential occupation as indicated by the 134 rooms that contained hearths. The pueblo experienced considerable structural and spatial change through room remodeling, abandonment, and combined planned and accretional growth. The enclosed central plaza had three kivas, while the open plazas had four moderate size and one large kiva (Snow 1976). Population estimates range from 80 to 400 individuals.

Tashkatze Pueblo (LA 249), east of NM 22, was primarily a large Glaze A or early Classic period site. Described in more detail later in this report, it consisted of two rectangular masonry and adobe room blocks with an enclosed kiva. The majority of the surface ceramics dated to the fourteenth century with lesser frequencies from later periods suggesting periodic reoccupations, probably in support of farming.

Chapter 3
The Peña Blanca Research Design: Fifteen Hundred Years in the Northern Santo Domingo Basin

Stephen S. Post and Eric Blinman

In general, the research design as originally written and submitted by John A. Ware (1997) provides theoretical and methodological direction for the Peña Blanca research. The temporal scope of the project was expected to range from Early Developmental (AD 600 or 700) to the end of the Classic period (AD 1600). Based on surface indications, substantial cultural deposits were expected at six of the sites with the seventh site, LA 115863, showing less research potential. Investigation of Developmental period (AD 600 to 1200) components focused on residential occupations. Coalition and Classic period components (AD 1200 to 1600) were expected to focus on agricultural technologies and field-house/seasonal occupations.

Ware's research design anticipated finding significant and extensive Early Developmental components at five sites: LA 265, LA 6169, LA 6170, LA 6171, and LA 115862. The sixth Early Developmental component found at LA 249 was not anticipated, but it is easily accommodated by the research framework. The main thrusts of the Early Developmental research were culture history and change, settlement and subsistence, and community patterns and organization.

The research design did not anticipate the complexity of the Late Developmental and Coalition period components, but the Late Developmental components will fit comfortably within the research framework suggested for the Early Developmental period. The Coalition period components were largely restricted to LA 6169 and LA 6171. These sites were expected to yield agricultural features and ephemeral architectural remains. No agricultural features were identified. Instead, four pit rooms and a surface structure were uncovered at LA 6169. Coalition period ceramics were widespread at LA 6171, but most of the architecture was outside the project area. These Coalition period components may represent seasonal agricultural occupations that can be integrated with existing data from Cochiti Dam and Reservoir investigations (Biella 1979). Research issues of settlement and subsistence and the attendant technological and economic issues proposed for Developmental period data can be used to examine occupation and behavior persistence and discontinuity throughout the evident 900-year ancestral Pueblo record.

Classic period deposits are restricted to LA 249. The refuse observed on the site surface is probably associated with the adjacent Tashkatze Pueblo. Because the surface deposits are from a slope and dune setting, it is expected that they are mainly secondary refuse deposits generated by activities in and around the village. Where possible, and at the appropriate scale, these data will be compared with previous Classic period excavations at Pueblo del Encierro, the Alfred Herrera site, and the small sites within the reservoir floodpool. Classic period data presentation will be primarily descriptive.

Historic period research will examine existing historical and ethnohistorical data on Peña Blanca and Cochiti Pueblo settlement and land use. Historic features at LA 249, LA 6169, and LA 6170 will be described and interpreted within a limited framework of archival and ethnohistorical research. The contextual framework focuses on the nineteenth and early twentieth-century settlement and land-use patterns between the town and Peña Blanca, and the Pueblo of Cochiti.

The research design will be divided into the broad temporal periods suggested by excavation results: the Developmental period (AD 600 to 1200), Coalition period (AD 1200 to 1325), Classic period (AD 1325 to 1600), and the Territorial period to World War II (AD 1848 to 1945). A summary of the available regional data will be presented, followed by research issues, and data needed to address the research issues. Portions of the original research design will be interspersed with new research goals that more completely reflect the project scope.

The Developmental Period (AD 600–1200)

As outlined in the culture history section of this report, the Developmental period can be divided into three subperiods, Early (AD 600 to 900), Middle (AD 900 to 1000), and Late (AD 1000 to 1200). We use the same divisions in this enumeration and discussion of research issues and data needs.

The Early Developmental Period

Information on the Early Developmental period occupation of the Northern Santo Domingo Basin is scarce. Therefore, the Peña Blanca excavation results are expected to make a significant contribution to our understanding of that period. This anticipated research contribution was separated into three main research issues in the original research design: culture history and culture change, settlement and subsistence systems, and community patterns and social organization (Ware 1997:44). Ware provides a cogent overview of the different issues that contribute to our understanding or confusion about this little-known period. In the following, we will use direct quotations and paraphrasing to present the ultimate direction of the Peña Blanca project research.

Research Issue 1: Culture History and Culture Change. In the research design, Ware cites historical and theoretical factors that conditioned the interpretation of Early Developmental period occupation of the Middle and Northern Rio Grande (Ware 1997:45). First is a slow progression of settlement by farmers (relative to the Colorado Plateau) of the most Northern Rio Grande that did not occur until after the tenth century AD. Second, differences in the contemporary archaeological records of the Colorado Plateau and San Juan Basin and the Northern Rio Grande led to the interpretation that the latter was retarded or exhibited a cultural lag such as might be advanced by a core-periphery model of cultural diffusion. Two primary "lagging" characteristics were the continued production and use of plain ware ceramics well into the twelfth century AD and the retarded (after AD 950) pithouse-to-pueblo transition. Third is a "Plateau-centric" perspective on culture change and continuity in the Northern Rio Grande. This was an outgrowth of the application of the core-periphery model, whereby the Northern Rio Grande was not in the cultural core, but as part of the periphery was affected by change in the Colorado Plateau-San Juan Basin core. Variability in the Northern Rio Grande was interpreted relative to the eastern Anasazi of Chaco and Mesa Verde. These interpretations employed a progressive, unilinear model to interpret culture change and continuity. When evidence of change in architecture or ceramic styles was observed, they were interpreted as a consequence of migration or diffusion, not of independent or multicausal variables. Ware (1997:45) concludes that, "What is needed to resolve basic issues of culture history and patterns of culture change in the Rio Grande Valley are fewer unicausal theories of complex sociocultural processes and more basic research on patterns of change and continuity in the middle and northern Rio Grande."

In retrospect, these limiting factors are largely a product of disproportionate research in the west and a focus in the east on the late, large, ancestral Pueblo village sites of the Middle and Northern Rio Grande. Lost in the migratory or interpretive leap from Chaco and Mesa Verde to the Galisteo Basin, Pajarito Plateau, and the Northern Rio Grande were the small sites that might best explain the mechanics of early settlement and expansion. For the Early Developmental period, this was further exacerbated by a small excavation sample and a general lack of absolute dates for sites predating AD 1000. As Ware has called for, early village and settlement and technological patterns in the Middle and Northern Rio Grande should be examined according to their intrinsic qualities, as a reflection of an adaptation that could have been conditioned by different social, economic, and environmental factors than are evident for the central and western Anasazi. With an Early Developmental period excavation sample that spans AD 500 to 900, the Peña Blanca excavations should shed considerable light on basic research issues that apply to the Santo Domingo Basin, the Northern Rio Grande, and relationships with Middle Rio Grande and the Colorado Plateau.

What is the nature of the Early Developmental archaeological record suggested by the Peña Blanca excavation data? Initial characterization of Early Developmental period settlement and subsistence in the project area was based on the excavation of one site, LA 272. Three pit structures and a surface room block were associated with Red Mesa Black-on-white and neckbanded pottery. Although Honea (1971a:18) suggested an AD 850–950 occupation date, LA 272 seems to date more closely to the Middle Developmental period or AD 950 to 1050. Honea does indicate that since LA 272 was the only early site investigated by the Cochiti project, it could not be assigned a regional phase designation. An interesting aspect of LA 272 ceramics is the preponderance of Northern Rio Grande utility ware. Its abundance indicates that utility ware production along the base of the Sangre de Cristo Mountains was well established by the time that LA 272 was occupied. This further supports the observation that LA 272 was established later in the 900s or early 1000s, when settlements in the Northern Rio Grande were available as a potential source of exchange.

Given the likelihood of a post-AD 950 occupation date for LA 272, the Peña Blanca sites represent the earliest examples of ancestral Pueblo settlement in the Santo Domingo Basin. Therefore, detailed characterizations of site structure and associations, artifact assemblages, and samples will be an important outcome of excavation and analysis recording, description, and interpretation. Even though investigations were restricted to a linear transect within the construction right-of-way, substantial feature and artifact data are associated with chronometric and stratigraphic documentation of sequential and contemporary occupations. The initial expectation was that the data from the Early Developmental sites would lead to synchronic and diachronic interpretations that would extend beyond the immediate Santo Domingo Basin to the village sites consisting of pit structure and extramural feature assemblages reported for the Artificial Leg and River's Edge sites in Rio Rancho and Corrales (Frisbie 1967; Schmader 1994).

Initial observations suggest that the Peña Blanca project could fill the Early Developmental gap for the Santo Domingo Basin and provide an important context for understanding site patterns north of La Bajada. The site, artifact, and analytical descriptions will become the primary reference for all subsequent work in the area. It should provide the basis for putting to rest the unilinear models of cultural lag and backwater or marginality settlement. These data also allow an honest appraisal of the relative influence of the San Juan Basin and Colorado Plateau versus southern Anasazi or Mogollon. Even further afield from cultural-historical frameworks, we may be able to ask if the observed variability is social, economic, or environmentally determined? What elements reflect endogenous versus exogenous stimuli for culture change?

Description, comparison, analysis, and interpretation will be accomplished by consistently reporting the structure and feature data for each site. For structures, minimal data presented in tables and as text includes structure dates, dimensions as measured north to south and east to west, floor area in square meters, construction methods including wall, roof, and floor, structure orientation (azimuth) as determined by the hearth-ventilator axis, the number and spatial arrangement of floor and wall pits, storage pits, and thermal features, the construction and arrangement of the hearth, ash pit, deflector, ventilator complex, evidence of remodeling or reuse, structure dismantling and abandonment, and post-abandonment fill processes or activities.

Current models of intra-community organization on the Colorado Plateau rely heavily on suites of presumed ritual features, such as *sipapus, paho* stick impressions, foot drums, and altar postholes. Peña Blanca feature suites will be compared with the Colorado Plateau data to identify potential similarities that may relate to social and ritual organization. Obviously, structure plans and profiles, and feature tables with plans and profiles, will provide most of the data to support architectural and site structure characterizations.

Extramural features are critical to understanding the range of strategies employed by Peña Blanca site residents in response to changing or stable subsistence opportunities. Morphological and functional variability may reflect changes in subsistence focus from farming to hunting and gathering or a change in their relative contribution to the subsistence regime. River's Edge and Artificial Leg excavations also report on feature types and variability allowing for examination of potential technological differences with Peña Blanca that may relate to a more northern or montane-proximate subsistence pattern. While extramural features are not expected to have culturally specific or stylistic meaning (i.e., features that are more Mogollon or Anasazi in form or style), the quantity, spatial arrangement, evidence of multiple uses or remodeling, and intensity of use of extramural features may reflect general aspects of occupation intensity, duration, seasonality, and general organizing principles and behaviors.

Consistent reporting of extramural feature dimensions including length, width, depth, and estimated or potential volume, form, and content allows comparisons between sites and regions. Plans, profiles, and photographs document similarity and variability. Observations on feature content relative to primary and secondary deposition, intentional filling, or remodeling inform on occupation sequences and spatial organization during specific occupations. These descriptive-level interpretations of the management of space, facilities, and refuse will be the foundations of subsequent interpretations of season, length, and intensity of occupations.

Artifact and subsistence data are presented in a uniform format for components within and outside of structures. Because there are almost no comparable economic data for the Early Developmental period, systematic reporting of assemblages is an important key to comparing intra- and inter-site chronologies and for placing Peña Blanca sites in a regional context. Detailed descriptions of artifact assemblages and subsistence data will establish a baseline for all future work in the Santo Domingo Basin as well as early occupations in the Middle and Northern Rio Grande.

Research Issue 2: Settlement and Subsistence. In the introduction to settlement and subsistence studies in the research design, Ware returns to the early unilineal characterizations of the Middle and Northern Rio Grande adaptation as retarded, marginal, or lagging in comparison to the more "precocious" cultural developments on the Colorado Plateau (Ware 1997:46). Ware restates Cordell's 1978 proposition that the early Pueblo populations in the Rio Grande Valley did not have to rely heavily on agriculture. He states that,

> the adoption of agriculture and the attendant consequences of food production were delayed in the Rio Grande Valley because the area was such an optimal region for hunting and gathering. According to Cordell, the foraging potential of the Rio Grande was so great that there would have been few incentives to adopt labor-intensive food-production methods. . . ., but during the early Pueblo period, when population densities were low, farming may have been no more than a minor component of a subsistence economy that was focused primarily on seasonally available wild foods. (Ware 1997:47)

This implies that our investigation should focus on the degree of reliance on wild versus cultivated foods and what that might mean relative to mobility, seasonality, and residential patterns.

Ware (1997:47) enumerates the main characteristics of the Middle Rio Grande archaeological record that are consistent with seasonal mobility and what he terms "Cordell's refugium hypothesis." These characteristics are the persistence of pit structures and subsurface storage facilities as a strategy for overwintering. Subsurface storage may have served as one form of caching food for the winter when the group returned from fall or late fall foraging and hunting forays. Pit structures with their well-documented thermodynamic properties were suggested to be most effective as winter residences (Gilman 1987; Glennie 1983). He suggests that the "delay" in the pithouse-to-pueblo transition was "entirely consistent with [a persistence of] high group mobility, seasonal settlement patterns, and an emphasis on wild plant and animal resources." The degree to which our study ultimately proves, disproves, or incorporates this hypothesis is one main research avenue. To this end, Ware proposes that, "One of the most important goals of our research in the Middle Rio Grande will be to collect basic data on human adaptation and interaction that will allow us to characterize patterns of change and continuity in the region . . ." and to test Cordell's subsistence and settlement hypothesis. This is to be accomplished by collecting basic economic and ecologic data and characterize them in terms of the Early Developmental archaeological record.

What are the available data with which the "refugium hypothesis" may be tested, resulting in an elaboration of our understanding of Early Developmental period subsistence and settlement dynamics? Preliminary assessment of the potential ceramic, faunal, human osteological, and site structure data suggest consistency and variability that may reflect mobility and seasonality and a mixed agricultural and foraging/hunting economy as anticipated by Ware and Cordell, but perhaps not as uniformly practiced as they might have expected.

Ceramics.Ceramic analysis from Middle Rio Grande Early Developmental period sites in the Rio Rancho and Corrales areas has revealed a strikingly consistent pattern of high frequencies of plain gray jar sherds made from locally available materials, with lower frequencies of decorated wares. This predominance in plain or unmanipulated surface vessels is widely associated with loosely organized Basketmaker III populations on the Colorado Plateau and early part-time sedentism in the Mogollon region. Dean Wilson following Mills's (1989) studies of Pueblo II assemblages has suggested that this high frequency of gray wares is consistent with an expedient ceramic technology.

Expediency is expressed in the use of local raw materials and anticipated vessel durability. Typically, plain ware vessels were made from the most readily obtained raw materials. Lower quality source materials were used because vessels were not expected to last for years, but only for a season. This does not mean the better quality materials were ignored, only that less selectivity was exercised in obtaining clays for utility ware production. Vessels were meant for short-term storage, cooking, and processing. They did not move with the residents nor were they expected to last for many years, especially since there was no guarantee that the residents would return the following year.

This persistence of plain pottery in association with low proportions of decorated vessels is a pattern that John P. Wilson (1995) has observed throughout a large part of the Anasazi and Mogollon culture areas. He suggests that this may have been the norm from AD 600 to 900, while the abundance of decorated pottery or utility wares with manipulated exterior surfaces found in the San Juan Basin and Colorado Plateau may be the exception rather than the rule. This pattern may or may not be consistent with a more mobile residential pattern, and it will be useful to conduct more subtle comparisons with assemblages from demonstrably sedentary Pueblo I communities.

Faunal Remains. Faunal remains provide an important link between subsistence strategies and degrees of mobility and sedentism (Speth and Scott 1985; Szuter and Gillespie 1994). A growing body of data indicates that the initial strategy of Southwestern farmers was one of garden hunting. Increased horticulture results in more habitat for small mammals initially increasing their abundance and density. Larger mammals or more specific faunal resources were exploited through long-distance and targeted forays. The mixed hunting strategy results in a wider variety of faunal remains occurring on sites occupied by sedentary groups. With increased seasonal mobility it is expected that species diversity and distribution decreases, especially since a segment of the hunting and consumption cycle occurs at a different location.

Expectations of the faunal assemblage can be stated in terms of relative level of sedentism and mobility. If some or all of the site residents were permanent residents, then faunal assemblages would be expected to exhibit the greatest species diversity with a particular emphasis on those species associated with a garden-hunting strategy. From a residential base anchored by farming, long-distance species could be taken in season to fulfill the critical dietary requirements of high-quality animal protein. These long-distance species would be brought to the site as meat packages, possibly resulting in a restricted range of skeletal elements; especially those with highest meat yields or those with important secondary uses as tools or ritual items.

If the site residents were very mobile or there were episodes of high mobility, then there should be fewer species evident that were dependent on the season and length of occupation. For instance, if part-time residents focused on riparian and grassland species, then there would be fewer montane species expected. This might be the expected pattern if the hunting was coincidental with farming. If montane hunting forays were staged from the sites, then montane species would be expected with some riparian species.

Obviously, to sort out and interpret variability relative to sedentism or mobility, discrete assemblages from dumping episodes, middens, or terminal occupation discard would be optimal. Therefore, samples from the best spatially, stratigraphically, and temporally controlled proveniences should be analyzed. Comparison of faunal assemblages within and between sites according to depositional histories or site structure should allow for identification of meaningful differences in species occurrences. Attributes that relate to butchering, cooking, and discard may also inform on relative levels of mobility and sedentism. How meat is prepared may suggest if it is fulfilling short or long-term needs. Roasting or boiling of meat may reflect domestic or camp consumption.

Chipped and Ground Stone. Chipped and ground stone data are obvious avenues for investigating sedentism and mobility. This is primarily through different technological and production trajectories. These trajectories are conditioned by raw material availability and suitability, expedient and planned tool production, and the amount of evidence for the staging of and retooling for long distance or logistically organized hunting (Andrefsky 1994; Kelly 1988; Binford 1979).

The technological dichotomy between expedient and planned tool manufacture is an obvious analytical path for addressing mobility. Gearing up for hunting at the sites should result in broken bifacial tools or projectile points as well as the potential for clustered distributions of biface reduction or retouch flakes. Refurbishing hunting tool kits may result in the discard of exhausted tools or the distal or basal portions of hafted tools or projectile points. A focus on field hunting and more expedient or less planned tool production should use the most readily available raw materials and result in an unpatterned distribution of core reduction debris and unmodified utilized flakes with a wide range of used edge angles and wear patterns. If the bulk of the on-site food processing focused on field species and plants gathered from within a diurnal foraging range, then expedient technologies may overshadow the more concentrated and specialized biface manufacture and maintenance. Discard patterns for debris and tools related to hunting or foraging and plant processing may reflect seasonal residence patterns. Cold-weather activities performed indoors may result in more concentrated discard or midden formation. Warm-weather outdoor activities would result in a higher proportion of dispersed defacto refuse, contributing to general sheet trash more than formal midden development. The composition of analytical units or components will have an important effect on the ability to interpret assemblages in terms of discard patterns.

Ground stone artifacts will also be important indicators of plant processing. One-hand manos and basin metates are usually interpreted as optimal for small seed and nut or plant processing, and therefore may be good indicators of a more mobile or seasonal subsistence pattern. Larger seeds such as maize, and the larger volumes of meal associated with agricultural economies, are more efficiently prepared with two-hand manos and trough or slab metates. Obviously, a predominance of these grinding tools are more in line with an economy that is heavily dependent on farming.

One way to examine changing or flexible subsistence patterns is through an analysis that can measure diachronic variation in tool efficiency. Following Bleed (1986:739), efficiency is the amount of output (e.g., flour) rendered by a system divided by the amount of input (e.g., grinding with a mano and metate). Variation in use surface area, which has commonly been used as a proxy measure for efficiency, may provide insight into subsistence strategies (Plog 1974:139–141; Lancaster 1983:2–3, 1984:256, 1986:188; Hard 1986:9–10,103,105–108, 1990:136–138; Mauldin 1991:59, 61, 1993:318–322; Diehl 1996:105–106). Hard (1986, 1990) has used this proxy to evaluate a group's relative dependency on agricultural produce.

Material selection can also be considered in the evaluation of efficiency. Specifically, variation in the use of self-sharpening, vesicular tool stone, which may be better suited to grinding dried corn kernels or other large, hard seeds, may provide additional insight into the users' degree of agricultural dependency.

Diachronic variation in artifact morphology and how it may relate to efficiency will be presented. An assessment of grinding intensity, which is defined as amount of time spent at the grinding task, will be attempted. It is assumed grinding intensity would concomitantly increase with agricultural dependency or with population growth. As suggested by Mauldin (1993) and Adams (1993, 1999), the presence of multiple use surfaces and of finger grooves on manos can inform on the degree of grinding intensity.

A "technological dichotomy" between expedient (informal) and planned or strategic (formal) tools is useful for examining assemblages relative to more mobile or sedentary patterns. The typological scheme used in the analysis of food processing ground stone tools allows for this differentiation. Manos and metates are formal tools that evidence production input and/or maintenance, while expedient handstones and grinding slabs are informal tools that lack evidence of production input and maintenance. An informal to formal tool ratio may have some analytic utility.

Often co-occurring with an increase in reliance on ground corn is the designation of space for grinding activities as denoted by low walls, metate rests, or catchment basins. This progressive investment that culminates in the dedication of entire structures to corn grinding, and the presence of mealing rooms is a common aspect of Colorado Plateau Pueblo II to Pueblo III sites. Designated grinding space was observed or inferred by Schmader within some of the Artificial Leg and River's Edge pit structures. Ground stone distribution within structures and activity areas may indicate shifting reliance on cultivated or wild plant foods.

Archaeobotanical Data. Archaeobotanical data are expected to be extremely informative given the range of contexts that were suited to sample collection and analysis, but the results may not be unambiguous. Direct evidence of consumption and use of cultivated and wild plant foods and resources can be indicators of seasonality, subsistence strategy, and site structure and function. Although macrobotanical remains are an important source of dietary information, limitations introduced by preservation, sampling, and a focus on charred remains may constrain interpretations that assess relative contribution of wild and domesticated plant species.

The quality and quantity of macrobotanical data can be enhanced, but also biased, by examining samples from certain features and contexts that are typically most productive for sites occupied by people that were at least part-time farmers. Burned feature or midden contexts are optimal for recovering macrobotanical specimens that reflect consumption. Corn parts tend to be common in these contexts, due to ubiquity in the diet, methods of processing, and the tendency for corn by-products to be used as fuel. Wild plants that can be common constituents include cheno-ams, a variety of cacti species, and a range of other wild grass seeds or shrubby fruits. Despite the preservation problems, the wider the spectrum of macrobotanical remains the greater the likelihood of a year-round or extended seasonal occupation. Contrasts between the contents of different spatial types of trash (sheet trash vs. discrete midden samples vs. dumps) may reflect seasonal differences in consumption patterns. Discrete midden formation represents the most controlled and repeated discard practices that are mostly likely to occur during winter or long-term occupation. Within a single component, we might also expect differences between different types of trash samples that would be analogous to summer and winter consumption and discard patterns.

Palynological data often complement macrobotanical remains because they provide more reliable information from unburned contexts, such as storage features, temporary storage or processing pits, and structure floors. Pollen also provides evidence for economic resources, which, while important, are underrepresented in macrobotanical samples due to the plant parts being consumed or to low risks of carbonization during food preparation (such as Rocky Mountain beeplant).

Preservation and contamination play an important role in determining the validity and representativeness of the feature associations. Samples from rapidly buried, undisturbed, or sealed contexts potentially provide a wealth of information relating to local environment and to foraging, storage, and consumption behaviors. Pollen data may inform on the organization of storage facilities within and between sites, and some taxa can contribute to interpretations of seasonality.

At the minimum, pollen data from Peña Blanca provide baseline observations that can be compared with later occupations in the Tewa Basin and earlier and contemporaneous occupations in the Corrales and Rio Rancho areas to the south. We would expect that if all or a segment of the population were year-round occupants, a full-range of potential economic species would be represented. These data can be compared with the plant inventory conducted by Gail Tierney for the Cochiti Dam and Reservoir project in 1977, which suggests that even a 5-km foraging zone would have afforded access to a broad spectrum of seasonally available plants.

Human Skeletal Remains. Human skeletal remains were expected to be recovered from the Peña Blanca sites given their common occurrence on Basketmaker III and Pueblo I sites in general. Even though an unknown proportion of the former site residents will be represented by the human skeletal remains, the age, sex, and pathological and physical characteristics of the burial population should provide important demographic, mobility, and subsistence information. Comparison of these data with other Basketmaker III and Pueblo I populations may provide interesting perspectives on the rate and extent to which farming was adopted as the main subsistence strategy.

Direct evidence of mobility can be found in measurements taken on the femurs of human burials. Because bone tissue responds in the direction of functional demand, the size and shape change as new bone is added to regions where the strain is greatest, where the use is of low or moderate intensity and repeated (Bridges 1989:387). In general, hunter-gatherers tend to be more robust and have more midshaft strength than agriculturalists (Larsen 1997:204–205). If the Early Developmental Peña Blanca population was more mobile than later occupants of the general area, this should be evident in indices that reflect the strength (robusticity) and midshaft shape of the femur.

By comparing these two indices with groups employing a range of subsistence mixes, we should be able to estimate the relative degree of mobility for the early population as well as the timing of changes in later groups.

A similar principal can be applied to the degree of agricultural dependence. Females from Southwestern populations that were heavily dependent on agriculture display evidence of increased upper arm strength acquired by spending long hours grinding corn. In these populations, the maximum humerus diameter tends to be large, generally larger than the males in the same population. Using this measurement to indicate arm strength, we can compare the Peña Blanca females with later groups from the area and with known agriculturalists and estimate the general dependence on corn or, at the very least, those processing methods practiced by intensive agriculturalists.

From the perspective of health, several negative responses followed when corn became a key component of the diet. Caloric requirements could be met, however, corn is deficient in several essential amino acids and is a poor source of protein. In many areas, the adoption of a predominantly corn diet resulted in a reduction in stature and a deteriorated health due to declining nutrition and increased infectious disease (Larsen 1997:16–17). More mobile groups with diets supplemented by hunting and gathering should have fewer of those conditions associated with sedentism and dependence on maize agriculture, e.g., iron deficiency anemia, infectious disease, and poor dental health. Again, by comparing the Peña Blanca population to other Southwestern groups, their relative health can be assessed.

Site Structure. Site structure data are also relevant for evaluating mobility and seasonality. Much research has been conducted on the advantages and disadvantages of pit structure architecture and subsurface versus aboveground storage. Ethnographic data indicate a continuum of least agriculturally dependent/most mobile to most agriculturally dependent/least mobile. The least dependent/most mobile groups may reoccupy the same residences, either annually or in different seasons for different purposes (Binford 1981). They may build sheltered but informal activity spaces (in open sites) that serve as focal areas, but the spaces are irregularly maintained, resulting in a light and spatially extensive trash distribution. The most dependent/least mobile populations tend to exhibit structure differentiation, have radiating, maintained activity spaces, and practice highly controlled or maintained trash deposition (Schmader 1994). Obviously, there is a mid-range where aspects of site structure will intermingle.

Matthew Schmader's (1994) ethnographic research suggested structure characteristics that could relate to function and seasonality. He suggests that cooking structures may have less than 14 sq m of floor space, shallow depth (not more than 30 cm deep), no formal entryway or ventilator system, a relatively high number of floor cists and auxiliary hearths and less open floor space. Warm weather cooking structures would be less substantially built, cold weather structures would be more substantial. Sleeping structures may have more than 14 sq m of floor space, could be shallow or deep depending on the season, had an entryway-ventilator system, and few floor features that usually included a shallow hearth. Adding to this picture is Glennie's (1983) and Wilshusen's (1988a) argument that depth not only serves to improve winter insulation of the pit, but it also provides the most efficient source of soil for either roof insulation or mortar or jacal for associated living or storage structures.

Undoubtedly, a sufficient winter food supply was key to making it through to the late spring. The actual storage technology may have depended on group mobility organization. If the site was temporarily abandoned, then secure caching would have been necessary to ensure that foods would be viable for winter and early spring. If a segment of the group remained, this would have allowed for protection and monitoring of stored foods and a greater flexibility in food storage options.

Paleoenvironmental Data. Studies in the

Four Corners and Upper San Juan Basin areas have demonstrated the strong effect that climate may have on regional productivity and settlement or occupation patterns. Settlement along the Rio Grande to the north of Bernalillo may be viewed as pulsing to the base of La Bajada, but not quite extending to the north until after AD 850 to 900. This settlement pattern shift toward higher elevations is very similar to that which has been documented for the Montezuma and La Plata Valleys. For the Colorado Plateau, Petersen (1981) has argued for a progressively drier climate through the eighth and ninth centuries, coupled with a shift in seasonal rainfall distribution toward a stronger summer monsoon pattern. The progressive upslope movement of people is so dramatic and consistent, it's tempting to see the settlement pattern change as the strongest evidence for the climate change.

In the Cochiti area and Santo Domingo Basin, it is most likely that farming occurred on the flood plain rather than as dryland farming. This different setting for fields might make water table levels more important than rainfall. Are there characteristics of the paleoclimate that indicate when floodplain farming would have been optimal or when it would not have been possible? If the Peña Blanca site data indicate mixed subsistence practices, are there indications that the climate would have been more productive for foraging and hunting rather than farming? These are questions that are addressed by reviewing the available paleoclimate literature as well as examining ancillary studies that further inform on climate and environment and their potential effect on farming and foraging subsistence adaptations.

Research Issue 3: Community Patterns and Social Organization. Our knowledge of early Pueblo community and social organization as manifested in the Middle and Northern Rio Grande between AD 500 and 950 is limited. This deficiency stems from the fact that only one early Pueblo site that may date to the end of the 450-year span has been excavated. The reporting on the excavation is minimal by current standards, but was certainly sufficient by 1971 standards (see Snow 1971a:1–17). Other site data that can be used to examine community patterns and social organization are the scattered Early to Late Developmental structures excavated from 1950 to 1970 between La Bajada and Isleta and the more recent excavations of the Artificial Leg and River's Edge (Schmader 1993) sites (Walth 1999; Van Pool and Van Pool 2003). In contrast, there are abundant comparative data and interpretations of social organization from contemporary sites on the Colorado Plateau. Anchored by the research of the Dolores Archaeological Program, there are detailed demographic, economic, and social integration models for the Four Corners area that can be compared with the Peña Blanca patterns.

The Middle Developmental pattern suggested by LA 272 is of one or more pit structures associated with linear room blocks of two and nine rooms. The nine-room structure had three intramural hearths. One room within the two-room structure had an internal hearth. Internal hearths within the three pit structures and four surface rooms suggest that both the above- and below-ground structures may have been at least part-time residences. The change from subsurface living and storage to surface living and storage or the Pueblo I pithouse-to-pueblo transition is a widespread phenomenon. However, the co-occurrence of pithouses and minimally built surface rooms at LA 272 suggests that at AD 950, the residence pattern may have been biseasonal, although year-round occupation by a portion of the commensal group was possible or probable. There was no apparent evidence that the pit structures functioned as other than residences, but that is not inconsistent with the observations for joint domestic and ritual use of contemporary (Pueblo I) pit structures on the Colorado Plateau (Wilshusen 1988a). Although a room block-kiva pattern characteristic of the Pueblo II pattern on the Colorado Plateau is not indicated by the excavators or the excavation report, the LA 272 pattern is not incompatible with elaborate ritual systems as reflected in the pit structure-room block patterns of the Pueblo I period on the Colorado Plateau (Wilshusen 1988a).

Schmader's research at the River's Edge sites (1994) suggests that a full range of pit structure morphology and spatial organization can be expected at Peña Blanca. The abundance of plain ware pottery on the surface of six Peña Blanca sites suggested that their excavation could yield results comparable to River's Edge and the Jemez River sites. As stated in Ware (1997:48), "One of the principal objectives of excavations on the Peña Blanca Project will be to enlarge the sample of Developmental period sites to test the validity of the single-household pattern. If such a pattern is indeed ubiquitous in the northern Santo Domingo Basin, then there will be important implications for regional settlement systems and organizations." So, do the Peña Blanca sites represent single-family households operating independently or is there evidence that multiple households were integrated for social or economic benefit and cooperation?

Drawing on research from the Colorado Plateau, aspects of social organization and community patterns can be examined. What follows is a brief middle-range theoretical background that may be useful for guiding the research and interpretations.

A working functional definition of household proposed by Wilshusen (1988a:636) is "the social unit that occupies a dwelling unit (house); and a dwelling unit is a sheltered and enclosed space in which domestic activities, such as food storage, processing, and consumption, and child-rearing are performed. This definition purposefully reinforces the association of a dwelling unit with a household." Wilshusen follows the formula that co-residency and shared domestic duties or activities are linked by a one-to-one relationship; one household equals one dwelling unit. Within this definition of household it was assumed that ". . . people organize their social behavior to accomplish certain basic tasks. The basic functions that must be accomplished are (1) reproduction (genetic and social), (2) production or procurement of resources for a household's basic subsistence needs, (3) distribution of this production, and (4) transmission of rights (or means) of production to the next generation" (Wilshusen 1988a:637).

Ricky Lightfoot amends Wilshusen slightly based on his studies at a small Pueblo I hamlet in the Four Corners area (1994). His refitting and spatial analyses led him to conclude that architectural households (room block suites of a living room and one or more storage rooms) were not necessarily independent social units, although they could be defined as independent commensal units. Adjacent surface "households" were co-dependent in at least some social and economic measures, and they were clearly cooperating within the economic and social contexts of the associated pit structure. One gloss for Lightfoot's perspective is that Wilshusen's households are independent segments of what might be better described as an extended family, which in turn participates as an equal partner with other extended (and probably related) families in the larger room block-pit structure complex that Wilshusen defines as an interhousehold unit.

For our purposes, households may consist of a family, an extended family, or members of multiple families that share architectural facilities. The household is assumed to be a fluid, flexible social and productive unit, linked by reproduction and shared use-rights to living space and probably agricultural land. Changes in household composition may occur for numerous social and economic reasons. This fluidity is implicit but not easily modeled from the archaeological record, except where it exceeds the design flexibility of the associated architectural units or when it is apparent in the biological data. To the extent that architectural units change, we can assume that there are related changes in the nature of the household unit and its functions.

Wilshusen suggests that the most promising household functions that can be investigated with archaeological data are production and distribution (including interaction). These broad functions may often be defined in terms of self-sufficiency or redundancy relative to some hierarchically higher level of social or economic organization that uses the household as its foundation (Wilshusen 1988a:641). Wilshusen does recognize the potential for isolating evidence of productive activities of individuals or special task groups, but he does not elaborate because his ultimate goal was to model suprahousehold and community organization in the Dolores Pueblo I data using the combined concepts of households and dwelling units as building blocks.

Suprahousehold organizations satisfy social or economic needs or are responses to conditions that affect the households' ability or capacity to fulfill one or more of its basic reproductive or productive functions. Colorado Plateau Pueblo I hierarchical organization is modeled as consisting of households, interhouseholds, room blocks, villages, and communities (these terms depart slightly from the project-specific jargon used by the Dolores Archaeological Program). As amended by Lightfoot (1994), a household consists of one or more commensal units that are adjacent and that share domestic roles to form an economically complete domestic unit. Households are probably analogous to an extended family in a multiple generational sense.

Interhouseholds are one or more households that may be independent while sharing ritual organization and space in the form of pit-structure ceremonialism and not in the more exclusive architectural expression of the later kiva. John Ware (2002) would argue that the interhousehold on the Colorado Plateau represents closely related extended families or a matrilineage. Room blocks represent adjacent interhouseholds (with or without conjoining walls) that may or may not be related in a kinship sense. Cooperation is expressed in the use of extramural space by the interhouseholds, and that cooperation probably extends to the allocation of arable land in the immediate vicinity of the room block.

The village consists of residences that are so closely aggregated that there is no possibility of independent action to satisfy needs for arable land. The spatial foot print of each residence is so concise that apart from arable land, there is probably little requirement for interhousehold cooperation in other economic pursuits.

Communities can be defined as geographically close settlements that function independently in the allocation of arable land. Communities can consist entirely of interhouseholds, room blocks, or villages in any combination. Communities may have boundaries that can be discerned through broad areal surveys, and the minimum level of participation would encompass the population necessary to maintain a functional pool of marriage partners.

Sufficient data are available from the Dolores Pueblo I communities to support a model of social hierarchy that integrates the architectural building blocks. The theory comes from Johnson's sequential hierarchies, the supporting data come from measures of pit structure size and ritual feature elaboration, and the extension to the issue of arable land allocation comes from a simulation of growth, catchment adequacy, and conflict (Orcutt et al. 1990). The model proposes that population aggregates in response to local population density that increases to the point where settlements are in conflict over the allocation of arable land (this occurs as a management issue not a survival issue, since there is plenty of agricultural land, they are jostling over convenient field locations). Aggregation redefines the allocation unit upwards in the settlement hierarchy, with decisions made at the level of the settlement as a whole. The structure that validates and facilitates allocation is a ritual hierarchy, building on the basic interhousehold ceremonialism that is the smallest unit of ritual expression (the pit structure-sipapu complex). As the number of interhouseholds grows within a settlement, pit structure ceremonialism is elaborated. This is manifest first as the substitution of Wilshusen's "complex sipapu" for the simple sipapu of the interhousehold pit structure. That substitution appears to follow the Johnsonian rule of six, with one complex sipapu for every grouping of six interhousehold pit structures, usually within a single large room block. Where room blocks cluster to form a village, if there are six or more room blocks, two of the sipapu features will be replaced by more elaborate rectangular central vaults or foot drums, usually with an increase in pit structure floor area as well. For the largest villages (100+ households), two pit structures of unusually large size will be constructed, with elaborations of the floor vaults, often forming two lateral foot drums. Unfortunately, this pattern consists of a single case, so we lack the redundancy that would confirm this as a structural solution to the social problems posed by extremely large population aggregates.

Of interest is that these levels of pit structure hierarchy are local (intravillage) phenomena, independent of the larger community. In the Four Corners area, beginning as early as Basketmaker II, great kivas (including unroofed dance plazas) appear to serve the role of community integration facilities, and they persist into the Chacoan period independent of the rise and fall of village aggregates.

As outlined in the preceding discussion, identification of intra- and inter-community organization is built on the foundation of household. Household in its most simplified form is characterized has having a one-to-one relationship with an architectural unit such as a pit structure or room block. For the Peña Blanca sites, the initial question that can be asked is what is the lowest or most basic level of household organization? Are there components that are even simpler or less basic than the household as defined by Wilshusen and Lightfoot? Are there indications of organization at the interhousehold or village levels?

Fieldhouses or seasonal residences are well-documented in the literature, but they are not well described for Early Developmental or Early Pueblo occupations. They represent an organizational unit that may be more basic than the household. In other words, seasonal residences may represent segmentation of the household. Is there evidence of seasonal segmentation of the household for productive activities and what might that mean in terms of the household or community organization? Which household members would be sent on such long-distance seasonal work? How would this kind of productive organization be manifested in the archaeological record? From these perspectives, we may be able to examine changing household organization beginning for the early expression of an agriculturally focused economy. Agricultural production that relies on the use of fieldhouses and segmentation of the household tends to be described in association with higher population density and greater demands on immediate land resources. Early Developmental populations in the Middle Rio Grande are usually not portrayed as having reached a size that would outstrip local productive carrying capacity. Hence, other factors may have influenced what appears to be low-level, pulsing, establishment of seasonal settlements at the foot of La Bajada in the Santo Domingo Basin between AD 600 and 850.

The Peña Blanca excavations should yield architectural and site data similar to the River's Edge, Artificial Leg, and Jemez River sites. Assuming this is true, we can expect that the bulk of the Peña Blanca Early Developmental occupation will comfortably fit Wilhusen's model of household, village, and community organization. To explore the implications of this model for Santo Domingo Basin Early Developmental settlement, we will need to establish sufficient chronometric control to argue for contemporaneous or sequential occupation of sites or components within sites. Obviously, if sites or components were not contemporaneous, there is no argument for more complex social organization. If the occupations are sequential, then there would be important implications for the mechanics and organization of settlement of the Santo Domingo Basin.

Dating will be constrained by numerous factors. Ceramic assemblages dominated by plain gray pottery are poor temporal indicators because they have longevity spanning four hundred or more years. It is unlikely that temporal resolution of less than one hundred years could be obtained by cross-dating ceramic types. Stratigraphic sequencing may be the most reliable tool for sequencing occupations. Stratigraphically or depositionally defined sequences can be supplemented to some extent with our other dating techniques. Archaeomagnetic dates have less built-in error than other methods and depending on the sample may have low standard error ranges. Radiocarbon dates from annual plants may yield low precision due to the nature of the calibration curve through the Early Developmental period. Through a combination of techniques, a sequence may be established from which arguments for social organization may be built and evaluated.

Once we try to demonstrate contemporaneity within sites, the next step will be to compare adjacent site sequences to see if we have contemporaneous occupations at a larger geographic scale. If we find that we have adjacent contemporary pit structures (within sites or between the closely spaced sites), we can begin to invoke the models of intra-settlement social integration from the Colorado Plateau for comparison. If contemporary pit structures exist only at larger scales, then we need to focus on the inter-settlement or community models of social organization. The alternative for our sample is that we have some robust temporal sequences of occupations, which would then allow us to explore continuity and change in interaction and adaptation.

Interaction can be viewed first synchronically in terms of assessments of household autonomy and self-sufficiency in production versus suprahousehold organization of nonsubsistence or technological activities, such as ceramic manufacture and distribution and the direction, nature, intensity, and influence of extralocal interactions. Interaction can then be viewed diachronically, looking for continuity in patterns that would suggest a stable community system (at least for a few generations).

Obviously, the composition of the households will be difficult if not impossible to isolate. However, the human skeletal data will provide insight into, and directions for, identifying household composition or that of a segment of the household that was interred on site. By examining age-sex patterns and the presence of inherited pathologies or conditions, we can examine issues of residential stability and locality rules.

Site structure is another research avenue for examining social organization. Size and intramural organization of pit structures may be important keys to recognizing higher levels of organization beyond the household. The ritual feature suite identified for the Dolores project or a similar complex of features may be applicable in part or whole to the Peña Blanca pit structures. Population levels in the Santo Domingo Basin may not have reached similar thresholds to the Dolores area and therefore did not trigger alternate or more complex organizational schemes, but some elements may be present.

The Late Developmental Period

The Late Developmental period as defined in the research design spanned AD 900 to 1200. The first 100 to 150 years of the period are poorly represented in the available site data for the Santo Domingo Basin and adjacent Galisteo Basin (Lang 1977) and White Rock Canyon/Pajarito Plateau (Biella 1979) areas. An occupation hiatus or low intensity, low frequency use of these areas is suggested (Ware 1997). The survey data suggested that Red Mesa Black-on-white, the diagnostic pottery type for this early span, occurred in very low frequencies, if at all, on the sites. Therefore, the AD 900 to 1050–1100 span was minimally addressed in the research design with the initial focus on evaluating the "hiatus" hypothesis. As it turned out, the hiatus seems real, except for the previous excavation of LA 272, which appears to fit the early portion of the 150- to 200-year span. Discussion of this period will be limited, except that the occupation hiatus in the Santo Domingo Basin and the corresponding settlement of the Tesuque Valley to the north may be addressed through the paleoenvironmental research and in the examination of regional trends in Developmental period settlement and socio-economic interaction.

The period from AD 1100 to 1200 is better known than earlier occupations of the Santo Domingo Basin. Excavations by the first Cochiti Dam project (Lange 1968b) at LA 6461 and LA 6462 revealed four and eight pit structures, respectively. These pit structures lacked associated surface rooms, though the authors admit that they could have been missed by the excavation. If surface rooms were truly absent, the Cochiti Dam sample suggests that there was a very short-lived, or differently manifested in terms of timing, sequence, and organizational consequences, pithouse-to-pueblo transition in the northern Middle Rio Grande. There are two very interesting aspects of the Late Developmental or late Kwahe'e phase components. First, two of the four pit structures at LA 6461 were unfinished, while the two occupied structures appeared to reflect sequential rather than contemporaneous occupation. At least during the late 1000s or early 1100s occupation was by a single household unit that returned to this location over period of years, perhaps building new structures as earlier ones became unreliable as residences. Interior hearths suggest year-round occupation to some (Biella 1979), while intramural storage could be interpreted as supporting seasonal occupation (Ware 1997; Wills and Huckell 1994). The latter interpretation of intramural storage suggests that the LA 6461 residents were organized similarly or even more loosely than the Early Developmental period residents. Much larger, roughly contemporaneous villages, were established in the Santa Fe and Tesuque Basins and, perhaps, throughout much of the Tewa Basin (Anschuetz et al. 1997) by the AD 1100s. Potentially, the LA 6461 residents were part of a later and a continuation of a southern seasonal occupation pattern that was initiated by the occupation at LA 272. The two unfinished pit structures at LA 6461 that had anticipated or planned occupations could not be sustained by available resources or support systems.

The later occupation at LA 6462 consisted of eight pit structures, of which, four were clustered. This residence pattern seems similar to the LA 6461 pattern, except at a slightly greater quantitative scale. Interestingly, abandonment of isolated pit structures and the pit structure cluster are succeeded by a Coalition period occupation that included surface rooms and, usually, a subterranean structure identified as a kiva (Bussey 1968). This Coalition period architectural pattern of surface rooms with a kiva is the primary architectural/residential pattern found on the Pajarito Plateau (Powers and Orcutt 1999) and other areas of Northern Rio Grande, where surface structures followed small-scale Late Developmental occupations consisting of pit structures and a few surface rooms (Wiseman 1978; Skinner et al. 1980).

The rapid Late Developmental reoccupation sequence of LA 6462 suggests that later residents were descendants of or related to the earlier occupants. As Late Developmental populations began to increase along major watercourses, such as the Rio Grande, ancestral land use patterns may have helped determine who could settle in the most favored or productive areas.

This brief introduction to the Late Developmental period provides a background for research issues that could be examined with Peña Blanca data. For the most part, these research issues follow those proposed for the Early Developmental period. But, because these sites date later in time and potentially follow a 150- to 200-year occupation hiatus, they can be view in terms of continuity, stability, and change.

Research Issue 1: Culture History and Culture Change. To date there is little consensus on the origin or cultural affiliation of Late Developmental populations in the Northern Rio Grande. Early and recent research in the Tesuque Valley suggest that many Late Developmental sites have ceramics that indicate interaction with the San Juan Basin into the early to middle 1000s (Boyer and Lakatos 2000; Wiseman 1995; Wendorf and Reed 1955; Mera 1935; McNutt 1969). This apparent influence or evidence of socio-economic interaction was diminished or less pervasive by the middle to late 1000s as indicated by the increasing occurrence of decorated pottery types with southern origins. The influence of the Chaco sphere was not as strong as early investigators suggested and any real influence may have waned before the height of the Classic Bonito phase.

Site structure patterns indicate architectural variability throughout the period with pit structures occurring with and without surface rooms. Absence of surface rooms in many cases may reflect actual architectural patterning, but it is also possible that ephemeral structural remains may have been missed by rapid excavation methods. Sites or locales may have a single or multiple pit structures with surface rooms typically numbering from 3 to 25, except in the most extreme cases. As indicated by the Cochiti excavations, Late Developmental architectural patterns may be obscured later Coalition period occupations.

For the Late Developmental components revealed during the Peña Blanca excavations, many of the same questions relating to Early Developmental period culture history and culture change still apply. The Peña Blanca Late Developmental period occupations can be characterized in terms of site structure and material culture and compared with available data from sites north of La Bajada and south along the Rio Grande. In addition, Early and Late Developmental components can be compared at all levels of analysis looking for continuity or change. Description and analysis will follow the protocol outlined for the Early Developmental period sites. If the surface indications were less abundant for Late Developmental components, analysis and interpretation may be scaled back.

Research Issue 2: Settlement and Subsistence. For settlement and subsistence, the smaller scale Late Developmental period data will be applied in the same way as the Early Developmental data. Similar issues relating to mobility and subsistence can be addressed. Questions include: Why is there no pithouse-to-pueblo transition or why is the transition not uniformly distributed throughout the Northern Rio Grande? Is there a continued pattern of settlement mobility that is influenced by environment and available subsistence options? If the site residential pattern was seasonal, where were the cold-weather settlements?

Similar site structure, material culture, and paleoenvironmental studies planned for the Early Developmental components can be applied to the Late Developmental period with the added benefit of historical precedence for comparison. Research directions stated for the Early Developmental period can be revised to better fit the Late Developmental period context.

With regard to the ceramic assemblage, does the dichotomy of maintainable versus reliable in vessel forms and pastes reflect similar or different mobility and subsistence patterns? Early Developmental period ceramic assemblages emphasized maintainable ceramic technology as reflected in the very high proportion of plain to decorated pottery (Mills 1989). In addition, there was considerable potential for vessel form variability, but this variability was always represented by only a few of the forms that were part of the plain ware technological repertoire. For the Late Developmental period, one expectation might be that the ceramic assemblage would reflect a shift toward a more reliable rather than maintainable technology, as is found at contemporaneous San Juan Basin sites. In the upper San Juan Basin especially, this shift is manifested in a nearly 50-50 proportion of utility to decorated wares. Examination of vessel form and style distributions contribute to an assessment of the degree of mobility that was practiced by Late Developmental period residents.

The faunal analysis focused on recognizing different hunting strategies. Garden hunting was expected if growing season occupation occurred. Long distance or logistically organized forays yield larger mammals from a broader range of environmental zones. Heavy emphasis on garden hunting with little or no evidence of large mammal exploitation would support a interpretation of a seasonal occupation with non-growing season residency occurring at another location. Obviously, a heavy emphasis on large mammal consumption might suggest a fall-winter occupation. Mixed assemblages would be expected in part or all of the residents were full-time. Again, comparison with Early Developmental and Coalition period assemblages will provide a comparative basis for determining the degree of mobility and seasonality.

For chipped stone, the technological dichotomy of expedient and planned tool manufacture, as described for the Early Developmental period, applies to the Late Developmental. If the majority of site activities were organized around agricultural scheduling and opportunities, then the main focus of chipped stone tool production should be expedient. Abundant, locally available fine-grained raw materials further enabled resident's use of expedient tools. In fact, low frequencies of edge damaged or modified tools would be expected because tools with fresh edges were easily made. Evidence for tool production or maintenance that supported logistically organized hunting or specialized resource processing might be absent if garden hunting and local resource processing were the focus. Evidence of logistically organized hunting might be broken and resharpened or reworked tools made from non-local materials with little or no manufacture debris. Tools would have been produced off-site and brought back to the residential site if they were still useful, embedded in meat packages or attached to hunting implements that could not be retooled in the field. Staging hunting or gearing up for future hunts from the residential site could result in core reduction and formal tool manufacture debris mixed in middens or found in primary contexts on floors of structures or as debris swept into intramural floor features.

Ground stone, especially manos and metates, are key indicators of reliance on wild or cultivated plants. Mano and metate attributes or types and their distribution reflect the technological organization and degree of dependence on wild or cultivated plants. Abundant whole or fragmentary metates and manos reflect a focus on plant processing. Proportions of one-hand and two-hand manos and trough, slab, and basin metates reflect which plant products were more commonly processed. Concentrations of ground stone may reflect organization for intensive or higher volume processing. Dedicated space with associated ground stone also may reflect an emphasis on processing. Caching or storage of grinding implements suggests planning or anticipated needs. Planning indicates expectations for the future, which is based on past experiences. In other words, if we were growing and grinding corn last year and this year, then we expect to be doing the same next year. Planning for the future indicates an expectation to occupy the site in the future, whether that occupation is seasonal or permanent. If seasonal mobility is less of an option and there is an increased reliance on agriculture, then dedicated grinding and storage space, tool caching, and the accumulation of broken or depleted tools would be expected. Patterns of distribution and use can be compared with Early Developmental and Coalition period assemblages resulting in an estimation of relative mobility and reliance on agriculture on the scale of more mobile, less dependent to less mobile more dependent.

Archaeobotanical data from Late Developmental period components can be compared with Early Developmental and Coalition period components. If Early Developmental residents were less dependent on agriculture and Coalition period residents were more dependent, do Late Developmental residents fall somewhere in the middle or do distributions of pollen and macrobotanical remains indicate more or less reliance on cultivated versus wild plants? Distribution and variety of wild plant species found within structures may indicate season of occupation or at the least, season of abandonment.

Human skeletal remains data from the Cochiti area for the Late Developmental period totaled thirteen. The mortality distribution describes a U-shaped curve typical of preindustrial societies. The majority of the burials were children under age 8 and adults older than age 36. The composite burial population included men, women, and children, suggesting that LA 6462 was occupied by family-based households for all or part of the site history.

Measurements that can be used to infer mobility and agricultural dependence were not taken on the LA 6462 burials. However, burials from LA 103919, a Late Developmental site in the Nambé River Valley, suggest that the population was relatively sedentary, though the faunal remains indicated that large mammals were an important part of their diet. These data suggest that segments of the population were less mobile, perhaps remaining at the site year-round, while more able individuals that were not buried at the site or at least not within the project corridor carried out the long-distance hunting.

How does the Peña Blanca Late Developmental burial population compare with Early Developmental and Coalition populations from the Cochiti area and with their northern neighbors in the Pojoaque and Nambé River valleys? Are the Peña Blanca populations more or less mobile and agriculturally dependent than their neighbors or antecedents or descendants? Are there regional patterns that might suggest different degrees of mobility and agricultural dependence in contemporary populations of the Northern Rio Grande? These are some of the compelling questions that will guide the human skeletal remains study and tie it to broader issues of mobility and subsistence.

The degree to which site structure studies will be appropriate depends on the number of structures and datable extramural features that are found. LA 6169 has pottery from Early and Late Developmental and the Coalition periods. This suggests that there will be spatial overlap in feature distributions and sheet trash deposits that will make it difficult for temporal differentiation. Therefore, it is likely that the most productive avenue for addressing mobility and subsistence will be through individual architectural units. Pit structures can be described and compared with previous Late Developmental structures from the Cochiti project (LA 6461 and LA 6462 [Lange 1968a]). They may also be compared with similar aged structures from south of the Santo Domingo Basin and with those recently excavated in the Pojoaque Valley (Boyer and Lakatos 2000). Formality and frequency of floor features, durability of construction, and structure size and depth may be keys to season and duration of Late Developmental occupations. Specialized features not found in Early Developmental components may indicate a changing subsistence focus as population increases in the Northern Rio Grande, resulting in different strategies and options.

Paleoenvironmental study will extend to the sixteenth century. Trends in climate change and corresponding settlement and technological responses can be compared with earlier and later occupation periods. Is the Late Developmental settlement of the Peña Blanca area a response to region-wide conditions that were generally wetter and warmer? Or were the characteristics of Late Developmental period settlement and subsistence a response to local conditions related to aggrading floodplains, rising water tables, and the potential of salinization and the degradation of soil quality below the level that would sustain agriculture? Were climate and environment too unpredictable to sustain large populations resulting in the dispersed small-scale settlement pattern reported by Biella (1979) and others?

Research Issue 3: Community Patterns and Social Organization. This research issue has been extensively treated for the Early Developmental period. Because the Late Developmental period components are expected to be relatively limited in scope, they may be interpreted within the framework of household and interhousehold cooperation for subsistence. Trade and extralocal contacts are expected to show substantially different or better defined patterns than the Early Developmental period because surrounding areas are more populated. This increased population should result in more social and economic interaction as increasingly more diverse groups move into the Northern Rio Grande. Extralocal interactions may extend north of La Bajada, down the Rio Grande into the Albuquerque District and west to the San Juan Basin. Changes in non-local pottery types, lithic raw materials, and specialized ornaments and mineral resources may reflect the period immediately preceding and following the destabilization and abandonment of Chaco Canyon and many of the outliers in the eastern Red Mesa Valley and Mount Taylor area.

The Coalition Period

Coalition period sites are typically defined by the occurrence of carbon-paint decorated pottery. Three pottery types have been defined for this period: Santa Fe Black-on-white, Wiyo Black-on-white, and Galisteo Black-on-white. Santa Fe Black-on-white can be seen as a continuation of design systems established for Kwahe'e Black-on-white during the Late Developmental period. Continuity of design styles from Late Developmental to Coalition period indicates that at least some of the sudden increase in site frequencies in the Northern Rio Grande and specifically in the Cochiti-Southern Pajarito Plateau during a 125-year period was due to local growth. However, the occurrence of upper San Juan Basin design components on Kwahe'e and Santa Fe Black-on-white indicate a longstanding connection between the two areas. This hypothesized long-lived connection serves as the foundation for arguments that a large part of the increase in site frequencies, and by inference, sudden increase in population, can be explained partly by migration during the thirteenth century. This argument is particularly strong for the Pajarito Plateau, where few Late Developmental residential sites have been identified and the settlement pattern strongly fits a migratory model (Preucel 1988).

In 1977, there were 363 Coalition period sites or components documented for the nine quadrangle area that made up the Cochiti Dam study area. Of these 363 sites, 268 have associated architectural features. These architectural components or structures range from 1 room to 500 rooms with the majority of structural sites having 6 to 10 rooms (Biella and Chapman 1977a:303). Sites with 10 to 30 rooms are another well-represented class that is rarer for the Classic period. Correspondingly, the 200- to 500-room pueblos most common in the Classic period are rare, but present for the Coalition period. It is this florescence of small-to-medium size architectural units that underlies the migratory model and is one defining aspect of the Coalition period.

Currently, the New Mexico Cultural Resources Information System (NMCRIS) at the Archeological Records Management Section shows 673 components that could date to the Coalition period. This frequency is a gross estimate because the time range is AD 1100 to 1300 resulting in a few Late Developmental components being included. Also there are other broader date ranges, AD 1 to 1600, for example, that include sites with Coalition period components and that are not included in the 673 components. Without worrying too much about the actual number of Coalition period components, it is clear that the last 22 years of research have added significantly to a pattern of a Coalition period site increase that was already very strong and well represented.

Biella (1979:142–143) emphasizes the sudden appearance of a large number of Coalition period sites in the Cochiti and southern Pajarito Plateau. As stated before, there were three distinct architectural units that defined the settlement pattern: 1 room, 6 to 10 room, and 20 to 30 room components. The three architectural types occur and exist simultaneously with no evidence of a temporal trend from small to larger room blocks. This unstandardized early settlement structure may reflect an attempt on the part of immigrant populations to retain socioeconomic flexibility, while adjusting to new social and environmental conditions. The change to the room block/kiva pattern follows the Late Developmental period single household pithouse pattern within a short time of 25 to 50 years. Multi-tier room blocks are not unknown for the Late Developmental period, but they are mostly found in the Santa Fe, Tesuque, and Tewa Basins to the north. The room block/pithouse or kiva pattern is rare on the Pajarito Plateau prior to the Coalition period. Concurrent with the residential pattern change is the switch from mineral- to carbon-paint decorated pottery that shows evidence of design system continuity and not a wholesale change. In other words, the design styles on Kwahe'e Black-on-white appear to continue in Santa Fe Black-on-white rather than changing to an upper San Juan Basin design system.

A recent inventory of Bandelier National Monument provided excellent data on initial settlement, settlement structure, and settlement expansion and contraction (Powers and Orcutt 1999). Settlement patterns are modeled as a reflection of subsistence strategies developed in response to changing environmental conditions and population growth (Powers and Orcutt 1999:551–552). The aggregation model anticipated initial, small, dispersed settlements that were decadally or generationally mobile. As wild resources and agricultural productivity declined, a group moved to a new location. As population increased, settlement size also increased, as did the number of larger (10 to 30 room) villages. This increase in population was accommodated by the small to medium room blocks with limited storage capacity as long as precipitation was sufficient for farming. Extended dry conditions forced settlement reorganization with a temporary population decline followed by a pattern of highly aggregated settlement that was tried during the Late Coalition period and became the main settlement pattern in the Classic period. During the Early Coalition, intervillage or household cooperation occurred but was not critical to success or survival. Increased population and restricted mobility that resulted in more aggregated settlement required social mechanisms that ensured generational land use rights and mitigated against destructive or debilitating land ownership disputes. Also, as access to a broad range of resources declined or required more social negotiation, specialized production and increased exchange between villages was expected, though did not demonstrably occur during the Coalition period (Powers and Orcutt 1999:563–564).

During the Coalition period, population grew faster than a natural reproductive rate. Powers and Orcutt (1999) attribute part of this rapid growth to immigration. The most rapid or dramatic population increase in Bandelier National Monument occurred between AD 1200 and 1250. Even though this is earlier than the dramatic late thirteenth-century population decline for the upper San Juan Basin, they suggest that earlier migration from that area did occur at the household rather than village or settlement level. Archaeological manifestations of such an early move are difficult to identify. Obviously, the introduction of carbon-paint decorated pottery and some stylistic similarity with Mesa Verde style pottery is one indicator. The sudden occurrence of "Prudden Units" as the primary architectural form is suggested as another possible upper San Juan Basin marker. Powers and Orcutt (1999:588) suggest that the early appearance and rapid dispersal of aggregates on the Pajarito Plateau may have been an attempt to implement a familiar socio-economic organization developed under different conditions into a new area that ultimately required a different socio-economic complex.

Within the Peña Blanca project area, there were three sites, LA 6169, LA 6170, and LA 6171, with room blocks consisting of an estimated six to ten rooms. The Cochiti Dam excavation at the North Bank site, LA 6462, reported by Lange (1968a) revealed five parallel-tier room blocks. Estimated room counts ranged from 7 to 20. Each room block had an associated kiva and, based on a one hearth per household model, housed from three to five households. Except for Unit VI, there was a slightly higher than 1:1 storage to living room ratio. Unit VI had a 3:1 storage to living room ratio. Powers and Orcutt (1999) suggest that Early Coalition settlement was based on agricultural production and wild resource procurement for a single year with limited provision for storage of a surplus. Through time this early pattern was replaced by larger room block arrays with more storage capacity. This increased capacity was one suggested response to higher population density where surpluses could be used to buffer against short-term agriculture decline and a decrease in available wild resources resulting from depletion and territorial restrictions.

Research Issue 1: Migration, Indigenous Growth or Both? Obviously, a continuing and important enquiry for the Coalition period is the issue of the "sudden" population growth. This "sudden" growth is inferred from the large number of sites with Santa Fe Black-on-white and room blocks with kivas that appeared on the Pajarito Plateau and Cochiti area after AD 1200. Migration can be argued from the standpoint of the emergence of a settlement pattern that was well established in the eastern Anasazi area by the middle to late AD 1000s and was elaborated during the 1100 and 1200s in the Chaco and Mesa Verde area. There was a predominant architectural pattern of 1- to 20-room pueblos or structures built in a single episode or over a short time with structures over 5 rooms having an associated kiva, an efficient, low cost way to build and establish a presence or claim to farming territory. A close relationship between the kiva volume and the adobe needed for adobe-making and roof covering has been demonstrated in the Dolores Project area (Wilshusen 1988a; Glennie 1983). Many small residential units reflect gradual small-scale movement of population into or a restructuring of a segment of the indigenous population of the Middle and Northern Rio Grande between AD 1200 and 1275. This pattern fits the Peña Blanca settlement pattern. Another pattern that is not documented by excavation in the Peña Blanca/Cochiti area, but is visible on the Pajarito Plateau, is the construction of larger plaza pueblos that may represent larger scale migration, such as at the community or lineage level. This pattern occurs later in the period, concurrent with the late thirteenth-century depopulation of the San Juan Basin.

Therefore, it can be asked if the Early Coalition period settlement in the Peña Blanca area exhibits patterns in architecture and material culture that reflect migration by household-level segments of a population or do they reflect restructuring of local population? Three potential data sources for addressing this problem are the architectural patterns, ceramics, and human skeletal remains.

The general expectation for the Peña Blanca architectural pattern is based on inventory data. A portion of a room block or a surface structure extends into the project area at LA 6169. The room blocks are outside the right-of-way, however other structures may not be visible as surface remains. The surface structures at these sites co-occur with earlier components. Depending on any temporal gap between early and late components, the surface may reflect reoccupation of the terraces above the Rio Grande and along the Santa Fe River by descendant populations. This would suggest that earlier and later populations were related, and therefore, the Early Coalition period settlement might represent a restructuring of local populations. Presence of a kiva associated with the surface structures would indicate settlement by a group intending year-round, and perhaps, a lengthier occupation. This might be expected of a migratory population that had or could not establish a seasonal occupation pattern in a new region. A lack of a kiva might suggest that the sites were seasonally occupied by groups with ties to other areas within the region where socially integrative events or rituals were conducted.

Pit rooms occurred at three sites: LA 6462, LA 9128, and LA 12123. These structures had limited floor space, 3 to 7 sq m, and central hearths with ventilators. Subrectangular in shape, they appear to be fieldhouse cognates, although they are partially subterranean with adobe superstructure completing the wall. Other one-room structures are more typical of San Juan Basin-style fieldhouses with a cobble foundation and an inferred jacal and adobe superstructure. In terms of simple thermal properties, the subterranean structures are more suited to cold weather occupation and all had hearths indicating that they were heated. Often pit rooms are spatially associated with room blocks, but are not necessarily contemporaneous. The accepted interpretation of the pit rooms is that they are seasonally occupied fieldhouses. If this is the case, then it is likely that they were built and used by members of an established population rather than a construction option used by a migratory population. Dating pit rooms or surface structures and monitoring architectural characteristics may provide support for migratory or local population use of the Peña Blanca area.

Another data source is the pottery. It is expected that Coalition period components will yield Santa Fe Black-on-white and utility wares. Santa Fe Black-on-white recovered by the Cochiti excavations typically had a fine silty, self-tempered paste with a gray to blue-gray color. Variations in the "classic" Santa Fe were assigned new type names by Honea (1968). While our analysis will not attempt to duplicate Honea's type-splitting, it is important to note that the variability may reflect local production of Santa Fe Black-on-white in conjunction with either production or acquisition of the more "standard" type. The degree to which Santa Fe Black-on-white is locally manufactured or obtained through an exchange network may inform on the origin and economic relationships of the resident population.

Historical continuity in design style on Santa Fe Black-on-white with Kwahe'e Black-on-white may provide additional support for a restructuring of local population. Design styles or elements found on Kwahe'e Black-on-white from Peña Blanca Late Developmental components can be compared with those from the Northern Rio Grande Late Developmental sites to look for similarities that would suggest a regionwide design tradition or exchange system. Then, Kwahe'e Black-on-white and Santa Fe Black-on-white from the Peña Blanca sites can be compared for continuity or innovation. Santa Fe Black-on-white can also be examined relative to Upper San Juan Basin design traditions for evidence of influence and continuity. A stronger tie with existing or ancestral Northern Rio Grande traditions might suggest that the population has local roots rather than being new to the area. Closer affiliation with Upper San Juan Basin design traditions would suggest northern ties, even though raw materials are most likely to be from local sources.

Utility pottery may provide some indication of the origin of the Peña Blanca site residents. Recently, Blinman and Price (1998) have shown that utility ware coiling method may be regionally sensitive. Typical corrugated pottery from the Colorado Plateau is coiled by lapping upper coil over the coil below, which is how clapboard corrugation is formed and defined. The overlapping coils are then smoothed, indented, left clapboard, or modified in other ways. The typical Northern Rio Grande corrugated pottery is formed by placing the lower coil over the upper coil or underlapping. This "underlapping" style is evident in the Northern Rio Grande by the AD 1000s. Late Developmental and Coalition period pottery can be examined for coiling method. If the population is new to the area and they come from the Colorado Plateau, then overlapping utility wares may be present, if not common. A continuous tradition of underlapping coils would suggest local tradition and production. At least in the early 1200s use of local production sources would be more likely for a locally linked population.

Other traits of utility ware may be sensitive to manufacture source and may reflect continuity or change in pottery production and acquisition. Continuity in Late Developmental to Coalition period utility wares would be reflected in similarity in paste and temper. Typical tempers are sand and crushed granite or metamorphic rock. These two tempers were observed by Honea in the Cochiti Dam assemblage. Crushed metamorphic rock is typical of a Sangre de Cristo foothills or piedmont slope production. Isolated sources for crushed metamorphic rock may exist near the Peña Blanca area, but the main source should be north of La Bajada. Sand-tempered utility ware could be local or come from the Pajarito Plateau. Late Developmental and Coalition period temper types can be compared within the Peña Blanca sample and with Pajarito Plateau and Sangre de Cristo foothills pottery to define likely sources. A strong tie with the Sangre de Cristo foothills source would suggest local production and perhaps lend more support to restructuring of local population. Peopling of the Pajarito Plateau is in part attributed to migration. Therefore, if the Peña Blanca residents had ties to the Pajarito Plateau it might be expected that some of the utility pottery would reflect production in that area. While residents might not have migrated onto the Pajarito

Plateau, a change from a Tewa Basin to a Pajarito Plateau influenced utility ceramic assemblage would suggest fundamental shifts in the social and economic organization of the Peña Blanca populations.

Human skeletal remains may provide direct evidence of continuity or change in the Peña Blanca site residents. Craniometric data may be sensitive to genetic relationships within or between populations. Late Developmental and Coalition period craniometric data can be compared. Significant differences may reflect population replacement, while similarities may suggest that the two populations are related. Inherited or genetic traits may be visible in skeletal remains. Occurrence of outstanding genetic traits or pathologies may indicate descendant populations. These data can be compared with the Cochiti Dam human skeletal remains to verify the strength of the relationships or differences.

Research Issue 2: Residential Patterns and Subsistence. In contrast to the Developmental period, the Coalition period subsistence pattern is expected to reflect a high agricultural reliance supplemented by wild plants and field and logistical or long-distance hunting. The Early Coalition period with its relatively dispersed, small-scale settlement pattern may reflect placement of primary residences adjacent to the best or most available field locations. Fieldhouses may have been used later in the Coalition period and during the Classic period when populations aggregated thereby increasing distance to fields in favor of a more community-oriented social and economic organization. The Peña Blanca sites therefore may reflect different levels of organization of agricultural production. One pattern would reflect a year-round occupation and the other a seasonal fieldhouse occupation. Different types and combinations of structures may be indicative of these residential patterns. Room blocks with kivas are usually interpreted as supporting a year-round residential pattern; pit rooms or surface structures with one to three rooms and no kiva suggest a seasonal residential pattern. Seasonal and year-round occupations should leave evidence of different subsistence strategies or a difference in the mix or intensity of particular strategies. These different strategies should be evident in the range of intramural features and the composition of the ceramic, lithic, faunal, and ethnobotanical assemblages.

Year-round occupations should have the most diverse range of material culture and subsistence remains in conjunction with a full range of intramural and extramural processing and productive features. Surface storage rooms and living rooms with hearths should be present, as were found at the North Bank site, LA 6462 (Lange 1968). Subsistence should focus on agriculture supplemented by wild plants and hunting. The ceramic assemblage should have the most varied selection of vessel forms reflecting a full range of local and non-local production and exchange. Chipped stone tool manufacture and use should be overwhelmingly geared to expedient tool manufacture and use of local materials. Discarded formal tools will remain from specialized activities or maintenance and production connected with specialized activities. Grinding tools and other ground stone tools may be abundant and varied. Grinding implements may be associated with specialized work space or grinding facilities. These may be kept in storage rooms or cached within structures. Ethnobotanical and faunal remains may show a heavy reliance on cultigens and the animals that frequent fields and disturbed environments. Large mammal remains should be present, but the remaining bones should reflect transport of meat packages with the highest caloric and protein values.

Seasonal residences or fieldhouses may be present and will vary in construction and complexity with the duration of the occupation. Full-season residences should have the most formal and substantial construction. These fieldhouses might have intramural hearths, could be surface or subsurface one to three room structures, but lack long-term storage facilities or features. On-site processing should be limited to food needs for daily consumption and subsistence remains should reflect exploitation of field and riparian species of plants and animals. Ceramics will occur in lower frequencies and the variety of forms may be limited. Use of partial vessels may be more evident than for year-round residences. Nonlocal ceramics may occur, but only in very low numbers or perhaps as recycled tools or temporary containers. Ground stone artifacts may occur, but in low frequencies. Ground stone fragments should be rare, since the intensity and frequency of ground stone tools used should be low.

As duration of the seasonal occupation is shortened, is more sporadic, or does not include overnight stays, the frequency and durability of artifacts, features, and structures may be reduced. Ephemeral four-wall surface structures to ramadas may be constructed. Few or no thermal or processing features may be present. Domestic refuse may be negligible. Obviously, sites where different seasonal residential patterns occurred over the length of the occupation may exhibit a mix of artifacts, features, and structures that cannot be attributed to a specific strategy.

The Classic Period

Classic period occupation within the project area is primarily represented by LA 249, Tashkatze Pueblo. This large, multistory plaza village site has a long occupation history with the bulk of the occupation occurring during the Early Classic period, based on surface ceramic collections. The majority of the site is outside the project limits. Extending into the project area is a high-frequency sheet trash deposit. Excavation of the deposit was expected to yield sufficient temporal information through ceramic cross-dating to determine which occupation period the refuse was left from. Because sample size, relative to the large artifact assemblage associated with the main site area, will be small, it is expected to reflect only a small proportion of site activities and social and economic interactions. Therefore, the main goal of the research will be to determine which period the refuse comes from and then interpret any social or economic data in terms of patterns described for more completely excavated Cochiti Dam sites, such as LA 6455 (Lange 1968a) and LA 70 (Snow 1976).

The Historic Period

Although historic components were noted at more than half of the sites on the Peña Blanca Project (LA 249, LA 265, LA 6169, LA 6170, and LA 6171), no historic features or artifact concentrations have been noted within the project limits. Moreover, the likelihood of buried historic features and deposits is considered very small due to the depositional environment of the terraces (there has been generalized deflation around most of the late prehistoric features on the project, suggesting that any subsequent features or deposits would be either obliterated or visually obvious).

Historic features found within the project limits will be systematically excavated. Material culture remains will be used to date the features and assign them a cultural affiliation, if possible. Additional research will include ethnohistorical study of the project area. Interviews and archival sources will be examined for information on site residents and historic residential patterns.

Chapter 4
Environmental Setting of the Peña Blanca Project
Jonathan Kaplan

Defining the environmental setting of the Peña Blanca sites is important to elucidate each of the research questions guiding the Peña Blanca project: (1) the Peña Blanca sites represent the earliest examples found thus far of ancestral Pueblo settlement in the Santo Domingo Basin; (2) in the absence of more finds to date, three discrete occupations from AD 500–650 appear to confirm a late and limited appearance of agriculture in the Peña Blanca area, which is somewhat surprising because of an irrigation potential from the confluence near the sites of the Rio Grande and Santa Fe River; (3) the sites, in general, should shed light on the Early Developmental period, still quite obscure in the history of the northern Middle Rio Grande; and (4) the project should increase what we know about the Late Developmental/Early Coalition cultural frame with respect to autonomous as opposed to intrusive or migrational subsistence activities in the region; specifically, it may help to answer questions about interaction with the Pajarito Plateau.

Consideration of the environment when trying to explain human culture and behavior has become standard in any modern or conjunctive archaeology and the literature on the role of the environment in the human past is enormous. In general, when employed within archaeological field research, environmental data redirects attention away from sites—"cultural" but contextless as such—to consideration of "the actual empirical nature of archaeological distributions across the landscape" (Chapman 1988:30). It also reframes analytical issues with respect to "human-land" interrelationships, with an emphasis not only on synchronic (i.e., systemic) conditions and factors but also on diachronic (e.g., natural historic) perspectives. As a result, archaeologists are apt to base their analyses on quantifiable information as well as on intersecting or overlapping data sets. Accordingly, human cultural variation and change may be considered not in a vacuum but rather as part of a dynamic in which humans play one role along with many actors in the events and processes studied in the archaeological record.

Some examples from the Southwest demonstrate how the environment may (largely) have structured different human adaptive strategies at the sites through time, and, therefore, how such an interpretive approach and its methodological underpinnings, in general, can be productive. Analytic considerations, in general, take into account both type and scope of environmental factors. An environmental orientation in archaeology focuses on the physical environment as reflected in physiography and geomorphology, geology, soils, climate, hydrology, flora, and fauna (see Edwards in Lang 1997).

Regional and Local Setting of the Sites

This section places the sites in their regional and local environmental, physiographic, and biotic setting. Discussed generally and specifically about the project area are: (1) the nature and location of land forms, and particularly as these are related to settlement patterns and land usage; (2) geologic and mineral resources utilized by prehistoric and historic inhabitants of the Santo Domingo Basin; (3) soils, soil-forming factors, and the life forms and patterns corresponding to the soils of the sites; (4) climate, both present-day and extrapolated from ancient times, such that inferences may be drawn as to how given climatic conditions have influenced land forms as well as human, plant, and animal life at the sites; (5) hydrology, including estimates of the potential availability of runoff water for human subsistence and agricultural strategies (e.g., dry farming, floodwater farming, or *ak-chin*); (6) vegetative types and patterns that prevail within stated elevation regimes or stratified into vegetative zones and communities; and, (7) the life zones as well as specific mammalian, avian, and fish populations that would have been economically important to ancient populations, for example, as food or fur resources. In addition, the chapter describes the environmental bases upon which research may enable stratification of the sites and their immediate resource areas into measurable agriculture "land classes," the purpose of which is to shed light on prehistoric utilization of the land for purposes other than as biotic communities.

Physiography

The larger geophysical region entailed is the Basin-and-Range "physiographic province." Regional, but also more site-specific or local physiography and geology lay the foundations for discussion of landscape patterns with respect to soils, climate, hydrology, flora, and fauna. Differences between the project area and the immediate neighboring areas highlight the most significant environmental factors impacting human developments. The regional but also more site-specific or local physiography and geology take into account structural (e.g., rift) and topographic and geomorphic characteristics, and geological characteristics (e.g., volcanic and/or sedimentary).

Geomorphological setting and general topographical factors may be distinguished between the two most pronounced local physiographic features, the Santo Domingo Basin, which incorporates a well-defined Rio Grande floodplain and depression and, immediately to the north, White Rock Canyon, created over time by the flow of the Rio Grande through the extensions of the Jemez and the Nacimiento volcanic uplifts (Warren 1977c:15). As mentioned, a further, closely adjacent feature, the Pajarito Plateau, is important for elucidating questions of culture history as well as social and evolutionary process at Peña Blanca because of its archaeological heritage and which, notably, includes the Bandelier cliff-dwellings.

The Peña Blanca sites lie within the Santo Domingo Basin at the northernmost edge of the Middle Rio Grande Basin. The Santo Domingo Basin, comprising some 25 sq km, is the northernmost extension of the Albuquerque Basin, one of four larger valley basins in the Middle Rio Grande depression. The Middle Rio Grande Basin is part of the larger Rio Grande Basin, which begins in southern Colorado and ends in Mexico and consists geomorphically of a major rift valley produced by a series of grabens that have subsided along the crests of surrounding plateaus and mountains (Loftin et al. 1995:80–81). Extending some 200 km, the Middle Rio Grande Basin is demarcated to the north by Cochiti Lake and ends at Elephant Butte Reservoir to the south; it is bounded to the west by the San Juan Basin of the Colorado Plateau and on the east by the Sandia, Manzano, and Los Pinos mountains (Fox et al. 1995:52). The Albuquerque Basin, while only the third largest of the four valley basins of the Middle Rio Grande Basin, is the most important of them with respect to modern settlements because in it lies a large aquifer that supports the city of Albuquerque (Fox et al. 1995:53).

The Albuquerque Basin covers approximately 7,925 sq km (Fox et al. 1995:52). Its northern boundary, and hence the northern boundary of the Santo Domingo Basin, is formed by two major uplifts, the Nacimiento, consisting primarily of Precambrian plutonic and metamorphic rocks overlain by Paleozoic strata, and the Jemez, consisting mainly of Cenozoic volcanic rocks. The basin's eastern margin abuts massive fault blocks forming the Sandia, Manzano, and Los Pinos mountains, which consist principally of Precambrian and metamorphic rock with overlying Paleozoic limestones and sandstones. More locally in the Santo Domingo Basin, geomorphological characteristics are determined by the Rio Grande and its floodplains and broken and hilly semiarid grasslands. Just to the north of the Peña Blanca sites lie gravel terraces consisting of an upper and lower deposit of axial Rio Grande gravels and a middle fine-grained overbank with a combined total thickness of 49 m (Smith 1996:91). The first terrace above the floodplain traversed by NM 22, is capped by fine-grained eolian and redeposited alluvial sands and silts that range from a few centimeters to several meters in thickness (see below). Smith dates these sediments between 15 and 30 thousand years (see McFadden, Chapter 6). Archaeological deposits of much more recent origin (circa 1000–1500 BP) erode from these sediments, suggesting significant deposition in the last 2,000 years.

White Rock Canyon is a deep, basalt-rimmed gorge, about 20 km long, carved by the Rio Grande during the past one to two million years through basalt flows of the Cerros del Rio; the river enters the canyon below Otowi Bridge and emerges about 5.6 km north of Cochiti Pueblo. The canyon lies on the southeastern flank of the volcanic peaks of the Jemez Mountains and separates the Pajarito Plateau on the west from the basalt mesas of Cerros del Rio on the east. As mentioned, the canyon is framed to the south by the Santo Domingo Basin and to the north by the Española Valley. It is bordered for most of its length by high lava cliffs, talus slopes, and landslide debris. Altitudes in the canyon range from 1,584 m at Cochiti Dam and 1,638 m at Sagebrush Flats to over 2,190 m on the Cerros del Rio and from 1,920 to 2,400 m on the Pajarito Plateau. Canyon walls rise to heights of over 305 m above the river. The lava mesa of the Cerros del Rio, which borders the canyon to the east, has two levels formed by basalt flows and cones of two different geologic periods (Warren 1977c:15).

West of the canyon and the Pajarito Plateau are the volcanic peaks of the Jemez Mountains. A local manifestation of the Jemez is the Valles Mountain chain, with altitudes ranging from 3,000 m to 3,300 m. The Pajarito Plateau, capped by rhyolite-welded tuff, forms an east-sloping apron of these mountains. Flowing eastward to the Rio Grande, erosional channels have cut many narrow and deep canyons into the plateau resulting in digitate mesas or "potreros," which are capped by cliffs of pinkish tan colored Bandelier tuff (Warren 1977c:15).

Geology

The Albuquerque Basin and the Santo Domingo Basin contain sediments from the Miocene to early Pleistocene Santa Fe Group, dating from ca. 15 to 1 million years ago. Much of this sediment fill was deposited from adjacent high-elevation uplifts, the Colorado Plateau to the west and the southern Rocky Mountains to the east and north. The Santa Fe Group sediment varies from 720 to 900 m thick along the basin margins to 4,200 m in the center. Over the last one million years, basin fill has been subjected to cyclical incision and aggradation. Erosion has predominated since the Rio Grande began cutting its valley during the Pleistocene. However, for the past 10-15 thousand years the river valley has been gradually aggrading, producing young sediments that are as much as 60 m thick.

Human settlements in the Santo Domingo Basin have exploited the geology of White Rock Canyon, which is both sedimentary and volcanic. The oldest sedimentary rocks exposed in the canyon date to the Late Tertiary Santa Fe Group, and include an unnamed lower undifferentiated unit of arkosic sand, silt, and gravel exposed in the northern 3.7 km of the canyon: the Totavi Lentil of the Puye Conglomerate and the Puye Conglomerate (Griggs 1964). The Totavil Lentil was deposited by a large river ancestral to the Rio Grande, and is composed of silt, sand, and clay, and cobbles of granite, chert, schists, metarhyolite, quartzite, and volcanic rock. Chert cobbles include Pedernal-like chalcedony and chert; olive-brown chert of Pennsylvanian age; cream-colored, sometimes fossiliferous, chert; and cherry metarhyolite. The chert cobbles are well rounded; the latter two types may have thick yellow cortices. Quartzites may be white, gray, red, yellow, or tan. Metamorphic rocks include amphibolite, phyllite, sillimanite and quartz-mica schist, and gneissic granite. White rock quartz, of the type used for "lightning stones," occurs. Volcanic rocks are usually light to medium gray in color (Warren 1977c:17).

The silt and sand of the Totavi contribute to colluvial slopes and channel material and are probably reworked by wind. Lenses of clay, gray to red in color, have been noted in several areas (Warren 1977c:17).

Basalt flows from the Cerros del Rio coursed to the west at one interval during the deposition of axial gravel, which forced the ancestral Rio Grande 2–3.5 km west of its present bed. The basalt also formed dams on the river, resulting in lake clay depositions (Warren 1977c:17).

The Totavi Lentil underlies, and is occasionally interbedded with, Tertiary Age basalt flows from the Cerros del Rio. On steep talus slopes the axial gravel and sand is usually obscured by the basaltic debris. The Puye Conglomerate, a fan deposit composed of early volcanic rocks of the Jemez Mountains, overlay the Totavi Lentil. Pleistocene deposition of the Otowi Member of the Bandelier Tuff, occurring as an air fall of white pumice fragments and which remain exposed as outcrops generally near the top of the basalt cliffs, took place after the deposition and erosion of the Tertiary Age basalt flows. One outcrop of the Tshirege Member of the Bandelier, the upper cliff-forming rhyolite, occurs east of the Rio Grande and, to the west, capping the high narrow ridges of the Pajarito Plateau; weathering of the rhyolite results in formation of small caves, which were enlarged for the use of early inhabitants as dwellings.

Sedimentary rocks of Pleistocene Age include landslide debris composed mainly of basalt clasts. Throughout the canyon, landslide areas have formed benches and ridges of varying heights above the river. Soils, composed mainly of colluvium and windblown sand, which filled the hollows created by the landslides, have formed on many of the benches. Landslides have continued up to the present, evidenced by rubble piles of basalt blocks.

Pyroclastic debris, composed of large boulders of glassy basalt, obsidian nodules, cinders, and volcanic bombs, occurs on the higher mesas bordering White Rock Canyon. Large dunes or blankets of popcorn pumice, in turn, overlay this debris in many places. The pumice, which may correlate with the El Cajete Member of the Pleistocene Valles Rhyolite and which dates to a little over 42,000 BP (Bailey et al. 1969:18), is overlain by a younger reddish brown paleosol, which developed later, during eolian activity, in sand dunes. These dunes, and subsequent younger sand dunes, are the locales of many prehistoric occupations from Early Archaic to late prehistoric times. A grayish brown soil, formed in colluvium and windblown sand during the Holocene, occurs above the reddish brown paleosol (see below); in this soil, many archaeological sites have been discovered in White Rock Canyon and adjacent areas. Sandy to pebbly colluvium, often mixed with wind-blown sand, forms slopes along the narrow valley floor of White Rock Canyon. Much of this colluvial material appears to derive from the Totavi Lentil channel sand and gravel that underlies the basalt flows along the river (Warren 1977c:17).

Other Holocene deposits in White Rock Canyon include alluvial fans of tributary canyons, channel sand and gravel, rock fall and talus (mostly of basalt clasts), and recent landslide debris. Temporary rock shelters on the talus slopes often were used by prehistoric travelers through the canyon (see below). Breaks in the basalt cliffs, due to landslides or rock falls, often mark the entry points for ancient foot trails or roads (Warren 1977c:22).

As indicated, geologic and mineral resources for the ancient inhabitants of the Peña Blanca sites are found mainly in White Rock Canyon. Prehistoric uses of geologic resources include architectural materials, clays for pottery production, stone tool raw materials, and rock walls for petroglyphs. Examples of these uses were outlined in Warren (1977c:22–30) and are summarized below.

Masonry structures, crudely made of basalt blocks, are found on stabilized floodplains or higher on the sandy colluvial slopes at the foot of the basalt talus; a pithouse site, LA 12522, was excavated in the soft sand of the Totavi Lentil, a short distance up the talus slope. Occupation sites also exist on the valley floor near the Canyon and somewhat upslope, just below lower talus falls. These date from the Late Archaic, ca. 800 BC–AD 400. Seasonal camps were often built on the sandy colluvium or dune areas along the narrow valley floor. Small rock shelters, with tumbled basalt blocks as overhangs and, often, crude walls of dry basalt masonry, are common on the talus debris; recovered artifacts indicate brief or occasional use.

Other materials used to construct pit rooms and kivas include eolian sand deposits with sufficient carbonates to allow cohesion or cementation; accordingly, firm walls were constructed for rooms dug into the soil. An example of this may be LA 5014, built on a landslide bench and at which lithic scatters were found. In addition to the use of naturally cohesive sand, an abundance of angular and slab basalt clasts were employed for walls, such as those found at LA 9138; basalt terraces also were constructed across small arroyos within the canyon on the mesa tops.

Petroglyph sites, numerous concentrations of which are found along both sides of the river, illustrate another ancient use of the geology of White Rock Canyon. Basalt boulders, weathering to a dark brown glossy varnish, serve as excellent media for rock art.

Clay, employed in the production of ceramics, derives from occasional beds or pockets found in outcrops of Totavi Lentil of the Puye Conglomerate (late Tertiary). Red plastic clay was collected near LA 10108 on a talus slope below basalt cliffs. A deposit of gray clay, also in axial gravel, was found on a ridge at the foot of Potrero de los Idolos. Tempering materials include basalt scoria, fine-grained basalt, rhyolite-welded tuff, intermediate or andesite-welded tuff, andesite vitrophyre, crystal pumice, vitric tuff, and volcanic sandstone. Mineral pigments available for ceramic decoration include hematitic sandstone (red but also yellow, gray, and lavender pigments) occurring at the base of basalt flows and lead ores, used in glaze painting, perhaps sourced from at or near the mines of Bland Canyon.

Stone tool materials include a wide variety of minerals and rocks (see Warren 1977c:25–28 for a comprehensive list): obsidian, glassy basalt, and chert were the most commonly used, according to artifacts recovered at Peña Blanca and elsewhere in the basin.

Soils

Soils in the Peña Blanca site are characterized by constituents and have a modifying affect on the project area landscape, as well as on the local flora and fauna.

Soils may be distinguished from geological characteristics by constituent as opposed to formal geomorphological characterizations; a "map-based" classification formerly in use largely has been supplanted by constituent-based classification (*Soil Taxonomy: Agriculture Handbook* No. 436, the U.S. Department of Agriculture 1975). Information about Peña Blanca soils is derived somewhat obliquely, from general soil descriptions of the southeastern part of Sandoval County (Maker et al. 1971), but also from broad floodplain and alluvial fan studies further to the south (e.g., Loftin et al. 1995).; a complicating factor for Peña Blanca and one that probably is essential to understanding early developments in incipient plant domestication strategies in the northern Middle Rio Grande is the fact that the Rio Grande and Santa Fe River join roughly near the center of the project area.

Soils for the larger Middle Rio Grande Basin, that is, those that associate with the grassland and shrubland ecosystems of the larger basin, are classified within the orders of Aridisols, Entisols, and Mollisols. Suborders of Aridisols common in the basin include Argids, Calcids, Cambids, and Gypsids. These calcareous and alkaline soils contain relatively low organic matter and have soluble secondary salts such as calcium carbonate and gypsum. The most important property of soils in any arid or semiarid ecoysystem is organic matter. Although soil organic matter is relatively scarce in the Middle Rio Grande Basin grassland and shrubland soils, ranging from 3 percent to less than 1 percent, soil aggregate stability and resistance of site stability and productivity inhibits desertification and erosion (Tate 1987, cited in Loftin et al. 1995:82). Argids are older soils generally found on the older and more stable landscapes, and have well-developed secondary clay (Loftin et al. 1995:81–82). Entisols, soils with little pedogenic development, are represented in the basin by the suborders Orthents, Psamments, and Fluvents. Of particular relevance are the Orthents, which are widely distributed on the more active landscapes and include recently active alluvial fans and arroyos and in shallow sediments over slowly weathering volcanic basalts and sedimentary bedrock, and the Fluvents, which are characterized by stratification and irregular decreases in organic matter with depth, and which are common on floodplains along perennial stream channels as well as on ephemeral drainages (Loftin et al. 1995:82).

In general, and employing the older soil classification scheme, most of the Peña Blanca soils have been classified geographically, that is, as "Rough Broken Land–Embudo Association" (Maker et al. 1971:13), currently found in areas in New Mexico used for range purposes and corresponding to areas of the floodplain not immediately within the riverbed alluvium. The latter is classifiable as Gila–Vinton Glendale. Embudo soils, defined thus geographically, in accordance with the above constituent characterizations, have been found to consist of a light brown, calcareous, fine sandy loam or gravelly fine sandy loam subsoil and display an extremely variable soil mantle depth. Geographically defined soil subcomponents include Cascajo and Bluepoint soils.

Cascajo soils grade to a pinkish white or white strongly calcareous horizon with lime coatings on the gravel and sand particles occurring at a depth of 25 to 35 cm (10 to 14 inches). Bluepoint soils are characterized by light brown loamy fine sand surface layers over weakly stratified loamy fine sands to a depth of 1.5 m or more.

Most Embudo soils form on unconsolidated old alluvia that are coarse- to medium-textured and have high percentages of gravel. The typical topsoil layer is a gravelly sandy loam or gravelly loamy fine sand. Gravel and cobbles are common over many of the surfaces, tending to reduce soil erosion.

Rough Broken Land includes steep to very steep and severely dissected ground; it consists of shallow soils amidst exposures of unconsolidated to weakly consolidated alluvial sedimentary deposits (Maker et al. 1971:13), the latter characterized by gravelly and sandy sediments. Further, "barren or nearly barren erosional remnants capped by moderately erosion-resistant sandstone" are common throughout this component (Maker et al. 1971:13).

The soils of this association tend to support sparse to larger stands of native vegetation including an overstory of thin groups of piñon and juniper (Maker et al. 1971:13). Common grasses and shrubs in the association include blue grama, sideoats grama, black grama, Indian ricegrass, ring muhly, sand dropseed, three-awn, snakeweed, rabbitbrush, chamisa, and yucca. Plant growth and productivity in the Santo Domingo Basin are greatly modified by soil parent material and topography (Loftin et al. 1995:81). Generally, because of unfavorable properties to the Embudo soils and also because of unmaneuverable and highly dissected landscapes, "there is little or no potential for development of irrigated land" in the Rough Broken Ground–Embudo Association (Maker et al. 1971:13), leading one to speculate about the conditions in which the particular kind of incipient or contingently opportunistic efforts at plant domestication did occur at three of the Peña Blanca sites. Gila–Vinton Glendale Association soils are found on level or nearly level ground; well-drained and loamy, they occur, for example on the floodplain along the Rio Grande.

Modern Climate

The climate of the Middle Rio Grande Basin and, by extension, of the northern Albuquerque Basin, is semiarid and may be described, in general, as one of extremes (Loftin et al. 1995:81). Within this context, Peña Blanca exhibits some peculiarities.

Most of the Southwestern United States has a bi-seasonal regime with distinct winter and summer precipitation maxima. Winter is characterized by infrequent intrusions of Pacific air. The winter rains are brought to the Southwest by migrating low-pressure systems and troughs of low pressure associated with the westerly jet stream. This particular pattern is dominant from November to March. Westerlies and accompanying storms normally follow a route to the north of the high-altitude ridge of high pressure off the west coast and enter the continent through Washington and northern Oregon. These pressure systems and storms move south along the eastern side of the Rockies, east through the Central Plains, and then northeast around a trough of low pressure centered over Hudson Bay. Under these conditions, winter storms usually produce only partly cloudy skies and strong southwest winds throughout the western United States. In the Southwest when the moist air sweeps in from the south and southwest, precipitation occurs mainly from convective cells initiated by surface heating, convergence or, less commonly, orographic lifting. These summer convective storms form in clusters many tens of kilometers across, with individual storm cells covering altogether less than 3 percent of the surface area on regional weather maps at any one time and persisting for less than an hour on average (Barry and Chorley 1970). Precipitation during the summer months in north-central New Mexico, critical for the dry farming of certain crops, results primarily from the monsoon moisture sweeping in from the south and southwest. In Chapter 5, evidence will be examined for changes in the boundaries, strength, and the timing for the arrival and withdrawal of the summer monsoon. Soil water content in the region is highly variable within and between years, and depends on precipitation.

Grasslands in the basin are controlled not merely by total annual precipitation but also by complex relationships such as the precipitation-evaporation ratio and the seasonality of precipitation in relation to the temperature regime and growing season (Risser et al., cited in Loftin et al. 1995:81). Rainfall in the Middle Rio Grande Basin grassland and shrubland ecosystems ranges from a low of 200 mm to over 400 mm at the higher elevations to the north, much of which occurs as high intensity, short-lived thunderstorms (Dick-Peddie et al. 1993, cited in Loftin et al. 1995:81). Extrapolating from Loftin et al. (1995:84), the vegetation type predominating in the eastern Santo Domingo Basin is Plains-Mesa grassland; it may be pertinent to note that, corresponding to such a vegetation type, rainfall tends to be more evenly distributed throughout the year than in the lower, drier portions of the Albuquerque Basin. Snow is common in winter; however, net precipitation is less than in other seasons. Rainfall in White Rock Canyon averages 250–300 mm annually. Precipitation is greater in the summer months than in the winter. On the Pajarito Plateau, annual rainfall ranges up to 410 mm; a similar increase is not noted for the Cerros del Rio. Peña Blanca, located in the Rio Grande trough at an elevation of 5,230 ft, averages only 6.96 inches per year (Gabin and Lesperance 1977). The frost-free period for the region is from 180 to 200 days (Tuan et al. 1973). Temperature in the Santa Fe region is mild, with observable ranges from -17 degrees C to 4.4 degrees C during the winter and from 15 degrees C to 20 degrees C in the summer.

Hydrology

With an average flow of 1,682 cubic feet per second at Otowi Bridge (Griggs 1964:89), the Rio Grande is the major drainage in the northern Middle Rio Grande region (Fox et al. 1995:57). Cochiti Dam, the major artificial landmark for the Peña Blanca project, is located at the northernmost reaches of the Rio Grande Basin system and lies north of the Peña Blanca sites. Constructed in 1973, it was intended for flood and sediment control. The Rio Grande is considered to be an aggrading river, based on observed increases in the height of the river bed or floodway above the adjacent floodplain; aggradation in the Cochiti Division at the upstream end of the valley, however, is practically zero. Drainage tributaries to the Rio Grande on the west side of White Rock Canyon are intermittent except for the Rio de los Frijoles. Some tributaries carry small amounts of water in their upper reaches and a few springs are dependable as water sources; for example, water in Rio Chiquito, in nearby Cochiti Canyon, is presently used to irrigate apple orchards. Short, deep canyons have cut the high mesa of Cerros del Rio, but none contains permanent water flow. Few pond or lake formations exist in the Santo Domingo Basin, and perennial surface water is scarce in general in the larger Middle Rio Grande Basin. The closest large aquifer lies to the south of the basin and supplies modern Albuquerque.

Surface runoff (e.g., forming piedmont terraces) is important in human-land relationships, and for human habitation, agriculture, and wildlife. Historically, the availability of clean water for these purposes has been most critical (Loftin et al. 1995:82). Vegetation in the grasslands and shrublands of the basin depends on surficial hydrological processes, such as runoff, runon, infiltration, and evapotranspiration. High intensity thunderstorms common during the summer (July through September) often generate large volumes of runoff. Many ephemeral channels carry water only after such intense storms, and this runoff is apt to contain large amounts of suspended solids. High gully erosion may occur. In general, runoff and sediment yields in the Middle Rio Grande Basin are highly variable and depend on plant community composition, ground cover, and specific soil properties such as infiltration tendencies.

Modern Vegetation

The vegetation type predominating in the eastern Santo Domingo Basin is Plains-Mesa grassland (Loftin et al. 1995:84) merging with Great Basin Grassland (Brown and Lowe 1980); the dominant grass is black grama *(Bouteloua eriopoda).* Plains-Mesa grassland generally occupies an elevation of 1,200 m to 2,300 m. Rainfall necessary to support this vegetation is between 300 and 400 mm per year. In general, more riverine and floodplain vegetation such as tall grasses and cottonwoods may be distinguished from shorter and more xeric shrubs found away from the major streams. Juniper trees increase in number as land surface rises in elevation. Maxwell (1998) indicates that for the Peña Blanca Archaeological Project, most of the prehistoric agricultural fields were located on Pleistocene terraces overlooking the Rio Grande floodplain. With only 6.96 inches of precipitation today at Peña Blanca, and the fact that the effect of monsoon rains are not evident until August, localities could not support dry farming of maize today. Calculations into the past should note, in general, that grassland overgrazing in the last 100 to 150 years has resulted in extreme depletion and deterioration and, as a result, a sharp decline in forage productivity.

Dominant shrub species include Bigelow sagebrush, winterfat, rabbitbrush, and broom snakeweed. Grass species include blue grama, sideoats grama, galleta, ring muhly, Indian ricegrass, and sacaton/dropseed (Loftin et al. 1995:82). According to ethnohistory and archaeology, wild plants have been used for food and for other purposes by the Rio Grande pueblos and include such storable plants as amaranth, beeplant, purslane, piñon, yucca, and sunflower, and such nonstorable ones as chenopodia, rumex, dandelion, wild onion, serviceberry, milkweed, June grass, bear grass, *atriplex, berberis, celtis,* vetch, glazing star, prairie clover, puffballs, bracket fungus, kutokani, monkey-flower, monarda, rabbit brush, clammy weed, desert plume, sophia, echinocereus, horsetail, strawberry, bog orchid, ocean spray, rock spiraea, walnut, juniper, wild pea, cottonwood, portulaca, mesquite, screw bean, wild plum, *pseudocymopterus,* wafer ash, *quercus*, marigold, wild celery, *physalis*, rock pine and western yellow pine, cone flower, Solomon's seal, wild potato, Indian potato, wild grape, opuntia, *mammilaria, ribes,* and New Mexico locus. Additional discussion of flora, habitat, and subsistence potential are provided by Mollie Toll and Pamela McBride later in this report.

Modern Fauna

Faunal species present in the arid and semiarid grassland and shrubland ecosystems of the Middle Rio Grande Basin include a few species of artiodactyla, chiroptera and insectivora, somewhat more carnivora, and a large number of rodentia, chiefly mice and rabbits. Mule deer and pronghorn antelope represent the artiodactyla. Coyotes are numerous, with sparser populations of smaller carnivores. The rich and various rodent populations consume and utilize for other purposes seeds, grasses, and other vegetative, animal, or insect matter. In addition to foraging habitat, desert grasslands provide breeding or year-round habitat supporting a diverse avifauna, including hawks, ravens, owls, doves, kingbirds, and sparrows (Loftin et al. 1995:86). Reptiles and amphibians are fairly numerous and include turtles, frogs, toads, lizards, and snakes (Loftin et al. 1995:87). Additional discussion of fauna, habitat, and subsistence potential are provided by Nancy Akins later in this report.

Summary

In consideration of the above, we may draw certain general conclusions about the characteristics of the environment of the Santo Domingo Basin. The physiography is Basin-and-Range; landscapes are frequently hilly to steeply hilly and broken with flat areas of varying size immediately adjacent to the Rio Grande. Geological characteristics, particularly with respect to mineral resources in White Rock Canyon, provide some useful information about materials for cultural development, including clay and pigments for ceramics, carbonate-rich sandstone soils for masonry, and basalt for structures and rock art. Climate is semiarid, however, precipitation patterns are fairly regular. Water resources are generally scarce except for the Rio Grande and its few tributaries; riparian communities would be expected to have subsisted near the perennial water sources of the Rio Grande and its tributaries. Soils are sandy and loamy, with generally poor agricultural potential, albeit with some ameliorating factors; vegetation generally is shrubland and grassland, with thin stands of piñon and juniper. Although with some larger deer species present animal species are generally smaller and herbivorous, and are accompanied by predators such as raptors and snakes.

Chapter 5
Paleoenvironmental Context for the AD 1–1700 Period in the Northern Santo Domingo Basin Area

Kenneth L. Peterson

The past environment is an essential element of the history of human occupation of north-central New Mexico. Environmental factors condition the productive potential of both foraging and the farming subsistence systems, settlement locations, degrees of sedentism, potential degrees of reliance on agriculture, catchment sizes, the extent of regional systems, and relative attractiveness for both emigration and immigration. This synthesis focuses broadly on the climatic and vegetational history of the Northern Rio Grande within the greater Southwest, with the specific goal of providing a context for understanding the human occupation history of the NM 22, Peña Blanca Project. The project area is in the vicinity of Cochiti Pueblo, in the northern Santo Domingo Basin, and the cultural resources fall within the AD 1–1700 period. The specific archaeological record of the NM 22 project includes evidence of farming as early as AD 500, pithouse communities dating to the eighth and ninth centuries, and intermittent twelfth- and thirteenth-century agricultural occupations (Ware 1997).

Regional Setting and Modern Environment of the NM 22, Peña Blanca Project

The Peña Blanca project area (Fig. 5.1) is located in the Rio Grande trough at an elevation of 1,695 m. The Jemez Mountains caldera rises to more than 3,400 m immediately to the northwest, the Sangre de Cristo Mountains rise to more than 3,600 m to the northeast, and Basin-and-Range topography dominates the quadrants on either side of the Rio Grande to the south. Under current climatic conditions the project area averages only 17.9 cm of precipitation a year (Gavin and Lesperance 1977), and the frost-free period for the region ranges from 180 to 200 days (Tuan et al. 1973). Although the onset of monsoon rainfall for the region is usually in July, at the relatively low elevation of the project area, monsoon rainfall onset is usually in August. The vegetation of the region has been classified as Great Basin Grassland (Brown and Lowe 1980), with the dominant grass being black grama (*Bouteloua eriopoda*). The active floodplain of the Rio Grande supports a narrow strip of riparian vegetation immediately adjacent to the project area, and juniper trees increase in number as the grassland-dominated pediment surfaces rise in elevation away from the river to the east and west. Juniper and piñon woodlands give way to ponderosa pine, Douglas fir, and spruce forest in the higher elevations of the mountains within 25–50 km to the northwest and northeast.

The excavations from the Peña Blanca Project have yielded evidence of three discrete occupations that appear to be agricultural, and there are additional farming occupations that are represented by sites immediately outside of the project construction zone. The earliest occupation consists of bell-shaped storage features that have some evidence of occasional use as shelters (interior hearths). The pits are located on an upper tread of a Qta4 terrace remnant, about 1,610 m in elevation (McFadden, Chapter 6), compared with a modern floodplain elevation of 1590 m. The features are dated by archaeomagnetic samples and fall within the AD 500–650 period. These features represent a consistent type of economic behavior that is repeated through a 100+ year span. Although the pits were most likely used for storage, and corn storage would be the most reasonable assumption, corn pollen or macrofossils have not yet been identified from any of the interior feature samples.

There appears to be a hiatus in the farming exploitation of the project area from circa AD 650 through about AD 750. At this point, an

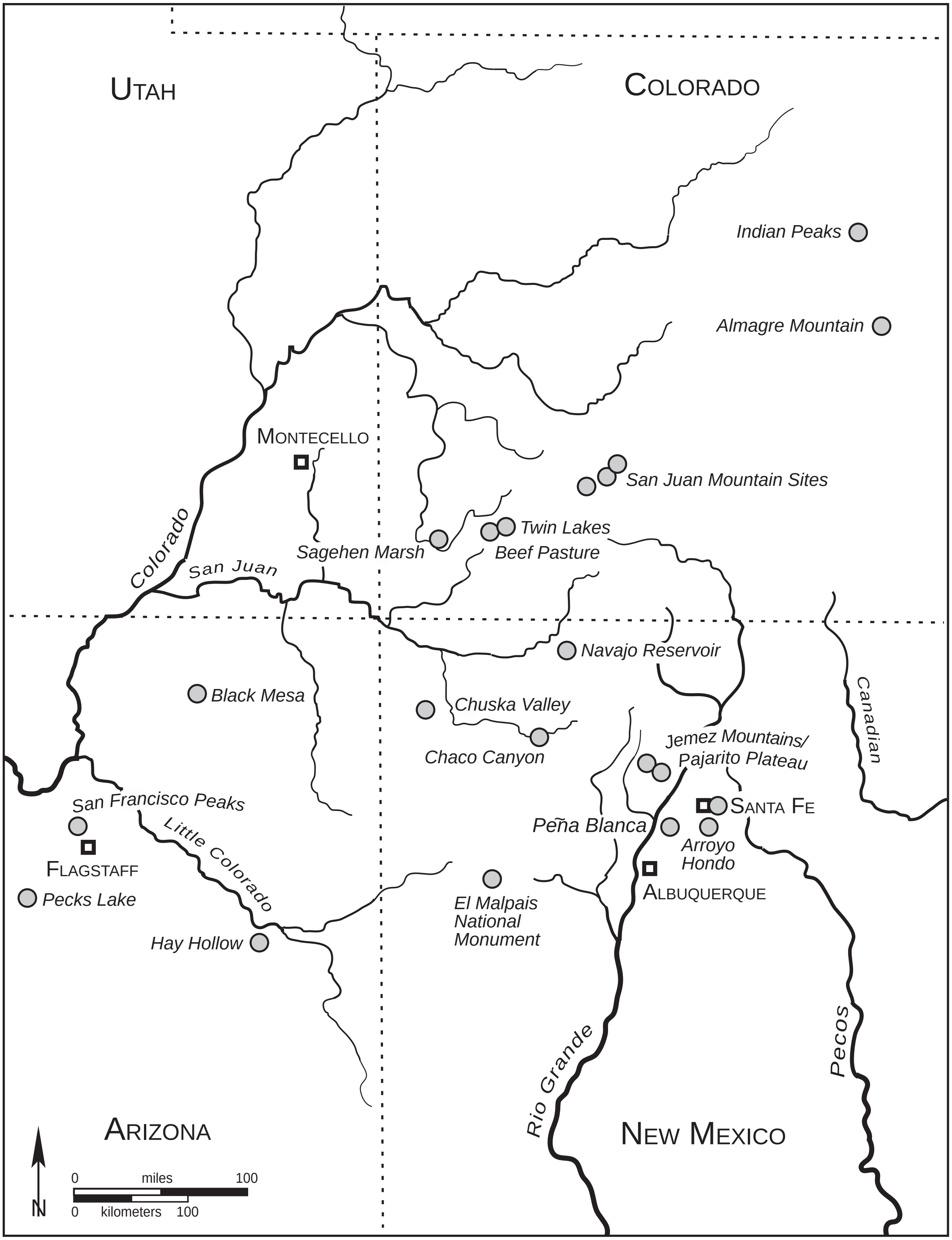

Figure 5.1. Project vicinity; sites mentioned in text.

Early Developmental community is established within the project area on a slightly lower tread of the same Qta4 terrace. The archaeomagnetic results suggest a continuous occupation from the late eighth through the mid-ninth century and perhaps slightly later. Evidence of corn is ubiquitous, and the grinding complex consists of fully developed trough metates and two-hand manos. This component wanes in the late ninth century and seems to end by the mid-tenth century. Faunal and physical anthropological data suggest that hunting and foraging at some distance from the river augmented a significant reliance on agricultural produce. This is a higher degree of mobility than is assumed for other contemporary communities in the Southwest.

There is no reoccupation of the project area until the terminal Late Developmental period, probably around or shortly after AD 1100. Excavated structures date to about AD 1200 and span a continuous occupation that stretches to AD 1300. There are no sites that date to the fourteenth or fifteenth centuries within the immediate project area, although there are very large aggregated villages nearby. These villages are sufficiently close that the project area would have been easily within their subsistence catchment (potentially including field locations). From a regional settlement perspective, although residential occupation of the project area ceased by the fourteenth century, the project area remained a part of a continuous local agricultural subsistence system from the twelfth century into the historic period. Within the early historic (ethnographic) period, the subsistence foundation of Cochiti Pueblo and the local Hispanic community consisted of fields within and adjacent to the Rio Grande floodplain. These fields were irrigated from the Rio Grande with ditch systems, some of which may pre-date Spanish colonization of northern New Mexico.

Although past environmental variability would have affected all subsistence resources to some degree, the focus of this study consists of those variables that would have affected the productivity of corn agriculture. All of the excavated components of the Peña Blanca project appear to be maize-dependent, although nonagricultural resources play important if variable roles in the subsistence systems. Corn is a tropical grass that needs substantial amounts of water during the growing season (a corn plant can require as much as 260 to 450 g of water for 1 g of dry matter produced [Jenkins 1941:312]). In addition to this large amount of soil moisture, corn requires a relatively long growing season, prefers warm nights, and is highly susceptible to killing frost. The environments of the greater Southwest are marginal for these climatic variables, leading to dynamic fluctuations in the success of corn-based subsistence through time. This susceptibility of Southwestern agriculture to even small environmental fluctuations is credited with both shaping the flexibility of Native American cultures of the region and with placing limitations on the Southwestern social complexity trajectory as compared with other Formative populations such as those in Mesoamerica.

Data are inadequate to directly reconstruct the climate or environmental history of the Peña Blanca project area. Detailed climate and environmental reconstructions have been proposed for the Colorado Plateau to the northeast, and paleoenvironmental records are available for a few geographically isolated locales in the Northern Rio Grande Valley. Despite the richness of the Colorado Plateau record, it is not directly applicable to the project area, and the incompleteness of data from elsewhere in the Rio Grande Valley precludes the confident development of a local empirically based model of climate change. Until the richness of the local paleoenvironmental data set improves, paleoenvironmental reconstructions must be derived from comparisons of regional and continental climate models with the detailed records that are available for the adjacent areas. Therefore, this paleoclimatic study is an exercise in model development. Although intended to be immediately useful for the interpretation of culture change in the Peña Blanca area, the model will need to be evaluated and modified as additional data become available.

Modern Climatic Characterization of the Greater Southwest

Climate in the Western United States is complex, and general patterns are linked to much larger global weather systems and to a deep geologic history. Petersen (1994a) provides a brief review that contains an extended bibliography of more detailed modern climate studies. Adams and Comrie (1997), Carleton et al. (1990), Douglas et al. (1993), Higgins et al. (1998), and Woodhouse (1997) provide additional coverage and references. The following discussion summarizes what is known about modern-day climate. Although the primary focus of this report is on north-central New Mexico, discussion of climate systems both present and past requires a much broader geographic treatment.

To understand the climate in the northern Southwest United States, it is important to understand the sources of moisture that enter the Southwest. The Pacific Ocean has little direct effect on the climate of much of the North American continent because of the high mountains and plateaus of the Western United States (Hare 1966). One of the reasons is that much of the maritime character of the moist Pacific air is soon lost as it travels inland. As a parcel of air gains or loses altitude, it will change temperature in response to the changing pressure gradient. As the air parcel gains altitude—for example, when it goes over a mountain—its volume increases and its temperature cools. If the temperature of an air parcel cools below its dew point, condensation occurs and water vapor changes to liquid water that can fall as precipitation. If, after crossing a mountain, the air parcel descends, its volume decreases and its temperature warms. As soon as its air temperature rises above its dew point, the liquid water within the parcel changes back to the vapor phase. Because of the changes in temperature, water phase, and moisture content connected to differences in elevation, it is quite difficult to trace Pacific moisture-bearing air masses that have to negotiate mountains and valleys as they travel across the Western United States.

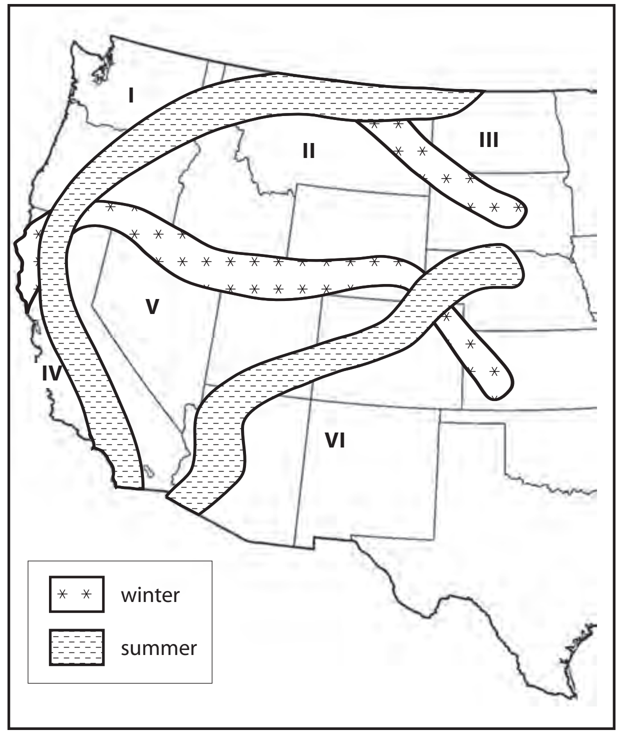

Figure 5.2. Western U.S. climatic regions. These regions are delineated by major summer and winter equivalent potential temperature boundaries (redrawn from Mitchell 1976, fig. 3.

Mitchell (1969, 1976) overcomes some of these problems associated with identifying air mass source by providing a classification of climatic regions of the Western United States (Fig. 5.2). His broad lines show the winter and summer boundaries that help to distinguish climatic regions with specific winter and summer precipitation characteristics. Region I receives winter and much of the summer precipitation through frequent air mass intrusion from the Pacific. This region is largely shielded from outbreaks of winter arctic and polar air because of its proximity to the ocean and mountains located to the north. Located in the zone of westerlies, winters are very cloudy, which tends to modify temperature extremes. There is a definite winter precipitation maximum. Region II receives winter precipitation through frequent air mass intrusion from the Pacific that provides considerable cloudiness, but the region receives little summer rainfall because it is mostly under the influence of what could be called interior air (mostly modified air coming from the Southwest). Region III

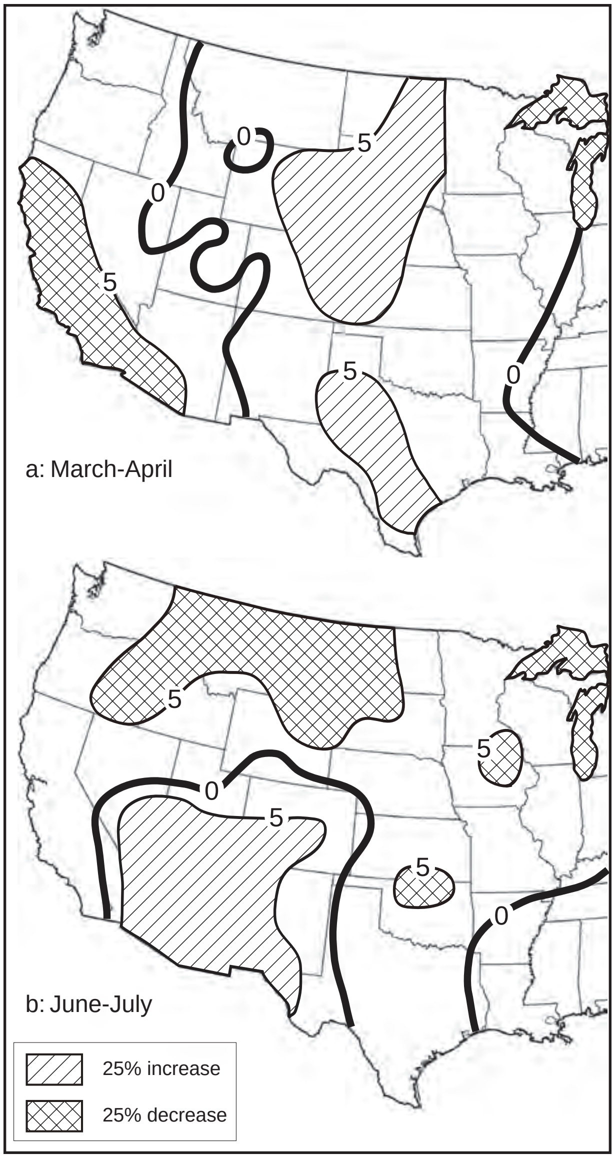

Figure 5.3. Precipitation changes in the western U.S. Changes from March through April (a) and June through July (b) are shown as a percentage of the mean annual total (redrawn from Barry and Chorley 1970, fig. 5.9).

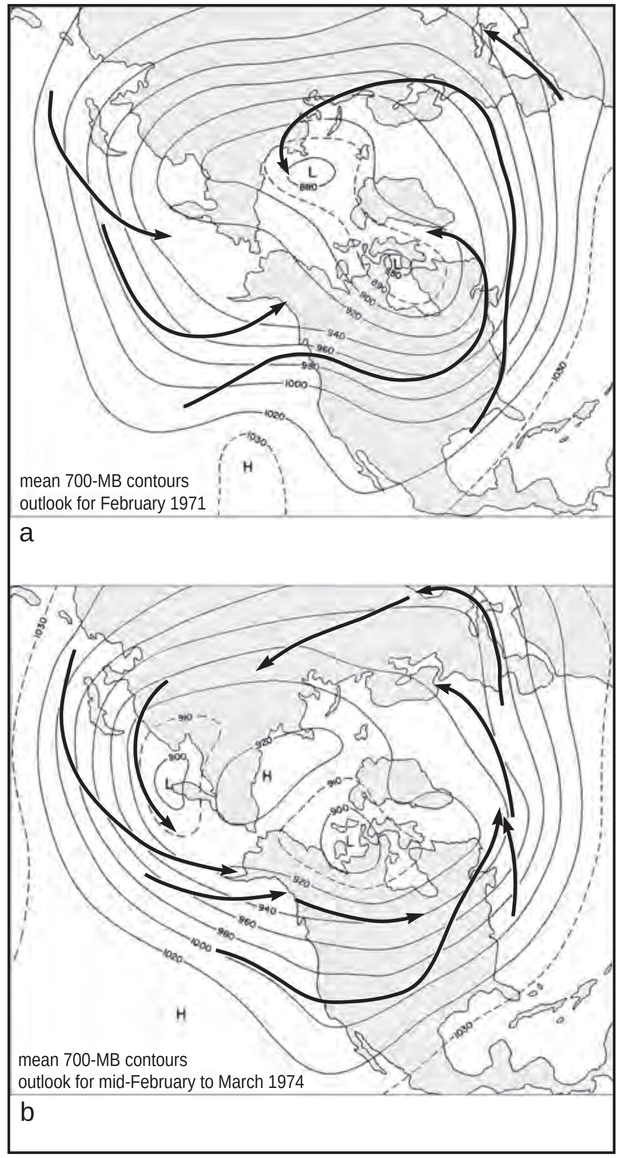

Figure 5.4. Winter circulation patterns, showing the patterns of prevailing airflow at 3,050 m. The arrows are principal cyclone tracks at sea level; (a) is more typical; however, conditions similar to (b) occur when the low over the Hudson Bay and the high off the coast of California are both shifted to the west (adapted from U.S. Department of Commerce, National Weather Service 1971, 1974; redrawn from Petersen 1988, fig. 7).

falls outside the major pathways of both summer and winter moisture-bearing air masses, and its winter is characterized by frequent outbreaks of polar and arctic air. Summer is warm with a precipitation maximum. Region IV is limited to southern California and receives winter moisture from infrequent intrusions of Pacific air; winters are mild, but summers in the interior are hot and very dry. Region V encompasses most of the Great Basin and falls largely outside the major pathways of both summer and winter moisture-bearing air masses. It receives winter moisture infrequently from Pacific air masses, and winter days are largely cloudless and mild, whereas summers are generally hot, with some cloud formation in late afternoon. This region is under the influence of interior air during the summer, with mostly southwest winds bringing dry air into the region (Fig. 5.3b).

Most of the Southwest falls within Region VI and has a biseasonal regime with distinct winter and summer precipitation characteristics. Winter is characterized by infrequent intrusions of Pacific air. The winter rains are brought into the western area by migrating low-pressure systems and troughs of low pressure associated with the westerly jet stream. This particular pattern is dominant from November to March (Fig. 5.4). These westerlies and accompanying storms normally follow a route to the north of the high-altitude ridge of high pressure off the coast of the Western United States and enter the continent through Washington and northern Oregon. They then follow a path that usually takes them southward along the eastern side of the Rockies, eastward through the Central Plains region, and then northeastward around a trough of low pressure centered over Hudson Bay. Under these conditions, winter storms usually produce only partly cloudy skies and strong southwest winds throughout the Western United States south of the Region II/V boundary (Fig. 5.2).

The anomalous conditions that bring abundant winter precipitation south of the Region II/V boundary in the Great Basin and the northern Southwest result from a westward displacement of the ridge of high pressure that normally resides over the Western United States to a position well off the coast in the eastern Pacific Ocean and the formation of a low-pressure trough in its place (Fig. 5.4b; Ely et al. 1994). Under these circumstances, storms follow the prevailing flow southward along the West Coast of the United States (often as far south as central California) before entering the continent. Such storms pass through the Great Basin and the northern Southwest region from the west and continue to the northeast. Once established, this pattern tends to persist or recur, thereby producing several storms in succession.

In the spring a change begins as part of hemispheric readjustment of the circulation at about the beginning of April, when the Aleutian low-pressure cell, which from September to March is located at about 55 degrees North and 165 degrees West, splits into two cells, with one centered in the Gulf of Alaska and the other over northern Manchuria (Barry and Chorley 1970). Figure 5.3a illustrates that the arrival of spring is marked by a sharp decrease in precipitation from March to April in California. This reduction is due to the northward extension of the Pacific high, which establishes a high-pressure ridge off the West Coast of the United States. There is usually no rain during the remainder of the summer because of the blocking action of the high, and precipitation returns only with the cool season and the southward migration of the circulation belts following the direct rays of the sun (Pyke 1972).

In late March, precipitation intensity increases east of the Rocky Mountains, with influences from both the north and south. In Figure 5.3a, more cyclogenesis (the formation or intensification of lower pressure storm systems or cyclones, often in the lee of major mountain barriers) can be seen between Colorado and Alberta. At the same time, beginning in Texas, there is evidence of the northward extension of maritime tropical air over the Midwest from the Gulf of Mexico.

During May and June, Arizona and adjacent areas west of the Continental Divide are overlain by a warm, relatively dry air mass governed by a high-elevation anticyclone centered over the Mexican Highland. In late June there is a rapid northward displacement of the subtropical high-pressure cells in the Northern Hemisphere (Barry and Chorley 1970). In North America this pushes the depression tracks northward, resulting in June-to-July precipitation decreases over the northern Great Plains, parts of Idaho, and eastern Oregon (Fig. 5.3b). When this anticyclone shifts northward, usually around July 1 (Fig. 5.3b), easterly flows dominate bringing in moisture from the Gulf of Mexico and the tropical east Pacific. These general conditions are augmented by the effects of tropical cyclones, particularly in September (Adams and Comrie 1997; Higgins et. al. 1998), and bring the convective storms of summer monsoon into Region VI west of the Continental Divide.

Global computer simulations indicate that monsoons are driven by land-sea thermal contrasts—the stronger the contrast, the stronger the monsoon (Joussaume et al. 1999). Summer monsoons are like a giant sea breeze. The faster warming of the land than sea on a summer day induces a sea breeze at the beach because warm air rises over the land and draws in moist air from the sea. The warm land of the Western United States produces a massive global bulge of rising air that is roughly 2.5 million sq km in area (stretching from the Sierra Nevada to the Southern Rocky Mountains) and stands 1.5 to 2 km high. Because the atmosphere is less massive and thinner at those altitudes, winds can be driven faster by the same amount of heat energy. Given the breadth of the Colorado Plateau, the rising warm air forms an intense updraft that draws in air around its base. Under the influence of the earth's rotation, this air blows counterclockwise around the updraft, forming a huge, permanent low-pressure system (Kerr 1989; Tang and Reiter 1984). Winds such as the jet stream must swing to the north to get around the low. The air swirling into the plateau during the summer carries moisture off the Gulf of Mexico and from the eastern tropical Pacific to create what has been called Mexican or North American monsoon (Adams and Comrie 1997; Douglas et al. 1993; Tang and Reiter 1984). Air flow from the Gulf of California can be further enhanced with the development of a low trough in the Salton Sea region of southern California (Douglas et al. 1993).

In the Southwest when the moist air sweeps in from the southeast and south (and southwest), precipitation occurs mainly from convective cells initiated by surface heating, convergence, or, less commonly, orographic lifting. These summer convective storms form in clusters many tens of kilometers across, but individual storm cells cover altogether less than 3 percent of the surface area on regional weather maps at any one time, and they persist for less than an hour on average (Barry and Chorley 1970). Although the formation of thunderstorms can be predicted accurately on a regional basis, this extreme and unpredictable variability or spottiness in rainfall can leave areas within the storm track soaked or dry, adding uncertainty to dryland farming within the region.

Figure 5.5 shows the current summer monsoon boundary and the summer precipitation limit based on the discussion above. As an example of monsoon precipitation, Figure 5.6 shows the monthly precipitation for six weather stations in north-central New Mexico, and Figure 5.7 shows the location of those weather stations. Except for Peña Blanca, July precipitation shows a clear signal for the arrival of the summer monsoon, and rainfall remains high in August and tapers off through October with November consistently shown as the driest month of the year. (The record for Peña Blanca reflects its lower elevation and greater variability in the onset of monsoon rainfall under current conditions. Average rainfall increases slightly in June and July, but the onset of the monsoons is not consistently evident until August.)

Interannual variation in the intensity of Southwestern monsoon rainfall is patterned with linkages to larger circulation systems. Higgins et al. (1998) characterize summer monsoons that enter the Southwest as being average, or being wet or dry. The wet and dry monsoons have contrasting characteristics as shown in Table 5.1. Rainfall during wet monsoons exceeds that of dry monsoons by more than 50 percent over Arizona and western New Mexico. The interannual variability in monsoon rainfall intensity is linked to both annual and continental patterns of precipitation. Areal estimates of monthly precipitation show that winters in the Southwest and those of the Pacific Northwest are out of phase whereas the Pacific Northwest and the Great Plains are in phase. These precipitation estimates show that winters characterized by dry conditions in the Pacific Northwest and Great Plains and wet conditions in the Southwest tend to precede Southwestern summers that are characterized by dry monsoons. Whereas, winters character-

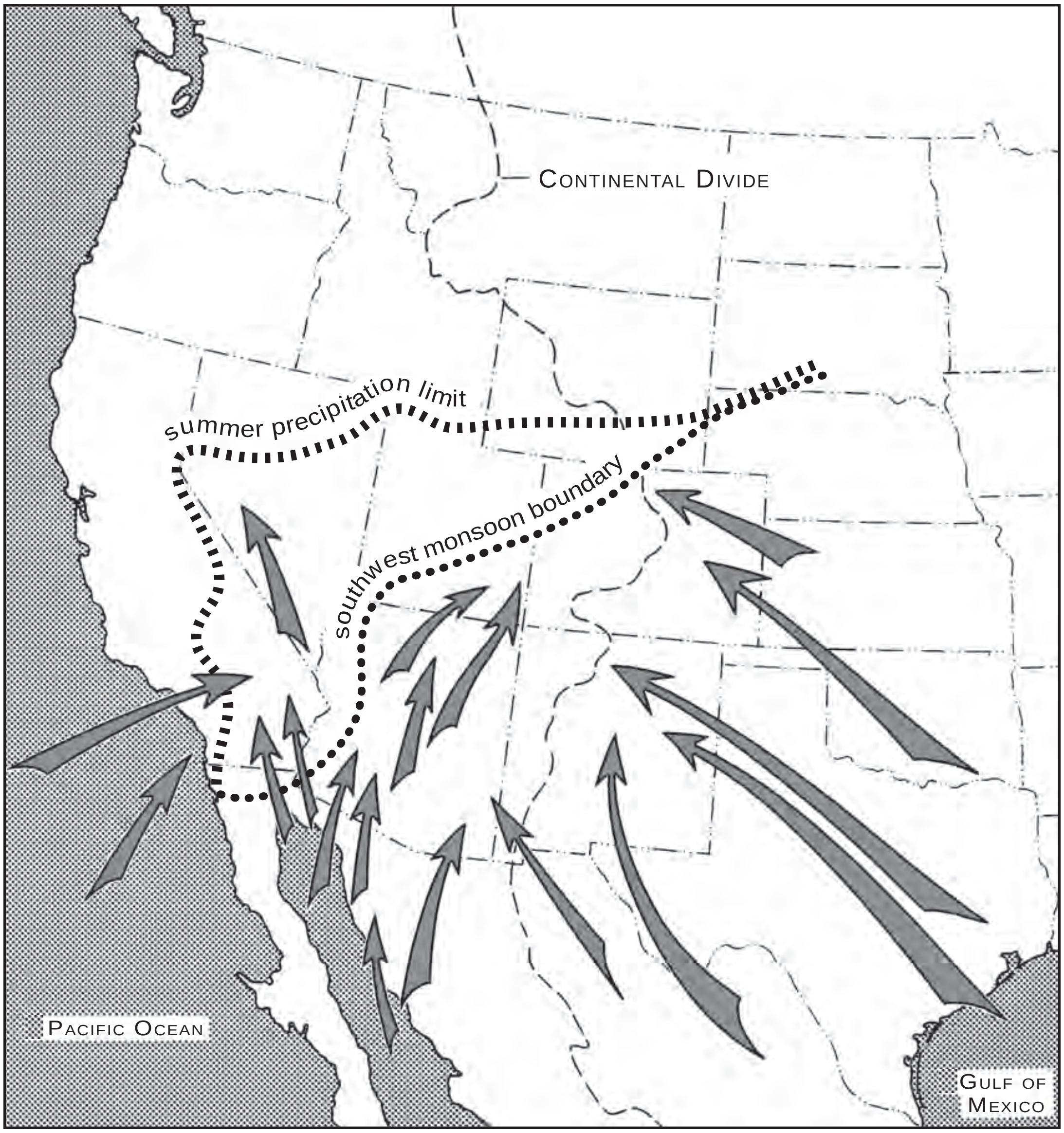

Figure 5.5. Climatic boundaries for the Southwest monsoon (after Petersen 1994b). Precipitation is greatest east and south of the southwest monsoon boundary of Mitchell (1976), where more than half of the annual precipitation occurs during the warm season (Dorrah 1946). North of that boundary the amount of warm-season precipitation decreases until it reaches the summer precipitation limit of Pyke (1972). Arrows show the main paths of moisture in the southwest U.S. during the summer (adapted from Miller et al. 1973).

ized by wet conditions in the Pacific Northwest and the Great Plains and dry conditions in the Southwest tend to precede summers characterized by wet monsoons.

Higgins et al. (1998) further conclude that this interannual variability of the United States warm season precipitation regime is linked to the season-to-season memory of the coupled atmospheric and ocean circulation system over the Pacific with sea surface temperatures (SST) in the eastern tropical Pacific playing a major role. Because of the slow moving nature of the ocean circulation, a string of wet or dry monsoons can persist for a number of years. Enfield et al. (2001) have also detected that there is a slow but regular warming and cooling trend for the North Atlantic Ocean that also appears to have a strong impact on rainfall trends in the United States. The North Atlantic Ocean temperatures oscillate over a range of about 0.4 degree Celsius during a 65- to 80-year period. Enfield et al. (2001) studied the cycle, called the Atlantic Multidecadal

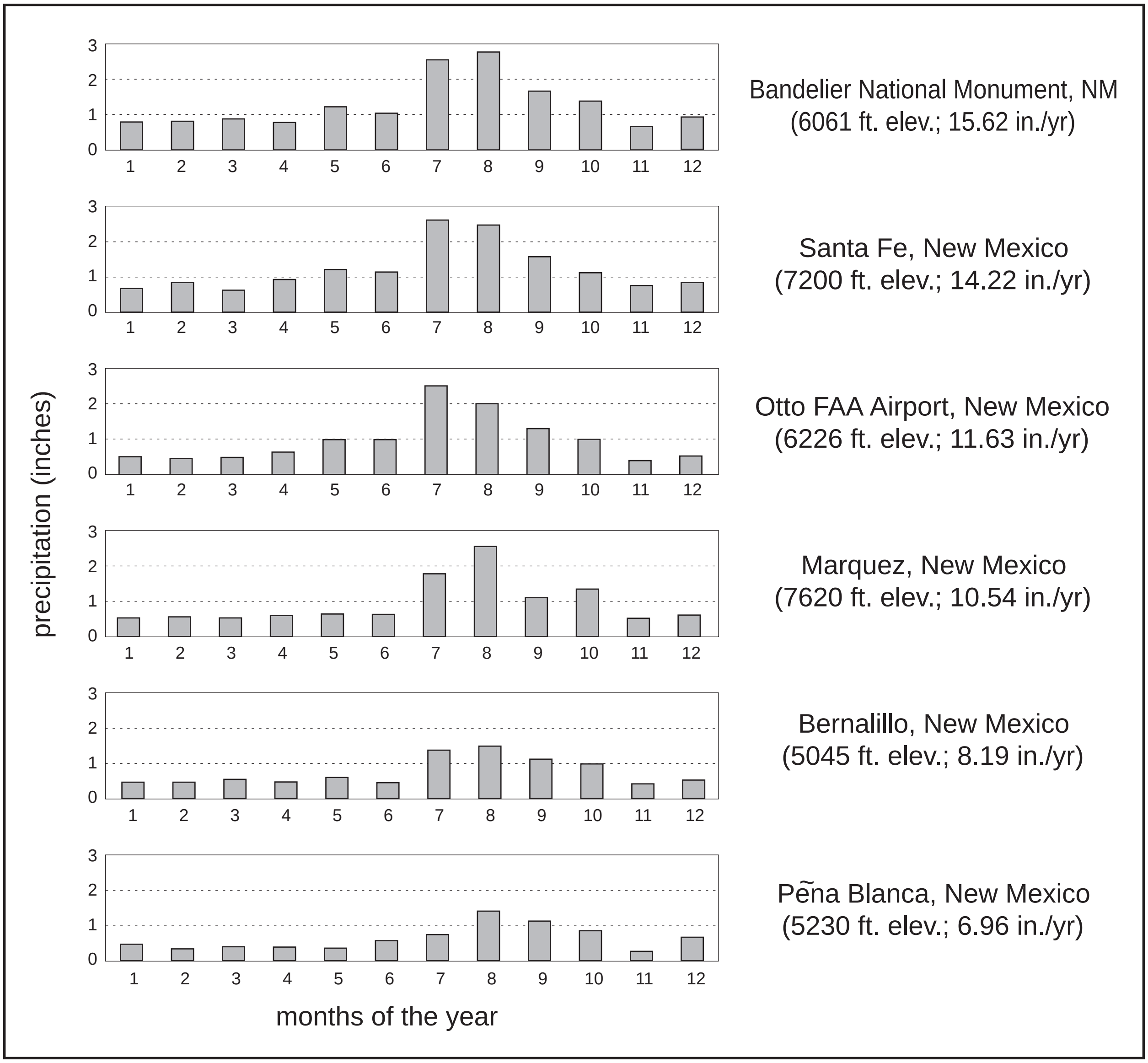

Figure 5.6. Monthly precipitation from six weather stations in north-central New Mexico arranged in descending order of yearly total precipitation. In general, the greater the elevation of the site, the higher the annual precipitation. Typically the highest month averages occur with the onset of the summer monsoon beginning in July and tapering off in October. November is the driest month of the year. Location of the weather stations are shouwn in Figure 5.7 (data from Gabin and Lesperance 1977).

Oscillation, using temperature and weather records from 1856 to 1999. They found warm phases in 1860–1880 and 1930–1960 and cool phases in 1905–1925 and 1970–1990. The work of Enfield et al. (2001) indicates that the Midwest droughts in the 1930s and 1950s were related to the warm phase of this cycle. During warm cycles, the total Mississippi River flow, which drains much of the Great Plains into the Gulf of Mexico, was 10 percent less than during cool phases.

This is further illustrated by comparing the Enfield et al. (2001) SST anomaly (SSTA) cycle with the precipitation record from Durango, Colorado. The timing between the two records for the 1905–1925 cool phase is striking. Note that the 1930s drought in Durango was characterized by high July and low January precipitation, suggesting a string of years with wet monsoon characteristics coinciding predictably with the dry conditions in the Great Plains (as reflected in reduced Mississippi River flow).

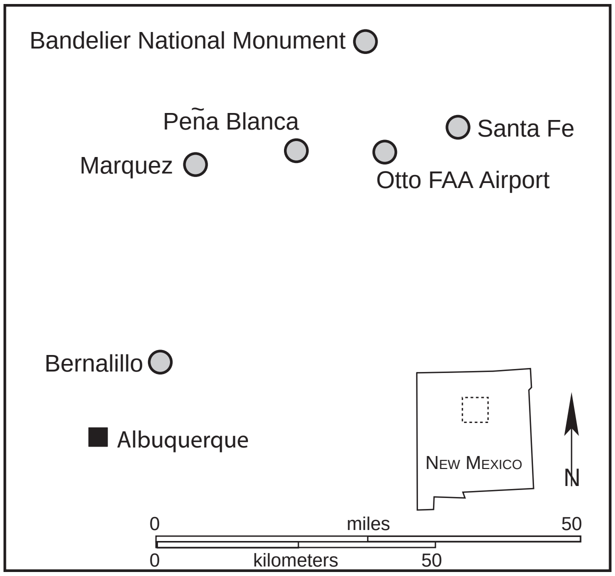

Figure 5.7. Location of six weather stations shown in Figure 5.6. Albuquerque is shown on the map for orientation, but is not included among the weather stations.

Endfield et al. (2001) also note that this Atlantic SSTA cycle appears to affect not only U.S. rainfall but also water temperature in the North Pacific. The cycle's warm phase results in drought. Complicating the question is the tropical Pacific phenomenon known as El Niño, which also involves the warming and cooling of large masses of ocean water. When the Atlantic cycle is in its warm phase, weather patterns crossing the United States tend to move generally west to east, rather than dipping south in a trough that brings storms to the northern Southwest and Midwest. This differs from the pattern caused by El Niño, which tends to push storms into southern California and on into the Southwest (Swetnam and Betancourt 1990).

Later in this report, evidence will be examined for changes in the boundaries, strength, and the timing for the arrival and withdrawal of the summer monsoon in the northern Southwest. Such changes, if they coincide with the periods of occupation and abandonments within the Peña Blanca Project, an area that falls below the current 2,000 m lower boundary for non-irrigated farming of corn in the region, may provide evidence for the lowering of that boundary.

Evidentiary Basis for Environmental Reconstruction in the Southwest

We only have about a 150-year perspective on the variability of the climate system as a whole based on instrumental records for the measurement of temperature, precipitation, sea level pressure, and wind speed and direction (Bradley 1999, 2000). For longer periods paleoclimatologists use natural environmental (or "proxy") records to infer past climatic condition. Several such proxy climate records are discussed below.

Tree Rings

Tree rings are valuable sources of proxy climatic data because they are continuous in nature (allowing for precise dating as well as providing annual resolution), and research has shown that tree-ring widths can provide estimates of climatic conditions (Fritts 1976, 1991). Work by the Laboratory of Tree-Ring Research at the University of Arizona indicates that there is a relationship between tree growth, as manifested in the annual tree rings, and stored food reserves. The amount of food manufactured and stored by a tree, rather than residual soil

Table 5.1. Characteristics of Southwest Monsoon Types

	Wet Monsoon	Dry Monsoon
Average date of onset	July 1	July 11
Average daily precipitation for 90 days following onset	1.77 mm	0.98 mm
Characteristics of summer rainfall in the Great Plains region	Great Plains drier	Great Plains wetter
Months of above or below normal rainfall	June-October above	June-September below

moisture, seems to be the main link between the environment and tree growth. At low-elevation locations, the amount of food manufactured and stored by a tree for the winter is directly related to the amount of moisture available during the current growing season as well as the amount of food held over to be consumed at that time. On the other hand, high-elevation trees near the upper limits of their ranges are not usually limited by moisture but by temperatures during the current growing season as well as the amount of food reserves available for consumption. Thus depending on the location of the tree, narrow rings form when environmental conditions (precipitation or temperature) during the previous year were not conducive to the production and storage of adequate reserves, coupled with insufficient moisture (low elevations) or low temperature (high elevations) during the current growing season.

Dean (Euler et al. 1979:1094) notes that periodicity of greater than 100 years usually is not seen in the archaeological tree-ring data because of the sampling limitations and because of the mathematical transformation of ring widths to indices tend to suppress low frequency variability. Thus, long-term wetting or drying trends (those that last longer than 100 years) will not be evident in the tree-ring plots.

The strengths of the tree-ring record (a precisely dated record of high frequency variation in climate variables) can be expanded by calibrations with other variables of interest. Tree-growth indices have been transformed into estimates of past precipitation, Palmer drought severity indices, and into crop yield estimates (Burns 1986). These indices and estimates in turn have been used to support simulations of regional agricultural productivity and models of economic success and failure. Caveats to these secondary data sets and models rest primarily on the relatively limited depth of calibration data and on the incomplete or lack of accommodation of low frequency climatic variation. Any gradual or long-term trend toward any particular condition will not be reflected in the tree-ring record or the transformations thereof.

Pollen

Pollen records provide evidence of vegetation change through time (Berglund 1986; Bryant and Holloway 1983). The most useful records for reconstructions of environmental change are derived from continuous depositional contexts such as lakes or bogs. Pollen data are quantified as percentages of each taxon for each spectrum or sample of the record. However, frequencies of pollen types in the pollen rain of a particular location frequently do not have a linear relationship with the abundance of species within the regional vegetation. Pollen grains provide generally low taxonomic resolution and can usually be identified only at the family or genus level. Although the fossil pollen record is clearly generalized, pollen data have been the primary source of information for many climatic reconstructions. Pollen frequency variability in a given record usually only reflects long-term, low-frequency fluctuations in climate. They usually indicate effective moisture changes lengthy enough to allow plant migration, seedling establishment, and eventual pollen production (or plant stress and extinction, resulting in a decrease in pollen production). Short-term, high-frequency changes on the order of individual years or decades will not be evident in such records.

Continuous pollen records are relatively rare in the Southwest due to a scarcity of suitable depositional contexts. Instead, the majority of pollen sampling in the Southwest has been carried out within archaeological sites or nearby alluvial sequences. Samples from archaeological room floors and features are usually relatively precisely dated, and the close temporal relationship between the pollen data and the human occupation is desirable. However, pollen spectra from prehistoric cultural contexts are usually strongly affected by non-climatic factors such as tree clearance (e.g., Wyckoff 1977), local disturbance and subsequent invasion by weedy plant species, and intentional or incidental introduction of pollen into the sites from plants gathered elsewhere. Thus, the pollen spectra from archaeological sites may not represent an unbiased picture of the natural pollen rain. In addition, records constructed from archaeological pollen samples are, by their nature, discontinuous. Alluvial sample sequences augment archaeological records but are better characterized as intermittent than continuous. Alluvial sequences only rarely are datable with high precision and can also be influenced by local (non-climatic) factors. These weaknesses in the archaeological and alluvial pollen records make them only weakly comparable to the few continuous pollen records of the region.

To overcome the limitations that may be associated with pollen samples from archaeological sites (particularly the non-climatic factors that influence certain types of vegetation), researchers have used standard and adjusted pollen sums, ratios of arboreal to nonarboreal pollen, pine to juniper pollen, and large to small pine pollen. These ratios filter out the human-caused variability in local pollen production and focus attention on the natural vegetation surrounding archaeological sites (e.g., Hevly 1981, 1988; Schoenwetter 1970). Climatic reconstruction is accomplished by comparing and contrasting the prehistoric pollen spectra or ratios to modern pollen spectra or ratios from an elevational transect through different vegetation types and their associated climates (Davis 1995). (These data and techniques allow the characterization of long term [low frequency] climatic change, but the quality of the characterization is determined primarily by the geographic distribution of the higher quality continuous bog and lake records.)

Pack Rat Midden Analysis

Pack rats (*Neotoma* spp.) are small rodents that collect leaves, sticks, fruits and other materials from the area within tens of meters of their nests. They bring these items into their homes for food, nesting material, etc., and through time these nests can become cemented by desiccated pack rat urine. In dry caves and rockshelters in western North America, these urine-cemented pack rat middens can be preserved for tens of thousands of years (see papers in Betancourt et al. 1990 for further discussion). Plant remains in pack rat middens can generally be identified to the species level, and a given midden plant assemblage provides a detailed inventory of the species growing within 50 m (or less) of the pack rat's nesting site. The plant remains are often extremely well-preserved and provide excellent material for radiocarbon dating. The plant remains occur in assemblages that appear to represent a short interval of time, perhaps as short as a few years of an individual pack rat's life span. Although vegetation assemblages preserved in pack rat middens have been studied since the 1960s, no uniform method of quantification has been developed. Relative abundance within an assemblage probably does not have much meaning except to indicate the presence or absence of a given plant species at a given midden site.

Geologic and Geomorphic Records and Data

Although many researchers have linked climatic change and cycles of alluvial aggradation and degradation, entrenchment may not be clearly related to drought because of a multitude of other factors including channel slope, vegetation, change, and human activity (Cooke and Reeves 1976; Huckleberry and Billman 1998). Moreover, alluvial downcutting may not be continuous within a single watershed; if one segment of a fluvial system is eroding, the products of erosion must be deposited somewhere. It should also be noted that by nature, such alluvial paleoenvironmental records are discontinuous and dating correlation between areas must be demonstrated rather than taken as a given.

Brief Review of Notions About Movement and Settlement in the Northern Southwest

One of the most comprehensive treatments of a wide variety of paleoclimate indicators in the northern Southwest is that of Dean (1988, 1996) who presents a preliminary model for behavioral adaption of Ancestral Puebloans to climatic change. Although the work is centered on Black Mesa in northeast Arizona (Fig. 5.1) it has been used by Orcutt (1991) to test the timing of settlement changes on the Pajarito Plateau, New Mexico.

Figure 5.8 shows the reconstructed environmental variability for the Colorado Plateau. The environmental variables used by Dean (1988, 1996) are arbitrarily divided into two types: those termed low-frequency variation with base periodicities are greater than or equal to 25 years (one human generation or more). Those variables with shorter periodicities termed high-frequency variation (Fig. 5.8d, e). One of the reasons that such a distinction is made is that each record type can provide information that is unobtainable from the other. For instance, short-term drought may be reflected in tree rings, but it takes a very long-term drying trend to shift a vegetational boundary. High-frequency climate change includes proxies for precipitation and temperature derived from tree-ring studies on scales ranging from days to decades. The low-frequencies variables include the deposition and erosion of floodplain sediments along drainage (Fig. 5.8a) and the rise and fall of alluvial groundwater levels (Fig. 5.8b; Karlstrom 1988), and effective moisture as reconstructed from pollen (Fig. 5.8c).

Dean and Funkhouser (1995:97) note while describing the distinction between low- and high-frequency processes that,

> Climatic variation with frequencies longer than 25 years generally are not reconstructible by dendroclimatology, which is relatively insensitive to low frequency fluctuations. Recent progress along these lines, however, has been made through the analysis of the chronology of the El Malpais National Monument [Fig. 5.1] constructed of extremely long individual sample components. This preliminary reconstruction of low frequency climatic variability over the last 2,000 years (Grissino-Mayer 1996) bears an uncanny resemblance to Karlstom's (1988) hydrologic curve. [Fig. 5.8b]

Figure 5.9a shows the reconstructed annual rainfall for El Malpais National Monument. Figure 5.9b shows a 100-year smoothing spline fit that accentuates the low frequency trends, and Figure 5.9c shows the aggradation-degradation curves developed by Euler et al. (1979) and Karlstom (1988). Dean and Funkhouser (1995:99) sum up the implications derived from Figure 5.8. Major depositional and hydrologic stress would have occurred during periods of floodplain erosion (Fig. 5.1a) and falling or low water table (Fig. 5.8b) at AD 750 to 925, 1275 to 1450, and 1875 to the present. Secondary fluvial minima are centered on AD 1150 and 1700. Effective moisture fluctuations (Fig. 5.8c) would have exacerbated the conditions shown in Figure 5.8a and 5.8b between AD 800 and 1000 and between AD 1250 and 1400. However, the favorable conditions between AD 1000 and 1250 were reinforced.

According to Dean and Funkhouser (1995:99), high temperable variability (Fig. 5.8d) would have provided enough decade-to-decade variability to moderate adverse fluvial and effective moisture conditions during the AD 750 to 1000, 1350 to 1550, and 1730 to 1800 time periods. The greater climatic persistence in the intervening periods would have reinforced the favorable hydrologic conditions of AD 925 to 1130 and AD 1750 to 1850, but exacerbated the unfavorable conditions between AD 700 and 1000 and between AD 1150 and 1300.

Grissino-Mayer (1996) provides a 2,129-year reconstruction of precipitation for northwestern New Mexico (136 BC to AD 1992) based on cores from subfossil wood and long-lived conifers growing on lava flows in El Malpais National Monument (Fig. 5.1), astride the Continental Divide in west-central New Mexico. Figure 5.9 shows his reconstruction: Above-normal rainfall occurred AD 81–257, 521–660, 1024–1398, and 1791–1992, while below normal rainfall occurred during AD 258–520, 661–1023, and 1399–1790. In Figure 5.9 there are many areas of correspondence between the tree-ring reconstruction of droughts and the aggradation-degradation curve of Karlstom (1988).

In his evaluation of changes of foraging

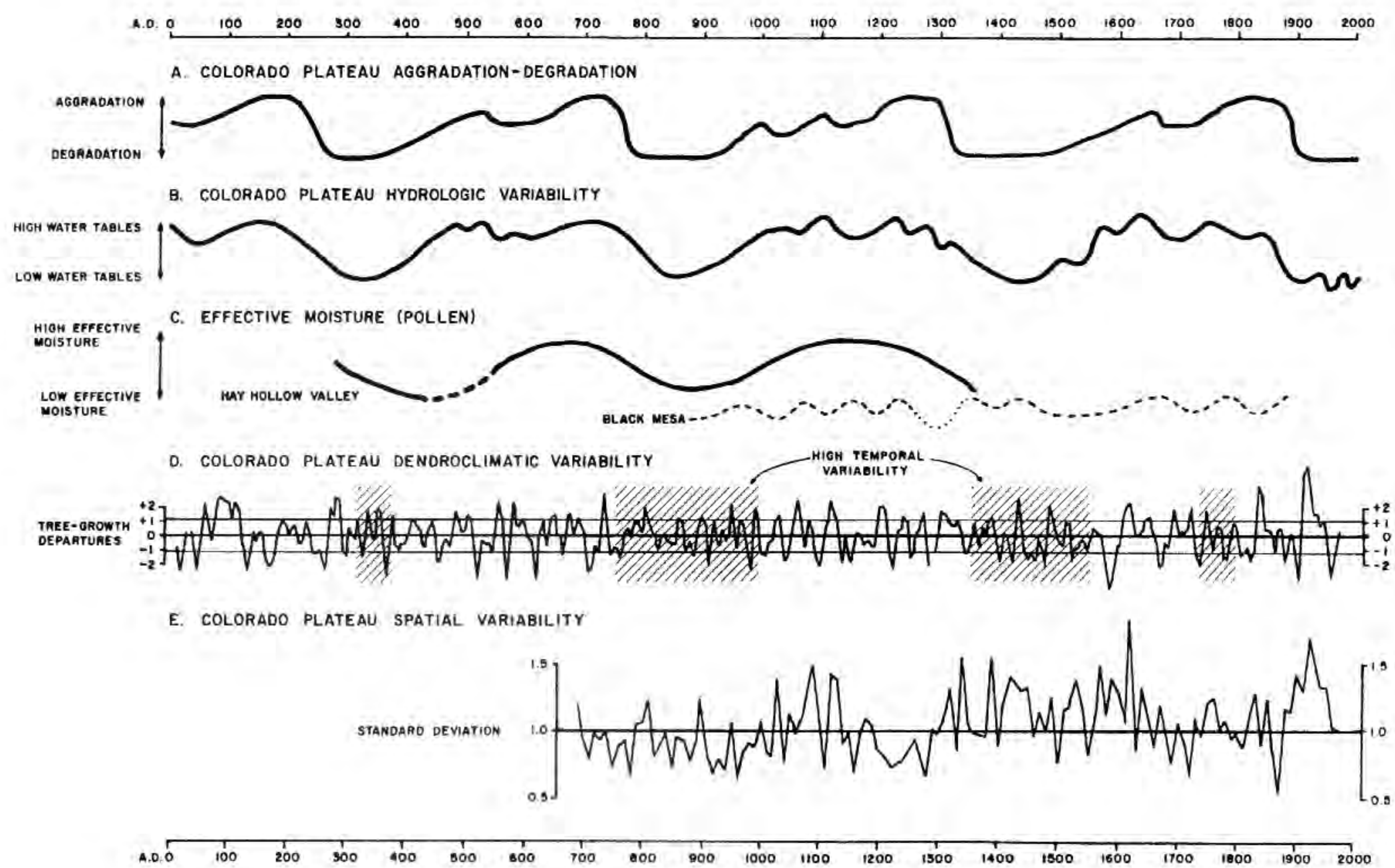

Figure 5.8. Low and high frequency environmental variability on the Colorado Plateau: (a) deposition and erosion of alluvium; (b) primary and secondary variations in alluvial groundwater levels; (c) fluctuations in effective moisture; (d) decadal variability in relative dendroclimate expressed as standard deviations from the long-term mean (hatching indicates periods of high temporal variability); (e) spatial variability in dendroclimate measured by the standard deviations of chronology station values for each decade (from Dean and Funkhauser 1995, fig. 10).

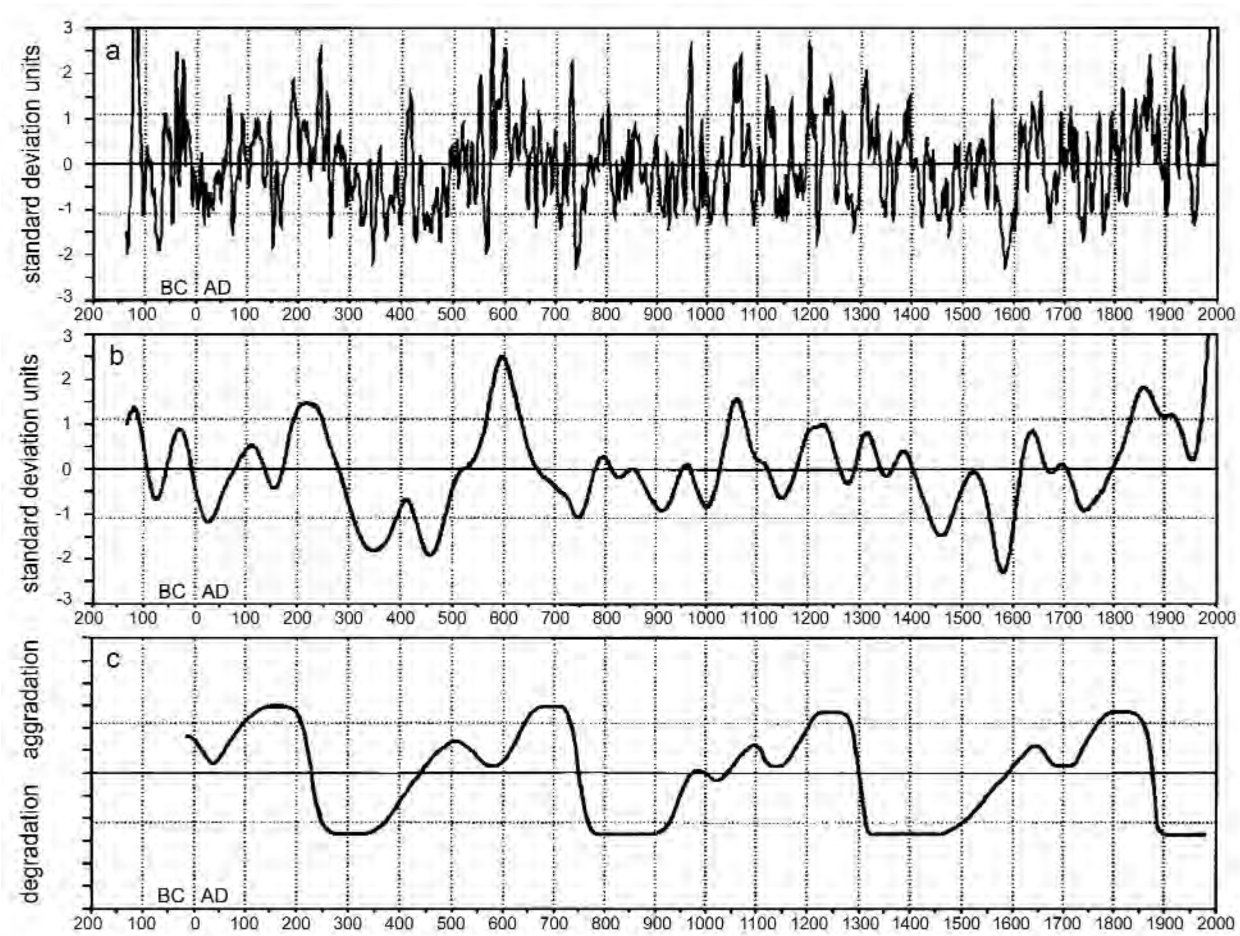

Figure 5.9. (a) The final reconstruction of annual rainfall (in standard deviation units) reconstructed from the MLC. The curve represents a 10-yr smoothing spline fit through the reconstruction to accentuate short-term (< 50 yrs) climate episodes. Dashed horizontal lines indicate the + 1.1 standard deviation thresholds discussed by Dean (1988). (b) A 100-yr smoothing spline fit through the reconstruction to accentuate long-term (> 100 yrs) trends in climate. (c) The primary aggradation-degradation curve developed by Euler et al. (1979) and Karlstrom (1988) for the Black Mesa area of northeastern Arizona. The curve is relative and therefore dimensionless.

behaviors during the Late Archaic/Basketmaker II period in the Middle Rio Grande Valley of New Mexico, Dello-Russo (1999) relies on Grissino-Mayer's (1996) reconstructions and qualifies the above-normal and below-normal rainfall as favorable or unfavorable relative to human occupation of the Middle Rio Grande Valley. The period AD 258–520 is below normal conditions and unfavorable. Dello-Russo (1999:53) cites Grissino-Mayer (1996: 200) as saying, this period is "the most severe of any long-term drought period in the last 2,129 years" and anticipates that it would have impact on the human occupants of the Middle Rio Grande Valley.

As discussed, Orcutt (1991) used the low-frequency alluvial and hydrological changes on the Colorado Plateaus discussed above to derive expectations for changes in settlement organization on the Pajarito Plateau on the eastern flanks of the Jemez Mountains (Fig. 5.1). Orcutt (1991) also used yearly July values for the Palmer Drought Severity Index (PDSI) reconstructed for the Northern Rio Grande by Rose et al. and quotes them (1982:224) as indicating that PDSI should provide a better overall measure of climate than precipitation or temperature alone. Orcutt (1991) looked at the low- and high-frequency processes specifically between AD 1150 and AD 1600.

Orcutt (1991) notes that one of the reasons for using the Colorado Plateau low-frequency processes record is that specific evidence for low-frequency variability in the vicinity of the Pajarito Plateau is sparse. In the Gallina area, northwest of the Pajarito Plateau, Mackey and Holbrook (1978) inferred increased aridity for the period AD 1250 to 1300 using faunal, corn, and pollen data. Orcutt (1991) cites the work of Pippin (1987:172–173) who concludes from tree-rings and alluvial records that conditions became drier and warmer during the early twelfth century in the Rio Puerco area west of Albuquerque.

Orcutt (1991) concludes that using the record of low-frequency processes from the Colorado Plateau appeared to fulfill the expectations she derived for settlement as regard to elevations of settlements and fieldhouses on the Pajarito Plateau up until AD 1450. Ancestral Puebloans occupied the higher elevation of the Pajarito Plateau during a period of low frequency process conditions and variable rainfall that followed the mid-AD 1100s. The major population increase probably occurred around AD 1275–1325, just before or soon after the period when low frequency conditions began to deteriorate; this was accompanied by aggregation into large plaza pueblos such as Arroyo Hondo (see discussion below). In the AD 1300s, population shifted down in elevation during a period of poor, low frequency process conditions accompanying the mild drought from AD 1338 to 1352. Once populations were settled at the lower elevations, they never again moved back up to higher elevations (at least not permanently). After AD 1450, settlement does not conform to the climatically driven expectations of Orcutt (1991) based on the Colorado Plateau sequence. Population continued to decline in the Pajarito region, but in the Santa Fe area, population increased.

Another study from the Northern Rio Grande region of central New Mexico comes from the fourteenth-century town of Arroyo Hondo (located 4.5 miles south of Santa Fe; Fig. 5.1), which was excavated by the School of American Research. Rose et al. (1981) use tree rings to reconstruct annual and seasonal precipitation in inches from AD 985 to 1970 and concluded that the AD 1415–1425 drought, the most intense drought of the entire dendrochronological record, coincides with the final abandonment of Arroyo Hondo Pueblo. Prior to this, the Arroyo Hondo population seems to covary with the reconstructed variation in rainfall.

Dean et al. (1994) summarize what was known at the time of their publication about the regional population distribution in the Southwest with a series of maps for AD 400, 800, 1100, 1200, 1300, and 1500. From these maps, it is clear that between AD 400 and 1100 there is a steady expansion of population generally west of the Continental Divide (the location of which is shown in Figure 5.5) in New Mexico and Arizona that continued up into southern Utah and southwest Colorado. By AD 1200 the higher population concentrations had spilled over the Continental Divide into the Northern Rio Grande Region. But by AD 1300 there had been a retraction of the population centers from the northern areas back to the Little Colorado region in Arizona and the Northern Rio Grande region in New Mexico where these populations remained until the eve of European contact.

Brief Review of Global Climate History as it Affects Monsoon Rainfall in the Northern Southwest

Monsoon history in the northern Southwest is probably a key component to the ability of prehistoric farmers to grow non-irrigated corn at any given locality. The following discussion puts the Southwest monsoon in a larger historical picture.

The astronomical or Milankovitch theory of climate change suggests that the differences in the shape of the earth's orbit, the tilt of the polar axis, and the time of year when the earth is nearest the sun affects changes in solar insolation (for a more detailed discussion of the topics covered in this section, see Bradley 1999). Because the earth's orbit is "out of round," its shape lengthens and shortens with a periodicity that varies slightly through time but averages about 95,000 years. That means the planet receives relatively little sunlight at the time of year when it reaches the outermost part of this orbit. This regular pattern appears to explain the expansion of glaciers every 90,000 or 100,000 years during the last 900,000 years. Another cycle affecting global climate change is the regular change in the angle of the earth's axis of rotation, which seems to govern the waxing and waning of glaciers. Every 41,000 years, this angle is farthest from the vertical, which means that the north and south poles are aimed farthest away from the sun during their respective winters—and winters in both hemispheres are especially cold. During these intervals of especially cold winters, glaciers expand to their maximum extent.

The atoms of oxygen in fossils preserved in deep-sea sediments provide a record of the expansion and contraction of glaciers on land. This is reconstructed from the ratio of two isotopes, oxygen 16 and oxygen 18, incorporated into the skeletons of calcium carbonate formed by Foraminifera, nicknamed forams. These are single-celled amoeba-like protozoans, some of which float in the ocean and eventually are incorporated into bottom sediments. Because oxygen 18 has two more protons, these molecules are slightly heavier. The relative mobility of these two isotopes varies with temperature and the result is that less oxygen 18 ends up in the skeleton of floating forams at high temperatures than at cold temperatures. When glaciers have expanded, oxygen 18 has increased in the skeleton of floating forams for two reasons. First, under the cooler condition, the forams have incorporated more of this heavier isotope. Second, with the expansion of glaciers, there has been a higher percentage of oxygen 18 in seawater to begin with—the lighter oxygen 16 is more readily transported into the overlying atmosphere as water vapor. This double effect has endowed the fossil record with a powerful signal of the waxing and waning of glaciers recorded in sedimentary cores recovered from the ocean bottom.

Studies of ocean sediment-core data identify seven glacial-interglacial cycles over the past 600,000 years. In each cycle, the build-up of ice took place gradually, over a period averaging 80,000 years, while the melting that followed happened quickly, always taking less than 10,000 years before the cycle repeats itself. We are currently in an interglacial called the Holocene and have been for nearly 10,000 years. Based on the pattern that is driven by changes in solar insolation, which has happened over and over again in the past, the earth will be going back into another ice age at some point in the future, although there is little agreement as to when and how rapidly that will occur.

In this chapter we will examine three time periods: (1) the last glacial maximum (18,000 radiocarbon years before present [yr BP]), one of the coldest periods in recent global history, (2) the mid-Holocene (6000 BP), one of the warmest, and (3) the present or modern case. These three time periods provide specific baselines against which we can compare and contrast the last 2,000 years or so in north-central New Mexico.

During the Last Glacial Maximum (centered on 18,000 yr BP) it appears that the modern summer monsoon regime in the Southwestern United States and adjacent Mexico collapsed due to the extensive Laurentide ice sheet that rerouted global winds (Thompson and Anderson 2000), cooled sea surface temperatures over the Gulf of Mexico (Guilderson et al. 1994), and lowered sea levels (some 100 m) due to global water being locked up in glacial ice located on land (Bradley 1999).

As discussed above, monsoon circulation is driven by land-sea thermal contrasts. The modern dominant summer rainfall regime in the Southwest does not seem to have been established until after 9,000 yr BP when northern hemisphere insolation was at a maximum during the summer (Metcalfe et al. 2000). An et al. (2000) found that in China the timing of the Holocene summer monsoon maxima (based on lake levels, pollen profiles, and loess paleosol records) was also in accord with changing solar inclination and that over the last 9,000 years the zone of maximum precipitation moved a distance of 2,000 km from north-central to southeastern China where it is located today. That produced a rate of movement of 250 km per 1,000 years in accord with the changing angle of the axis of rotation of the earth.

In one of the most ambitious efforts to compile pollen and pack rat midden data from western North America, Thompson and Anderson (2000) have provided a convincing picture of the composition and distribution of biomes in the western United States at 18,000 yr BP, 6,000 yr BP, and the modern situation. Thompson and Anderson (2000) indicate that biomes represent broad physiognomic vegetation types that are based on the co-occurrence of plant species that respond individualistically to climatic gradients and climatic change.

Thompson and Anderson (2000) also indicate that climate conditions at 18,000 yr BP, as compared to the present, were characterized by: (1) a southward displacement of the westerlies, and their persistence throughout the year, (2) the near elimination of the present summer monsoon circulation, and (3) a steepened temperature gradient between very cold temperatures in the north and mild conditions along the Mexican border. These resulted in steppe and tundra biomes in what is now maritime western Washington, open conifer woodland from Wyoming south to the Mexican border and the lack of any deserts in the Southwest.

Thompson and Anderson (2000) biome reconstructions for 6,000 yr BP show that steppe was more extensive in the northern Great Basin than that of the present, implying warmer and drier conditions there (cf. Grayson 2000). Also at 6,000 yr BP, Thompson and Anderson (2000) show the existence of cool conifer forests at several sites in Colorado (cf. Fall 1997) and northeastern Arizona that are characterized as open conifer woodland, or steppe in the modern case. This indicates that conditions were wetter than present 6,000 yr BP at those locations, providing clear evidence for enhanced summer monsoon circulation in the Southwest.

Mock and Brunelle-Daines (1999) developed a modern analog of the summer paleoclimate for the western United States for 6,000 yr BP based on broad-scale patterns from proxy climate data and general circulation model simulation. Mock and Brunelle-Danes (1999) indicate that August 1955 serves as a close analog for 6,000 yr BP. It features an amplified subtropical ridge aloft and anticyclonic flow near the surface over the central United States, stronger westerly flow along the Canadian/northwest United States border, and stronger monsoonal activity in the Southwest extending up into Utah and Colorado. Figure 5.10 shows the composite anomaly map of precipitation derived by Mock and Brunelle-Daines (1999) to represent typical summer conditions at 6,000 yr BP.

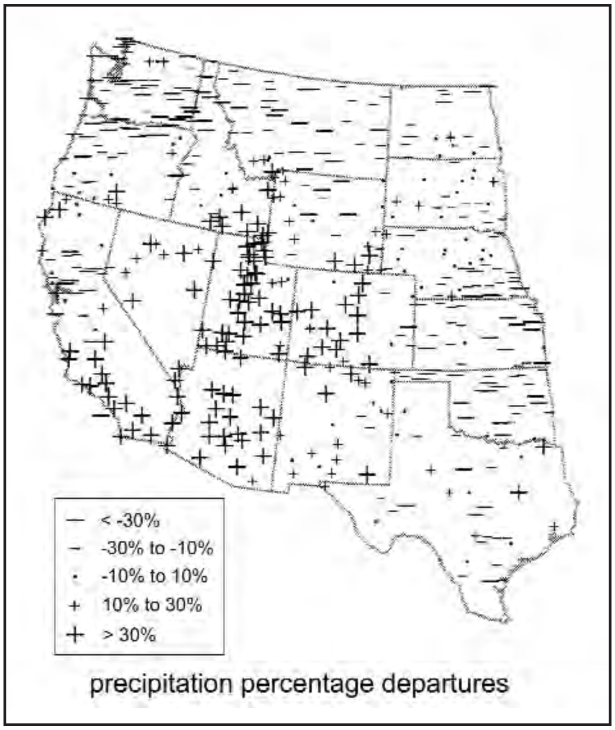

Figure 5.10. Composite anomaly map, based on eight August Southwest monsoon index extremes for precipitation showing percentage departures based on 1946-94 averages (Mock and Brunelle-Daines 1999, fig. 2) believed to be a good analog for sumer climatic conditions 6,000 years ago and other times of strengthened monsoonal circulation.

Figure 5.11 shows Bradley's (2000, fig. 1) northern hemisphere mean annual temperatures (as departures from 1902–1989 means) reconstructed from selected paleoclimatic records and calibrated against instrumental data for 1902–1980 (Mann et al. 1999). This 1,000-year reconstruction reveals evidence for (1) mild episodes, lasting a few decades in the eleventh and twelfth centuries; (2) a long-term cooling trend from AD 1000 to 1900 that culminated in the nineteenth century—the coldest century of the millennium, about 0.28 degrees C colder than the twentieth century; and (3) the uniqueness of the twentieth century in both its overall mean and rate of temperature change—possibly as a result of climate forcing from enhanced levels of industrial carbon dioxide.

Bradley (2000) indicates that this long-term cooling trend in the northern hemisphere is related to orbital effects where there has been a decline in July radiation in the mid- to high-northern latitudes on the order of 4 W m^{-2} at the top of the atmosphere over the last 1,000 years. This implies that 1,000 years ago, monsoon effects could have been stronger in the northern Southwest due to orbital effects alone without having to resort to warmer land temperatures, although warmer land temperatures are evident due to the incident solar angle of the time.

Pollen Records and Black Mesa Climatic Reconstructions

During the late 1950s and early 1960s, Paul S. Martin (1963; Martin and Byers 1965) and his students and associates at the University of Arizona undertook investigation of pollen preserved in alluvial, lacustrine, and archaeological sediments in the Southwest, a region noted for its lack of more traditional basins of pollen deposition such as lakes and bog. One of Martin's associates, James Schoenwetter (1966, 1967, 1970, 1987; Schoenwetter and Eddy 1964), compared modern pollen ratios and pollen spectra with those from dated alluvial and archaeological sites in the Colorado Plateau. From these, Schoenwetter was able to reconstruct an effective moisture curve for the Navajo Reservoir and Chuska Valley areas of northwest New Mexico (bottom curve, Fig. 5.12 locations shown Fig. 5.1). Higher arboreal (tree) pollen values are interpreted by Schoenwetter as indicating greater effective moisture at his research localities, likely due to greater winter-dominant precipitation. Schoenwetter (1966) was the first to propose such a chronology of winter precipitation fluctuation for the Four Corners region.

Another of Martin's students, Richard H. Hevly, became involved in the study of the paleoenvironment of Black Mesa in northeast Arizona (Euler et al. 1979). As discussed above, this long-term, integrated effort has been one of the most productive and most fruitful of all Southwestern studies examining Ancestral Puebloan and climate interactions. Another low frequency environmental variable used at Black Mesa is the changes in effective moisture

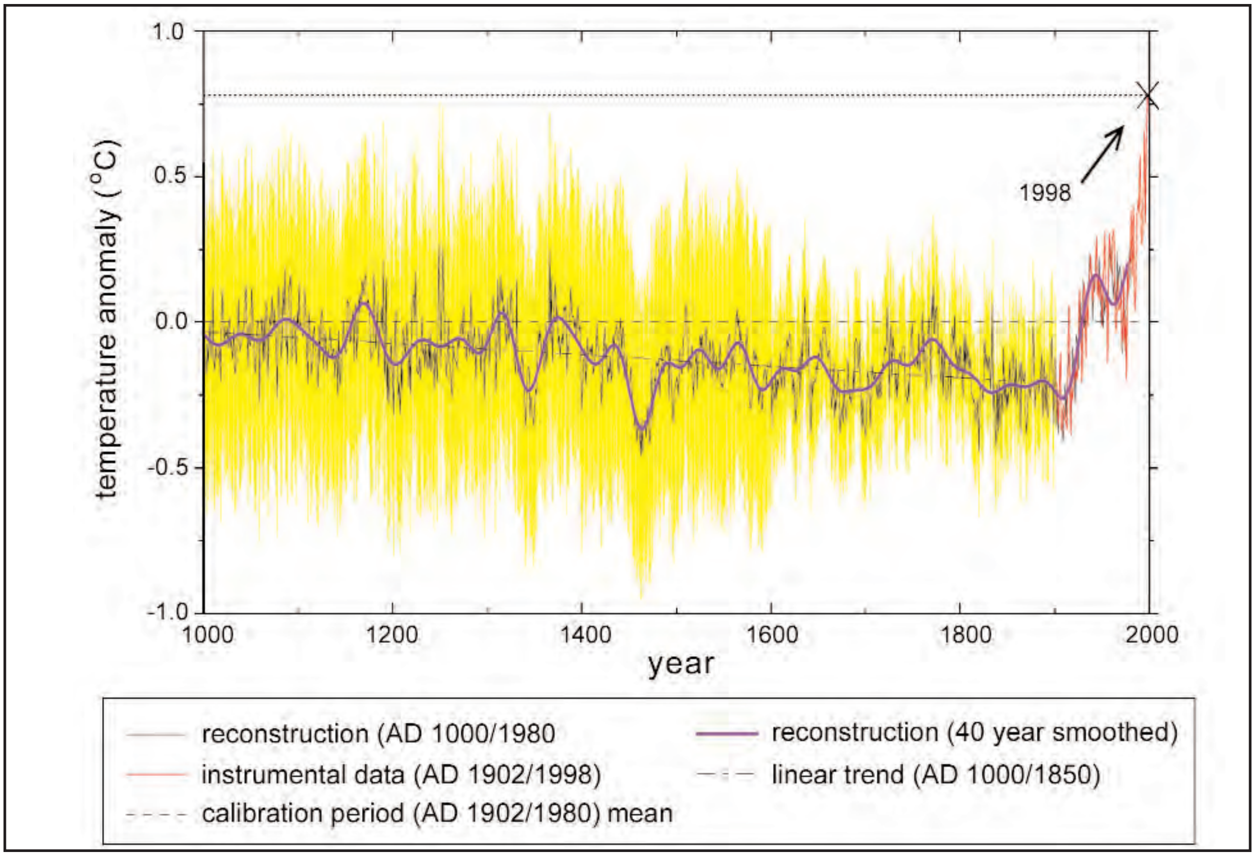

Figure 5.11. Northern hemisphere mean annual temperatures (as departures from 1902-1989 means) reconstructed from a limited set of paleoclimatic records (from Bradley 2000, fig. 1), calibrated against instrumental data for 1902-1908 (Mann et al. 1999).

and the composition and elevational boundaries of plant communities (Fig. 5.8c; Hevly 1988).

Hevly (1988) also presents a very thorough review of prehistoric vegetation and paleoclimate for other portions of the Colorado Plateau and indicates that although pollen records have been obtained from numerous lacustrine environments, only a few have yielded data that are radiometrically or archaeologically dated within the last 2,000 years. He presents a selection of these in the three center panels of Figure 5.12, including data from Hay Hollow near the headwaters of the Little Colorado River in east-central Arizona, Black Mesa, and Elden Pueblo near Flagstaff, north-central Arizona. Each of the samples have been plotted in such a way that up indicates greater effective moisture. As mentioned in the section on pollen, interpretation of pollen frequency changes from plots derived from archaeological sites and alluvial sections have special problems that have been addressed in various ways.

Hevly (1988) also shows a plot of the spruce/pine pollen ratio from a continuous, radiocarbon-dated pollen record from Beef Pasture, La Plata Mountains, southwest Colorado (Petersen 1988). Beef Pasture, at 3,060 m in elevation, is currently located within the spruce forest but near its lower elevational limit (Fig. 5.12, top panel). Modern surface pollen transects indicate that as one goes down the mountain, the ratio becomes smaller (Petersen 1988). Or, if conditions were to become drier, and the ponderosa pine forest followed the spruce forest retreat upslope, the ratio would also become smaller. In this figure, any value lower than a ratio of 0.60 indicates drier conditions than that of the present (Petersen 1988). The dotted line in the top panel of Figure 5.12 is the mean ratio for the last 2,800 years.

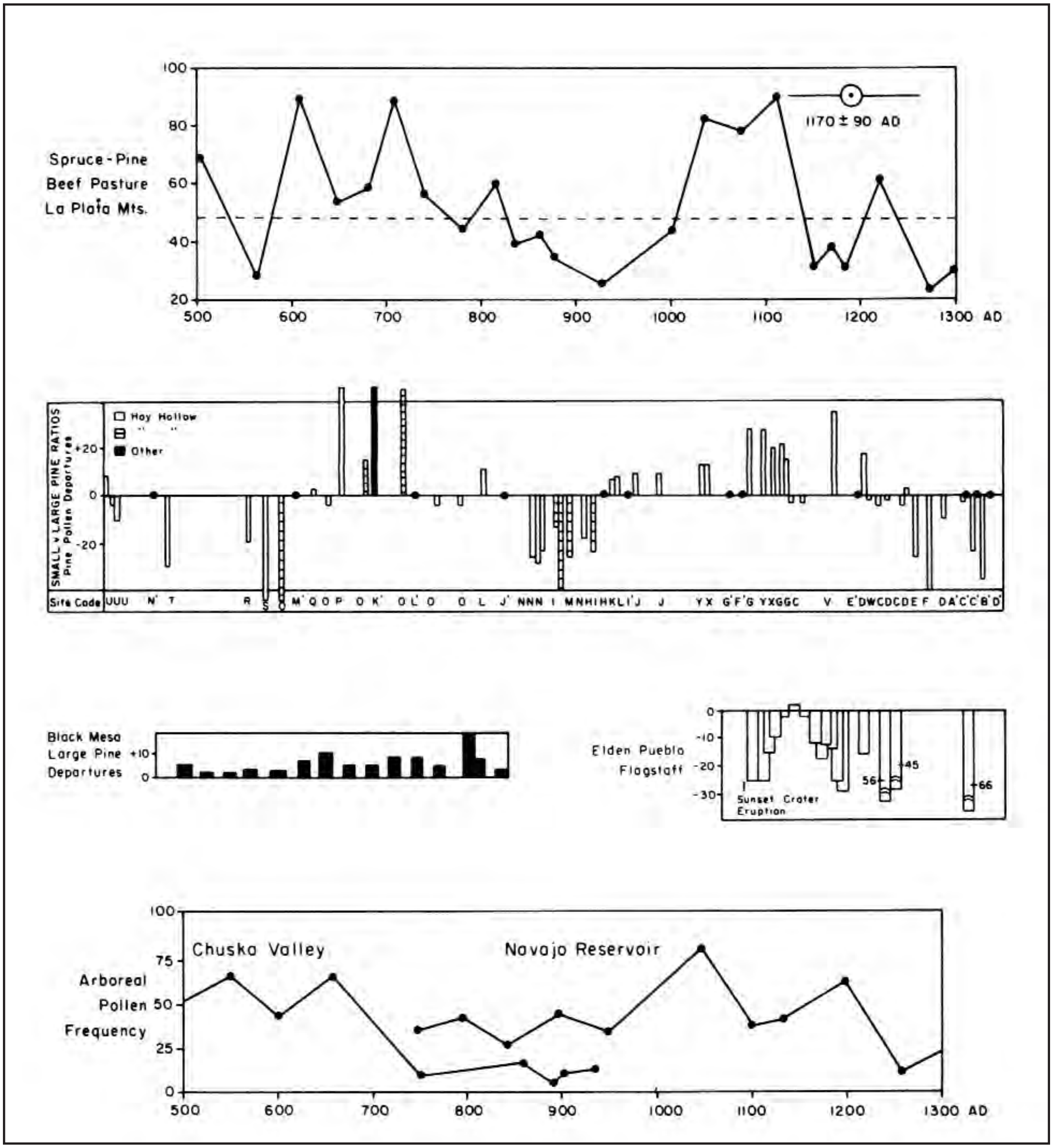

Figure 5.12. Long-term oscillations exhibited by arboreal pollen in a lacustrine pollen record from Beef Pasture (La Plata Mountains, Colorado), and archaeological and alluvial pollen data from Arizona (Flagstaff, Elden Pueblo, Black Mesa, and Hay Hollow Valley), and New Mexico (Chuska Valley and Navajo Reservoir). Data from Hevly 1981, Hevly et al. 1979; Petersen 1985a; Schoenwetter 1966, 1967; Schoenwetter and Eddy 1964. Note that different pollen types have been used at different localities to illustrate these long-term trends, which appear to be generally parallel over a wide geographic area (reprinted with permission of Cambridge University Press).

After developing this figure, Hevly (1988) concludes that despite the different pollen types that have been used at different localities, the long-term trend for the northern Southwest is amazingly similar over a large geographic area (Figs. 5.1, 5.12). The fact that they were derived and dated independently suggests that they are truly reflecting a robust vegetation signal that is responding to long-term changes in climate.

DAP Environmental Archaeology

Like the Black Mesa work, another thoroughly integrated archaeological project was undertaken by the Dolores Archaeological Program (DAP) on the Dolores River in southwest Colorado in the late 1970s and early 1980s (Robinson et al. 1986). However, the scale of the DAP was much more massive than that of Black Mesa (the DAP was one of the largest archaeological mitigation projects ever carried out in the United States) and the volumes of research results could fill a large shelf.

To facilitate interpretation of the DAP findings, a number of researchers in the DAP Environmental Archaeology Group developed a model of past climatic change and related it to physiographic and agricultural conditions in the Dolores Project reservoir area (Petersen 1985a, 1985b, 1986, 1987a, 1987b, 1987c, 1987d, 1987e; 1988, 1994b; Petersen and Clay 1987). The climatic model was based on non-DAP supported studies begun by another student of Paul S. Martin, Peter J. Mehringer, Jr., in the early 1970s. These studies were subsequently taken over by Kenneth L. Petersen, one of Mehringer's students (Petersen 1981; Petersen and Mehringer 1976). Earlier, work by Mehringer et al. (1967) had demonstrated that pollen analysis of discontinuous alluvial sediments could be used to document an increase in summer precipitation even when other geologic evidence might suggest otherwise. The pollen analysis that was undertaken in the La Plata Mountains was an attempt to obtain a continuous and well-dated pollen record of climatic change that could be applied to archaeological questions in the Four Corners region.

The model developed for the DAP by Petersen and colleagues included palynological data from two bogs (Beef Pasture and Twin Lakes) at different elevations within the spruce forest of the La Plata Mountains (Fig. 5.1) and tree-ring data from several areas of the Four Corners region, plus Almagre Mountain (Fig. 5.1) in the Colorado Front Range (for a high-elevation bristlecone pine tree-ring sequence indicative of summer temperature variations). Additional palynological data were obtained in the Dolores Project area from a dated, but discontinuous record (Sagehen Marsh), which allowed a local calibration of the findings obtained from the La Plata Mountains. Using these data, Petersen and colleagues reconstructed relative measures for annual precipitation (primarily jet-stream derived), summer precipitation (primarily monsoon derived), and summer warmth, as well as the effects of physiography on cold-air pooling. Based on these, and taking into account elevation, aspect, exposure, and cold-air drainage, Petersen (1987d, 1988, 1994b) proposed that for the period from late AD 500 through AD 1300 there were episodic changes in the width and elevation of the "dry-farming belt" (today, located between 2,000 m and 2,300 m elevation in the DAP area). Using the data on the frequency of droughts and short summers enabled measures of agricultural costs and stresses to be derived (Orcutt 1986, 1987; Kohler et al. 1986).

The DAP model of environmental and subsistence potential showed generally good agreement with estimates of project area populations and settlements (Schlanger 1986, 1988). The eighth and ninth centuries in particular showed declines in annual precipitation (Fig. 5.12, top panel) that would have made the high-elevation environment of the Dolores Valley attractive for farmers who would have had less favorable results from farming at lower elevation in other parts of southwest Colorado in the very late AD 800s and early 900s. This narrowed farm belt, coupled with reconstructed short growing seasons in the early 900s, may have contributed to a "push" for abandonment or near abandonment of the McPhee Reservoir area at that time (Petersen 1988, 1994b) as well as to the regional abandonment described by Wilshusen and Ortman (2000).

San Francisco Peaks Tree-Ring Evidence for Temperature Variability in the Northern Southwest

Salzer (2000) reconstructs temperatures based on tree rings (Fig. 5.13) from the San Francisco Peaks of northern Arizona (Fig. 5.1) and concludes that there are periods of shortened growing season and untimely frosts that could have been detrimental to prehistoric Southwest agriculture in northern and upland areas. Figure 5.13 suggests that shortened growing seasons soon after AD 850 and the early AD 1200s and mid-AD1300s could have impacted farming potential. Because early AD 1200 is one of the severest periods shown, it is not surprising that this period seems to coincide with the tumultuous nature of northern Ancestral Puebloan society at that time. Salzer (2000) tentatively links his cold periods to periods of explosive volcanism as recorded in the historical record and ice core record of eruptions. Extremely large explosive volcanoes modulate tropospheric temperatures by increasing the stratospheric aerosol load, which effectively reduces solar radiation receipts (Lamb 1970; Rampino and Self 1984), resulting in a reduction of the land-sea thermal contrasts that drive global monsoon circulation. Such cooling, explosive volcanic episodes are likely superimposed on the trend of cooling northern hemisphere temperature already detected by Bradley (2000) as a result of changing solar incidents.

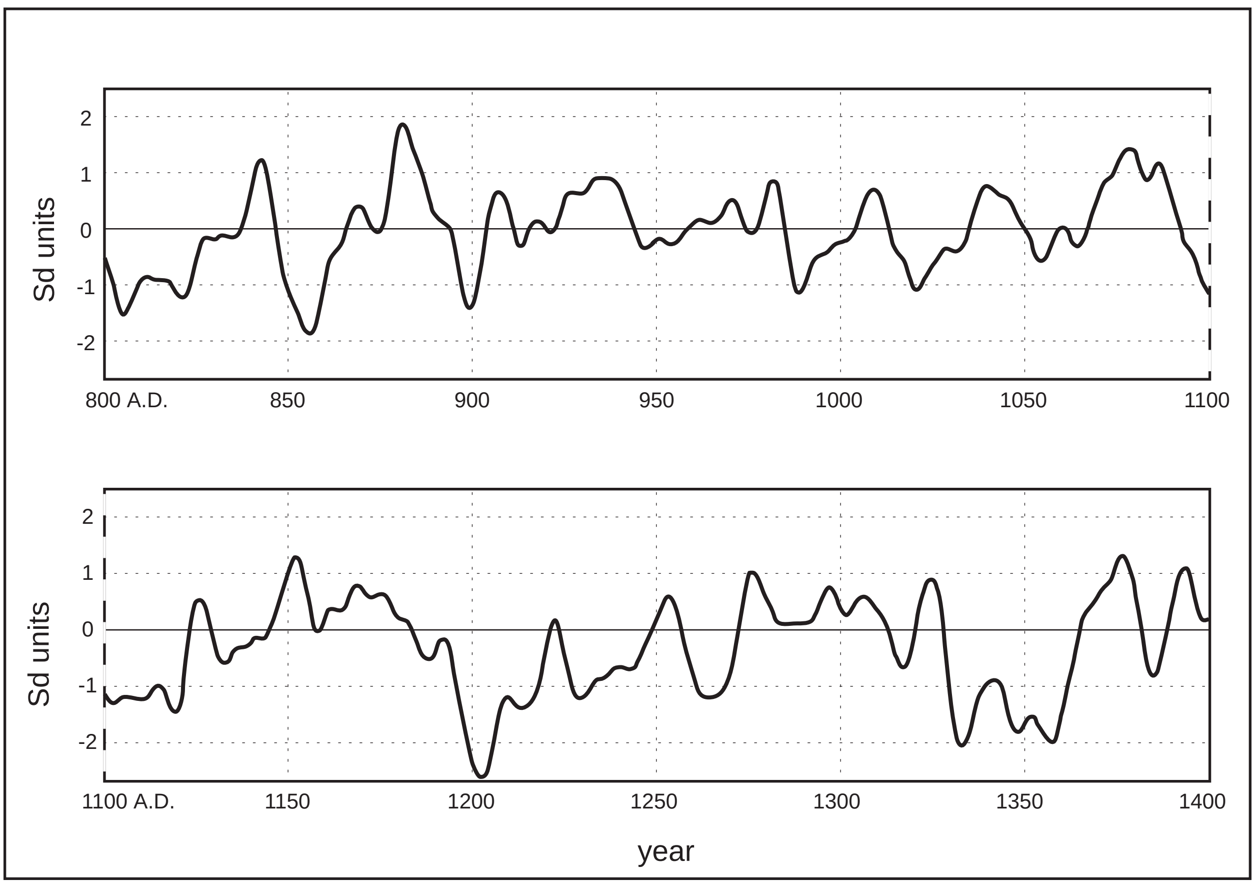

Figure 5.13. San Francisco Peaks temperature reconstruction from AD 800 to 1400. Data expressed as Z-score values and smoothed with a 10-yr cubic smoothing spline (Cook and Peters 1981).

Discussion of Regional Environmental Records that Affectthe Peña Blanca Project Tree Rings

Dean (1988) reports the results of analysis of a network 27 long tree-ring chronologies for the period AD 680 to 1970. Contour maps of tree-growth departures were constructed for each decade of the record. For instance, mapping shows that the Northern Rio Grande area largely escaped the "Great Drought" of AD 1276–1299 (Douglas 1929, 1935), while areas to the west were severely affected. Dean and Funkhouser (1995) report the use of principal component analysis to investigate the geographic patterning of co-variation among the tree-ring chronologies. Figure 5.14 shows the principal components of Southwestern tree growth (climate) for the AD 966–1988 period. Dean and Funkhouser (1995) indicate the pattern in Figure 5.14 bears an uncanny resemblance to the modern spatial distribution of seasonal precipitation during the last 70 years (Dean 1988, fig. 5.1). In the south and east, precipitation exhibits a unimodal, summer-dominant pattern, while to the north and west, a bimodal distribution with both summer and winter maxima prevail (see Figure 5.15 for an example).

Principal component analysis was done for each 100-year period from AD 539 to 1988 overlapped by fifty years. However, this process revealed that during a 200-year period from about AD 1250 to 1450 this long-term pattern breaks

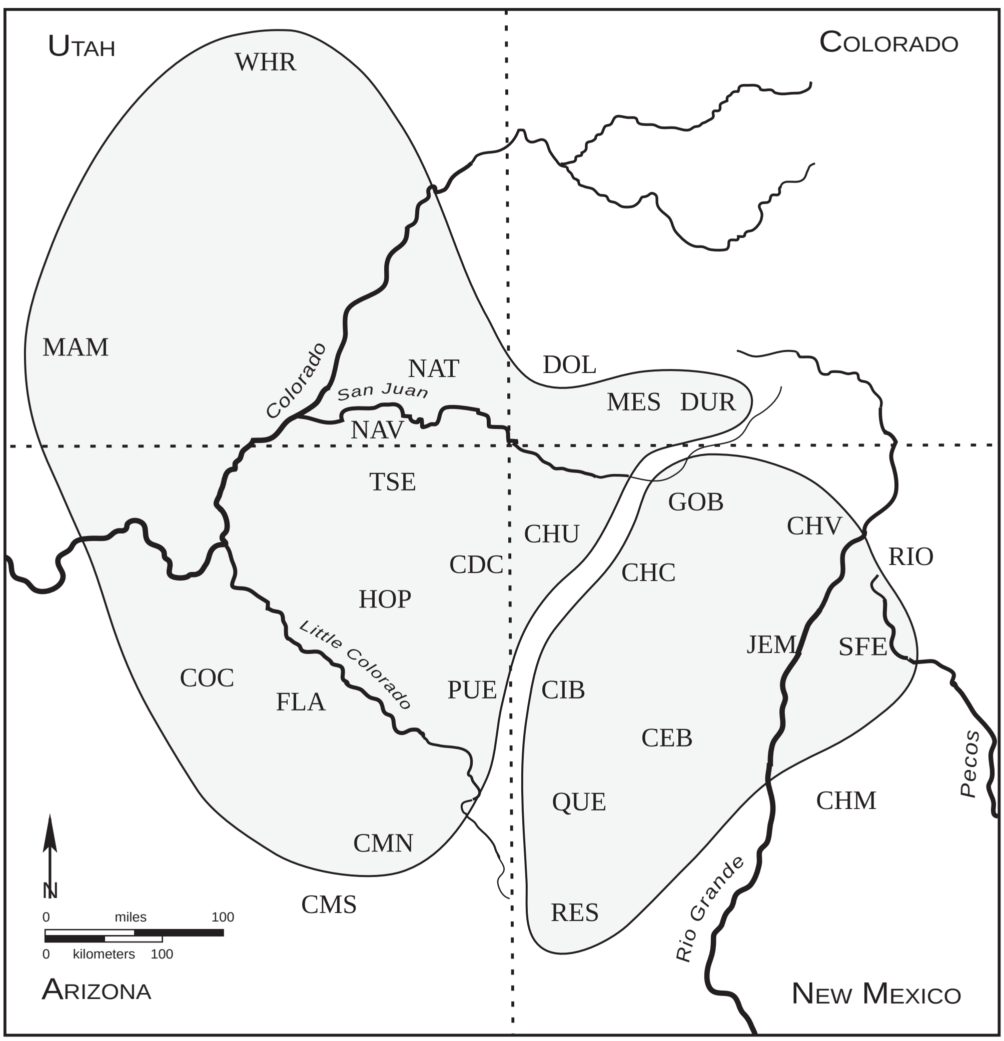

Figure 5.14. Principal components of Southwestern tree growth (climate) for the AD 966-1988 period.

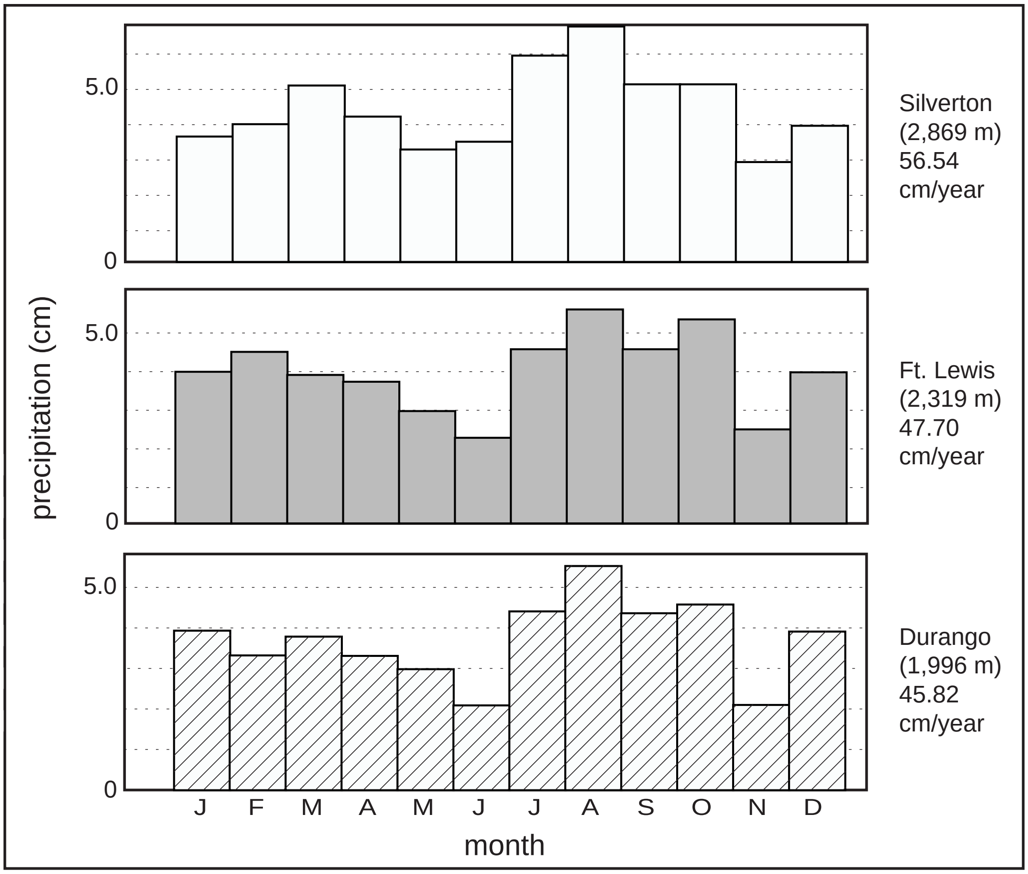

Figure 5.15. Monthly precipitation in southwest Colorado. The bimodal distribution of precipitation is separated by lows in June and November, with the highest monthly averages occurring from July through October (redrawn from Petersen 1988, fig. 6; data from U.S. Department of Commerce, Weather Bureau 1964).

down completely. The AD 1339–1438 interval (Fig. 5.16) typifies this 200-year period. Although the southeast component remains unchanged, the rest is chaotic and makes little sense in terms of modern climate, suggesting a collapse of the two-season precipitation maxima system to the west and northwest. Figure 5.5 illustrates the different sources of moisture depending on what side of the Continental Divide is being talked about. If the primary system collapse was in the tropical eastern Pacific, sources of moisture could still be driving the monsoon out of the Gulf of Mexico to produce the pattern shown in Figure 5.16. It was not until the environmental situation ameliorated after AD 1450 that conditions return to the stable pattern that were evident prior to AD 1250, but those regions in Utah and southwest Colorado had already been abandoned by corn-growing Ancestral Puebloans.

Pollen

Petersen (1988, 1994b) reconstructs the strength of the summer monsoon in southwest Colorado from the inferred changes in the areal distribution of piñon pine as reflected by the annual numbers of piñon pine pollen grains wafted up to the Beef Pasture pollen site and deposited on a 1-cm-sq area. Using modern analogies and calibration, Petersen (1985b, 1988, 1994b) argues that piñon seedling establishment is a good proxy of monsoon strength. Figure 5.17 suggests the correlation between piñon pine tree establishment and wet monsoon conditions.

Davis (1994, 1996) concludes from pollen analysis of other sites within the monsoon boundary (Fig. 5.5), such as Peck Lake (Fig. 5.17), in central Arizona (Fig. 5.1), that there

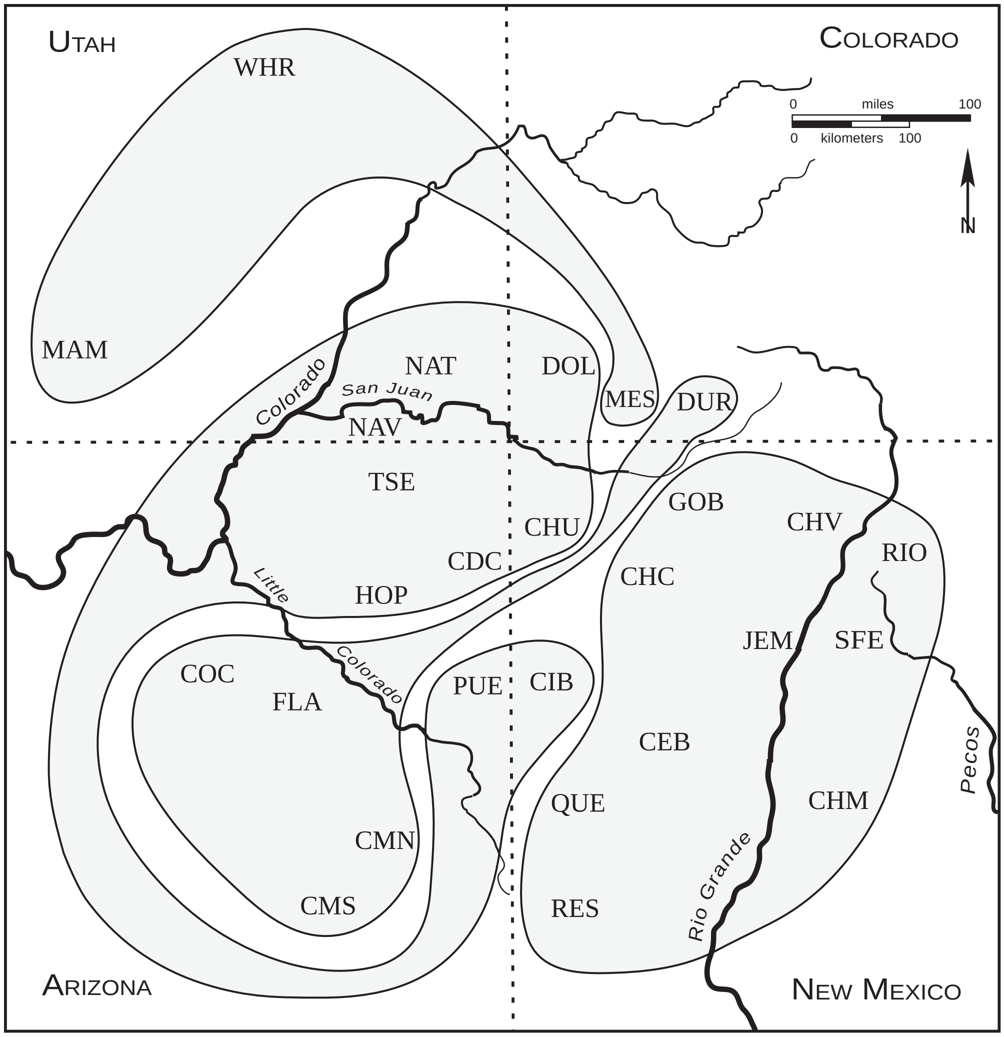

Figure 5.16. Principal components of Southwestern tree growth (climate) for the AD 1339-1438 period.

was an increase in lake levels from AD 700 to 1250, thereby suggesting support for Petersen's (1988, 1994b) contention that summer precipitation during that time period was much higher than the subsequent period. Petersen's (1988, 1994b) integrated record of tree-ring and pollen analyses from the Southern Rocky Mountains is interpreted as showing that temperatures were relatively mild and growing-season moisture abundant as indicated by successful corn-bean-squash horticulture beyond the present limits of non-irrigated farming on the Central Plains (Wedel 1986) and up into present-day Utah (Fig. 5.18). Episodes of high-elevation lichen snow-kill and reestablishment in the Indian Peaks portion of the Colorado Front Range (Fig. 5.1) suggest the period was also characterized by heavy spring snowfall and cool, cloudy summers—a natural by-product of increased warm season precipitation (Benedict 1993).

Comparison of where corn was grown prehistorically (Fig. 5.18) with that of the monsoonal rain distribution shown by the large plus marks contained in Figure 5.10 suggest a plausible reason why corn was being raised in the Central Plains and northern Utah, areas that are too dry in the summer today. After the thirteenth century, based on the pollen evidence shown in Figure 5.17, monsoon rains arrived later in the early summer, did not penetrate as far north, and left earlier in the fall

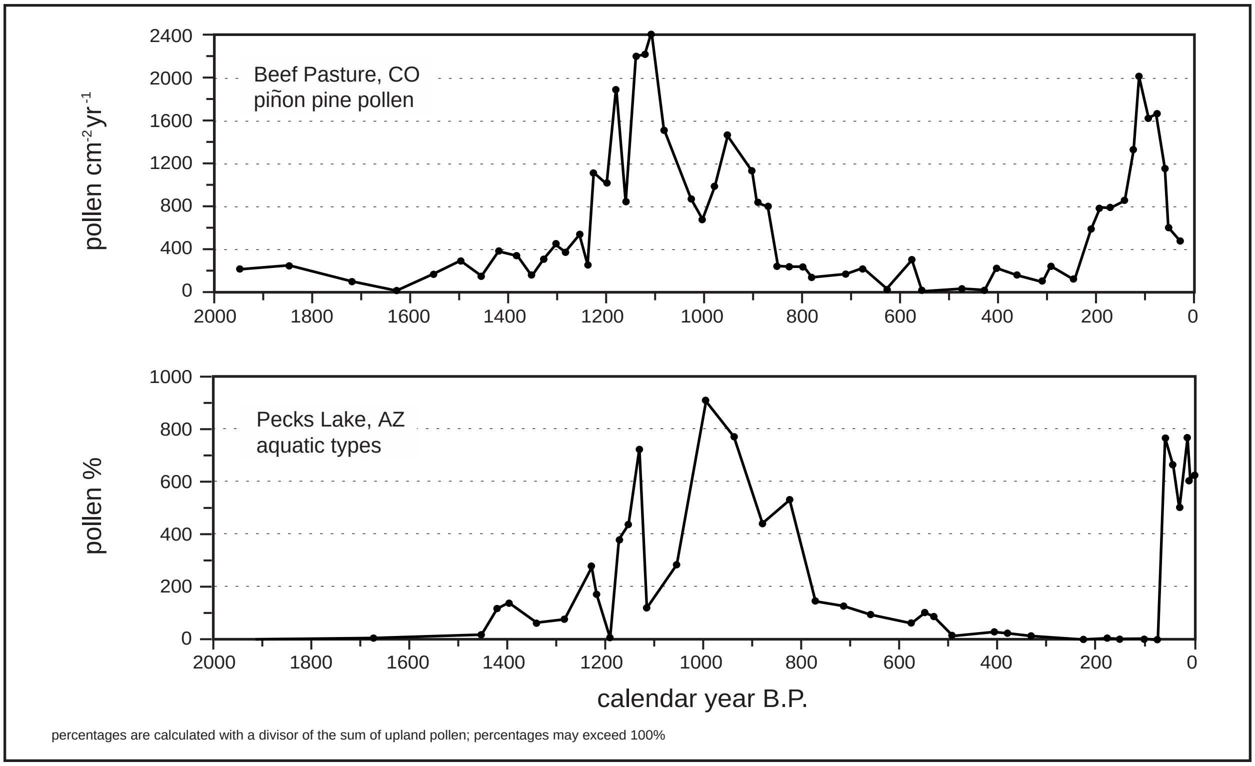

Figure 5.17. Climatic reconstruction of the Southwest U.S. for the Medieval Warm period (after Davis 1996, fig. 12-5). Beef Pasture and Pecks Lake indicate greater summer precipitation and higher lake levels during the Medieval Warm period, suggesting strengthened monsoonal precipitation.

than that of today. And it wasn't until about AD 1800, that the monsoon system again took on its modern character in the northern Southwest.

Ensey (1997) did pollen analysis of sites from the Jemez Mountains. The upper 70-cm portion of the sediment record recovered from Laguna de los Pinos at 2,700 m in elevation is controlled by three radiocarbon dates (ca. AD 950, 1350, and 1550) and indicates that precipitation increased in the Jemez Mountains from AD 770 to 950 followed by a decrease that looks like the record in at Beef Pasture before AD 1000 (Fig. 5.17). Ensey (1997) notes that her record for AD 950–1100 shows drought conditions. Based on some aquatic plant pollen types, Ensey's (1997) record provides evidence for shallow, stagnant water conditions for the period AD 1350 to mid-1800s and thus is not unlike the Peck Lake record (Fig. 5.17).

In the Rio Grande region, Stearns's (1981) pollen analysis of Alamo Bog (2,630 m in elevation), Jemez Mountains, indicates drier conditions in the region after AD 1275. Brunner Jass et al. (2000) report they have gone back to Alamo Bog and found evidence that at ca. AD 600, swamp birch (*Betula glandulosa*) dramatically expanded at the site, then decreased before the present. It is currently located at the site today, but had not previously been reported in New Mexico.

Besides Black Mesa and the DAP discussed above, another region that has had a lot of paleoenvironmental studies undertaken is that of Chaco Canyon, northwest New Mexico (Betancourt 1984; Betancourt and Van Devender 1981; Betancourt et al. 1983; Betancourt et al. 1986; D'Arrigo and Jacoby 1991; Fredlund 1984; Fredlund and Johnson 1984; Hall 1977, 1980, 1983, 1985; Mathein 1985; Samuels and Betancourt 1982; Schoenwetter 1967; Wright et al. 1973). As shown in Figure 5.12 (bottom panel), the pollen record for the Chuska Valley (Schoenwetter 1967) seems to reflect what has been found in other regions. However, a number of other climatic studies do not seem to match that presented here. For instance, Hall (1977, 1985) uses changes in pine pollen frequencies and taxa in the discontinuous alluvial record of Chaco Canyon to reconstruct climatic change in an area that is now modern piñon and juniper woodland.

Hall (1977) concludes that conditions during Pueblo occupation in the canyon were more arid than that of today and that the piñon woodland on Chacra Mesa may have been less than one-half as extensive as that of today. After this arid period during Pueblo occupation times there was a large expansion of piñon cover to almost that of the modern range between 860 and 600 years ago. The interpretation by Hall (1977, 1985) is exactly 180 degrees out of phase with that of Petersen (1988, 1994b) who reconstructs a reduction of piñon cover in the Four Corners region between AD 1200 and 1800. Elsewhere, Petersen (1981:157–161) attempts to reconcile the differences between the discontinuous Chaco Canyon alluvial record of piñon and the continuous pollen record from the La Plata Mountains by suggesting that Hall's (1977, fig. 9) Post Bonito fill unit from Gallo Wash I and II (with its relatively high pine content and high concentrations of corn pollen) may have been incorrectly dated (refer to the previous discussion in Geologic and Geomorphic Records and Data). The deposition of corn pollen into sediments for hundreds of years after regional abandonment does not seem very likely, while deposition of corn pollen during Ancestral Puebloan occupation does seem much more likely.

Pack Rat Midden Analysis

Betancourt and Van Devender (1981) use plant macro-fossils in a well-dated series of fossil pack rat (*Neotoma*) middens to reconstruct past vegetation below 1,950 m on the northern, xeric side of Chaco Canyon. The midden record, as discussed above, is by its very nature, a periodic sampling of local vegetation at discrete periods of time. The composition of the local vegetation between the dated midden samples is then extrapolated. Using these samples, Betancourt and Van Devender (1981) conclude there had been a persistence of piñon-juniper woodland for at least 5,500 years prior to their last midden containing piñon (dated at about AD 720). The next midden is dated at about AD 1490 and contains no piñon remains. They suggest that the lack of piñon in their youngest midden is best explained by the fuel needs of the resident population which overtaxed the local stands of piñon and juniper to the point they were never able to recover. Samuels and Betancourt (1982) use computer simulation to show that such a scenario is possible. However, examination of Figure 5.17 suggests that the midden sample intervals at AD 720 and again at AD 1490 likely missed the expansion of piñon when the monsoon system was strongest in the record. The lack of piñon in the youngest pack rat midden is more congruent with Petersen's (1988) characterization that the post AD 1200 period was a time characterized by reduced summer monsoons west of the Continental Divide. Also, the lack of piñon in the AD 1490 sample does not seem to support Hall's (1977) reconstruction of a piñon cover in the region since AD 1200 as being equivalent to that of modern times.

Discussion

The geomorphic setting is relevant when interpreting the interaction between people, climate, and agriculture. All of the sites in the Peña Blanca project area immediately overlook the Rio Grande floodplain, and the project area tightly embraces the confluence of the Santa Fe River and the Rio Grande. There are patches of arable soil on the terrace treads interspersed with the sites, and there are patches of arable land in small drainages that head in the slightly higher terraces and drain through the occupation area. Above the sites are broad pediments that could support dryland farming under ideal conditions but that today are desert scrub. The floodplain itself provides two settings for agriculture: the Rio Grande floodplain proper and the fan surfaces that interfinger with the floodplain. A salinity problem has been reported for the floodplain itself, aggravated by rising water tables that bring up the salts from the alluvial valley fill.

So, in the immediate vicinity of the sites there are: (1) upland surfaces that would be subject to dry farming only. (The possible presence of gravel-mulched fields was given prominent treatment in the original data recovery plan for this project, but there is *no* evidence for this sort of land-use based on either survey observations around the project area or in the excavations.) (2) Local patches of arable land are present on the Qat4 and Qat3 terraces. (3) Local patches of arable land are present in small (usually dry) drainages that cut across the terraces. (4) Fan surfaces are present where both local drainages and the Santa Fe River interact with the Rio Grande floodplain (*ak-chin* farming potential, although no water diversion or retention features have been noted). And, (5) the floodplain itself where high water tables could have supported agriculture but with a caveat about potential salinity problems.

In the broader region, corn was being grown in the Rio Rancho area (a northern suburb of Albuquerque) away from the Rio Grande floodplain in the seventh century, and that agricultural emphasis continued until the early tenth century. These observations tweak the contemporary concept of the farming belt, where dry farming today isn't practiced below 2,000 m. Clearly farming, including dry farming, was practiced below 2,000 m at discrete periods in the past and most likely they were times when there was a string of years that favored wet monsoons.

These are the natural setting and culture history patterns that can be played off against environmental parameters and agricultural potential. But a couple of critical questions must be addressed:

1. Because the bulk of the paleoenvironmental data and models current in the Southwest have been constructed with the geographic and climatic setting of the Four Corners area as the focus (both for model generation and model application), can those models be applied to the Rio Grande Valley region? The climate changes are undoubtedly related, but are there differences in the dynamics or timing?
2. Because mobility is real as part of the Peña Blanca subsistence adaptation, at least for the sixth to seventh and eighth to ninth century occupations, are there relationships that can be drawn between the available climatic reconstructions and changes in the productivity of the various woodland, grassland (Estancia and Galisteo basins), and forest ecosystems?

The location of the Continental Divide seems to affect the sources and the timing of monsoonal and winter moisture coming into the Southwest (Fig. 5.5). Ensey's (1997) observation of greater moisture in the Jemez between AD 770 and 950 matches the La Plata Mountain's summer monsoon record (Fig. 5.17). However, it does not match the winter precipitation record (Fig. 5.12, top panel). And Ensey (1997) notes she fails to detect the peak of precipitation interpreted for the AD 1000–1100 from all the pollen sites west of the Continental Divide (Figs. 5.12, 5.17). The fact that the tree-ring evidence (Figs. 5.14, 5.16) also displays such division between areas on either side of the Continental Divide suggests that there is a real environmental boundary that could result in one area being favorable for non-irrigated corn farming while the other is not and part of the key to the differences may be in the role that winter precipitation plays.

As shown in Figure 5.6, winter precipitation does not play a significant role east of the Continental Divide (partly due to what is known as the rain shadow effect). So even if there is a substantial increase in the frequency of winter storms crossing the Southwest (like during the times when there is a series of years characterized by dry monsoon conditions), the winter precipitation will have little affect in the Rio Grande Valley, while at the same time it will have a much larger affect west of the Continental Divide (Fig. 5.15). Winter precipitation seems to be what is reflected in all the records west of the Continental Divide as shown in Figure 5.12. The smoothed tree-ring record from El Malpais National Monument (Fig. 5.9b), astride the Continental Divide, shows more affinity with tree-ring sites to the west (Grissino-Mayer 1996) and compares favorably with the pollen records shown in Figure 5.12.

Petersen (1988, 1994a) estimates that the farming belt in southwest Colorado and adjacent areas during the AD 1000–1100 period was twice as wide as that of modern conditions and that it extended nearly 300 m lower in elevation than that of today. This was due to moisture contributions from both winter precipitation that wet the soil profile to field capacity and summer monsoon moisture that continued to keep the soil moist (even if the monsoons were the dry type). The best modern analog for the AD 1000–1100 period is the 1905–1925 period. However, as noted, Ensey's (1997) pollen record in the Jemez Mountains for the period AD 1000–1100 largely reflects drought conditions. Without a winter component to the annual precipitation cycle and the dry monsoon conditions (delivering moisture later in the season, up to 50 percent less moisture during the summer than wet monsoon conditions, and withdrawing earlier) would have the affect of being registered as a drought. That is the same chronology of monsoonal precipitation as shown at Peck's Lake (Fig. 5.17). After peaking at AD 1000, the summer monsoon strength decreases steadily at Peck's Lake. Ensey's (1997) site continues to show overall dry conditions from AD 1100 to 1420 with shallower water and more eutrophic conditions. Sometime after AD 1500, conditions improve in the Jemez Mountains and the same can be said from the tree-ring record from El Malpais National Monument (Fig. 5.9b).

Beginning about AD 1200, the northern reach of the monsoon system began to disintegrate (Figs. 5.15, 5.17), most likely due to the loss of the land-water thermal contrasts. Summer temperatures in the thirteenth century (Fig. 5.13) were cooler due to the impact of explosive volcanism that veiled the Earth with solar reflecting dust (Salzer 2000). The evidence is pretty clear that about AD 1200 summer temperatures decreased the thermal driver for the monsoon system. The fact that the Galisteo Basin was far enough north to benefit from winter storms may have turned it into a relative Garden of Eden with the failure of the Four Corners monsoon cycle west of the Continental Divide.

As suggested above, mobility appears to be a real as part of the NM 22 subsistence adaptation, at least for the sixth- to seventh- and eighth- to ninth-century occupations. Abundant moisture, whether it comes in the winter or the summer, will favor plant growth—some of which was exploited by ancestral Puebloans. Summer moisture favors shallow rooted grasses and grazing animals while winter moisture favors deep rooted shrubs and browsing animals. With the penetration of the effects of monsoon precipitation much further to the north (Fig. 5.10) between AD 800 and AD 1200 (Figs. 5.18, 5.19) more grasses and the accompanying bison show up in archaeological sites in central and northern Utah (Jennings 1978). Similar increases in grasses and grazing animals would be expected during Ensey's (1997) wet period of AD 770 to 950.

Summary

Jones et al. (1999), in their article entitled "Environmental Imperatives Reconsidered: Demographic Crises in Western North America during the Medieval Climatic Anomaly (AD 800–1350)," see decreased environmental productivity from reoccurring droughts directly influencing population settlement and relocations. Schoenwetter (1966) was the first to propose a chronology of fluctuating winter-dominant precipitation during Ancestral Puebloan occupation of the southern Colorado Plateau region. Figure 5.12 (bottom panel) shows that reconstruction and it is carried over into Figure 5.8c. For instance, AD 700–1000 is reconstructed to be a period of drought. This is matched by the spruce/pine curve from the La Plata Mountains shown in Figure 5.12 (top panel). However, Schoenwetter (1966) also suggested that the times of low winter precipitation were offset by increased summer precipitation, although, as discussed, he lacked the evidence for this from pollen.

Figure 5.18. Areal distribution of non-irrigated corn farming practiced at the time of European contact, AD 750-1250 (after Driver and Massey 1957).

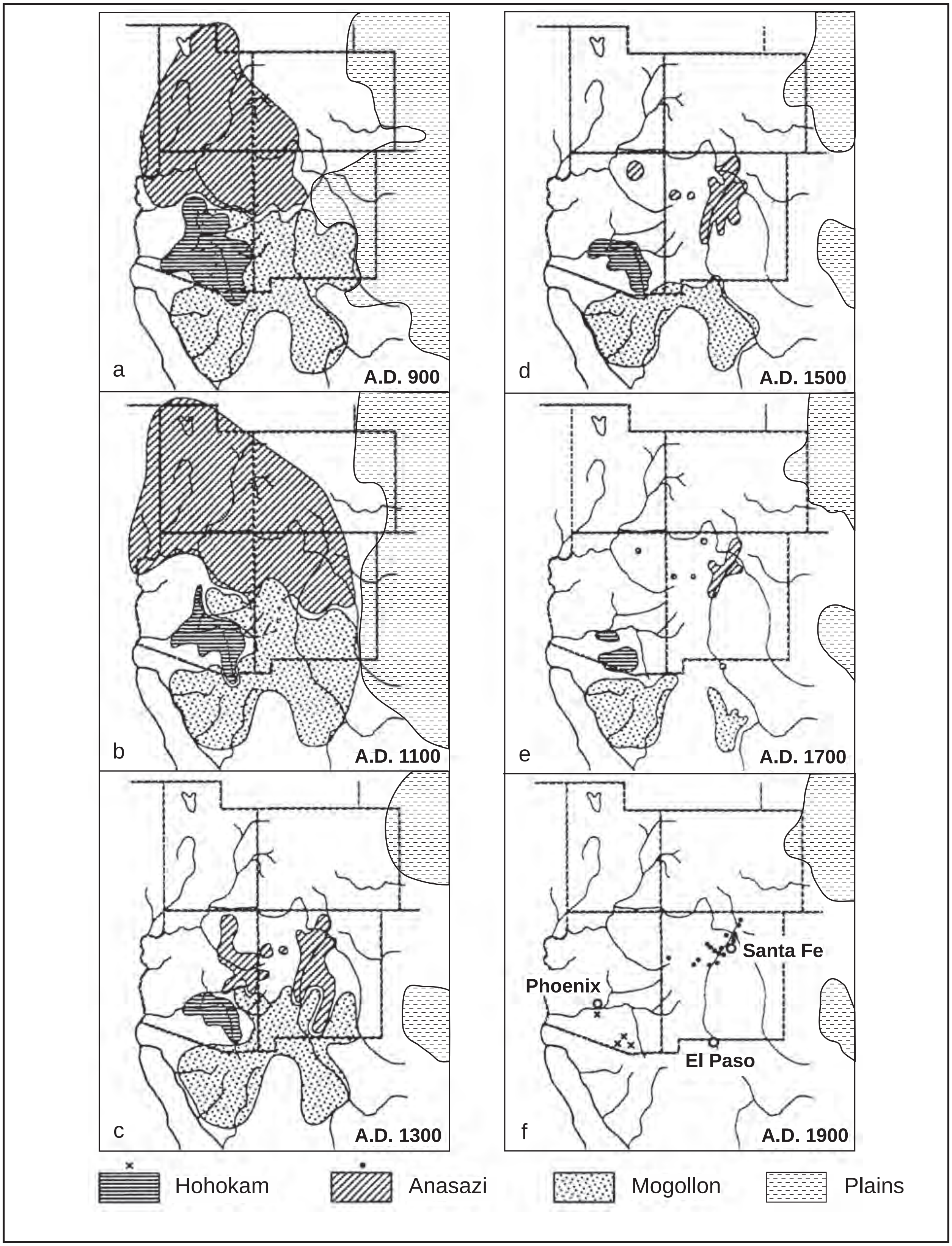

Figure 5.19. The approximate extent of corn-growing among Southwest and Plains Indian cultures at 200-year intervals (redrawn from Jennings 1968, fig. 7.2; Driver and Massey 1957).

Petersen (1988, 1994a) interprets an integrated record of tree-ring and pollen analyses from southwest Colorado as showing changes in the monsoonal-wind systems' strength over the last 2,000 years (Fig. 5.19). Piñon pine pollen influx values are believed to be proportional to the number of piñon trees on the landscape in the lowlands adjacent to the La Plata Mountains and that natural piñon pine distribution is dependent upon summer monsoon precipitation (Petersen 1988). Thus the reconstruction of piñon pine distribution is also a reconstruction of the local strength of the summer monsoon.

Based on Figure 5.19, the northern reach of the monsoon system was strong between AD 700 and 1200, with a pronounced peak at AD 900 in southwest Colorado (that was most likely the wet monsoon type). This peak corresponds to periods of farming corn on the Pleistocene terraces along the Rio Grande in north-central New Mexico. The sparser occupation at Cochiti Pueblo, dating to the twelfth and thirteenth centuries, seems to correlate with the secondary monsoonal peak of the same age in Figure 5.19, most likely characterized by the dry monsoon type.

The vigor of the summer monsoon between AD 700 and 1200 moved the western boundary of non-irrigated corn to nearly the Rocky Mountains as far north as Montana and North Dakota (Figure 5.19) and Figure 5.10 shows the likely areas of precipitation increases under a strong monsoon system (including north-central New Mexico). Under such conditions, peoples such as the Fremont Indians of Utah (Lindsay 1986; Madsen and Simms 1998) and Upper Republican horticultural groups on the Central Plains (Wedel 1986) were able to raise non-irrigated corn a distance of up to several hundred kilometers beyond where it can be raise today (Fig. 5.10; Driver and Massey 1957, map 34).

Then, beginning about AD 1200, the northern reach of the monsoon system began to fail (Fig. 5.19), most likely due to the loss of the land-water thermal contrasts. Summers temperatures in the thirteenth century (Fig. 5.13) were cooler due to the impact of explosive volcanism that veiled the earth with solar reflecting dust (Salzer 2000). Monsoon rain likely arrived later in the early summer, did not penetrate as far north (Fig. 5.18), and left earlier in the fall, shrinking the area where corn could be grown.

The impact on the geographical distribution of cultures who relied on non-irrigated corn farming is illustrated in Figure 5.19. By 1300, northern and central Plains areas that had been able to raise non- irrigated corn could no longer sustain that way of life. Because of inadequate summer moisture and depressed summer temperatures, non-irrigated corn farming as a means of subsistence had to be abandoned in Utah, southwest Colorado, and the western Great Plains. At the same time, large population increases occurred in the warmer and relatively summer-wet region of the Little Colorado River of northern Arizona and the Northern Rio Grande Valley in central New Mexico (Fig. 5.9).

It was not until after AD 1800 that continental heating again increased (Fig. 5.11; Bradley 2000) and the monsoon system could take on its modern character of warmer, wetter summers in the northern southwest region west of the Continental Divide. However, since the last time that the monsoon system was vigorous, the tilt of the earth's axis of rotation has changed enough that the northern reach of monsoon influence is likely several hundred kilometers further south than it had been previously.

Chapter 6
Geomorphology of the Peña Blanca Project

Leslie D. McFadden[1]

Owing to a decision to widen a 6-km-long stretch of NM 22 located north of Peña Blanca, New Mexico, and immediately south of Cochiti Dam, archaeological investigations have been conducted periodically since the Fall of 1996 (Ware 1997) to determine the occurrence and nature of cultural sites that would be impacted by associated construction activities. Preliminary investigations revealed the probable occurrence of numerous significant cultural sites on the basis of observed artifact scatters. Subsequent and more detailed archaeological investigation of such areas confirmed the presence of a wide range of structures, features, and deposits from Early Developmental, Late Developmental, Coalition, Classic, and late Historic periods. These archaeological investigations led to the articulation of the following geoarchaeologically oriented questions concerning the sites:

1. What is the nature of the geology of the surfaces on which the large majority of the sites occur?
2. What is the nature of the soils associated with these surfaces, and what does the soil morphology and associated soil stratigraphy reveal concerning the age, origin, and evolution of these surfaces and the timing of construction of the sites relative to the formation of the surfaces?
3. What is the nature of the pithouse fill materials?

The purpose of this chapter is to present the results of field studies designed to address and answer these questions. Fieldwork entailed reconnaissance-level examination of the basic geomorphology and Quaternary geology of several sites and more detailed examination of the soils and stratigraphy of a few selected sites. These sites included LA 6170, LA 6171, LA 6172 and LA 6173, LA 265, LA 115862, LA 6169, and LA 249.

General Quaternary Geology and Geomorphologic Features in the Study Area

A comprehensive examination of the Quaternary geology and geomorphologic character of the study area and surrounding area is beyond the scope of this report, given the limited time and project duration; however, on the basis of the reconnaissance-level field studies and evaluation of previous geologic studies in this area (particularly the most recent geologic investigations of Smith and Kuhle 1998; Smith et al. 2001) of the geology of the Santo Domingo Pueblo quadrangle), the following general picture of the Quaternary geology and landscapes of the study area is presented. The cultural sites are constructed on the preserved surfaces (treads) of fluvial terraces of Quaternary age formed by past cycles of aggradation and incision and net channel lowering of the Rio Grande. The treads of these terraces occur at an elevation of approximately 1,610 m, which is approximately 20 m above grade (essentially the elevation of the modern floodplain).

The terraces are inset into older Quaternary terrace deposits and older alluvial deposits of Quaternary and upper Tertiary age associated with one of the younger formations of the Santa Fe Group, which, in this area, is principally the Sierra Ladrones Formation. The Santa Fe Group is generally regarded by most researchers as constituting the sedimentary fill associated with development of the Rio Grande Rift (RGR) in the last 10 to 15 myrs. The RGR is characterized by a mostly north-south trending sequence of basins bounded by complex structures that apparently accommodate variable rates of rift-related extension and other geologic factors. The study area is located within the Santo Domingo Basin (SDB), a relatively small and until recently, a geologically not well under-

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stood basin. It is located between the Albuquerque Basin, an east-tilted half graben to the south, and the Española Basin, a west-tilted half graben to the north. From tectonic considerations, the SDB represents a type of complicated accommodation zone that is required given the opposite polarities and net offset of the "axes" of the larger rift basins that flank the SDB (Smith et al. 2001). La Bajada Fault marks the eastern margin of the SDB; a series of faults including the Cochiti Fault bound its western and southern margins. The northern part of the SDB is bounded by the Jemez Mountains Volcanic Field, which has been active throughout the Quaternary period.

In the study area, sediments of the Ladrones Formation are uncomformably overlain by alluvium associated with an older geomorphic surface of Quaternary Age, which Smith and Kuhle have designated "the alluvium of La Majada surface." Very young alluvial deposits occur in association with active channels of tributaries of the Rio Grande, such as the areally extensive floodplain, gravel bar, and young terrace deposits (and terraces) of the Santa Fe River, which joins the Rio Grande about 3 km north of Peña Blanca. Recently active eolian deposits are also present in some areas.

Smith and Kuhle identified four terraces of Quaternary Age in the SDB and suggested that they can be correlated with suites of terraces associated with former levels of the Rio Grande described by Dethier (1988), Aby (1997), Connell (1995), and Rogers and Smartt (1996). The lowest of these terraces is referred to by Smith and his co-workers as the Qt4 terrace. They determined that this terrace is overlain in places by the El Cajete Pumice, known to have been deposited about 60 thousand years ago (ka) (Reneau et al. 1996). This observation was confirmed by investigations in this study noted later in this report. McCoy et al. (1993) estimated an age of about 95 ka for a terrace that also occurs about 15–20 m above the Rio Grande floodplain in the Española Basin. Smith and Kuhle also determined that large remnants of an older terrace, Qt3, occur in the SDB. Where the terrace is mapped, the associated topography is characteristically highly dissected and few tread remnants are evident. Where suspected tread remnants exist, they are completely mantled by much younger alluvial and eolian deposits.

Fieldwork conducted as part of this study (and described below) demonstrated the existence of another terrace on which many of the archaeological sites are located and that had been apparently unrecognized in the previous studies of Smith and his co-workers. Where preserved treads of the Qt4 and this additional terrace occur in close proximity, their elevations are very similar. Because (1) many other studies elsewhere in this region show that the next oldest terrace, Qt3, occurs between 35 and 40 m above the Rio Grande, and (2) Qt3 is shown as the much higher and next oldest terrace in this area, the origin of this additional terrace and its geomorphic relationship with the previously identified terraces, Qt3 and Qt4, is unclear. Because of the unambiguous presence of the Qt4 terrace and the presence of the additional and clearly older terrace, for the purposes of this report and to minimize confusion, the additional terrace is referred to as Qt3, whereas the Qt3 mapped by Smith and his colleagues is referred to as the "Qt3 of Smith et al."

Smith and his colleagues also note that in this region, younger Quaternary terrace remnants only occur on the east side of the Rio Grande. They suggested that this may reflect tectonic tilting to the west in the last 300 ka related to continuing deformation associated with development of the Santo Domingo Basin, in part given the estimated age of the Qt3 of Smith et al. about 200 ka. Such tilting would presumably favor net westward migration west of the main channel of the Rio Grande. Such a scenario presumably explains the origin and preservation of the Qt4 and Qt3 terraces in the study area and also accommodates sustained incision of small westward-draining channels tributary to the Rio Grande. Sustained net incision has promoted the progressive evolution of increasingly larger drainage basins in the deposits of the Sierra

Ladrones Formation associated with these tributaries. Most of the Early Developmental pithouses are located on the preserved remnants of the treads of the Qt4 surface and the newly recognized terrace, Qt3. The pithouses were largely excavated in soils, however, that formed in fine-grained sediments deposited on the terrace treads subsequent to the time of incision and abandonment of the active valley floor by the Rio Grande. The fine-grained sediments typically overlie coarse, well-rounded axial channel gravels or less commonly fine-grained sediments of presumed floodplain depositional origin associated with the Rio Grande.

Results of Site Investigations

LA 265 and LA 6170

LA 265, originally described in the 1930s, is a relatively large site that, on the basis of archaeological excavations has been subdivided into two sites (LA 6172 and LA 6173) (Ware 1997). This site was the location of extensive archaeological studies given the numerous cultural features discovered in the area. LA 265 is a relatively large site that is located on the treads of terrace Qt3 and possibly Qt4 (as mapped by Smith and Kuhle); the site is bisected by NM 22 and is located just south of the confluence of the Santa Fe River and the Rio Grande at an elevation of approximately 1,616 m. LA 6170, described initially in 1961 by Dittert and Eddy (1961), is also located on the treads of these terraces less than 1 km north of the confluence of the Rio Grande and the Santa Fe River. Several trenches were excavated at both sites, many of which were excavated with a north-south orientation. The walls of the archaeological excavations at these sites exposed the stratigraphy and soils of the deposits associated with the terrace(s) in great detail, as well as the stratigraphy of the post-pithouse abandonment fill sediments were exposed. Accordingly, I examined soil geomorphic and stratigraphic features at these two sites in somewhat more detail than many other sites. Examination of the sediments and soils in these excavations and at several other sites in the study provide the basis for defining the following basic stratigraphic units (from surface to base of trench and underlying the base of most archaeological excavations). These units can be correlated in most cases with geologic units or geomorphic surfaces:

1. (Qs) A relatively thin (a few centimeters to a decimeter), nonstratified, symindurated (loose), weakly calcareous yellowish brown, pedogenically unmodified nongravelly surface deposit. Granules and sand-sized clasts of the El Cajete Pumice typically occur in these sediments.
2. (Qpf) An approximately 1–2-m-thick, brownish yellow, generally massive but locally stratified, weakly calcareous, weakly pedogenically modified and locally bioturbated unit that fills abandoned pithouses. The stratigraphic character of this unit was characterized in detail at three sites. These characterizations show that the stratigraphy and associated pedogenic features vary slightly at the different sites. These descriptions are presented below and in other subsequent sections in this report.
3. (Qp) A moderately thick (less than 1 m to as thick as 3 m), weakly stratified to massive, weakly to moderately indurated, moderately calcareous brownish yellow moderately pedogenically modified, generally nongravelly and relatively fine-grained deposit, which, as described in a subsequent section, is geomorphically associated with a dissected piedmont linked with small streams that drain basins eroded in the Sierra Ladrones Formation or other Santa Fe Group sediments. Locally, this unit contains poorly to moderately sorted lenses that are up to 40 to 50 cm thick, composed of subrounded to rounded gravel (predominantly pebbles with intermediate diameters typically less than 5 cm). The gravel clasts often exhibit thin, discontinuous coatings of pedogenic carbonate and less commonly pedogenic gypsum. The soils in this unit have been

buried by sediments associated with Qs; sediments of Qpf are largely inset into this unit. Typically, the soil exhibits a weakly developed, weakly reddened (typically 7.5YR 6/4) but moderately thick Btk or Bwk horizon (probably qualifying as, respectively, argillic, cambic, and calcic horizons). Usually the overlying unit and the uppermost horizons of the soil associated with this unit are only weakly decalcified. The pedogenic carbonate occurs largely as common fine nodules and filaments (segregated carbonate); however the soil matrix is also weakly calcareous (disseminated carbonate). Occasionally this unit can be stratigraphically subdivided on the basis of the presence of buried soils into units that compositionally and pedogenically are somewhat similar, although in some cases the uppermost unit, where present, exhibits locally noneffervescent character or a somewhat weaker stage of carbonate accumulation (stage I—few fine filaments) and slightly hard consistence. The upper unit is as thick as 60 cm in some locations. Locally, these units are characterized by moderately large (typical cross-sectional diameter up to 10 cm) rodent (?) burrows (referred to technically as rodent krotovina) filled with either relatively unmodified or reworked El Cajete Pumice. The burrow fills are more commonly present in the lowermost of these two units where both units are present. The thickness of this unit gradually decreases to a zero thickness at the topographic margins of the tread (tread-riser boundary), where gravels of the underlying Qt4 terrace surface are prominently exposed. The pithouses discovered at LA 6170 were originally excavated almost exclusively in this unit.

4. (Qa) A generally thin (1 dm to less than a 1 m) weakly stratified to massive, moderately indurated unit. In some locations this unit bears a moderately calcareous brownish yellow moderately to strongly pedogenically modified, generally nongravelly and relatively fine-grained deposit. The soil exhibits a brownish red (6.25YR–7.5YR) Bt (argillic) horizon and a carbonate-rich soil with a stage I or II morphology (carbonate present as many filaments). The soil also exhibits common tubular pores. The soil formed in this deposit formed prior to burial by sediments of Qp or younger sediments and is presumed to have formed in sediments associated with terrace Qt3 (see immediately below for definition of Qt units), or sediments deposited atop the tread of the Qt3, presumably prior to or perhaps coeval with deposition of fluvial deposits of Qt3.
5. (Qt4 or Qt3) A thick (greater than 3 to 4 m and as thick as 8 m in one outcrop of gravelly deposit; base of unit not exposed in roadcuts, trenches), massive, cobble to boulder gravel (Note: Qt should be considered to represent "alluvium of Quaternary terrace; Qt is typically a map symbol utilized to portray a geomorphic surface, not alluvial deposits). No detailed studies of this unit were conducted, but the unit was observed to consist predominantly of moderately well sorted, subrounded to rounded gravelly clasts, many of which are composed of a variety of metamorphic rocks (e.g., quartzite, schist), some plutonic rocks as well as occasional volcanic clasts (e.g., basalt). In some locations, the Bt horizon of the soil formed on the overlying unit extends into the upper several decimeters of this unit, and the pedogenic carbonate is present as discontinuous to locally continuous, moderately thick pedogenic carbonate coatings (morphological stage III). Where little or no soil is present in the gravels or in the sediments overlying the gravel, the gravels are presumed to be those associated with Qt4 of Smith and Kuhle (1994); Qt3 exhibits the presence of a strongly developed soil and is used to discriminate the two terraces.

At site LA 265, I described (1) the deposits and soil features present at "Study Unit 3," for the purpose of characterizing the nature of the most recent "post-abandonment" fill unit (Qpf) that was deposited immediately following rapid deposition of "roof collapse" sediments, and (2) stratigraphic and pedogenic features of Qp. Qs buries the entire area and has been colonized by a wide variety of perennial grasses and woody shrubs. At “Study Unit 3,” infilling what were interpreted as superimposed roasting pits, a 53-cm Unit 2 was observed underlying a 5-cm-thick Qs deposit and overlying unit Qp.

Qs

0–5 cm: C. Nongravelly yellow-brown (10YR 6/3 dry; 4/3 wet) slightly effervescent loamy fine sand; moderate medium platy; slightly hard, very slightly sticky and very slightly plastic; common fine roots; wavy and clear boundary.

Qpf

5–30 cm: Bw1. Largely nongravelly (rare cobbles present) yellow-brown (10YR–7.5YR 5/2 dry; 3/2 wet) moderately effervescent granule to sandy loam; massive to locally very coarse subangular blocky; slightly hard; slightly sticky and slightly plastic; no segregated carbonate, with the exception of very thin, discontinuous carbonate film noted on one cobble; few fine roots; clear, smooth boundary. Many granules are composed of the El Cajete Pumice, but some are composed of granite or crystals of feldspar.

30–58: Bw2. Largely nongravelly yellow-brown (7.5YR 5/2 dry; 3/1 wet) sandy loam. Effervescent, no segregated carbonate; slightly hard; massive to very coarse subangular blocky; few fine roots; abrupt, planar to wavy boundary.

Note: The observed content of El Cajete Pumice recognized in the coarse fraction (granules) and coarse sand fraction appears to slightly increase with depth in the uppermost 58 cm. Archaeologists also observed occasional unfired large cobbles and small boulders in some pit infills, apparently randomly located within the fill. The clasts are most likely derived from the locally exposed Rio Grande terrace gravels. As no natural, geogenic origin for these clasts is obvious, archaeologists attribute these clasts as having been thrown in the pits by prehistoric humans.

Qp

58 cm to base of excavated pit (about 1 m): Bwkb. Nongravelly yellow-brown (10YR 7/3 dry; 5/3 wet) sandy loam; moderate subangularly blocky; violently effervescent, carbonate both disseminated and segregated as fine, very hard nodules, coatings on ped surfaces, or in krotovina fills; hard, slightly sticky and slightly plastic.

At another location in “Study Unit 3,” a thicker section of Unit 3 (Qp2) was exposed in one wall of the excavation:

0–21 cm Unit 1 and Unit 2 (not described).

21–44 cm: Bwk1. Nongravelly yellow-brown (7.5–10YR 7/3 dry) sandy loam; hard, strong, medium subangular blocky; violently effervescent, both disseminated and segregated carbonate present as ped-face films, filaments, or films lining some common, tubulary pores with roots present; few fine roots, common krotovina, clear and smooth boundary.

44–61 cm: Bwk2. Nongravelly brownish yellow (7.5–10YR 7/3) sandy loam; hard, moderate medium and coarse subangular blocky; violently effervescent, disseminated and segregated as common filaments; few fine and medium tubular pores; few, fine roots; abrupt and wavy boundary.

61–72 cm: Bk. Nongravelly yellow-brown (7.5–10YR 7/3) loamy fine sand; slightly hard; massive; slightly sticky and slightly plastic; segregated carbonate present as few, fine carbonate filaments; clear and smooth boundary.

72–92 cm: 2Bwk1b. Nongravelly red (7.5YR 7/3) sandy loam; hard; moderate medium subangular blocky; violently effervescent, carbonate present as common fine filaments, multiple generations of tubular pores present; older pores have carbonate films and insect excretions; common ped-face films composed of silty to fine sandy (?) coatings; sticky and plastic; clear and smooth boundary.

92–112 cm: 2Bwk2b. Nongravelly red (7.5YR 6/3) sandy loam; massive; slightly hard; violently effervescent, carbonate disseminated and segregated as films lining the common fine and tubular pores or as few fine filaments; lowest 2 cm of horizon consists of granule sand composed largely of the El Cajete Pumice materials; abrupt and smooth boundary.

112–147 cm: 3Bkb. Nongravelly yellow (10YR 6/3) sandy loam; hard; moderate medium subangular blocky; moderately effervescent, carbonate as common very fine filaments; common to many fine tubular pores; coarse fraction El Cajete Pumice particle content decreases significantly with depth.

147–155 cm (base of pit): 3Bkb2(?). Nongravelly red (7.5YR 6/3) silty clay loam; hard; moderate to strong subangularly blocky; violently effervescent, segregated carbonate lines many fine and medium tubular pores; sticky and plastic.

At LA 6170, two long, parallel trenches were excavated to the east of Highway 22 exposing sediments and soils associated with surfaces that were both topographically higher and lower than the general level of the terrace surface. The southernmost part of the trench exposed only a small part of the area that is situated approximately 3 to 4 m above the rest of the terrace surface. Limited trench exposure and obliteration and/or modification of this landform owing to construction of NM 22 preclude identification of the exact origin of this area. It is likely, however, a fortuitously preserved remnant of an older terrace, a preserved element of a piedmont-related deposit that formerly graded to the surface of the terrace, or an eolian landform. Also observed just to the north of the topographically high area is a small basin bordered on its east side by a small scarp. No cultural materials were observed in this particular area. The origin of the area is unclear. Visual inspection of a stereopair of black-and-white, vertical area photographs of the area produced before construction of NM 22 suggest that it is perhaps a small basin formed by incision of a small tributary of the Santa Fe River channel to the north that was subsequently filled by relatively young sediments. The surface of this area exhibits small, 20-cm-high coppice dunes associated with rabbitbrush and rare clasts of basaltic scoria, and rhyolite (Bandelier Tuff or older tuffs of the Jemez Mountains). The upper part of the sediments here are present as a thin unit (Qs, 2 cm and up to 20 cm thick; a C horizon—soft to single grain, weak subangularly blocky to loose; weakly effervescent; 10YR 4/3 dry; nonsticky and nonplastic loamy fine and medium sand) with moderate amounts of El Cajete materials of coarse sand and granule size. This unit abruptly overlies a 44-cm-thick unit in erosional uncomformity. This unit exhibits a 24-cm-thick AB horizon (20–44 cm; slightly effervescent to moderately effervescent top to lower part of horizon; nongravelly, slightly hard, 10YR 7/3 dry; massive, disseminated carbonate; few pores containing live roots). The underlying Bw horizon (44–66 cm; strongly effervescent, 10YR 6/3 dry; disseminated carbonate, pores contain live roots, massive; few particles of El Cajete present) overlies a buried soil. The buried soil (Bwkb, 66–94 cm; strongly effervescent; locally cobbly, continuous thin coatings on coarser clasts and many fine nodules of carbonate; pores contain live roots; massive; slightly sticky and slightly plastic silt loam; rare particles of the El Cajete Pumice) overlies a Bkb horizon (94 cm to base of trench, 115 cm; strongly effervescent; nongravelly, 7.5YR 6/4; slightly hard; massive; few fine carbonate nodules, common fine tubular pores). Elsewhere at the base of the 1-m-deep trench, pedogenically unaltered soft, weakly calcareous sediments occurred whose grain size was a bit coarser than those associated with the overlying B horizons. Again, no cultural materials were found in this particular part of the trench. These data suggest that a significant part of Qp had been eroded prior to burial of the unit by the much younger Qs sediments. In addition, the unit exposed from 20 – 66 cm depth is clearly much younger than Qp. It was deposited following an erosional episode that truncated the upper part of Qp. The minimal pedogenic alteration of the unit is consistent with a relatively young age, perhaps less than 1,000 years.

About 100 m to the north along this trench, the stratigraphy and soils of the higher part of this terrace were characterized. Here, a 10–20 cm thick unit Qs is present. Underlying it is unit Qp, which contains a Bwb horizon (15–35 cm; 7.5YR 6/4 d; soft to slightly hard, massive and locally weak subangular blocky; moderately effervescent; nonsticky and nonplastic loamy sand with common coarse sand grains of El Cajete Pumice); a Bwkb horizon (35–55 cm; violently effervescent, continuous carbonate films on peds; moderate medium to coarse subangular blocky; few krotovina filled with reddish material inferred to represent the former presence of a Bt horizon; slightly sticky and slightly plastic silt loam); and a Bk horizon (10YR6/3; soft to slightly hard; massive, slightly sticky and slightly plastic silt loam) similar to that described above to the base of the trench.

At the northernmost part of the trench located closest to NM 22, a pithouse feature was exposed. The pithouse fill, Qpf, contrasts markedly with the materials associated with unit Qp, in which it was initially constructed. The base of the pithouse fill, according to Dick Chapman and John Ware, closely resembles typical roof fall materials that accumulate relatively soon after abandonment of the structure. Large blocks of the pre-pithouse, geogenic fill also occur near the base of the fill indicating partial collapse of some of the walls of the structure. Several large pithouses were also discovered and excavated west of NM 22 at LA 6170; they also exhibited deposits immediately above the pithouse floor that are massive and exhibit no features indicative of fluvial or sheetwash transport and deposition. This unit is also attributable to roof collapse following pithouse abandonment. Moderately large krotovina commonly occur within this unit. The rest of the fill exhibits a sedimentalogically fining upward trend, and the sediments contain fragments of charcoal. These sediments reflect both infilling due to (1) sheetwash and erosion of surrounding sedments that accumulate in the infilling depression, and (2) accumulation of eolian materials. The uppermost unit (Qs) contains El Cajete Pumice fragments, which again probably reflects an increased contribution of eolian material derived from a source area with abundant areas of the El Cajete Pumice. Eolian transport of relatively large granules of the pumice is attributable to its relatively low density compared to minerals such as quartz. A weakly developed calcic soil has formed in the pithouse fill (abundant thin films on ped surfaces and filaments and associated with animal burrow fills [krotovina]). The presence of such a fill in materials only a little older than 1,000 years demonstrates the rapidity of calcic horizon development favored by an initially calcareous unit and an arid climate conducive to shallow carbonate accumulation. A curious feature observed at this site was the presence of intact soil of Qpf directly overlying El Cajete Pumice-rich loose sediment. It appears to be some sort of subterranean feature constructed at the time of occupation of the pithouse that, subsequent to abandonment, was infilled by pithouse sediment.

LA 6171

As noted in Ware (1997), this site is also located on a terrace (mapped as Qt4 by Smith and Kuhle, but with Qt3 deposits in the area possibly buried by Qt4), but because it occurs at the confluence of the Rio Grande and Santa Fe River, is bound on the south by the latter. Ware also noted that much of the tread of the terrace at this site is mantled by eolian sand deposits, an observation confirmed by my examination of the surficial deposits exposed here. In addition, I observed climbing sand dunes on the scarps immediately below the terrace tread located immediately north of the Santa Fe River. The most recently deposited surficial sand deposit at the site ranges from 20 to as much as 40 cm thick. At least part of the sand accumulation at this site can be attributed to the surface roughness associated with cultural features (e.g., deteriorated wall features) that favors deposition of saltating sand. An only very weakly developed soil has formed in most of the exposed surficial deposits, as indicated by a 10-cm-thick, slightly darkened (7.5YR 6/3) and noneffervescent sandy A horizon that overlies a largely pedogenically modified sandy C horizon (7.5YR 7/3). The top of the C horizon is very slightly effervescent, and the degree of effervescence slightly increases with depth, although there are no observed carbonate filaments or nodules present. No artifacts or other cultural features are apparently associated with this unit, and the unit is observed to bury the Early Developmental pithouses discovered and excavated at this site.

One trench located on the easternmost part of the site exposed eolian dune deposits immediately overlying deposits correlated with unit Qp described in the previous section. At this site, the following soil stratigraphic features were observed:

0–19 cm: consisted of pedogenically unmodified, noneffervescent, medium to course eolian sand.

19–63 cm: an "Ab-Cb profile" formed in an eolian sand deposit that exhibits as coarsening-upward trend. The upper part of the Ab horizon is noneffervescent, but the lower part of the unit is progressively weakly effervescent.

63–103 cm: Cb horizon, exhibiting a loamy fine sand texture and weak effervescence.

Qp

103–110+ cm: Bwkb2 horizon, hard consistence, stage II carbonate morphology. The upper contact is abrupt, smooth, but locally bioturbated. In some cases, the pedogenic carbonate lines polygonal, interpedal vertical planar pores.

The trenches are insufficiently deep to expose the presumably underlying, gravelly terrace deposits; so the identity of the terrace at this site cannot be confirmed. The relative degree of development of the unit referred to as unit Qp, however, suggests that it may be associated with the older of the two terraces (Qt3).

LA 115862

This site is the southernmost of the sites described in the project area and is located at an elevation of just over 1,610 m. A large pithouse excavated at this site is located on the tread of a terrace, but the presence of a well-developed soil in gravelly alluvium at the surface demonstrates that this is the tread of Qt3, not Qt4. Reconnaissance-level observations at this site and the excavation of a trench in alluvium within a few meters of the pithouse excavation that was not affected by cultural activities demonstrate that the gravelly unit that caps this terrace is between 1 and 1.5 m thick. A brief description of the trench excavated in this unit indicated the following, highly generalized stratigraphic and pedogenic features:

Alluvium of Qt3

0–15 cm: Btk 5YR hue, gravelly loamy alluvium; the matrix is noncalcareous; carbonate present as interped fillings and thick filaments.

15–approximately 100 cm: oxidized C horizon Gravelly sand and sandy gravel; matrix noneffervescent; few thin coatings on the bottoms of some clasts, proportion of such clasts decreases with depth in the horizon.

Approximately 100–115 cm: 2C Sand, 10YR hue.

115–130 cm: 3Ck clay-rich sediment; common carbonate filaments.

130–150 cm: 4C strongly oxidized (5YR 6/4), noneffervescent gravel.

150–160+ cm: 5C nongravelly, fine grained alluvium, common carbonate filaments. Locally, the unit exhibits dark films preliminarily identified as manganiferous oxides (mangans) and orange-red iron oxide films probably composed of lepidicrocite.

The gravel cap overlies a moderately thick (approximately 3 m), relatively fine-grained unit that contains a few thin, interbedded gravels. The latter unit stratigraphically overlies another gravelly unit of unknown thickness. The fine-grained unit locally thickens to as much as 10 m, suggesting the possibility of its association with a paleovalley inset into the underlying gravels. If this interpretation is correct, at least part of the fine-grained fill is associated channels of the large tributary basin located immediately east of this site, and not fine-grained floodplain deposits associated with the floodplain of the Rio Grande.

The stratigraphy above demonstrates that the pithouse at this site was originally constructed almost entirely in gravelly alluvium (Qa and Qt3), in marked contrast to all other pithouses I observed that were constructed almost entirely in the fine-grained unit Qp. The stratigraphic features of the pithouse fill (Qpf) located near the center of the pithouse are as follows.

Qs

0–5 cm: C. Nongravelly, yellow-brown (10YR 6/3) weakly calcareous loamy sand; strong platy; slightly hard; carbonate disseminated, no segregated carbonate; abrupt wavy boundary (unit thickness ranges from a few cm to 17 cm).

Qpf

5–50 cm: C2. Nongravelly, dark yellow-brown (10YR 5/3) loamy fine sand; effervescent, carbonate disseminated; rare coarse clasts (coarse pebbles, small boulders); massive; unit exhibits slightly darker value with depth. Large, horizontal burrow defines base of unit.

50–100 cm: C3. Nongravelly, yellow black (10YR 6/3 to 5/3) loamy fine sand; massive; carbonate disseminated, but few coarse clasts in unit exhibit very thin, discontinuous segregated carbonate coatings on their bottoms. A large, locally gravel filled burrow defined the base of unit.

100–142 cm: Bwkb. Nongravelly, yellow (7.5YR 7/4) sandy loam; strongly effervescent, carbonate both disseminated and present as few very fine filaments associated with tubular pores; massive; hard; sticky and plastic; common fragments of charcoal.

142–180 cm: 2Ckb. Nongravelly yellow (7.5YR 7/4) interbedded finely bedded and coarsely laminated granule sand and loamy clay and massive loamy clay; strongly effervescent; abrupt and smooth boundary. Large (approximate diameter 10 cm) fine-grained, massive, hard fragment with pedogenic calcareous veins present at base of unit.

180–200 cm: 3Ckb. Locally gravelly yellow (7.5YR 7/4) sandy clay loam; strongly effervescent, carbonate segregated as apparently randomly located nodules; very hard, sticky and plastic; locally surfaces of some coherent fragments of fill are coated with carbonaceous material (inferred to be burned surfaces).

200 cm: Pithouse floor. Bottom of pithouse located in fine-grained sediment correlated with fine-grained unit (Qa) described previously in this section.

Characterization of the stratigraphy of the pithouse-filling alluvium in the vicinity of the pithouse wall revealed the presence of remnants of a several centimeters thick, 30-cm high man-made vertical wall composed of indurated fine-grained material. Construction of this wall was presumably necessitated by the excavation of the pithouse into a 1-m-thick unit composed of largely noncohesive gravels (Qt3). This markedly contrasts with the cohesive materials of Qp in which all other pithouses were excavated and that have the required shear strength to maintain vertical walls. The lowermost 90–100 cm section of the pithouse walls was vertical. Only the lower 50 cm of the vertical pithouse wall was excavated into cohesive clay; the upper 40–50 cm of the vertical wall was constructed in gravel. Archaeological excavations revealed the abrupt, smooth contact between coarse-grained, gravelly pithouse filling sediment (Unit 2) and the original gravels of the Qt3 terrace alluvium are inclined, with a dip of approximately 45 degrees towards the pithouse center. In addition, a large fragment of fine-grained material that exceeded 20 cm in diameter was observed in Unit 2 within a decimeter of the pithouse wall. These data strongly suggest the former presence of a "layback," which was probably structurally strengthened by a man-made layer of indurated, clay-rich material. Collapse (mass wasting) of this material following abandonment accounts for the presence of the fragments of such material in the pithouse fill.

Clasts of the El Cajete Pumice were notably lacking in the pithouse fill (although detailed point counts with a binocular microscope might possibly reveal the presence of traces of the material). This presumably reflects the fact that unit Qp was either never deposited at this site, or was sufficiently thin such that the unit had been completely removed by erosion prior to occupation of this site. Thus the El Cajete Pumice, which must have been once present at the site, must also have been rapidly removed by erosion. As indicated in the next section, relatively high surface erosion rates may be favored at this site owing to the relatively narrow width of the terrace tread and the presence of a relatively large tributary basin.

Excavations of the slopes beneath the terrace tread associated with highway construction at this site enabled evaluation of the geomorphic character of hillslopes. These excavations revealed the presence of colluvial deposits filling gullies or erosional hollows on the slopes. The exposures were limited, but some additional excavations by myself and the archaeologists working at this site suggested that (1) the gullies are about 2 m wide; (2) there are at least two ages of colluvium indicated by stratigraphic and geomorphic relations; (3) the colluvium is inset into the fine-grained terrace alluvial unit described previously in this section. The younger colluvial fill is about 30 cm thick and is composed of cobbly, relatively dark sediment. The lower 15 cm of this unit is notably darker than the uppermost 15 cm. The older colluvial unit is also gravelly and is about 50 cm thick.

LA 249

LA 249 is the site of a large pueblo named Tashkatze Pueblo, recorded for the first time in the 1930s by H. P. Mera (Ware 1997). The site also occurs on a terrace of the Rio Grande (presumably Qt4 as mapped by Smith and Kuhle 1998) and is located just south of the confluence of the Rio Grande and the Cañada de Cochiti. The trenches in which I described soils and sediment on the terrace tread were excavated a few meters below the pueblo site and within the right-of-way, which is at an elevation of 1,616 m. Therefore, the elevation of this part of the terrace occurs within 1 or 2 m at most of the elevations of the previously described sites.

Reconnaissance-level observations of the terrace, piedmont surfaces, and drainage basins immediately above and generally east of this site were made to help elucidate the origins of the sediments that bury the fluvial terrace gravels and the genesis of soils within those sediments. A small distance north of the pueblo site, a few 1 to 1.5 m deep headcuts associated with several small channels exposed a fine-grained unit similar to that observed at other sites described above that have been designated unit Qp. However, the former sedimentary deposit stratigraphically overlies a relatively coarse-grained unit that contains abundant gravel clasts composed of El Cajete Pumice. This relationship demonstrates that the unit significantly postdates the El Cajete Pumice, as the pumice in the underlying deposit has been eroded from a source area (possibly an intact fall unit on hillslopes of the upstream drainage basin). In addition, the overlying fine-grained unit exhibited a relatively weakly developed soil that possesses only a Bw horizon and stage 1 calcic horizon morphology (expressed as filaments). Thus, in some areas, Qp should be separated into units of differing age.

At another site immediately east of the large Pueblo site, gully incision has exposed approximately 2 m of fine-grained sediment that resemble sediments of unit Qp, that in turn overlie a gravelly, El Cajete Pumice-rich fluvial unit in which a buried soil is present. The overlying, fine-grained surface deposit exhibits a soil with a Bw and Bk horizon that has stage I carbonate morphology. Another gully, approximately 2 m high, headcuts even closer to and immediately east of the large Pueblo site exposes, from top to bottom, a fine-grained unit (again resembling sediments of unit Qp); a gravelly unit; a 60-cm-thick, fining upward unit composed entirely of El Cajete Pumice (largest clasts at base of unit have diameters of about 1 cm, unit fines to granule-size material at top); a buried, reddish (7.5YR hues) soil form in fluvial sediment. Finally, numerous terraces composed of fine-grained sediment are present in the larger, permanent arroyo that occurs immediately east and south of the Pueblo.

Other observations of the highest geomorphic surfaces and sediments shed light on some aspects of the geomorphic evolution of the entire study area. The highest, topographically level surface east of LA 249 is mapped as Qpu, presumably the buried tread of the Qt3 of Smith et al. Stratigraphically below these surficial deposits are gravels and fine-grained alluvium associated with the Qt3 of Smith et al. Other observations suggest that erosion of this area provided sediments that at one time accumulated immediately west of the escarpment in the area of LA 249. However, the extension of tributaries from the southwest has resulted in capture of much of the drainage area east of LA 249, thereby diverting channel flow and sediment transport generally south of the area of LA 249.

In the right-of-way area of LA 249, archaeologists designated two main study units. Sediments of Unit 1 were exposed by two trenches (A and B) in the southernmost part of the site. Trench A, approximately 30 m long, parallels Highway 22 and extends from the southern to the northern margins of the convex-up, terrace tread remnant. Trench B was excavated perpendicular to Trench A. Unit Qp, in the northern part of the site, is exposed by a main trench C (excavated parallel to Highway 22) and three trenches, D, E, and F, excavated perpendicular to trench C. At this site, the 1.5-m-deep trenches primarily expose fine-grained sediments with El Cajete Pumice-rich units that cap the terrace. This sediment is underlain by a 2-m-thick, gravelly unit, which in turn overlies an approximately 2-m-thick fine-grained nongravelly unit with interstratified lenses of gravel. This unit overlies a thick (greater than 5 m, the base of the unit apparently occurs below the elevation of the bed of Highway 22, the lowest part of the unit exposed), coarse, gravelly unit that contains interstratified, cross-bedded and oxidized sands that are up to 50 cm thick. The gravels of this unit contain clasts that are strongly imbricated and appear to be coarser than the gravel clasts of the overlying units described immediately above. The lack of any thick, strongly reddened soil suggests that this gravelly unit is alluvium associated with Qt4.

Trench A exposes materials that are interpreted as the primary El Cajete Pumice fall unit. The pumiceous deposit is primarily exposed in the central part of the trench located on the topographically highest part of the terrace and is a maximum of 25 cm thick. At the margins of the trench, the unit has been removed by erosion associated with channels that contain reworked, oxidized (7.5YR hues) El Cajete Pumice and other sediments (crystalline, plutonic clasts) and possibly by locally extensive bioturbation. A detailed description of one part of trench A provides additional data for these sediments.

Qs1

0–14 cm: this unit dominates much of the length of the trench and is up to 1 m thick in other trenches; thickens towards the east; generally nonstratified.

0–7 cm: A. Dark (10YR 6/2) loamy sand; weak medium platy; soft dry consistence; locally highly bioturbated.

7–14 cm: Ck. Yellow (10YR 7/3) loamy sand; single grain, loose; moderately effervescent; at base of unit larger clasts have carbonate coatings that formed at sites prior to redeposition at this site, coatings dissolving on tops of clasts, pedogenic carbonate reforming on sides and bottoms of clasts, locally cementing the surrounding matrix to larger clast. Much of granules and sand are composed of the El Cajete Pumice.

Qs2

14–21 cm: cobbly, reworked, subrounded El Cajete Pumice and much less common basaltic and plutonic clasts (some of these clasts are up to 5 cm in diameter). Largely pedogenically unmodified; weakly effervescent; rare coarser clasts exhibit very thin carbonate coatings on the bottoms of clasts. Unit associated with small channels incised into Unit A.

21–26 cm: El Cajete Pumice; mostly pedogenically unmodified except for locally slightly oxidized surfaces and local presence of Bt lamellae.

Qp1

26–51 cm: Fining upward, nongravelly sediment (7.5YR 7/6), moderate soil development (buried soil) with Btk horizon exhibiting strong medium angular blocky structure; ped faces exhibit carbonate filaments and thin coatings; common, locally dark tubular pores. Base of soil contains pedogenic gypsum. Locally bioturbated, large channels filled with sediment containing abundant clasts of the El Cajete Pumice.

Qp2

38–65 cm: Nongravelly sediment; moderate soil development (buried soil) resembling that observed in immediately overlying soil. Bt horizon exhibits common, locally dark tubular pores. Upper part of Btk exhibits locally stronger carbonate cementation, attributable to leaching of carbonate from overlying units and accumulation favored by presence of buried, clay-rich Bt horizon.

Gravel of Qt4 (?) 65 cm to Base of Trench

Observations of the stratigraphy and soils of the other trenches exposed at this site reveal the same sequence described immediately above.

LA 6169

This site is located on what is mapped as the Qt4 terrace (Smith and Kuhle 1998) and occurs about one half mile northeast of the confluence of the Rio Grande and Santa Fe River at an elevation of about 1,609 m (Ware 1997). Archaeologists at this site excavated four long trenches (labeled, from east to west, 1, 2, 3, and 4) oriented parallel to NM 22. These trenches spanned the entire width of the terrace tread remnant and were approximately 60 m long. Most of the key stratigraphic units defined in the previous sections were well exposed at this site. For example, at the southern end of one of the trenches (Trench 2), the underlying gravels of the terrace (Unit 5) were exposed, as well as the uppermost part of a very reddened (6.25YR 5/4) well-developed soil with strong subangular to angular blocky structure and common carbonate filaments associated with this gravelly unit and an overlying fine grained sedimentary unit (Qa). The presence of this soil demonstrates that, although mapped as the Qt4 terrace, this is far more likely to be the Qt3 terrace. Observations at this site also indicate that there is a topographically low area located between the topographically higher, western-most part of the terrace tread and the hill slopes associated with higher terrain to the east. The formation of this area can be attributed to changes in the pattern of relatively recent incision of small tributaries that bound the northern and southern margins of this terrace remnant. The uppermost reaches have been headcutting in a generally more northerly or southerly direction, respectively, effectively cutting off much of the terrace remnant from the source-area drainage basin immediately to the east. This unusual pattern of erosion, one that ultimately completely isolates much of the surface of the terrace remnant, has been described in other similar settings in New Mexico (Treadwell 1996).

The long, north-south oriented trenches enabled characterization of the nature of the stratigraphic units that overlie the terrace gravels relative to the geomorphic character of the terrace landform. A paleogully fill was observed at the southernmost end of Trench 2 that was composed of fine-grained, largely pedogenically unaltered, moderately effervescent alluvium. These relations demonstrate that there have been relatively recent cut-and-fill events that significantly post-date accumulation of and soil development in Unit 3. For example, at the topographically highest (and approximate center) of Trench 2, a 20-cm-thick unit with a basal, gravelly unit is inset into a fine-grained unit, Qp, which occurs along the entire length of the trench. This inset alluvial unit is associated with an approximately east-west oriented paleochannel that indicates that it was probably a former tributary associated with drainage basins located immediately east of this site. It may also reflect the recent development (late Holocene) of small, discontinuous gully systems on these surfaces. These sediments are probably coeval with sediments of unit Qs as described above, given their stratigraphic, geomorphic and pedologic (lack of pedogenic alteration) character. A transverse-oriented trench at this location also exposes the inset unit as well as a pithouse fill (Qpf). The pithouse was clearly excavated into the unit just described and elsewhere at this site into Qp. A detailed description of the stratigraphy at this site was compiled.

Qs

0–20 cm: C. Unstratified, only very weakly pedogenically modified, yellow (10YR 6/3) gravelly sandy loam; thick, discontinuous coatings of carbonate on larger gravel clasts do not occur in preferred spatial positions, indicating their transport from other sites where the pedogenic carbonate initially accumulated. Very abrupt, smooth boundary suggests this alluvium was deposited on the subjacent Bwtk1 horizon subsequent to erosional truncation of the buried soil.

Qp

20–38 cm: Btk1b. Slightly red (7.5YR 6/4), non-gravelly to sandy loam; strongly effervescent, with carbonate both disseminated and segregated as few filaments; moderate medium subangular blocky; slightly hard; few thin clay films on ped surfaces; few tubular pores; clear smooth boundary.

38–48 cm: Btk2b. Slightly red (7.5YR 6/4) granule-rich sandy loam; strongly effervescent, with carbonate both disseminated and segregated as common filaments and as ped coatings; moderate medium subangular blocky; slightly hard; few, discontinuous clay films on ped surfaces and colloidal stains; common fine tubular pores; abrupt smooth boundary.

48–58 cm: Bkb. Slightly red (7.5YR 7/3) non-gravelly loamy sand; strongly effervescent; loose, single grain; abrupt smooth boundary.

58–82 cm: 2Bkyb. Slightly red (7.5YR 6/4) gravel and sand; most clasts have intermediate diameters of 1–3 cm, occasional clasts up to 10 cm in intermediate diameter; local lenses of sand that contain common carbonate filaments; loose, single grain; thin discontinuous films of carbonate on sides and bottoms of many gravel clasts; pedogenic gypsum (fine clusters of gypsum crystals) on bottoms of largest clasts; abrupt, smooth boundary.

82–102 cm: 3Cb. Slightly red (7.5YR 6/4) sand; unit thickness declines laterally over a distance of a few meters to zero thickness; noneffervescent; thin zones (approximately 1-2 cm) locally slightly cemented by pedogenic carbonate (suggest burial of sand prior to deposition of overlying gravel unit); abrupt, smooth boundary.

Qa

102–120+: 4Btkyb2. Sandy clay loam (?); many tubular pores.

Additional observations of this site suggest the following. Imbrication of several tabular clasts as well as the spatial location of this paleochannel gravel observed in the several parallel trenches indicate a northeast to southwest transport direction, consistent with transport from a source area located in the small drainage basins located generally east of this site. This is the same orientation of the modern channels near this site.

A detailed description of the stratigraphy and soils of Trench 2 was completed at a location 10 m south of the approximate center of the trench. An excellent exposure of Units Qs, Qp and Qa were observed at this part of the trench.

Qs

0–30 cm: C. Unconsolidated, unstratified, yellow (10YR 6/3) nongravelly to locally gravelly loamy sand; moderately effervescent; thin, discontinuous coatings of carbonate in random orientations on the larger gravel clasts; plentiful fine roots. Unit attributed to deposition of alluvium derived from higher parts of the terrace surface. Abrupt, smooth, boundary.

Qp

30–56 cm: Btk1b. Red (7.5YR 6/4) nongravelly sandy loam; strong medium subangular and angular blocky; common thin clay films on ped surfaces; strongly effervescent, carbonate both disseminated and segregated as many medium nodules; hard; common fine tubular pores; gradual smooth boundary.

56–75 cm: Btk2b. Red (7.5YR 6/4) nongravelly sandy loam; moderate medium subangular blocky; common thin ped face clay films; strongly effervescent, carbonate both disseminated and segregated as few to locally common fine and medium nodules and filaments filling fine tubular pores; hard; clear, smooth boundary.

75–100 cm: Btkyb2. Red (7.5YR 7/4) nongravelly sandy loam; few thin continuous clay coatings on ped surfaces; violently effervescent; carbonate disseminated and filaments filling many fine tubular pores; fine clusters of gypsum coating some ped faces; very hard; clear smooth boundary.

Qa

100–125 + cm: Btkyb2. Red (7.5YR 7/4) nongravelly sandy loam; common, strong, medium and fine angular blocky; thin ped face clay films; strongly effervescent; gypsum coating some ped faces; few thin dark manganiferous films on ped faces; abundant fine tubular pores.

Observations of the soil in Qp along the lengths of the trench over 50 to 60 m show that the piedmont soil is truncated by erosion of the northern and southern margins of the terrace surface, indicating formation of most of the soil prior to much of the erosion that has produced the convex-up surface form of the terrace tread. Within 10–15 m of the margins of the terrace, the trenches expose relatively well developed, calcic soils with very red (6.25YR 5/4) Bt horizons. These soils are interpreted to be associated with unit Qa and they are also truncated by erosion of the northern and southern terrace remnant margins.

Discussion

An evaluation of the (1) geomorphology of the project area, (2) stratigraphy of the sediments and the soils in which the pithouses, other cultural features, and selected trenches occur at this site, and (3) the results of other geological and geomorphic investigations in this region of

New Mexico can be used to characterize the Quaternary geologic evolution of the project area. These studies demonstrate that the majority of the cultural features are associated with fine-grained sedimentary deposits that were mainly deposited on the treads of either the Qt3 or Qt4 terraces, whose heights above the modern channel of the Rio Grande are similar, but whose ages are quite different. The character of the gravel associated with these terraces shows that its deposition reflects high energy processes associated with transport in a large channel. The gravels are generally well sorted, rounded and contain abundant plutonic igneous and metamorphic rocks that indicate provenance in mountain ranges (e.g., Sangre de Cristos) located well to the north of the study area. The gravels must have been deposited by the former channel of the Rio Grande prior to incision to its current base level elevation. The older terrace, Qt3, exhibits a well-developed soil whose development must have required as much or more than 100,000 years before its burial, given the similar degree of development exhibited by soils whose alluvial parent materials are known to be this old (cf. McFadden et al. 1996; McDonald et al. 1996). Moreover, because Qt4 gravels are clearly inset into gravels associated with the Qt3 terrace and the alluvium of the Qt4 terrace is overlain by the El Cajete Pumice, the gravels of Qt3 may be as old as 200,000 years. This age estimate is, however, problematic, given the results of several previous studies noted above that suggest a similar age for terraces in this region thought to be correlative with the Qt3 of Smith et al.

The moderately to strongly pedogenically modified, fine-grained unit (Qa) that often stratigraphically overlies terrace gravels is interpreted to represent floodplain sediments. The presence of common and abundant tubular pores indicates the former presence of abundant roots associated with a relatively dense vegetation community, consistent with a typically shallow groundwater-influenced floodplain environment. The presence of manganese films and lepidicrocite is strongly indicative of a redoximorphic environment (alternative reducing and oxidizing conditions), an environment that also typically characaterizes floodplains, reflecting seasonally rising and falling groundwater tables. Also, Dethier (1988) reports the presence of fossil snails in similar sediments associated with Quaternary terraces of the Española Basin, whose ecological adaptations also are suggestive of a floodplain environment. The physical character of this fine-grained unit renders it favorable for excavation of vertically walled pithouses.

Geomorphic Evolution of the Terraces

Soil stratigraphic and geomorphic evidence collected during this study largely support the Quaternary geologic interpretations of Smith and his co-workers. As noted in the previous section, however, the origin of terraces Qt3 and Qt4 and their geomorphic significance and age are problematic. As noted previously, although it is almost 100,000 years old, no moderately to strongly developed soil has formed directly in the gravels or floodplain deposits of the Qt4 terrace, and only weakly to at best moderately developed soils have developed in the overlying sediments that buried the tread of this terrace. These geomorphic and pedologic attributes are similar to those described for the Qt4 terrace identified in previous studies in this region. Within a few meters of the surface of Qt4, and in some cases within a few decimeters of the eroded surface of this terrace, a strongly developed soil is present that has formed in gravelly alluvium that is also typically capped by a fine-grained unit (Qp). This gravelly unit is most likely an older axial channel and floodplain deposit of the Rio Grande. The outcrop pattern of the soil, for example, strongly indicates that it is associated with an older Quaternary terrace rather than sediments of the far older Sierra Ladrones Formation. Exhumation of interstratified gravelly units in thick, fine-grained deposits are observed in some cases to produce landforms that superficially resemble terraces, given the faster erosion rates of the overlying fine-grained sediment compared to gravel and the tendency of gravel to resist erosion. However, the process is generally not observed to produce apparent "treads" that are as wide as those observed in the study area. Moreover, the Qt3 terrace persists for nearly 5 km along the course of the Rio Grande at essentially the same height above grade. Sediments of the Sierra Ladrones Formation in this region are reported by Smith and his colleagues to be dipping up to 7 degrees, and so the likelihood that an exhumed gravel unit in this formation would exhibit this pattern is presumably low. Moreover, the presence of a well-developed soil also suggests soil formation on a stable terrace tread, rather than the exhumation of a buried soil in the Sierra Ladrones Formation (or within sediments of the "Qt3 of Smith and his colleagues"). Formation of such a well-developed soil following exhumation of the gravel is considered unlikely, given the largely erosional environment required to form a bench by this process.

Also as noted previously, and assuming Qt3 is in fact a terrace, a relatively long period of terrace tread stability for Qt3 is required for the formation of the well-developed soil, perhaps 100,000 years or more given its similarity to soils of this age documented elsewhere in New Mexico in several previous studies. As pointed out previously, an estimated age of 200,000 years for Qt3 is problematic, because this is the indicated age of the Qt3 terrace of Smith et al., which is present in the study area as a topographically much higher and areally extensive terrace. Also, in some settings, most of soil development on Qt3 has occurred directly in axial fluvial sediment, not in the overlying sediments of units Qp or younger deposits. The interpretation implies some incision of the Rio Grande to enable surface stabilization as well as diversion of piedmont sediment (see below for discussion of origin of piedmont alluvium of Qp) via incised tributaries to enable sustained, extensive soil development on the terrace tread. Notably, where alluvium of Qt4 is present, soil development in overlying sediments is generally much weaker and is largely confined to overlying sediments of Qp or Qs units.

The geomorphic interpretation of these terraces is also complicated because in some locations in this area, Smith and Kuhle (1998) describe a thick section of Qt3 gravels that are overlain by a fine-grained unit that is in turn overlain by a thin gravelly unit. Such a sequence was observed at site LA 115862. Accordingly, in some cases this lower Qt3 gravel unit might be confused with Qt4 gravels. The lack of strong development of a soil associated with the terrace tread observed at LA 249, however, strongly suggests this is the much younger terrace, Qt4, and not terrace Qt3. Of course it is also possible in some areas that removal of a soil once hypothetically associated with the tread of Qt3 by erosion has occurred. At site LA 115862, the presence of a large paleovalley that was subsequently filled by gravelly alluvium, which in turn was buried by a thin veneer of gravel in which a strong soil formed. This shows that deep and widespread incision has occurred prior to maximum channel aggradation and terrace formation. The orientation of the paleochannel also suggests association with a channel that drained tributary drainage basins immediately north of this area. The lack of Qt4 surface remnants in many parts of the study area can be attributed to either (a) the locally spatially limited maximum eastward extent of the Qt4 floodplain, or (b) post-Qt4 incision and subsequent eastward lateral migration of the Rio Grande destroyed all of Qt4, forming the 20-m-high fluvial escarpment that now truncates the Qt3 tread remnants. Finally, it is also possible that the terrace that has been interpreted as Qt3 in this study is in fact a terrace not recognized or observed in other areas that post-dates the Qt3 of Smith et al., but significantly pre-dates Qt4. Geomorphic considerations minimize the possibility that the soil and underlying deposits of Qt3 are exhumed features associated with the Sierra Ladrones Formation. Alternatively, Qt3 may actually be correlative with the Qt3 terrace that has been recognized regionally in other studies in the region. If so, this would (1) require significant downstream convergence of Qt4 and Qt3, and (2) suggest the possibility that the Qt3 terrace of Smith et al. in the study area might be correlative with the Qt2 as recognized in these other studies. The latter interpretation, however, would also require significant downstream convergence of Qt2 and younger terraces, as the Qt3 of Smith and his colleagues is probably not much more than 42 m above grade in the study area, whereas it is reported to be 65 to 70 m above grade elsewhere in the region. Such convergence over distances of only tens of kilometers is not likely.

Post-Terrace Abandonment Units (Qp)

At many sites in the study area, unit Qp is thick and areally extensive, covering virtually all of the original treads of the fluvial terraces. Several lines of evidence demonstrate that the deposition of this unit can be attributed to the formation of coalescing, small fine-grained alluvial fans or "aprons" atop the terrace tread surface following its abandonment as an active floodplain. The resulting landform is analogous with the piedmonts associated with topographically much higher mountain fronts observed in this region and throughout the western United States, although the majority of the accumulated sediment reflects deposition associated with unconfined sheetflow processes. The deposits of Qp do not represent primarily deposition of fine-grained eolian sediment (loess). Nowhere in New Mexico are thick, late Quaternary deposits of loess documented. Modern analogues for the formation of these now locally deeply dissected piedmonts are provided by the presence of undissected, late Holocene piedmonts associated with such basins where tread remnants are not present and aggradation associated with largely unconfined channels is resulting in the burial of the outer (distal) part of the modern floodplain of the Rio Grande. The formation of the locally deeply dissected and largely abandoned piedmont surface is largely attributable to the migration of the active channel of the Rio Grande to the west. Movement of this channel and its associated floodplain to the west, but not accompanied by significant channel incision, minimally decreases local base level, but permits accumulation of relatively fine-grained sediments transported by tributaries that are associated with drainage basins immediately east of terrace tread or by sheetwash. As noted previously, these drainage basins formed in response to previous episodes of incision of the Rio Grande that caused the abandonment of the topographically higher geomorphic surfaces to the north.

Additional evidence for the proposed origin of this sediment is provided by other observations. For example, interstratified lenses of relatively fine gravel occur within unit Qp. The active, small channels associated with such tributaries are transporting similar fine gravel. The imbrication of flatter gravel clasts and the orientation of buried channels revealed by trenches also demonstrate that these clasts were originally derived from gravel units of the topographically higher sediments that outcrop in the drainage basins to the east. The latter sediments contain interstratified thick fine-grained units that presumably constitute the primary source of the fine-grained sediment of unit Qp. The west-sloping gradient of the geomorphic surface associated with unit Qp is also consistent with a piedmont origin.

Although a small fraction of the fine-grained sediment may reflect an initially eolian (loess) origin, most of the fine sediment deposition is attributed to unconfined surface sheetwash, or "roll wash," a depositional process actively occurring in modern aprons present in this area. Some of the sediment deposition may also be attributed to the formation of thin fans that form at the termini of incised reaches of discontinuous channels or gullies, as described by Bull (1997). The continuous channels responsible for dissection of the piedmont are capable of transporting gravel, as indicated by the presence of gravel in the active channels and the presence of attached and longitudinal gravel bars. Observations at site LA 249 indicate that initial movement of much of the gravel from higher surfaces and underlying hillslopes underlain by gravels of the Sierra Ladrones Formation occurs initially due to colluviation. Creep or other forms of mass movement favored by high gradient hill slopes moves relatively large quantities of gravel out onto the surfaces of aprons, producing a gravel-rich lag over fine grained sediment. Incision of the apron by major tributary channels triggers subsequent extension of tributary drainages onto adjacent aprons, subsequently favoring transport of gravel lag into the larger, higher order tributaries. Transport of the gravel occurs by episodic, infrequent floods downstream. As noted above, temporary storage of gravel in larger tributaries is indicated by formation of longitudinal and attached bars associated with sinuous, active channels.

Although in many sites the piedmont apron deposits (Qp) are relatively thick, at LA 115862, unit Qp is very thin. Given the proposed origin of these piedmont aprons, the presence of only very thin deposits might reflect relatively rapid and deep incision of the Rio Grande in close proximity to the drainage basins east of the Rio Grande at this site, circumstances that would produce incised tributaries and prevent the deposition of a thick package of piedmont sediment on the Qt3 tread occur. Dissection of Qt3 would also, of course, cause erosional removal of Qp sediments. Similarly thin post-Qt4 aprons here and at other sites may reflect such circumstances. Presumably at LA 115862, the narrow width of the Qt3 terrace tread and the position of a once-present Qt4 far enough to the west prevented reoccupation of the surface of Qt3 by active tributary channels. In marked contrast, in the area of LA 249, the relatively wide tread of Qt4, and if present, Qt3, has favored the accumulation of piedmont apron sediment well after deposition of the El Cajete Pumice, perhaps even during the Holocene. This is the case because the tributary channels have been unable to incise deep enough to cause permanent abandonment of the piedmont apron surface.

Age and Geomorphic Evolution of the Piedmont Surface and Soils

As noted above, the surficial deposits (Qs) in the study area commonly contain small concentrations of pebbles, granules, and coarse sand composed of El Cajete Pumice. The presence of virtually unaltered El Cajete Pumice in large burrows in the fine-grained sediment (presumably excavated by rodents) exposed in the trenches and pits during excavations demonstrates, however, that the sediment was deposited before emplacement of the pumice approximately 60,000 years ago. Presumably, the ease of rodent excavation through the initially loose, primary El Cajete Pumice deposits enabled its subsequent accumulation via gravitational settling in deep burrows excavated in the subjacent, cohesive Qp sediments. The exposure of intact layers of the El Cajete Pumice that stratigraphically overlie sediments associated with what is also interpreted as Qt4 at LA 249 confirm this interpretation. Thus, the Qp unit, as well as the terrace itself, is older than the El Cajete Pumice. Also, the presence of buried soils in sediments at LA 249 that post-date gravel accumulation of Qt4 but that are buried by the El Cajete Pumice show that the terrace surface had been stable there for at least several thousand years prior to the deposition of the pumice. The initiation of deposition of piedmont deposits on this surface, however, is shown by the presence of channels cut in the pumice filled with deposits of reworked pumice that are in turn overlain by deposits with substantially less pumice.

The presence of fragments of El Cajete Pumice in the surficial materials (Qs) throughout the study area must reflect either deposition of sediment derived from topographically higher sites via sheet flood deposition or by eolian deposition of the pumice. Locally deep bioturbation of the surface deposits in most areas could readily account for the derivation of El Cajete Pumice from subsurface sites and the continuing subareal accumulation of the pumice. Smith also reports exposures of El Cajete Pumice on some hillslopes in this general area (Smith, pers. comm. 1998). This pumice could readily be transported onto proximal and medial regions of the piedmont. At some sites, however, younger parts of unit Qp also exhibit burrows that contain materials with far less abundant clasts of this pumice. This demonstrates that the overlying material through which rodents were burrowing initially contained a smaller fraction of the El Cajete Pumice.

This is interpreted to reflect the former presence of an overlying soil developed in the pumice that contained other materials (e.g., thin sheetflow deposits, eolian dust) incorporated through pedogenic processes. Eventually, virtually all of these once much thicker and El Cajete-rich deposits and their associated soils have been removed by erosion. Sheetwash, bioturbation, and episodic eolian activity continue to modify the piedmont surface and modify the nature of the remnant surface deposits (Qs).

The deep incision of terrace Qt4 not only caused the termination of active deposition and net accumulation of sediment on its tread, but also accelerated erosion of the surface. Much of this erosion is directly related to movement of sediment from the higher parts of the interior of the surface remnants to the incising tributaries, causing the progressive development of a gentle, convex-up surface form. Thus, the variation in soil development observed is largely associated with the evolution of the associated slopes; such a sequence of soils constitutes a soil catena. Geomorphic features observed at LA 115862, however, demonstrate that there have been periods of very rapid erosion and surface destabilization, demonstrated by the presence of gully-fill deposits. These latter deposits are inset into diffusion-generated slopes that probably form subsequent to periods of rapid incision by major tributaries that initially generate scarps. Also, as noted above, in some areas, incising tributary streams increasingly isolate remnants of the terrace treads as the head-cutting upper reaches of the initially subparallel tributaries progressively converge. With time, Treadwell (1996) observed that such convergence may finally cause the beheading of the tread of the terrace/apron surface. Finally, on at least one broad tread remnant, cut-and-fill cycles are recorded in the stratigraphy of arroyos associated with some tributaries, showing that in many areas, these surfaces continue to be active, dynamic environments.

Recent Eolian Activity

Although loess deposits were not documented in the study area, at many sites recently stabilized eolian landforms are present, as demonstrated by the presence of only weakly developed soils as well as the well-expressed topographic form. These dunes have been inactive for many decades, as shown by the leaching of pedogenic carbonate from the uppermost centimeter to decimeter of the sand, the development of weak Ochric A horizons, and the establishment of some long-lived, perennial species. Active sand accumulation was only observed at a few sites in relatively small areas. Seasonally strong prevailing winds (southwesterlies) and the abundant sand transported and temporarily stored in the channel or parts of the floodplains of Rio Grande and its larger tributaries (e.g., the Santa Fe River) are the factors that favor episodic eolian activity. The origin of this apparently episodic nature is not clear, but extensive farming of some of this area, changes in the behavior of the river, perhaps coupled with climate change, provide some possible explanations.

In a few sites, the deep incision of tributaries of the Rio Grande and the Santa Fe River has caused the complete isolation of terrace surfaces, in some cases apparently relatively soon after formation of the terrace. Such surfaces, cut off from sources of apron sediments, are subject to the strong influence of eolian processes, particularly if there is an abundant, proximal source of sand. The limited area of the terrace surface and the accumulation of highly permeable eolian sand favor minimal runoff production. Consequently, on such surfaces eolian sand can continue to accumulate, and during periods of stability, soils form. A sequence of such soils and deposits was observed at LA 6171.

Post-Abandonment Pithouse Sediment Accumulation

Sediment accumulation in pithouses following their abandonment reflects several processes, some of which are occurring concomitantly, thereby producing locally complicated stratigraphy. At most sites, however, a generally similar sequence was discerned: (1) Initially, the combination of collapsed roof material, consisting of burned wood and other inorganic materials (e.g., soil) produces a basal unit of nonstratified, massive admixture of fine material; (2) The eventual collapse of material associated with vertical walls in which the pithouse was originally constructed, as the walls are subjected to repeated cycles of wetting and drying and shrink-swell-shrink (and fracture) cycles; (3) The subsequent filling of the pithouse with sediments transported to the site via overland sheetwash. Unusually large events result in pithouse basin deposition that reflects a high energy event associated with entrainment of coarser sediments that accumulate in prograding coarse deltas in the water-filled pithouse depressions. Settling of suspended fines (including abundant charcoal at site, hearths, dump-related charcoal, etc.) in the central part of the pithouse farthest from walls occurs later, and with sufficient accumulation of fine-grained sediment, onlapping of such sediment on the coarser, stratified, dipping delta-front facies produces juxtaposition of high and low energy sediment facies. At LA 249, the stratigraphic evidence from the lower part of the post-pithouse fill sequence demonstrated that in especially large events, active rilling of the pithouse walls formed, causing undercutting of the pithouse walls and the entrainment of additional gravel that was subsequently deposited; (4) As the pithouse becomes almost completely filled, an increasingly higher proportion of fine-grained sediment is observed in the fill sequence. In part this reflects the elimination of gravelly source sediment, but it may also reflect the accumulation of a higher proportion of eolian sediment, particularly during times of increased regional eolian activity noted in the previous section. The accumulation of fine-grained sediment ultimately favors bioturbation, as reflected by the numerous krotovina documented in previous sections of this report. The increasingly shallow depth of the pithouse and the correspondingly lower rate of depression favor the development of cumulic soils. Occasional erosion (deflation) of the surface may have also modified the uppermost part of this sequence.

The observed vertical variation in the color, texture, and composition of the pithouse fill directly reflects not only depth of pithouse, but also the composition of source materials in the vicinity. For example, the oldest, lower part of the fill often contains abundant charcoal. This material was easily eroded from nearby areas with abundant, organic materials, most of which was anthropogenic charcoal (e.g., hearths). If a well-developed soil was present at or very near to the site, the fill sediments are correspondingly redder (e.g., LA 115862); whereas, if unit Qp was areally abundant, a correspondingly browner (10YR) fill is present. Re-occupation of a site is hypothesized to favor the renewed accumulation of charcoal in remaining pithouse depressions (e.g., LA 115862). Even when pithouses are nearly completely filled, the remaining topographic depression acts as a sink for low energy sheetwash sediment or perhaps the accumulation of eolian sediment. This explains the presence of such sediment in the upper part of the fill at LA 115862, given the lack of any locally abundant source of unit Qp. Finally, later inhabitants in the region, long after the initial abandonment of the pithouses, apparently used them as dumps, as large rocks are found in the fills that are unlikely to reflect any natural cause.

Chapter 7
A Brief Ethnohistoric Examination of Three Sites (LA 6170, LA 6169, and LA 249) and Related Areas along NM 22 near Peña Blanca

Linda J. Goodman

Research Methods and Goals

A brief ethnohistoric study of LA 6170, LA 6169, and LA 249, near Peña Blanca and Cochiti Pueblo was conducted from August 22, 2000, through August 31, 2001, with occasional follow-up through March 2002. Research methods included a site visit which occurred after the conclusion of the archaeological field work, a review of relevant published sources, and interviews with several older residents of the area. The study was undertaken to try to discover possible settlement patterns, building styles, house types, and use areas relating to the historic cultural remains present on these sites. Questions raised in regard to these sites focused on which of several specific groups might have utilized them in historic times, when, and for what purposes. When and why were these areas abandoned? Is there any memory among local elders as to which families (Cochiti, Hispanic, or other) might have farmed or otherwise utilized the land in this area? Because of the location, it is possible that the historic structures formerly located on these sites might have been built and used by Tanoan Pueblo people, Keresan Pueblo people, or early Spanish settlers in the area. Since the historic remains on these three sites were badly eroded and included almost no historic artifacts, minimal archaeological data were available. Thus other sources of information were essential in order to try to explore some of the above topics.

A visit to the sites occurred on November 9, 2000, in the company of Stephen Post, project director. Both before and after, a limited review of relevant publications, archival literature, and legal materials was conducted at the New Mexico State Records and Archives Center, New Mexico State Historic Preservation Office, and the Laboratory of Anthropology Library in Santa Fe. Discussions were held with Father Hillaire, priest at Our Lady of Guadalupe Church, Peña Blanca, New Mexico; with five life-long Peña Blanca residents, three of whom were elders; and with two middle-aged members of Cochiti pueblo. All provided useful information.

This report presents an introductory overview of the history of the Peña Blanca/Cochiti area followed by descriptions of both Cochiti and Hispanic regional land-use areas and house types. That information is then compared with the results of the historical archaeological excavations on the three sites under consideration—LA 6170, LA 6169, and LA 249—all of which are located on Cochiti pueblo land.

An Historical Overview of the Central Rio Grande Area

The Pueblo Presence Before 1598

The Central Rio Grande area has been occupied by Pueblo Indian people who have survived over the centuries by hunting, gathering, and developing sustainable agriculture (growing principally corn, beans, and squash) in their desert environment. The principle focus of this report is the Keresan village of Cochiti, and the extinct Tano villages of San Lazaro, San Cristobal, and Galisteo located in the Galisteo Basin.

It is thought that the people of Cochiti Pueblo have occupied their present location for approximately 750 years. Before this time, the Cochitis feel that they were connected with ancestors who occupied both the areas of Cañada de Cochiti, several miles north of the pueblo, and Frijoles Canyon, further to the northeast (Lange 1959:8; Stubbs 1950:63, 121–122). (Please see the preceding Prehistoric

Cultural Background chapter of this report for an overview of the prehistory of the area.)

Early Spanish expeditions through the area paid little attention to Cochiti, perhaps because it was located on the west side of the Rio Grande, while the principal travel routes were on the east side. Since crossing the river was difficult, pueblos on the west side were often ignored. Only a few Spanish explorers even mentioned this pueblo. In 1540, Casteñada, the chronicler for the Coronado Expedition, passed through this area but never named the Keresan pueblos (other than to call them the seven villages at Quirix) in his writings (Schroeder 1979:244; Winship 1896:503, 519, 524–525). In the fall of 1581, the Rodriguez-Chamuscado Expedition did visit Cochiti. According to the Gallegos account (Hammond and Rey 1927a:8, 48), the pueblo consisted of 230 houses that were two- and three-stories in height. At that time this pueblo was named "Medina de la Torre" (Lange 1959:9). In 1582 the Espejo Expedition also visited Cochiti, as was briefly noted by Luxan, who stated that the pueblo was called "Cachiti," that the people were peaceful, and that they gave the Spaniards maize, tortillas, turkeys, and pinole (Hammond and Rey 1929:82,117; Hammond and Rey 1938:23–24; Lange 1959:9). Castaño de Sosa saw four pueblos in the immediate Cochiti vicinity when he traveled through the area in 1590, but it is not likely that he visited any of them (Schroeder 1979:246). In 1598, Oñate provided native names for almost all the Keresan pueblos, but little detail on any except Acoma (Hammond and Rey 1953, 1:337, 345). The four pueblos seen by Castaño de Sosa are never mentioned again by any later Spanish writers; only the village of Cochiti continues to be discussed. It is possible that the other villages may have been absorbed by Cochiti during the missionization process in the early 1600s (Schroeder 1979:246).

Little is known of the early history of the Tano peoples. At the time of first Spanish contact they were living in the Galisteo Basin, south and east of Cochiti. Precisely where they may have come from prior to this occupation remains unknown, as does the total number of their pueblos. Later in time they were uprooted and dispersed by the Spanish invasion of the area.

Several different explorers passed through this region and recorded varying numbers of Tano pueblos in existence at the time. In 1540–1542, the Coronado Expedition recorded two Tano pueblos in the Galisteo basin (Schroeder and Matson 1965:139–140). The Rodriguez-Chamuscado party noted four pueblos here in 1581, but one of them (San Marcos) was thought to be Keresan, thus leaving only three probable Tano villages (Hammond and Rey 1927b:342-343, 354). In 1582, Espejo noted several Tano pueblos in the Galisteo Basin and surrounding area. He stated that some were very large, had well-built houses three and four stories high, that they had movable ladders, and flat roofs with drainage troughs (Schroeder 1979:247; Hammond and Rey 1929:119-120; Bolton 1916:189). Castaño de Sosa named two pueblos in this area in 1590—San Cristobal and San Lucas (Galisteo)—from which he obtained maize, flour, beans, and turkeys, the same items he received from other pueblos in the region. In 1598, Oñate visited San Cristobal and Galisteo (which he called Santa Ana), and listed seven other pueblos in or near the Galisteo Basin. It is unclear exactly which pueblos these were and whether or not they were Tano villages (Hammond and Rey 1953, 1:321, 345; Schroeder 1979:247). Father Benavides, who visited the area in the 1620s, recorded five pueblos among the Tanos. One of these turned out to be the Keresan pueblo of San Marcos, however, which reduced the number of Tano pueblos to four (Hodge et al. 1945:67). In general, early exploratory contacts between Spanish and Indians in central New Mexico were brief and had minimal long-term impact on Pueblo life.

Spanish Colonization, Missionization, and the Consequences

The structure of the contact situation began to change irreversibly for the Pueblo peoples, however, soon after serious Spanish colonization and missionization began in the region in 1598. Initially, contacts with the Spanish were relatively peaceful. For example, on July 7, 1598, Don Juan de Oñate met at Santo Domingo Pueblo with seven caciques who were said to represent thirty-four villages. Without bloodshed or overt resistance, he was able to obtain agreements of obedience or submission from all of them. By the end of 1598, all the pueblo villages had made this same pledge, peacefully. Soon thereafter, rods of office were given to the head of each pueblo, and missionaries were assigned parishes among them. Fray Juan de Rosas had jurisdiction over the Tano area and the Keres pueblos on the Rio Grande, including Cochiti. No further information has been discovered concerning the activities of this priest after 1598 (Spicer 1962:157–158; Lange 1959:9; Bolton 1916:203; Scholes and Bloom 1944:327–328).

On July 11, 1598, the well-known colonizing expedition led by Oñate arrived at San Juan Pueblo (now known as Okay Owingeh), with the goals of territorial expansion, missionization, and acquisition of mineral wealth. Oñate and his captains were joined five weeks later by a cumbersone provision train of 83 oxcarts and wagons containing household goods, food, and equipment; 7,000 horses; cattle; sheep; goats; pigs; and barnyard fowl. Spanish personnel consisted of 400 soldiers, a number of men and women colonists, Mexican Indian servants, and 10 friars (Goodman 1992:87–88; Lent 1991:8; Hammond and Rey 1953:16). Shortly thereafter, a number of serious internal problems began to plague the new colony. Quarrels and discontent developed. The soldiers were unhappy because they found no treasure in the area. Missionaries felt there were too few souls to save. Most of the Pueblos were lukewarm, if not hostile, in their reception of the Spaniards, although all except Acoma remained ostensibly at peace with the intruders. Within a year or two, many of the Spanish colonizers and priests deserted and returned to Mexico. Troubles continued for those who remained, and finally, about 1610 the Spanish capital was moved from San Gabriel (across the river from San Juan Pueblo) to the current site of Santa Fe by Oñate's successor, Don Pedro de Peralta (Spicer 1962:157; Ortiz 1979:281; Goodman 1990:19; 1992:88; Pearce 1965:146).

Over the next twenty years, Spanish-Pueblo relations remained relatively peaceful. New priests came into the area and churches were built in all the pueblos. Native secular and church officers were also established in each of the villages: governors, *alcaldes, fiscales,* and others. Throughout the 1620s missionaries converted sizeable numbers of Indians to Catholicism. By 1630, 50 Franciscan missionaries were working in 25 missions, and a school was operating in each (Spicer 1962:157–158).

The next fifty years, however, saw a steady decline in the relations between the Spanish and the Pueblo Indians. Intense and bitter quarrels raged fiercely between the Spanish civil authorities and the clergy, each of whom were in competition for the labor and tribute of the Indians. Often the civil authorities were incompetent as well as corrupt. There were many documented cases of physical abuse perpetrated by these officials. The natives were required to pay annual tribute to the King of Spain, but the governors of New Mexico often forced the Pueblo people to labor for them for their own personal gain, as well. Under the *repartimiento* system, Pueblo Indians, who were living on land grants *(encomiendas)* given to Spanish soldiers, had to work for the landowner, a system which generated much hostility. The priests also created problems. Between 1630 and 1680, additional churches were built by the Franciscan friars using forced labor from the Pueblos. Aside from this, the Pueblo people were also required to maintain livestock and agricultural fields for each missionary and his staff. Some missionaries instituted severe punishment for a variety of offenses, and beginning in the 1650s, they also tried to forcibly eliminate the native religion. Thus, corruption was rampant, and great injustices were perpetrated by both the missionaries and the Spanish civil authorities. The result was increasing resentment and unrest among the Pueblo peoples which finally led to the Pueblo Revolt of 1680 (Spicer 1962:157–160; Schroeder 1972:51–52; Scholes 1935:80–82, 107–109; Goodman 1992:89).

The Pueblo Revolt and Its Aftermath

A series of events that began in 1676 led ultimately to the Pueblo Revolt of 1680. Initially, forty-seven Pueblo religious leaders were jailed and flogged in Santa Fe for their adherence to traditional Pueblo beliefs. Among them was the San Juan moiety chief, Popé, under whose leadership the Pueblo Revolt was subsequently planned and carried out (Spicer 1962:162–163; Goodman 1992:89–90). When the revolt began, Cochiti quickly joined with other Rio Grande pueblos to push the Spanish from the area, and also took part in a series of Pueblo-led skirmishes over the next number of years as the Spanish tried to regain control of the territory they had lost. During this period of unrest, the Cochiti people, fearing more Spanish brutality, left their village near the Rio Grande and moved several miles north to a pueblo located on Potrero Viejo, above Cañada de Cochiti (Lange 1959:9–10; Spicer 1962:164–165).

At the time the revolt began, the Tanos were still living in their villages in the Galisteo Basin. They and their Tewa neighbors to the north had been in closest contact with the Spanish over the preceding 80 years and knew in detail the atrocities they perpetrated. Therefore these two groups of people were most vigorous in the early fighting against the Spanish. The Tanos beseiged Santa Fe and were reinforced five days later by Tewas and a force of Tiwas from Taos. Spanish resistance quickly collapsed and on August 21, 1680, Governor Otermín was forced to surrender and evacuate the city. Many of the foreigners were allowed to escape to the south, back to Mexico. However, 21 of the 33 Franciscan missionaries were killed, many of the missions were destroyed, and approximately 400 Spaniards and numerous Pueblo Indians lost their lives (Hackett and Shelby 1942:11, 56–57; Spicer 1962:162–163; Goodman 1992:90; Lent 1991:9).

After the Spanish had been routed, the Pueblo coalition quickly fell apart, and each pueblo returned to the management of its own affairs. Many of the Keres and Pecos peoples became hostile to the Tewa and Tanos. Apaches began renewed raids on the eastern borderlands, and as a result, the Tanos were forced to abandon the whole Galisteo Basin. They settled elsewhere: some from Galisteo Pueblo moved into the Palace of the Governors in Santa Fe and converted it into a pueblo for their own use. The peoples of San Cristobal and San Lazaro settled in the former Spanish town of Santa Cruz and along the Santa Cruz drainage north of Santa Fe (Schroeder 1979:247–248; Spicer 1962:164).

Despite these changes and conflicts, the Pueblos managed to hold the Spanish at bay for twelve years. During the winter of 1681–1682 an attempted reconquest by Governor Otermín was turned back. Otermín managed to sack and burn most of the pueblos south of Cochiti, however, before returning to Mexico. Finally, taking advantage of inter-Pueblo factionalism which had strengthened over the intervening twelve years, a successful Spanish reconquest was initiated in 1692 by Don Diego de Vargas (Dozier 1970:61; Simmons 1979a:186; Lent 1991:9; Goodman 1992:90).

De Vargas planned a peaceful reconquest, but after encountering some resistance, his tactics became more brutal, which led to more unrest, upheaval, and rebellion. Throughout this period, a number of the river valley villages were abandoned in favor of less accessible sites on the mesas, in anticipation of the return of the Spanish and the inevitable warfare. In 1692, when the Spanish did return, they forced the Galisteos out of the Palace of the Governors. Some took refuge among the Tewas and joined those at San Ildefonso in continued defiance of de Vargas. Others gave up their rebellious ways and vowed peaceful allegiance to the Spanish. In 1694, members of San Lazaro and San Cristobal joined the Tewas and some Keresans from Cochiti in another short-lived, unsuccessful revolt. In this same year the Spanish built a new town at Santa Cruz and the Tanos who had been living there were forced out. Some moved east to the area around modern Chimayo and others moved as far away as Taos (Schroeder 1979:247–248; Spicer 1962:164).

In 1696, after a rebellion by the Jemez had been put down, a new revolt broke out, led by the displaced Tanos of Chimayo and Taos. They were joined by the northern Tiwa of Picuris and Taos, some Tewas, and by the rebellious elements from Santo Domingo and Cochiti. After killing two missionaries in their village, the San Ildefonsans fled again to the mesas. De Vargas eventually either killed or routed all the resisters, and after 1696 there was little further resistance from the Rio Grande Pueblos (Spicer 1962:164–165).

Over the next twenty years or so, even more dispersal occurred. The Tanos who had submitted to de Vargas were mostly distributed as slaves among the Spanish colonists. Others, who had been in Santa Fe but had not become slaves, moved to join some of the Tewa villages, particularly Tesuque. Many of the hostile Tanos, who had moved to Chimayo from Santa Cruz, moved westward after 1696, and took up residence among the Hopis. During the early years of the 1700s, several thousand Pueblo people moved out of the Rio Grande Valley, rejecting Spanish control (Spicer 1962:165).

The Spanish made an effort to gather dispersed Tanos and resettle Galisteo during the early 1700s, but this effort was abandoned by the 1780s, largely due to Apache raids. The remaining 52 Tanos from Galisteo Pueblo joined Santo Domingo sometime between 1782 and 1794. (In his journal entry for October 8, 1880, one of Bandelier's Cochiti informants told him that when the Tanos left the area near the turquoise mines, some of them settled and married at Santo Domingo. Therefore, some Santo Domingo people regarded themselves as heirs of the Tanos) (Lange and Riley 1966:142). Spanish control, slavery, Apache and Navajo raiding, plus a serious smallpox epidemic in 1780–1781 contributed to a decline in the Rio Grande Pueblo population and to a general loss of prosperity. On the other hand, the Spanish population steadily increased during the 1700s (Spicer 1962:166; Schroeder 1979:247–248).

From the above information, it appears that, in historic times, the Tanos from the Galisteo Basin probably did not live in or around Cochiti Pueblo. The *cacique* of Cochiti Pueblo confirmed this when he told Adolph Bandelier (journal entry for October 27, 1880) that nothing was known about the people who inhabited the ruins in the vicinity of the pueblo. The Tano, he said, were in the area southeast, toward Galisteo, and later moved to the Moqui (Hopi), passing through Cubero and Santo Domingo to the south (Lange and Riley 1966:177). However, several archaeologists have hypothesized that some Tanos did live in this area in late prehistoric times (see Peckham and Olinger 1990 for a discussion of this topic and also a statement from one archaeological crew member from the Ise, Mustard Clan, Santo Domingo Pueblo, who, in the 1960s, stated that some of his earlier Tanoan ancestors had lived in the Cochiti area [Peckham and Olinger 1990:209]).

Due to pressures exerted by the Spanish and/or Apaches, the historic Tano peoples moved a number of times, some to Tewa and Tiwa areas considerably north and east of Cochiti; some to Santo Domingo Pueblo, south of Cochiti; and some to the Hopi villages in Arizona. If this information concerning their movements is correct, it is unlikely that the small historic structures found on LA 249, LA 6169, and LA 6170, just east of Cochiti Pueblo and north of Peña Blanca can be attributed to the presence of Tanos in this local area.

Descriptions of Historic Cochiti Pueblo

Most early descriptions were written by Catholic priests and only fragmentary information is available. During the early 1600s, Cochiti was probably a Catholic *visita* of Santo Domingo Pueblo (Scholes 1929:47; Scholes and Bloom 1944:333–335). (A *visita* was a mission establishment visited at intervals by a Franciscan priest stationed permanently at a nearby head mission [Ivey 1998:149].) This situation developed because there were not enough missionary personnel to staff all the pueblo churches or chapels throughout the region simultaneously (Simmons 1979a:181). However, by 1637, Cochiti had its own convent with Fray Justo de Miranda as guardian. In following years, Cochiti again became a *visita* of Santo Domingo, indicating that this mission often lacked a resident priest (Scholes and Bloom 1944:66). The Cochiti *convento* was first called "San Buenaventura" in 1667 (Lange 1959:9; Scholes 1929:54–55).

The Catholic mission remained an important element at Cochiti throughout the period of Spanish occupation, the following Mexican Colonial Period (1820–1846), and the American Period (1846–present) (Lange 1959:11–12). In their writings, several priests made brief mention of it. In 1706, Fray Juan Olvarez stated that the mission, which was called San Buenaventura de Cochiti, had about 520 Indians, had a broken bell, and a church that was in the process of being built (Hackett 1923–1937:375). In 1744, Fray Miguel de Menchero described Cochiti as a village with more than 80 Indian families, some ranchos, and with a resident friar in the mission (Hackett 1923–1937:404).

In his report of 1776, Fray Francisco Atenasio Dominguez described the layout of Cochiti Pueblo, its blocks of houses, two small plazas, and its mission. He then went on to say that all the important farmlands owned by this pueblo were located on the east side of the river, extending as far south as the lands of Santo Domingo. There were some *milpas* (fields planted for a few seasons and then abandoned) on the bank where the pueblo stood and a few to the north on both banks. River water irrigated all these fields, flowing through deep, wide ditches, and the fertile farmland yielded an abundance of crops (Adams and Chavez 1956:159).

Over the next two hundred years, as control of the region was transferred from the Spanish to the Mexicans, and finally to the United States, life at Cochiti underwent a number of changes. Since approximately 1848, the introduction of American schools, Indian agents, and a whole host of government programs has gradually led to partial acculturation and modernization (see Lange 1959 for more information on this subject). The influence of the surrounding Euroamerican culture has led to alterations which, over the years, have taken a toll on the old Pueblo ways of life. Native Cochiti ceremonial activities, for example, a strong cultural focus for centuries, have undergone change, and today exist in somewhat modified form (Simmons 1979b:208–212; Lange 1959:30–32, 85; 1979:366–368). The traditional settlement pattern which consisted of a compact pueblo village on the west side of the Rio Grande and numerous individual fieldhouses located east of the river on ridges above the agricultural fields, has also seen alterations. Individual family homes are often built as separate entities, not attached to the compact pueblo room blocks. Summer fieldhouses no longer exist. It is probable that the use of summer fieldhouses in the Cochiti area began to decline as the automobile became increasingly common. With a car or truck, a family could go to the fields, do a day's work, and return home to the pueblo in the evening. Transportation has seen shifts from teams of horses and wagons used in the 1940s, to the presence of a few cars and trucks after World War II, and finally to the dominance of the automobile in more recent years (Lange 1959:74). Until recently, farming has been the economic mainstay of Cochiti and the surrounding area. Today agriculture has essentially been replaced by wage work and the production and sales of arts and crafts. A number of people have found employment away from the pueblo.

The Hispanic Presence

Spanish settlement in the region began when Oñate first established a colony at San Juan Pueblo in 1598. Throughout the Colonial period the Spanish population remained smaller than the surrounding Pueblo population. It is thought that in 1650 there were approximately 25,000 Indians and 1,000 Spaniards. After the reconquest in 1692, the Spanish population increased to 2,000. By 1776, when Fray

Dominguez visited New Mexico in order to report on the conditions of the missions, he recorded about 8,000 Indians and 10,261 Spaniards (Bunting 1976:52). Much of the decline in Indian population was a result of warfare with the Spanish which had occurred over the preceding 100 years. During the 1700s, the Spanish population was made up of a few crown officials, a handful of merchants and wealthy landowners, a large number of Spanish and mestizo laborers who worked either on the large land grants or on their own small plots of land, the friars assigned to Pueblo missions or Spanish communities, and a relatively small number of Spanish soldiers. The presidio in Santa Fe seldom had more than about 120 soldiers (Bunting 1976:52–53).

The economy of the region was based largely on agriculture, pastoral activity, and trade. There were no highly productive gold or silver mines or other great sources of wealth in the region, much to the chagrin of Spanish officials and military personnel (Goodman 1990:15–21). Coins and money were scarce, and people relied almost entirely on barter for their business transactions. Throughout the Spanish and Mexican periods economic survival for most ordinary Spanish settlers was precarious (Bunting 1976:53–54; Scholes 1935:109–110). Life was somewhat more comfortable for the wealthy who could afford luxury goods which they either brought with them or which were brought to New Mexico by caravans which traveled the Camino Real from Mexico once every three years (C. Snow 1993; Pierce and Snow 1999). Because the trade route from Mexico to New Mexico was 1,500 miles long and fraught with danger (from harsh terrain and hostile Indians), luxury goods acquired in this manner were extremely expensive and thus not available to most of the population (Scholes 1935:73).

Since the lives of ordinary settlers focused on subsistence and survival, there was little time, energy, or capital for new undertakings; thus, for may years, minimal technological or cultural innovation was evident. For example, substantial gold deposits weren't heavily mined until 1828 and silver deposits were not significantly exploited until approximately 1879 (Goodman 1990:35–36, 39–40; Levine 1990:41–45). Also, even though good clay was plentiful and there was a Mexican tradition of brick and tile-making, this industry did not develop in New Mexico. And, despite the fact that there was ample water power and fine stands of timber in the mountains, the Spanish colonists did not devise a water-driven sawmill (Bunting 1976:54). Major technological innovation was not critical for survival during the Spanish Colonial period and the early part of the Mexican period. Until the beginning of the nineteenth century, settlers were most concerned with putting food on the table and warding off frequent Indian attacks launched by various nomadic tribes: Apaches, Comanches, Utes, and later, the Navajo.

The U.S. Anglo Presence

American influence, minimal until the opening of the Santa Fe Trail in 1821, lead to a number of changes throughout the area, one of which was an increase in the number of items brought from the East (Sandoval 1989:22–25). Utilizing the Santa Fe Trail, first American, and later, Mexican merchants brought in wagon loads of goods unavailable before this time: needles and thread, bolts of cloth, axes, guns, coffee, and alcohol to name but a few. By the beginning of the American period in 1848, more items had been added: hand tools, iron plows, simple manufacturing machinery, plants and fruit trees. The army set up a sawmill in Santa Fe in 1848, and soon there were a number of other mills operating throughout the region (Bunting 1976:86–88). Thus New Mexico slowly became more productive and self-sustaining. Economic activity increased significantly after the coming of the railroads between 1879–81 (Jenkins and Schroeder 1974:64–66). This new form of transportation—improved, less expensive, and quicker—allowed goods and people to travel both west and east, thus spurring economic growth. At about the same time, the end of hostile Indian attacks allowed for expansion of agriculture, cattle raising, and mining, which brought prosperity to larger numbers of families in the region (Bunting 1976:86–88).

Important changes also occurred in the organization and administration of the Catholic Church. In 1851, New Mexico was separated from the Mexican Diocese of Durango and received its own bishop, the French priest, Jean Baptiste Lamy. Earlier, during the eighteenth century, approximately 66 priests had served the province. However, when Lamy arrived in Santa Fe, there were only 14 priests left in New Mexico. Over the next few years he brought in new priests from the Midwest, filled the vacancies, and began a program of church reform as well as actual repair of neglected church edifices (Bunting 1976:87).

In spite of the large number of changes in the region as a whole, the lives of the majority of Spanish-speaking people in the area remained largely unchanged. Most of the state's population was overwhelmingly composed of small, rural Hispanic landowners, many of whom were relatively poor. A scattered settlement pattern which had developed earlier and spread out along the major river valleys, still remained dominant. Members of these small communities supported a strong ritual god-parent system *(compadrazgo)* and a religious organization known as the Penitente Brotherhood, which served in the absence of priests in the area. These systems provided social integration, mutual aid, and religious observance for local residents in numerous small, isolated Hispanic communities (Swadesh 1974:2–5). Even as modernization and gentrification now make themselves felt in many of these villages, some descendants of the early settlers still manage to survive, utilizing the strength and resilience which have served them so well in the past.

Hispanics at Cochiti Pueblo and Surrounding Areas

One of the more unusual features of Cochiti Pueblo has been the significant presence of Spanish-American families living in the confines of the Indian village. These Hispanic families have held homes and lots on which their houses stood, and have held agricultural tracts as well (Lange 1959:14). In 1890, Henry Poore, the Indian agent, wrote the following: "Eight Mexican families dwell here and fraternize with the Indians. As long ago as 1820 the Mexicans acquired land here. They are regarded as under the jurisdiction of the pueblo, and perform communal work upon irrigation ditches and roads by command of the governor of the tribe" (Poore 1894:429; Lange 1959:14). Bandelier's journal of October 24, 1880, adds a little more information: ". . . at that time (1819), there were two parties in the pueblo. One of them, infected by the uprising of the Mexicans against Spain, sought the rights of citizenship, and sold many of their lands to Mexicans; therefore the Mexican population of Cochiti" (Lange 1959:14). Lange feels that it is possible that a few Mexican residents may have lived here before this time, possibly as early as the late 1600s (1959:15). Over the years, however, these Spanish holdings have gradually been purchased by individual Cochitis or by the tribe, and at present there is little land held by non-Cochitis (Lange 1959:15).

According to three life-long Peña Blanca residents, Clodoveo Hurtado (83 years old in 2001), Margaret Lucero (82), and Lorraine Ortiz (mid-50s), in the past there were quite a few Spanish people who lived in Cochiti Pueblo. Good relations existed between the two groups and each helped the other with a variety of tasks. Clodoveo Hurtado stated that the pueblo governor at times talked to the Spanish men in the village, requesting their help with particular communal projects. Every year, each group helped the other with planting and harvesting of wheat and corn. Clodoveo's parents lived at Cochiti before he was born and participated in these communal activities (Goodman, Field Notes 2001). As a child, Lorraine Ortiz used to visit her grandfather, Christino Tafoya and his family at their house in Cochiti Pueblo, every weekend. Margaret Lucero also used to visit friends who lived there (Goodman, Field Notes 2001–2002).

Presently (2001), only two elderly Spanish women continue to live in the pueblo: Eumelia Lucero and Maida Gallegos. They will be allowed to remain in their pueblo houses for as long as they live, but afterwards, it is unclear whether or not their families will stay. Another Spanish woman, Victoria Herrera, lived at Cochiti until her death about a year ago. Her children now claim her house, but it has been closed up since her death. These remaining Spanish families have documents showing that they own their land inside the formal pueblo boundaries, so, if Cochiti wishes to acquire these parcels, it will most likely have to purchase them (Goodman, Field Notes 2001).

A number of Spanish settlements were established in the area surrounding Cochiti pueblo. The earliest, called Cañada de Cochiti, was located about 8 miles northwest of Cochiti Pueblo. According to Fray Angelico Chavez, the grant called La Cañada de Cochiti was first made in 1728 to Antonio Lucero. Eventually, about 1742–1743, a community developed on this grant land, at the edge of Cochiti Canyon, below the orange mesa upon which stands the ruins of old Cochiti Pueblo (Chavez 1973:8). Fray Chavez stated that the village was blessed with rich pasture lands (including the Valle Grande), which allowed continued growth for over a century, in spite of fairly frequent and disruptive Navajo raids (Chavez 1973:8). Other priests presented differing interpretations. Some described the community as consisting of a number of small ranchos scattered throughout the canyon and then focused on the difficulties residents faced in producing adequate crops with inadequate water resources. For example, Fray Francisco Atanasio Dominguez, in 1776, stated that Cañada de Cochiti had a very limited stream that often failed, making life precarious in this location (Lange 1959:77–78). He also noted that the Spanish settlers who inhabited this area were from all classes and all walks of life. First mentioned in the Cochiti baptismal register in 1760, Cañada de Cochiti included 52 families. By 1776, 307 persons were listed, and in the year 1782, Father Morfi stated that 180 families of Spaniards lived there (Thomas 1932:99). This community managed to survive Indian raids and other difficulties for approximately 150 years. It was finally abandoned early in the twentieth century (Adams and Chavez 1956:159; Chavez 1973:12).

In 1928, a sizeable portion of La Cañada was bought by a wealthy Chicago executive, James W. Young. He planted an apple orchard farther up the canyon and created an agricultural business which has been quite successful. According to four Peña Blanca residents, he willed all of his land to the University of New Mexico, but allowed Fred Dixon and his descendants to live on the land and run the apple business for as long as they wish. No one knows how this arrangement came about. Currently, Fred Dixon's granddaughter is running the apple business for her grandfather and she has the right to take over from him and continue the business. If any of her children wish to do the same, they are entitled to do so when they reach adulthood. When the last Dixon descendant stops working the land, it will revert to the University of New Mexico. For years, this orchard has provided work for numerous Hispanic people from Peña Blanca and other nearby communities (Chavez 1973:12; Goodman, Field Notes 2001–2002).

The last resident of Cañada de Cochiti, a man named Marcial Lucero, stated that he had grown a type of native tobacco (originally brought up by his grandfather from Mexico) in his fields at Cañada de Cochiti all his life. This would imply that adequate water was indeed available, at least part of the time. Clodoveo Hurtado recalled that Marcial planted a wide-leafed tobacco plant when he lived at Cochiti Pueblo, and after it was harvested, the leaves were piled high and left to dry for a number of days. Then they were put in sacks and when they were completely dry, the leaves were crushed and put in a box (Goodman, Field Notes 2001). Margaret Lovato stated that this tobacco is called "punche" in Spanish and that her mother planted it in Peña Blanca, too. Her mother gave it to Indian friends from Cochiti who used it in rituals and ceremonies, and also for medicinal purposes (Goodman, Field Notes 2001–2002).

Clodoveo Hurtado recalled spending time in La Cañada as a child and watching the *molino* (mill) which ground the wheat or corn into flour for the residents (Goodman, Field Notes 2001). This statement also implies that there was enough water to grow these crops. When Marcial Lucero left La Cañada about the turn of the century, he moved into Cochiti Pueblo for a number of years, then, later moved to Peña Blanca, where he was living in 1951, at the age of 86 (Lange 1959:96). Marcial Lucero was Clodoveo Hurtado's mother's brother, and thus, his maternal uncle (Goodman, Field Notes 2001). If Marcial's relocation from village to village was typical, Spanish people moved from one locale to another fairly frequently in years past. Thus the larger picture would show a population continually in flux.

Several other small Hispanic communities sprang up around Cochiti Pueblo. Rancho de Santa Cruz, located on the east bank of the sharp elbow turn of the Rio Grande, north and east of Cochiti Pueblo, was deeded to Jacinto Sanchez of Santa Fe in 1704; however, there is no firm evidence that he ever lived here. By the 1750s, this land was occupied by members of the Ortiz family from Santa Fe, and, later in time, by other Spanish residents (Chavez 1973:12). Margaret Lucero recalled that when she was young, a number of Spanish families lived in the area called Santa Cruz and they had fine orchards and gardens. She and her family traveled there every summer to get excellent fruit, melons, chilis, and other produce. According to Margaret, this is the only place north of Peña Blanca where Spanish people lived (Goodman, Field Notes 2002). Clodoveo Hurtado remembered that his father, Eugenio, and each of the latter's four brothers owned land in Santa Cruz. All of it was eventually traded to Cochiti Pueblo for a piece of land in Peña Blanca proper. Santa Cruz is currently under water at the bottom of Cochiti Lake (Goodman, Field Notes 2001).

El Rancho de la Majada (the sheep shelter) was located near the place where the Santa Fe River emerged from La Cienega Canyon and was probably first settled about 1775. It was occasionally referred to as El Rancho de San Miguel, but has commonly come to be known as La Bajada (the descent), after the creation of the road from Santa Fe, which descended down the escarpment next to the village (Chavez 1973:13).

Peña Blanca, another small Hispanic farming and ranching community, is located on the east side of the Rio Grande between Cochiti and Santo Domingo pueblos. This land was first granted by Francisco Antonio Martín del Valle, Governor of the Province from 1754–1760, to Juan Montes Vigil in 1754. The elder Vigil immediately sold it to his son, Manuel Montes Vigil, "by oral conveyance," in the same year. Jose Miguel de la Peña bought this land in 1758 from Manuel Montes Vigil, for 500 pesos (Bowden 1969:1256–1257; Mitchell 1975:3). According to Fray Angelico Chavez, this area was first settled by José Miguel de la Peña, who established a ranch on the Juan Montes Vigil Grant, in 1770 (Chavez 1973:13). Though the elder Peña may never have lived on this ranch, his son, José Miguel II, who was also a chanter at the church in Santa Fe, apparently did move there with his family (Chavez 1992:256–257; Mitchell 1975:3). Somewhat different information was presented by Adams and Chavez, who stated that José Miguel de la Peña II was a native of Santa Fe who received his lands north of Santo Domingo as a grant (Adams and Chavez 1956:135; Pearce 1965:119). Support for the presence of this family is found in early Spanish documents which state that: 1 league to the north of Santo Domingo Pueblo was the rancho of a Spanish citizen, José Miguel de la Peña. He was so named in the Santo Domingo registers from 1777 to 1780. In 1791 this land was listed as "El Rancho de Peña," and from 1792 on it was called "El Rancho de la Peña Blanca" (Adams and Chavez 1956:135).

After 1792, other families, mostly from Cañada de Cochiti, Bernalillo, and Santa Fe, moved onto the grant. In 1798, Luis Maria Cabeza de Baca married Ana Maria Sanchez of the Rancho de la Peña Blanca, thereby acquiring an interest in the grant lands (Mitchell 1975:3; Chavez 1992:152–154). In 1805 Luis Maria Cabeza de Baca bought a tract of land from Cochiti Pueblo. This may have been the land comprising the northern portion of Peña Blanca. However, Lange (1959:194) noted that at about this time, the Turquoise kiva group at Cochiti Pueblo was trying to obtain citizenship for the members of the pueblo. (The Pumpkin kiva group opposed them in this effort.) The Spanish constitution of 1812 granted citizenship to settled Christian Indians. The pueblo, under the rights of citizenship, sold some of its lands to Hispanos between 1816 and 1819. Thus it is possible that the lands in the northern portion of Peña Blanca were acquired during this time. Luis Maria C. de Baca lived periodically in Peña Blanca and was killed there in 1827 by a Mexican soldier who shot him over a land dispute. His descendants continue to own much of the land in Peña Blanca (Laumbach 1933:245; Mitchell 1975:3).

Lange and Riley (1966:263) quote a section of Bandelier's journal dated April 12, 1882, in which Bandelier places the founding of Peña Blanca between the years 1816 and 1819. Evidently, a Catholic church was not built in this community until much later. Bandelier, in his November 8, 1880, journal entry stated that he was told by the padre that about 1852 there was a resident priest at Cochiti. This unnamed resident priest then moved to Peña Blanca where the church, begun in 1867, was consecrated December 12, 1869 (Lange 1959:86). In the 1930s and 1940s, subequent to the settlement of various land cases, most of the Hispanic families who had lived in Cochiti proper, moved out and took up residence either in Peña Blanca or Cuba, New Mexico (Lange 1959:17).

By the 1850s Peña Blanca had become a thriving farming community (Mitchell 1975:3). Between 1852 and 1876 it served as the county seat of Santa Ana Territorial County. From 1876 until 1903 it was part of Bernalillo County, and later became part of Sandoval County (Mitchell 1975:4; Chavez 1973:16).

A portion of the history of the Peña Blanca grant, as described below by Mitchell (1975:4) illustrates a complex situation:

> In 1871 the inhabitants of Peña Blanca petitioned the Surveyor General, T. Rush Spencer, asking for an investigation into their land grant history in order to validate their claim (Bowden 1969: 1257). Under the 1848 Treaty of Guadalupe Hidalgo, property belonging to, and occupied by, Mexicans, was to be inviolable (White et al. 1971:28–29). Enough confusion emanated from this, however, to necessitate the creation of the Office of Surveyor General in 1854 to review all claims before validation. The boundaries of the Peña Blanca grant were investigated and found to overlap with those of the La Majada grant. The citizens of Peña Blanca bought all interest in the overlap, the grant was surveyed for 585.66 acres, and in 1881 [this grant] was recommended by the Surveyor General to Congress for confirmation and validation. Congress, however, never acted on the matter. When the Court of Private Land Claims was created in 1891, taking over the job of the Surveyor General, the citizens of Peña Blanca, each of whom owned only a small portion of the grant, apparently did not feel justified in going to the trouble and expense to file suit in the Court of Private Land Claims. The La Majada grant, in which many Peña Blanca residents owned an interest, was confirmed in 1894, and this may have deterred further action on the part of Peña Blanca residents. In 1931 the District Court of New Mexico ruled on the question of occupation of Cochiti Pueblo lands in the northern half of Peña Blanca, honoring, in most cases, the Hispanic claim to the land. The total area involved was 379.36 acres and 34 claims (Bowden 1969:1259; Mitchell 1975:4).

Concerning issues other than grants, Bandelier included a few brief descriptive passages about Peña Blanca in his journals. On September 23, 1880, he stated that the Plaza de Peña Blanca contained about 100 Mexican families. The walls were all of adobe and cottonwoods grew there. The residents planted a large, long-grained wheat and mostly variegated corn. He also noted, on October 6, 1880, the presence of numerous threshing floors at Peña Blanca, Santo Domingo, and Cochiti. On October 4, 1880, he wrote that there was no trace of drunkenness or rowdiness in Peña Blanca. Activities were carried on quietly (Lange and Riley 1966:91, 127, 131).

Bandelier also included several references to Cochiti agricultural and living areas located quite near Peña Blanca. On October 5, 1880, he wrote that the Santo Domingo acequia was located 1,400 m west of the Peña Blanca church. The Cochiti acequia was located east of the Santo Domingo acequia. He stated that small patches of land to the north were worked by Cochiti Indians, whereas their ranchos of adobe were located east of the Santo Domingo acequia and west of their own (Cochiti) acequia. He went on to say that the agricultural field of the cacique of Cochiti Pueblo was located about a mile from Peña Blanca, northwest near the river and near the acequia of Santo Domingo (Lange and Riley 1966:128).

Another small Hispanic settlement, Cubero, on the west bank of the Rio Grande opposite Santo Domingo Pueblo, was probably part of a grant made originally to Diego Gallegos in 1730. His widow deeded it to Santo Domingo in 1748. Ownership of this land was then the subject of a dispute between the Indians and the Spanish until the latter established El Rancho de Cubero sometime before 1820. Cubero remained a Spanish community until sometime after the turn of the century, when the residents moved to Peña Blanca, and the land once again returned to Santo Domingo Pueblo (Chavez 1973:17).

The Hispanic community of Sile (Santa Barbara de Sile) developed on the west side of the Rio Grande, opposite Peña Blanca and directly south of Cochiti Pueblo. It was settled about 1790 by people who had formerly lived at La Cañada de Cochiti, and is still inhabited today (Chavez 1973:17; Father Hillaire, pers. comm., 30 Jan 2001; Goodman, Field Notes 2001).

With Hispanic settlement occurring in and around Cochiti Pueblo for over 250 years, it is certainly possible that Hispanic families could have erected small structures on top of prehistoric ruins at LA 6170, LA 6169, and LA 249. However, since several current Peña Blanca elders cannot recall any structures whatsoever on this land during their lifetimes, and since several others recalled small Cochiti houses on the ridgetops in this area, it is unlikely that there was Hispanic occupation here within the past 100 years. Since Bandelier stated that Cochiti Pueblo utilized the land east of the river and north and west of Peña Blanca for agricultural purposes, as well as for Indian ranchos, it is possible that Cochiti people built and occupied the historic structures on these three sites at some undetermined time in the past.

Cochiti Use Areas and House Types

Agricultural Fields, Bridges, and Ferryboats

The fields located east of Cochiti Pueblo and also east of the Rio Grande have been cultivated for an unknown period of time by the Cochiti people. In the past, evidence indicates that the Cochiti engaged in some dry farming, but probably a considerable amount of floodwater farming, mostly in fields located west of the pueblo (Lange 1959:77–80). It is likely, however, that they utilized good agricultural land on both sides of the river.

According to Esther Goldfrank (1927:92), sometime before 1900, the people planted primarily corn, melons, pumpkins, and beans at the foot of the mountains so that the crops might get as much moisture as possible. Utilizing a digging stick, a man dug up his field, created numerous small mounds, and planted the seeds in each mound, according to a traditional dry-farming method. Planting was begun from the outer edge of the field: the planter wound his way in, and finished in the center.

An irrigation system was in place at least by 1776 when Fray Dominguez mentioned fields irrigated by deep and wide ditches east of the river (Lange 1959:11, 80). According to Bandelier (journal entry for July 13, 1882, as quoted in Lange 1959:79–80), the Rio Grande could be quite treacherous and changed its course almost on a daily basis. On July 9–12, 1884, Bandelier noted that "the poor people are in a bad plight, the river is encroaching on the east side, and washing away or cutting up their fields." Thus he indicated that fields east of the river were being farmed at this time, though it is not clear whether by Cochiti people or Spanish settlers in the area. On July 15, 1885, Bandelier again wrote that the river was encroaching on "the right hand side" (Lange 1959:79–80).

In order to work these Cochiti fields east of the river, it was first necessary to cross the Rio Grande, and, in the days before sturdy highway bridges were built, there were several methods by which this was accomplished. Until approximately the mid 1900s, a tribally-owned ferryboat plied the river and facilitated travel between Cochiti and Peña Blanca. Many young Pueblo men served as crew members on this ferry, which was operated as a form of community labor, under the supervision of the governor. Generally the three-man crews changed daily: one man poled, or paddled, on each side, while the third guided the ferry from the stern. This ferry was a rectangular wooden structure, bulky and awkward, as described in 1882 by Bandelier and quoted in Lange (1959:60). It was large enough, however, to hold a team of horses and a wagon. According to Lange (1959:182), in the 1940s and early 1950s, Cochiti people traveled on the ferry for free, while others paid a fee. Bandelier, however, stated that those who operated it in 1882, charged passengers what they pleased, usually about 25 cents per person (April 23, 1882 journal entry, quoted in Lange 1959:60).

Footbridges across the river were also built and maintained by community labor. Bandelier spoke of them in 1880 and 1885; Starr wrote about them in 1897 (Lange 1959:57–60). Included are descriptions of these bridges, their construction, and accompanying ceremonial activities. Bandelier commented on November 19, 1880, that the Cochiti bridge was broken because beavers ate the beams, and that many large beavers frequented the river at that time (Lange 1959:57). From these descriptions it is clear that there was a significant amount of travel back and forth between the Pueblo of Cochiti and the agricultural lands to the east, and that adequate means of crossing the river were essential.

Regarding annual ditch-cleaning, on November 10, 1880, Bandelier noted in his journal that it often took five days to clean up the eastern acequia each March or April. By the early 1950s it only took two days to do this work, which began at the head of the eastern ditch. The men of Cochiti continued to work as far south as the community pasture near Peña Blanca (Lange 1959:81–82).

In the early 1930s, with the creation of the Middle Rio Grande Conservancy District and the completion of a concrete dam (about 3 miles north of the Pueblo) along with a major canal on either side of the river, the total irrigated acreage was considerably increased. This was an important improvement for all the nearby communities: Peña Blanca, Sile, Santo Domingo Pueblo, San Felipe Pueblo, and some fields north of Algodones, as well as Cochiti Pueblo (Lange 1959: 80). As a result of the dam, by the early 1950s all Cochiti crops still being grown were planted in irrigated fields, with the exception of a few vegetables nurtured in small gardens around the houses of Cochiti residents (Lange 1959:81). The considerable amount of irrigation farming which had continued through the time of World War II, began a steady decline after the war. This was partly due to water shortages, but more importantly reflected a steady shift away from agriculture in favor of other economic pursuits (Lange 1959:103–104).

In spite of the evident move away from agriculture, in the early 1960s work began on a new dam, located midway between the 1930s dam and the pueblo. It was to be much larger than the first, and was originally intended for irrigation and flood control. A recreational component was added later. Completed in 1975, this newer dam assured a more reliable supply of irrigation water for the fewer and fewer agricultural acres under cultivation (Lange 1979:366–368). This farmland, bounded by ditches and laterals, was located east of the pueblo and the Rio Grande.

Over time, Cochiti Pueblo officials have made a concerted effort to purchase land from non-Indians (mostly Spanish) who owned land on the reservation. Some of this acreage was purchased in the late 1940s and early 1950s and has become part of the pueblo community land. Much of it was in the vicinity of Peña Blanca. A portion of this land was fenced by the tribe, irrigated, and used as community pasture. Another piece, also located near Peña Blanca, was planted in fruit trees, but this orchard, several miles south and east of Cochiti, was and still is, mostly neglected by the tribe (Lange 1959:39–40; Goodman, Field Notes 2001).

Concerning the location of individual historic Cochiti structures on the east side of the Rio Grande, only fragmentary information exists. Apparently, at least by 1800, as stated to Bandelier by Juan José Montoya, the Cochitis had ranchos located on the east side of the river. Bandelier wrote on October 8, 1880, that an old Cochiti man named Antonio had told Juan José Montoya, when the two were sitting one time in a rancho across the river, in the year 1853 or 1854, that about 1800, the corn and fruit were much better and ripened earlier. According to old Antonio, the melons ripened by July 5 (Lange and Riley 1966:138). On April 17, 1882, Juan José Montoya told Bandelier that the pueblo was mostly depopulated each summer. Nearly everyone went out to the ranchos and remained until September or October (Lange and Riley 1966:265). Exactly where these ranchos were located, as well as their size and construction, remains unknown.

Margaret Lucero and Lorraine Ortiz, both life-long residents of Peña Blanca, recalled little houses on the ridge tops north of Peña Blanca, when, as children, they often traveled to Cochiti Pueblo. Both were very clear that Cochiti Indians lived in those little houses. Margaret remembered the Cochitis having ranchos out there. According to these two women, no Spanish families ever lived in those little houses (Goodman, Field Notes 2002).

In 2001, two Cochiti residents, each in their 50s (who asked to remain anonymous), stated that a great many small fieldhouses had formerly occupied the terraces above the agricultural fields east of the Rio Grande. The whole area was filled with them. (One of these individuals, as a very young child, spent several summers with parents and grandparents living in their fieldhouse. The other resident had heard stories about summers spent at the fieldhouses as told by family elders.) Many families crossed the river to work in their fields and either stayed in their little houses for several months each summer, or utilized these living spaces on a daily basis but returned to the pueblo at dusk. This was an enjoyable time, as children, parents, and grandparents often worked and relaxed together in a less formal setting, away from the pueblo. Their fieldhouses usually consisted of only one room and did not include an interior fireplace or hearth. Rather, the women built a cooking fire outside, often under a ramada, in front of the structure (Goodman, Field Notes 2001).

When farming activity began to seriously decline in the 1950s, less use was made of the little fieldhouses. By the early 1960s, most of them had been abandoned. Today, according to both Cochiti residents, no fieldhouses are left and no individual families are planting this land on the east side of the river (Goodman, Field Notes 2001).

During the 1950s there was a surplus of good agricultural land, especially east of the river. Some parcels lay idle for a number of years, with no one trying to claim and plant them. When assigned land was no longer being used, it reverted to the tribe for reassignment (Lange 1959:41). In 2001, according to life-long Peña Blanca resident, Clodoveo Hurtado, the fields located east of the river and across from Cochiti Pueblo, still belong to the tribe, and are irrigated, but are only used to grow alfalfa (Goodman, Field Notes 2001). Margaret Lovato and Lorraine Ortiz stated that after the completion of the new dam, the water level rose and all the surrounding fields were flooded. Now, alfalfa is about the only plant that will grow in those fields (Goodman, Field Notes 2002).

Cochiti House Types

In the past, Cochiti people maintained two principle types of house structures: those built as permanent homes in room blocks in the pueblo, and those known as fieldhouses, built as small individual structures near agricultural fields. Each was useful and convenient for specific activities that occurred at different times.

Fieldhouses. According to Mark Sutton (1977:35), "a field house is a small, seasonally occupied site, located . . . to allow for efficient exploitation of relatively distant agricultural land." Consisting normally of one to three rooms, it can be used for storage of crops, as a temporary shelter for agricultural workers, or as living quarters for families engaged in agriculture. If occupied for extended periods of time a fieldhouse may have a fire hearth and some associated trash; if only inhabited for short periods, these two elements may not be present (Sutton 1977:35–42). (For more extended discussion of pueblo fieldhouses, see J. Moore 1991:25–33).

Specific descriptions of historic Cochiti fieldhouses are rarely found in the literature, but following is one short general description: "Field houses were once common at Cochiti Pueblo but are used today [1965] by only a few families. A one-room house of adobe or jacal with an associated ramada was the common assemblage. Today, during the summer, some of these houses are lived in continuously, and others are utilized on a daily basis" (Skinner 1965a:21).

Skinner also includes several other common fieldhouse elements, though they do not specifically relate to Cochiti. He stated that in the Tewa area of Sapawe in north-central New Mexico, fieldhouses often consisted of a single room or a pair of contiguous rooms, usually defined by a rectangular arrangement of cobbles either sunk into the ground or present on the surface. There was no evidence of superstructures. Room sizes varied from approximately 4-by-5 ft to 10-by-12 ft, and sometimes a small room appeared to have been used for storage. Trash accumulation was seldom found with these remains and this lack is considered to be an indication of seasonal occupation (Skinner 1965a:18, 21) (see Table 7.1). In a 1978 publication, Florence Hawley Ellis described Tewa Pueblo fieldhouses dating from prehistoric through historic periods and provided useful general information as well as details concerning several specific fieldhouses near Santa Clara Canyon and also Nambé Falls (Ellis 1978:60–63). Although she does not provide room measurements, she states that these farm or fieldhouses generally consisted of one or two rooms, were located on tops of bluffs or steep hills bordering large and small river drainages, and that architectural remains were scanty. House foundations might consist of a line of stones one or two courses high, laid in clay. Scattered and limited trash remains reflect temporary occupation and discard down the steep terrace slopes. In some instances a small storeroom was located a short distance from a one or two-room fieldhouse, as was a thin scatter of sherds. If these descriptions are typical, then Cochiti fieldhouses (as well as Tewa) were occupied primarily during the summer agricultural season and differed significantly from regular Cochiti house construction, described below.

Cochiti Pueblo Room Block Houses. In the past, Cochiti farming families normally lived in sturdy, permanent houses in the village every winter and periodically during the summers. Now, these pueblo houses are generally occupied year-round. According to Charles Lange (1959:65–66), the typical Cochiti house foundation and lower courses were constructed of basalt, with the upper courses of adobe brick. Each wall was completely plastered both inside and out. The inner wall, which was smoother, was whitewashed with a special preparation of ground gypsum gathered in a canyon north of the pueblo. The lower quarter sof the interior walls were usually finished with a reddish brown wash made from ground stone found near the mouth of the Cañada de Cochiti. Roofs were constructed of vigas overlain by boards, tar paper, and adobe. Roof tops were carefully hollowed and in the center were one or more pipes which drained the basin.

Each house usually had a corner beehive

Table 7.1. Room Size and Description of Several Pueblo Fieldhouses

Pueblo Fieldhouses	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
Late Prehistoric Cochiti field house, LA 591, Las Mahadas site (Snow and Warren 1973:1-4)				Medium-sized flattish basalt slabs, laid on edge, two to three slabs wide. Larger, rounder rocks used for outside course. Small irregular stones used for chinking.	Hard adobe, in excellent condition	2	Shallow pit containing some ash in southwest corner of Room 1
Room 1 (Snow and Warren 1973:3-4)	2.00 m* (6.56 ft)	1.84 m (6.03 ft)	NA**				
Room 2 (Snow and Warren 1973:3-4)	1.95 m (6.40 ft)	1.40 m (4.60 ft)	NA				
Cochiti historic fieldhouse (no date) (Skinner 1965a:21)	NA	NA	NA	NA	NA	1 with associated ramada	Built of adobe or jacal
Tewa historic fieldhouses (Skinner 1965a:18)	(3.0 - 3.7 m) 10-12 ft	(1.2 - 1.5 m) 4-5 ft	NA	Cobbles on surface or sunk into ground in rectangular shape	NA	1 or 2	Associated trash accumulation seldom found
Tewa historic fieldhouses (Ellis 1978:60-63)	NA	NA	NA	A line of stones, one or two courses high, laid in clay	NA	1 or 2	Small and simply constructed. Located on tops of bluffs or hills bordering river drainages. Scattered and limited trash.
Historic Southwest fieldhouses (Sutton 1977:36-42)	NA	NA	NA	NA	NA	1 to 3	Seasonally occupied. Frequently lacked both fire hearth and trash.

* measurements made by original author have no parentheses around them
** information not available

fireplace, often near the door, and sometimes also a wood-burning stove. Floors varied between wood planking on joists and packed adobe. Either type was then usually covered with sheets of linoleum. The wood floor was easier to clean, but the adobe floor was less apt to become infested with mice, bedbugs, and other critters. The practice of rubbing fresh blood over the adobe to make a smooth, hard surface, noted by Bandelier in his journal of October 25, 1880, was still followed by Cochiti women in the 1940s and 1950s, whenever they were able to get sufficient quantities of beef blood to use for this purpose (Lange 1959:66–68).

In the summer, people spent much time outdoors, often under their ramadas, which also included adobe windbreaks and fires or wood stoves where most of the cooking was done. Barns, storerooms, and sheds were also common and provided storage space for certain items not needed in the house (Lange 1959:66–68).

In the literature, Cochiti room sizes were noted as follows. In 1884, Bourke, as cited in Lange (1959:70), stated that a room in the governor's house was 30 ft long by 15 ft broad, and 7 ft high, lighted by two selenite windows. . . . Another room was 59 ft long by 20 ft wide and 8 ft high. Bourke did not state whether just the governor's house had rooms this large or whether all the houses were so created.

In his diary entry for October 7, 1880, Bandelier gave the dimensions of a Cochiti room, and it too appeared to be quite large: east-west walls, 11 m; north-south walls, 5 m; wall thickness, 0.49 m; height of room inside, 2.60 m; window, 0.98 by 0.79 m; doorsill, 0.16 m below floor. Bandelier also stated that a stepping stone of lava, an old metate set in adobe, was placed before the door (Lange and Riley 1966:132–133). On this same date, Bandelier measured and described his own room, 3.72 m by 5.43 m, located on the northeast corner of the Cochiti home of Juan José Montoya (Lange and Riley 1966:136). On November 11, 1880, he briefly described Cochiti house foundations. Commonly, they were about 0.75 m underground, of stones (rubble), with adobe flung in between. When this wall reached the surface of the soil, then they began to lay the adobe (Lange and Riley 1966:202).

In historic times, Cochiti room sizes appeared to vary, but none of the few sets of existing measurements indicate that any of them were especially small. In general, based on sparse data, historic pueblo fieldhouses appear to be smaller in size than typical historic rooms found in permanent Cochiti pueblo homes. Prehistoric pueblo rooms, however, appear to be much smaller (Tables 7.1–7.2).

Table 7.2. Room Size and Description of Historic 1880s Cochiti Pueblo Houses

Historic Cochiti Rooms	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
Historic Cochiti Room #1 (Bourke in Lange 1959:70)	(9.15 m) 30.00 ft	(3.66 m) 15.00 ft	(2.13 m) 7.00 ft	-	-	-	Room in Governor's house; 2 selenite windows
Historic Cochiti Room #2 (Bourke in Lange 1959:70)	(17.99 m) 59.00 ft	(6.10 m) 20.00 ft	(2.44 m) 8.00 ft	-	Packed clay	-	Adobe walls, white-washed interior, two fireplaces
Historic Cochiti Room #3 (Bandelier in Lange and Riley 1966:132)	11.00 m (35.08 ft)	5.00 m (16.40 ft)	2.60 m (8.53 ft)	-	-	-	Cochiti family's winter room. Fireplace in center of south wall
Historic Cochiti Room #4 (Bandelier in Lange and Riley 1966:136)	5.43 m (17.81 ft)	3.72 m (12.20 ft)	2.00 m (6.56 ft)	-	-	-	Bandelier's room in northeast corner of house; chimney on north wall
Historic Cochiti Room #5 (Bandelier in Lange and Riley 1966:137)	11.00 m (35.08 ft)	3.50 m (11.48 ft)	NA	-	-	-	Storeroom with kitchen fire in southeast corner
Historic Cochiti houses (Bandelier in Lange and Riley 1966:202)	-	-	-	Stones (rubble) .75 m underground, with adobe "flung" between	-	-	-

Spanish (Hispanic) Land-Use Areas and House Types in the Cochiti-Peña Blanca Area

Agricultural Fields and Grazing Areas

The land ownership situation around Peña Blanca is quite complicated due to the preexisting Spanish land grants and the fact that formerly much of this area belonged to Cochiti Pueblo. Over the years a fair amount of this land was traded by the Cochitis to the Spanish because the pueblo wanted to consolidate their land holdings. So, gradually, much (though not all) of the land around Peña Blanca came under Spanish control. Some portions were planted in crops; houses were built on others. Peña Blanca people survived by raising livestock and growing corn, wheat, and a variety of fruits and vegetables. The system of ditches allowed for adequate irrigation in this hot, dry region.

According to Clodoveo Hurtado, the Indians formerly owned all the agricultural land located east of the Rio Grande. Both he and Margaret Lucero recalled that when they were young, in the 1920s, the Indians and the Spanish in the Cochiti-Peña Blanca area were friendly and got along well with each other. (Clodoveo's parents and grandparents had told him this same situation existed when they were young, also). Therefore, the Cochitis let the Spanish grow crops on some of the Indian-owned agricultural land near the river. No rental fees were involved. (Cordelia Snow also mentioned the Spanish practice of borrowing Cochiti land for cultivation purposes and provided evidence that such cooperation existed as early as the 1660s [1979:219].) It was standard practice for the two groups to support and help each other whenever necessary. Over time, however, as more land-trades took place, much of the land around Peña Blanca became the property of the Spanish residents and much of the surrounding land, especially north of the town, became the property of the Cochitis. Presently, cooperation between the two groups is much more limited (Goodman, Field Notes 2001–2002).

Clodoveo Hurtado also recalled that the Indians, in days past, kept their livestock on the west side of the Rio Grande. As mentioned above, the fields just east of the river were used by the tribe for agriculture, mostly for growing corn and wheat. He said that the Indians owned all the land clear up to La Mesa (this includes the land up to La Bajada), even though they didn't run sheep or cattle on it. For as long as he can remember, the Spanish never owned and never lived on any of this land. Margaret Lucero and Lorraine Ortiz could not recall any Spanish-owned cattle being pastured on the west side of NM 22, north of Peña Blanca because all that land belonged to the Indians. Rather, the Spanish ran their cattle on the east side of NM 22, but not near the present road. Many of the cattle were kept in an area called "Ojito" located northeast of Peña Blanca, up the hill by the Cochiti grade school. There was water up there and it was a good place for cattle. They also spoke of cattle being pastured each summer on La Mesa above La Cienega and La Cieneguilla, east and north of Peña Blanca, and in the Valle Grande, northwest of Peña Blanca. These were the traditional areas used in the past by the Spanish for their cattle (Goodman, Field Notes 2002).

When Clodoveo's father, Eugenio, was young, he, as well as a number of other men from Peña Blanca, worked as sheep herders for Elfego Pino, a wealthy patron from La Cienega, who owned large herds of sheep. Eugenio and the others herded the animals up into the Valle Grande every summer and brought them back to the Galisteo area each winter. Large herds were never kept in the Peña Blanca area due to insufficient corral space and pasture land (Goodman, Field Notes 2001).

Later, Clodoveo, himself, ran cattle up around La Bajada. In the summer he moved them to La Mesa or to Agua Fria near Santa Fe. However, he did say that Esquipula Baca at one time owned a great deal of land in Peña Blanca. One especially large tract, located on the west side of the highway (NM 22), began at the hill just north of Peña Blanca and continued north a little beyond the junction of NM 16 and NM 22. For a period of time, Esquipula's son kept cattle on this property, and Clodoveo sometimes helped him take them to the river to water them. Esquipula sold this tract of land to the tribe sometime during the 1930s. Now it belongs to Cochiti, it is fenced and gated, and no one is allowed to enter (Goodman, Field Notes 2001).

The above descriptions indicate that, at least in the recent past, the Spanish did not live or run livestock on the ridges located east of the Rio Grande, just east of the Cochiti agricultural fields. Clodoveo and his wife, Mary, both recalled the presence of several small, one and two-room Spanish houses on the hill just north of Peña Blanca, on the west side of NM 22, during the years they were growing up. But they, as well as other older residents of Peña Blanca with whom they had spoken, did not recall any similar small structures on the ridges farther north (Goodman, field notes 2001). Therefore, in the past 80 to 100 years, it is unlikely that Spanish residents occupied the historic structures on LA 249, LA 6169, or LA 6170. Margaret Lucero and Lorraine Ortiz, however, did recall a number of small houses on those ridges at the time they were children, and those houses were occupied by Cochiti people (Goodman, Field Notes 2002).

House Types

According to Pratt and Snow (1988) and Snow and Warren (1973) there was a tendency for early Spanish colonists to select building sites located as close as possible to a pueblo. There were three good reasons for this: (1) Indian goods and services were more readily available; (2) Indian people always lived near a permanent water source as well as good agricultural land; and (3) since a Catholic mission was present in the pueblo, a priest was nearby. All of these elements were necessary for the survival of Spanish colonists. Evidence of such living arrangements exists on a number of sites in and near Cochiti Pueblo, and covers several centuries. For example, during the seventeenth century, two Spanish colonial house sites (LA 34 and LA 591) were located about a league (approximately 3 miles) east of Cochiti Pueblo, just inside the present Cochiti grant boundaries (Pratt and Snow 1988:167). Two eighteenth-century sites (LA 70 and LA 6178), located between LA 34 and LA 591, were probably situated near Cochiti for similar reasons (Snow and Warren 1973:41). The Trujillo House, a later nineteenth-century site at Abiquiu, New Mexico, was located near a number of abandoned pueblos, but was a bit farther away from the still inhabited pueblos of Santa Clara and San Juan (J. Moore 2004).

Most Spanish dwellings built during the Colonial period were simple in concept and structure. Only a small number fit the "typical" Spanish Colonial pattern of a large house built around a central patio as described by Davis in 1857 (1938:40, 50–52). Initially, few families were wealthy enough to afford large homes, although over a period of years, some houses grew in piecemeal fashion as different relatives added rooms and moved their families into them (Bunting 1976:59–60).

In contrast to these few large structures, the typical seventeenth-century house consisted of two or three rooms which were approximately 15 ft in width and of variable length. E. Boyd noted that the Spaniards preferred a few relatively large multipurpose rooms, as opposed to the numerous small rooms used by the Pueblo Indians (Bunting 1976:60). Basically, each room in a Spanish house was large and rectangular in shape and could be used for a variety of purposes (Table 7.3). It was not unusual for household activity to be moved from room to room in order to stay warmer in winter, for example, or to move away from a leaky roof, etc. Sometimes a kitchen might have an extra-large fire place, which could differentiate it from other rooms in the house. Usually the largest and most elaborate room was the *sala* or parlor (Bunting 1976:60, 65).

Other structural features were also practical and straightforward. Floors were earthen. Wood was very expensive and bricks or tile simply were not used. Ceilings consisted of a primary system of large logs that spanned the

Table 7.3. Room Size and Description of Seventeenth-Century Spanish Colonial Houses

Historic Spanish Structures	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
General description (Bunting 1976)	Variable	15 ft	NA	NA	Earthen	2 or 3	Single-file string of large, multipurpose rectangular rooms built in a straight line, an L, or a U shape
Las Mahadas site, LA 591, NE of Cochiti (Snow and Warren 1973)			NA	Large to medium size cobblestones set in shallow trenches, 2-3 cobbles thick, 2 to 3 courses high; all faces contained adobe mortar	Not described	5	Single-file string of 5 large rooms built in an L shape
Room #1	6.15 m (20.2 ft)	4.30 m (14.1 ft)					
Room #2	6.00 m (19.7 ft)	4.65 m (15.3 ft)					
Room #3	5.00 m (16.4 ft)	4.15 m (13.6 ft)					
Room #4	8.00 m (26.2 ft)	4.30 m (14.1 ft)					
Room #5	5.75 m (18.9 ft)	5.60 m (18.4 ft)					

room and supported a secondary covering of smaller wood pieces usually laid at right angles. Aspen, cottonwood, willow, or cedar was often used for the secondary layer, which was then covered with a layer of brush or cedar bark. The entire ceiling construction was then covered with adobe to form the roof or the floor of the room above (Bunting 1976:65).

Many houses built during the seventeenth century consisted of a string of rooms in single file built in a straight line or bent into an "L" or a "U" shape. Any of these house plans allowed for expansion whenever necessary. Rooms built in this linear fashion may or may not have been interconnected. Each had an outside door or window, but seldom both, since squared timber for woodwork was difficult to find (Bunting 1976:63). Windows were one of three types: fixed sash, casement, or slabs of selenite built into the masonry. See Bunting (1976:67) for more detailed description of window construction. Glass for windows was unknown until the Americans began to import it roughly in the mid 1800s (Bunting 1976:69).

The portal, or covered porch, was a feature of many of these early structures (Bunting 1976:72). Most often located on the south or east side of a simple building, the portal consisted of a long beam, running parallel to the façade, and usually supported by two or more posts. The long beam supported a set of *vigas* approximately 15 ft in length, round and smaller in size. Corbelled brackets, known as *zapatas*, were fitted as extra supports between the principal beam and the vertical posts (Bunting 1976:72).

The interior of a Spanish colonial house was usually not elaborate. Walls were surfaced with mud plaster, the color of which depended on locally available clay. The earthen floors were sometimes sealed with a thin coating composed of clay and animal blood. Windows and doors were often deeply recessed. Heat was supplied by a *fogon* or fireplace, usually, but not always, built in a corner of the room. Generally the *fogon* was roughly a quarter round in plan, had a narrow (approximately 20 inches) parabola-shaped opening, a low (6 to 8 inches) hearth, a shallow firebox, a pronounced mantel, and a square projecting flue set into the corner. The firebox was usually so small that logs had to be placed in an upright position, but the thermal efficiency was quite good (Davis 1938:51–52). A kitchen sometimes needed a larger fireplace, and in this case the opening was made larger (up to 4 ft 4 inches) and the firebox was covered with a bell-shaped hood (Bunting 1976:72, 74–75).

One site with relevant descriptive material is the Las Mahadas site, LA 591, located approximately 3 miles north and east of Cochiti Pueblo, on the east side of the Rio Grande. It included both a late prehistoric Pueblo fieldhouse and a seventeenth-century Spanish Colonial house—offering some good comparisons. The wall foundations (which were all that remained) of the two-room, prehistoric (Pueblo IV) farmhouse or fieldhouse consisted of medium-sized flattish basalt slabs, laid on edge, two to three slabs wide. Somewhat larger, more rounded rocks comprised an outside course, while small, irregular stones were used for chinking (see Table 7.1). The floor was of hard adobe, in excellent condition, and an interior partition wall was added after the floor was completed. The depth of the floor below the top of the remaining wall foundations averaged 15 cm. The larger room measured 1.84-by-2.00 m and the smaller measured 1.40-by-1.95 m. A shallow pit was uncovered in the southwest corner of the larger room, some ash was present inside it, and there was evidence of burning (Snow and Warren 1973:1, 3–4). Thus, small room size, well-constructed foundations, and a solid floor appear to be characteristic of this late prehistoric pueblo farmhouse which was isolated from the pueblo.

Spanish house structure on the Las Mahadas site (LA 591) was quite different, however. It consisted of a five-room, L-shaped, seventeenth-century Spanish Colonial house. All of the wall foundations were constructed of large- to medium-size cobblestones set in shallow trenches. These foundations were two or three cobbles thick, two to three courses high, and all faces contained adobe mortar. It is thought that the walls were built of adobe bricks, though none were found in place. Floors were not described. The size of the rooms was considerably larger than those in the prehistoric Pueblo farmhouse. The smallest room (Room 3) in the Spanish Colonial house measured 5.00-by-4.15 m. The others measured 6.15-by-4.30 m (Room 1), 6.00-by-4.65 m (Room 2), 8.00-by-4.30 m (Room 4), and 5.75-by-5.60 m (Room 5) (see Table 7.3). All interior walls appeared to have been plastered and some were whitewashed. Fireplaces were present in two rooms, not in the other three (Snow and Warren 1973:3–9). Thus it is evident that Spanish residents moved into the Cochiti area quite early and it is also clear that the architectural styles and manners of living exhibited by the Spanish and the late prehistoric Pueblos were quite different.

By way of contrast, a small Spanish habitation area (Carnue, east of Albuquerque), occupied briefly in the 1760s but abandoned because of Indian raids, revealed even simpler dwellings than the house remains on the Las Majadas site. Each house on this eighteenth-century site consisted of a single room with a corner fireplace plus an attached shelter that was probably covered with corn stalks and hay. An outside *horno* (beehive oven) was also typical (Table 7.4). Houses were loosely grouped around two plazas, and a crude adobe wall, built for defense, surrounded the community (Bunting 1976:59–60).

Some eighty years later, this same house type was still quite common. As described by T. J. Edwards and various other authors in the 1840s and 1850s, and quoted in Bloom (1959:177–178), the houses of common people usually consisted of only one room (Table 7.5). The entrance was not always covered by a door, but often with coarse fabric or hides instead. Sometimes small windows were present. The interior was lighter and brighter than might have been expected because the walls were white-washed with a powdery white gypsum. Since the latter easily rubbed off on one's clothes, families that could afford to do so, covered the walls to a height of about 5 ft with calico or wallpaper. A type of banquette, or built-in bench, ran around all the interior walls of most (though not all) homes. Chairs and tables were rare in the homes of the poor. Floors were earthen. Poorer families often covered them with tattered blankets or old robes, while wealthier families used plush carpets. Ceilings consisted of large beams and smaller cross-pieces which supported thick, flat, earth-covered roofs. Each house contained a family

Table 7.4. Room Size and Description of Eighteenth-Century Spanish Colonial Houses

Historic Spanish Structures	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
Carnue, SE of Cochiti (Bunting 1976)	NA	NA	NA	NA	NA	1 with attached shelter	Each house included a corner fireplace, an attached shelter, and an outdoor horno. Houses built of adobe or jacal.
LA 70, NE of Cochiti (Snow 1976, Sect. E:5-9)			NA	NA	Layers of thin adobe plaster	4	Prehistoric pueblo rooms refurbished and reoccupied by Spanish. Fireplaces in 3 rooms, raised cobble sills in doorways, plastered walls.
Room 117	5.1 m (16.7 ft)	2.5 m (8.2 ft)					
Room 123	3.8 m (12.5 ft)	2.5 m (8.2 ft)					
Room 125	3.6 m (11.8 ft)	2.2 m (7.2 ft)					
Room 129	5.0 m (16.4 ft)	3.9 m (12.8 ft)					

Table 7.5. Room Size and Description of Nineteenth-Century Spanish Colonial Houses

Historic Spanish Structures	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
General description (Bloom 1959)	NA	NA	NA	NA	Earthen	1	Door opening often covered with coarse fabric or hide rather than wood. Some small windows. Often an inside banquette, and a family altar on one wall.
Trujillo House, LA 59658, Abiquiu (Moore 2004)				None present	Thin adobe layers; much deteriorated	8	C-shaped structure
Room #1	4.9 m (16.07 ft)	4.3 m (14.10 ft)	NA				
Room #2	6.0 m (19.68 ft)	5.0 m (16.40 ft)	NA				
Room #3	5.6 m (18.39 ft)	4.4 m (14.43 ft)	NA				
Room #4	7.0 m (22.96 ft)	4.4 m (14.43 ft)	NA				
Room #5	6.8 m (22.30 ft)	4.4 m (14.43 ft)	NA				
Room #6	4.1 m (13.45 ft)	3.8 m (12.46 ft)	NA				
Room #7	5.1 m (16.73 ft)	4.1 m (13.45 ft)	NA				
Room #8	4.4 m (14.43 ft)	3.0 m (9.84 ft)	NA				

altar or chapel with saints, rosaries, and other sacred objects, usually placed around a huge crucifix hung in the center of one wall (Bloom 1959:177–178).

In especially poor localities two other types of house construction were, on occasion, found: houses that were partially dug out, with above-ground adobe walls; and houses formed by placing logs upright in the ground, then plastering them over with mud. The roofs were flat and composed of the same materials (Bloom 1959:179).

An example of a nineteenth-century Spanish house comes from north-central New Mexico, LA 59658, the Trujillo House at Abiquiu, New Mexico. This 8-room house, built in a C shape, included mostly large, rectangular rooms built without foundations, and floors of thin layers of puddled adobe, most quite deteriorated. The largest room measured 22.96-by-14.43 ft; the smallest, 14.43-by-9.84 ft. The others fell in between (see Table 7.5) (Moore 2004).

Interviewees discussed rooms and houses in Peña Blanca, probably built between the late 1800s and the first half of the 1900s. Attached houses were fairly common; one family lived in one portion of a house and a related family lived in another portion. A wall with no interior door usually separated each family's unit. A two- to four-room house without hallways was typical. The door of one room just opened directly into another room. Adobe walls of old rooms were almost 2 ft thick. The ceilings were often made of *vigas* and *latillas*; however, some of these have been hidden by plastered ceilings. Remodeling of old homes is another fairly common pattern. The oldest parts of a house are often torn down and new rooms built to replace them. Rooms will often change function during the course of remodeling. A former kitchen can become a bedroom, a former bedroom can become a living room, and so forth. Mary and Clodoveo Hurtado described this process for the house they live in. Only one original room remains; all the other rooms were torn down and replaced by new ones in the 1960s. The remaining original room measured about 20 ft long by 14 ft wide. Mary Hurtado stated that people usually use adobe to make additions or partitions to their houses. The adobe bricks used in their own house are about a foot-and-a-half long and are very sturdy. Mary commented that the size of the rooms depended on how wealthy or poor a particular family was. Large rooms were found in homes of people with a little more money; smaller rooms in homes of those with less (Goodman, Field Notes 2001–2002).

Gloria Hurtado and her mother, Margaret Lucero, described the situation concerning their house. It has been in Margaret's family for at least three generations before her. No one knows who originally built it or when, but it is considered to be one of the oldest houses in Peña Blanca. Originally this house had four rooms in a straight row. Gloria's grandmother, Trinidad Aragon, gave half of this house (two rooms on the east side) to her son, Joseph, when he moved back to Peña Blanca after living for a number of years in Detroit. There was a dividing wall between the two halves of the house. Joe later added two more rooms to his half in order to create a larger house for his family. He also helped Margaret (who inherited her mother's half) add two more rooms to her part of the house. One of the new rooms was a kitchen. A former bedroom became a living room, and the former kitchen became a bedroom (Goodman, Field Notes 2001–2002).

Mary Hurtado spoke of the ways people helped each other with housing in the past. Her family moved to Peña Blanca in 1932, and friends lent them their house—free. People didn't have to pay rent in those days. If a family needed a place to stay, and there was an empty house, they usually could just stay in it. Their principle obligation was to take care of the house and keep it in good condition (Goodman, Field Notes 2001).

Historic Components of LA 6170, LA 6169, and LA 249

Archaeological Information Available on Historic Components of LA 6170

LA 6170 was first examined by Ed Dittert and Frank Eddy of the Museum of New Mexico in 1961. They excavated the eastern half of a structure they called an historic period farmhouse (Feature 1). This portion, which extended into the NM 22 highway right-of-way, included a footing wall composed of two parallel lines of upright river cobbles, approximately 1.5 ft apart and 0.6 ft high. The space between was filled with adobe melt and occasional large cobbles. There was no direct evidence of upper wall courses, and the floor was recessed only slightly below the bottom of the foundation wall. The floor surface was minimally present, with no evidence of plaster or intentional packing. The only floor feature was a shallow, circular, subfloor pit, measuring 2.4 ft in diameter, 0.8 ft deep, located 1.1 ft from the north wall of the structure. There was little modern refuse around this foundation; rather there were a number of Tewa Polychrome potsherds. Based on this evidence, as well as the large size of the structure (approximately 31 ft long and over 18 ft wide), they concluded that the structure was at least 100 years old, and probably older (Ware 1997:28–29, 1998:44–45).

One Cochiti laborer on the crew stated that the wall foundation of Feature 1 was much narrower than was traditionally constructed at Cochiti Pueblo, and that modern houses have much deeper recessed floors (up to 1.5 ft in depth). (This does not preclude the fact that a fieldhouse, used only seasonally in the summer, may have been constructed differently, and perhaps with less care, than a traditional Cochiti house in the pueblo). Another of the Cochiti laborers who worked for Dittert and Eddy in 1961, the Lt. Governor of the pueblo, told them that the Rio Grande terraces once supported numerous fieldhouses that were occupied each year only during the growing season. Most of these houses were abandoned with the advent of automobiles and roads in the area and very few were still in use in 1961 (Ware 1997:28–31, 1998:44–45). If this structure had been one of those fieldhouses, it most likely would have been built and utilized by Cochiti inhabitants in years past.

During the course of Nancy Akins's 1998 excavation of the western half of this same historic structure (Feature 1) (see archaeological section of this report), the remaining rectangular cobble foundation was uncovered, which measured 4.5 m sq. There was no evidence of an upper wall, which she felt probably had been built of adobe bricks that were later salvaged. The floor was poorly preserved and difficult to follow, with no evidence of intentional preparation or packing. Prehistoric pit structures were found underlying it. Feature 41, an amorphous pile of rock (2-by-3 m) located several meters north of the rectangular structure (Feature 1), may have been associated with it. The lack of datable material remains on or near these features made it difficult to determine their age (Ware 1998:45–50) or to establish a cultural affiliation (see Table 7.6).

Archaeological Information Available on the Historic Component of LA 6169

LA 6169 was first recorded by Ed Dittert and Frank Eddy of the Museum of New Mexico in 1961. They described a rectangular cobble

Table 7.6. Room Size and Description of Three Historic Sites of Unknown Cultural Affiliation LA 6170, LA 6169, and LA 249

Historic Structures of Unknown Affiliation	Length	Width	Height	Foundation Material	Floor	Number of Rooms	Additional Information
LA 6170	31 ft (9.5 m)	18 ft (5.5 m)	NA	2 parallel lines of upright river cobbles filled with adobe melt	Poorly defined, no plaster or evidence of packing	1	Shallow, circular subfloor pit near north wall; some Tewa polychrome sherds, little modern refuse
LA 6169	9.0 m (29.5 ft)	7.0 m (23 ft)	NA	Rectangular cobble footing	NA	1	Large subrectangular ring of poorly sorted river cobbles. Opening to the north, no cultural remains
LA 249				NA	NA	2	Some Tewa polychrome sherds present
Large room (Feature 1)	20.0 m (65.6 ft)	12.0 m (39.4 ft)	NA				Two rectilinear cobble concentrations superimposed on a prehistoric pueblo room block
Smaller room (Feature 2)	10.0 m (32.8 ft)	4.0 m (13.1 ft)	NA				

room northwest of a prehistoric adobe room block, near the edge of the gravel terrace. They thought that the cobbles probably had served as the footing for a “modern” Cochiti farmhouse. Being that this historic foundation was well outside the 1961 project area and would not be affected by it, no excavation or mapping of the site occurred (Ware 1997:25).

The site was revisited in the mid-1960s by Stewart Peckham and Susan Wells (1967) and was described as being largely destoyed by highway construction. Among several other features, it still contained a possible historic Cochiti farmhouse, called Feature 1. More than 30 years later, when Sandra Marshall examined it in her 1996 survey, she described Feature 1 as a house rubble mound (Marshall 1997). It consisted of a large oval to subrectangular ring of poorly sorted river cobbles, open in the center, with an entryway or opening in the north wall of the ring. The ring measured approximately 9 m north-south by 7 m east-west, and was raised about 30–40 cm above the surrounding terrace surface. There was no evidence of any superstructure nor of any historic artifacts in or around it (Ware 1997:26, 28).

Ware speculated that (1) the structure could have been very old—perhaps late prehistoric or early historic, which would account for the lack of historic refuse; (2) The superstructure might have been dismantled and moved off site, leaving only the cobble footings; (3) The location of this feature within 1 to 2 m of the western edge of the terrace may also help to account for the lack of material deposition; (4) It is possible that this feature was a Pueblo shrine, since its size and form are vaguely reminiscent of hilltop shrines in the Northern Rio Grande (Ware 1997:28).

Suppositions 1, 2, and 3 above are certainly possible. There is currently no way to prove or disprove them. It is rather unlikely, however, that a 7-by-9 m single-room structure would have been a prehistoric pueblo structure. These measurements are more in line with historic Cochiti or Spanish Colonial room size.

Supposition number 4, however, appears to be less likely. LA 6169, with its denseness of poorly sorted river cobbles forming a roughly rectangular or ovoid pattern with an opening to the north, simply does not fit the form of the traditional Pueblo shrine. In 1900, Frederick Starr (1900:219–223) carefully described and presented drawings of ten different shrines located in the vicinity of Cochiti Pueblo. Some were defined by a single line of stones placed in the form of a circle or ring. Others were either horseshoe shaped, semicircular, or consisted of one or several specially placed rocks. The stones used in a shrine always appear to have been carefully chosen and arranged in a particular manner, with an opening either toward the east or toward the Pueblo. The largest diameter measured for any of these circular shrines was 15 ft (Starr 1900:222), considerably smaller than the 30-by-23 ft rectangle or ovoid shape present on LA 6169. None of the Cochiti shrines described by Starr included a dense concentration of cobbles forming a large rectangle or ovoid, and none opened to the north. Material presented by Esther Goldfrank also supported Starr’s statements concerning Cochiti shrines (Goldfrank 1927:70–71).

Ellis (1969:166–175) presents information concerning Keresan shrines that supports and expands upon Starr’s statements and drawings. Stones in some Keresan shrines, according to Ellis, were shaped to represent animals or other spirits; stones in others were not shaped, but were used for the same purpose. Petrified wood, used to provide protection and to symbolize the War Gods, was often present, along with the other stones. Ellis stated that the most common Keresan shrines consist of a line of stones laid in a circular ring or a horseshoe shape with the opening toward the east, toward the village, or in some cases toward the supposed location of the spirit being addressed (Ellis 1969:167, 170). Since the structure on LA 6169 does not fit any of the above descriptions, it most likely is not a shrine (Fig. 7.1).

The ovoid cobble structure on LA 6169 was also briefly compared with *herraduras*—round or semi-circular prehistoric, Pueblo rock structures which are located near, and are markers of, some of the Chacoan roads farther to the

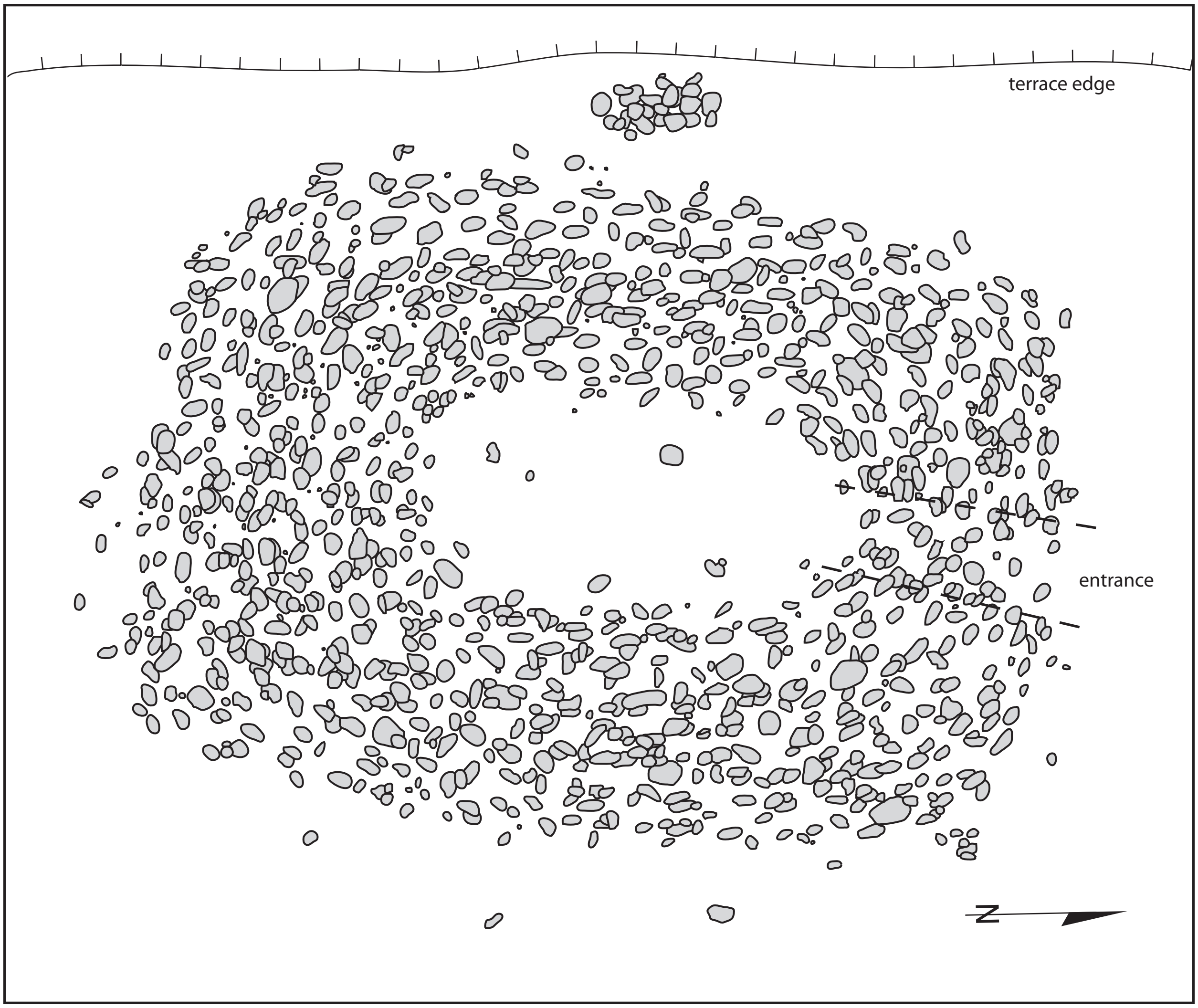

Figure 7.1. Rock fall remains of historic structure, LA 6169.

west (Kincaid 1983:C 13–C 20). However, the characteristics of shape and size, as well as the careful placement of stones in these Puebloan road markers do not fit with the description of the LA 6169 structure, thus eliminating this type of structure as a possibility.

In the 1998 site work carried out by Stephen Post, this structure was considered to be the remains of an historic period farmhouse, as had been described in the earlier archaeological surveys. Because it was outside the right-of-way and the project area, no excavation was undertaken. Since there were no material culture remains, there was no opportunity to either date this site or assign it a specific cultural affiliation (Ware 1998:42–44) (see Table 7.6).

Archaeological Information Available on Historic Components of LA 249 (Tashkatze Pueblo)

LA 249 was first recorded by H. P. Mera in the 1930s. According to Charles Lange, it is known as Tashkatze, "the place of the potsherds" (Lange 1968a:318). Lange stated that the site included a medium-sized pueblo, in the form of a block "O," with a superimposed rectangular foundation dating to the historic period (1968a:318). According to John Ware (1997:20), the historic features on this site consist of two rectilinear cobble concentrations that are superimposed on the northwest portion of prehistoric pueblo Room Block 1. These comprise two possible room foundations, located well outside the project limits.

The larger historic structure, noted as Feature 1, which measures approximately 20 m north-south by 12 m east-west, straddles the northwest corner of the earlier adobe structure. There are few visible cobble alignments but probably sufficient cobbles to construct an adobe and cobble wall about 1 to 2 m high (Ware 1997:20).

The smaller historic structure, noted as Feature 2, is located approximately 5 m east of the first, and partially overlies several rooms in the northern portion of Room Block 1. It consists of a rectangular alignment of large waterworn cobbles, two or more courses in width, measuring approximately 10 m east-west by 4 m north-south, which enclose a central area free of cobbles. There are fewer cobbles associated with Feature 2 than with Feature 1, and it is possible that the rock alignments represent the foundation of a structure that had either wood or adobe walls. A small amount of Tewa Polychrome potsherds probably correlate with the construction and occupation of Features 1 and 2. The function of these two historic structures is unknown. Ware hypothesizes that they are contemporaneous and that possibly they had some kind of complimentary function due to their close proximity with one another (Ware 1997:20–21) (see Table 7.6).

Discussion and Comparisons

Based on the findings presented above, it appears that in general, room size of both Spanish Colonial and historic Cochiti Pueblo house structures is large, ranging in length from approximately 13 to 59 ft and in width from 10 to 20 ft. By comparison, room size of late prehistoric Cochiti fieldhouses is significantly smaller, approximately 6 to 7 ft by 4 to 6 ft. Although descriptive information on historic Pueblo fieldhouses is extremely limited, room size of several historic Tewa fieldhouses does exist and shows them to be small to medium sized, approximately 10 to 12 ft by 4 to 5 ft (see Tables 7.1–7.5). Currently no published measurements of historic Keresan fieldhouses are available. Thus, Cochiti fieldhouses might or might not match Tewa fieldhouses in size. Upon examination of the room sizes of the historic structural remains on LA 6169, LA 6170, and LA 249, they appear to fit most comfortably with the sizes stated above for both the Spanish Colonial and the historic Cochiti houses. Rooms on these three sites range from approximately 29 to 65 ft by 13 to 39 ft (see Table 7.6). Thus, with the information currently available concerning only room size, there is no way to determine cultural affiliation of these three historic sites.

An examination of house foundations does little to help clarify the situation, either. Spanish Colonial house foundations appear to be composed primarily of cobbles with adobe fill. Cochiti house foundations are sometimes composed of stones with adobe fill but often are basalt slabs. During excavation of late prehistoric portions of LA 6455 (a probable Cochiti habitation site west of the Rio Grande), as part of the Cochiti Dam Project, Charles Lange described alignments of basalt and other cobbles mixed with adobe, and also foundations consisting of a single course of cobbles, which served as a base for the walls above (Lange 1968a:73, 78, 80). Apparently a variety of foundation and wall materials were used by the Cochitis in the past. Some late prehistoric Cochiti fieldhouse foundations consisted of flattish basalt slabs (Snow and Warren 1973:1–4). Specific descriptions of historic Cochiti fieldhouse foundations do not exist. More general Tewa pueblo descriptions support the presence of a rectangular arrangement of cobbles either sunk into the ground or present on the surface as indicators of former fieldhouses (see Tables 7.1–7.5). The foundations of all three historic archaeological sites: LA 6169, LA 6170, and LA 249, include variations on the theme of rectangular lines of river cobbles, usually with adobe fill (see Table 7.6). In general, cobble foundations might be more typical of Hispanic room structure than Cochiti, but on the three historic sites in question, it would have required tremendous extra effort to haul basalt slabs up on the river terraces just to build foundations of basalt, especially when river cobbles were ever-present on each of the building sites. Also, there was a precedent for using such cobbles in late prehistoric times. It is certainly possible that Cochitis from the historic period could have utilized cobbles present at these locations, if they were, indeed, the builders of these structures. Again, there is nothing definitive about the foundations themselves, however, to help distinguish the cultural affiliation of the historic rooms on these sites.

Even though no definite conclusion can be presented concerning the cultural affiliation of these rooms, a preponderance of circumstantial evidence (presented in the Summary below and in the Conclusions) leads to the possibility, perhaps even likelihood, that these structures were historic Pueblo fieldhouses rather than Spanish habitations. The following summary of findings is not exhaustive but does include several sets of comparisons of room descriptions and room sizes for both Pueblo and Hispanic structures in the Cochiti and/or Tewa Pueblo areas of New Mexico (see also Tables 7.1–7.6).

A Summary Comparison of Several Pueblo and Spanish Rooms with Historic Rooms on LA 6170, LA 6169, and LA 249

Prehistoric Pueblo Fieldhouses

Description of Cochiti Late Prehistoric Fieldhouse Rooms (see Table 7.1)

LA 591, Las Mahadas, two-room fieldhouse. Wall foundations consisted of medium-sized flattish basalt slabs, laid on edge, two to three slabs wide. Larger, more rounded rocks comprised an outside course, small irregular stones used for chinking. Floor of hard adobe (Snow and Warren 1973:1–4).

Sizes of Cochiti Late Prehistoric Fieldhouses
LA 591, Las Mahadas
1.84-by-2.00 m (approx. 6-by-6.5 ft) (Snow and Warren 1973:3–4).
1.40 by 1.95 m (approx. 4.6-by-6.4 ft) (Snow and Warren 1973:3–4).

Historic Pueblo Fieldhouses

Description of Historic Cochiti and Tewa Fieldhouses
Cochiti fieldhouses consisted of a one-room adobe or jacal house with associated ramada. As of 1965 they were only used by a few families, but had been much more common earlier (Skinner 1965a:21). No information is available on room size, foundations, or locations.

At Sapawe, north-central New Mexico, Tewa fieldhouse remains consisted of a rectangular arrangement of cobbles sunk into the ground or on the surface. Either a single room or a pair of contiguous rooms usually constituted a fieldhouse, although in two cases more rooms were present. No superstructures remained. No definable trash accumulation was present except on the two larger sites (Skinner 1965a:18).

From San Juan to Santo Domingo, fieldhouse remains could consist of a line of stones one or two courses high, laid in clay as a foundation. Walls were of post and mud jacal construction, but none remain. Some Nambé fieldhouses were one room, of jacal, on the crest of a steep knoll; others were two-room jacal fieldhouses, which included a cooking room and a sleeping room. Throughout this area, fieldhouses of the late nineteenth and early twentieth centuries held few household goods, were simply constructed, and were not spacious (Ellis 1978:60–63).

The average pueblo fieldhouse had one to three rooms, was seasonally occupied, and usually lacked a fire hearth and trash. Both might be present if the site were occupied for a longer period of time (Sutton 1977:36–42).

Sizes of Historic Cochiti and Tewa Fieldhouse Rooms
Cochiti: no information available.
Sapawe area: Rooms ranged in size from 4-by-5 ft to 10-by-12 ft (Skinner 1965:18).

Historic Cochiti Pueblo Rooms

Description of Historic Cochiti Pueblo Rooms
Regular Cochiti house construction consisted

of a foundation and lower courses constructed of basalt; upper courses of adobe brick. Inner and outer walls completely plastered. Floors of wood planking on joists or packed adobe. Nearby associated structures might include a ramada, barn, storeroom, or shed (Lange 1959:65–68).

Sizes of Historic Cochiti Pueblo Rooms (see Table 7.2)

Rooms described in 1884 by Bourke (Lange 1959:70)
Room #1: 30-by-15 ft (approx. 9-by-4.6 m)
Room #2: 59-by-20 ft (approx. 18-by-6 m)

Rooms described in 1880 by Bandelier (Lange and Riley 1966:132-137):
Room #3: 11-by-5 m (approx. 36-by-16 ft)
Room #4: 3.72-by-5.43 m (approx. 12-by-17 ft)
Room #5: 11.0-by-3.5 m. (approx. 35-by-11.5 ft)

Historic Hispanic Rooms

Description of Typical Seventeenth-Century Spanish Colonial Rooms
Each house consisted of two to three rooms, large and rectangular in shape, used for a variety of purposes. Floors were earthen. Usually a string of rooms in single file built in a straight line, an L, or a U shape (Bunting 1976:60–65).

LA 591, Las Majadas site, northeast of Cochiti, seventeenth-century site. Five rooms built in an L-shape. Wall foundations constructed of large to medium-size cobblestones set in shallow trenches, two to three cobbles thick, two to three courses high, all faces containing adobe mortar. Floors not described (Snow and Warren 1973:3–9).

Description of Typical Eighteenth-Century Spanish Rooms
Carnue, southeast of Cochiti, eighteenth-century site. Each house consisted of a single room, plus an attached shelter that was probably covered with corn stalks and hay (Bunting 1976:59–60).

LA 70, north and east of Cochiti, eighteenth-century refurbished site. Three groups of prehistoric rooms were refurbished and reoccupied during the eighteenth century, probably by Spanish settlers. Room Group A (the only group to be discussed here) consisted of four large rooms, most with thin adobe plaster layer(s) comprising the floor, raised cobble sills at a number of doorways, plastered walls, and some interior walls covered by whitewash. Fireplaces or hearths were found in three of the four rooms (Snow 1976, Sect. E:5-9; Sect. A, fig. 8A).

Description of Typical Nineteenth-Century Spanish Rooms
Houses of common people often consisted of only one room. Floors were earthen and covered with old blankets or robes (Bloom 1959:177–178).

Trujillo House, Abiquiu, New Mexico, LA 59658, nineteenth-century site. A different type of residence, the Trujillo House included eight separate rooms built in a C shape, no room foundations, and thin floors of puddled adobe, much deteriorated and hard to define (Moore 2004).

Sizes of Spanish Colonial Rooms (see Tables 7.3–7.5):

Typical seventeenth-century room sizes:

5 ft (approx. 4.6 m) wide by a variable length (Bunting 1976:60).

LA 591, Las Mahadas site, seventeenth-century Spanish Colonial rooms (Snow and Warren 1973:3-9):
Room 1: 6.15-by-4.30 m (approx. 20.2-by-14.1 ft)
Room 2: 6.00-by-4.65 m (approx. 19.7-by-15.3 ft)
Room 3: 5.00-by-4.15 m (approx. 16.4-by-13.6 ft)
Room 4: 8.00-by-4.30 m (approx. 26.2-by-14.1 ft)
Room 5: 5.75-by-5.60 m (approx. 18.9-by-18.4 ft)

Eighteenth-century remodeled rooms:
LA 70, Room Group A, prehistoric pueblo rooms remodeled into eighteenth-century Spanish Colonial rooms (Snow 1976, Sect. E:6-9). (Because already existing pueblo rooms were remodeled, they are probably somewhat smaller than those usually built by the Spanish.)

Room 117: 2.5-by-5.1 m (approx. 8.2-by-16.7 ft)

Room 123: 2.5-by-3.8 m (approx. 8.2-by-12.5 ft)
Room 125: 2.2-by-3.6 m (approx. 7.2-by-11.8 ft)
Room 129: 3.9-by-5.0 m (approx. 12.8-by-16.4 ft)

Typical nineteenth-century room size:

LA 59658, Trujillo House, Abiquiu (Moore 2004:111–114).

Room 1: 4.9-by-4.3 m (16.07-by-14.10 ft)
Room 2: 5.0-by-6.0 m (19.68-by-16.40 ft)
Room 3: 4.4-by-5.6 m (18.39-by-14.43 ft)
Room 4: 7.0-by-4.4 m (22.96-by-14.43 ft)
Room 5: 6.8-by-4.4 m (22.30-by-14.43 ft)
Room 6: 4.1-by-3.8 m (13.45-by-12.46 ft)
Room 7: 5.1-by-4.1 m (16.73-by-13.45 ft)
Room 8: 4.4-by-3.0 m (14.43-by-9.84 ft)

Historic Rooms on LA 6170, LA 6169, and LA 249

LA 6170, Room Description:
Footing wall composed of two parallel lines of upright river cobbles, approx. 1.5 ft apart and 0.6 ft high. Space between filled with adobe melt and some large cobbles. Floor recessed only slightly below the bottom of the foundation wall. Floor poorly defined, no evidence of intentional packing. Shallow, circular, subfloor pit present, measuring 2.4 ft in diameter (Ware 1997:28–29, 1998:44–45).

LA 6170, Room Size:
31-by-18 ft (approx. 9.5-by-5.5 m), size of the single room (Ware 1998:44–45).

LA 6169, Room Description:

1961 description: a rectangular cobble room northwest of a prehistoric adobe room block, near the edge of the gravel terrace. Cobbles perhaps had served as footing for a "modern" Cochiti farmhouse. Not excavated or mapped (recorded by Dittert and Eddy and cited in Ware 1997:25).

1967 description: site largely destroyed by highway construction. Feature was a possible Cochiti farmhouse (recorded by Peckham and Wells and cited in Ware 1997:26).

1996 description: a house rubble mound consisting of a large oval to subrectangular ring of poorly sorted river cobbles, open in the center, with an entryway or opening in the north wall (recorded by Marshall and cited in Ware 1997:28). Site remains outside the right-of-way and project area, so has not been excavated, dated, or assigned a cultural affiliation (Ware 1998:42–44).

LA 6169, Room Size:
9 by 7 m (approx. 29.5 by 23 ft), measurements of cobble remains (Ware 1997:28).

LA 249, Room Description:

1930 description: a rectangular foundation dating to the historic period, superimposed on a medium-sized pueblo (Lange 1968a:318).

1997 description: two rectilinear cobble concentrations superimposed on the northwest portion of a prehistoric pueblo, located well outside the project limits. Feature 1: larger room, few visible cobble alignments, but enough cobbles to construct an adobe and cobble wall 1 to 2 m high. Feature 2: smaller room, a rectangular alignment of large waterworn cobbles, possibly representing the foundation of a structure which had either wood or adobe walls (Ware 1997:20–21). Since this site is outside the right-of-way and project area, it has not been excavated, dated, or assigned a cultural affiliation.

LA 249, Room Size:

Feature 1: 20-by-12 m (approx. 65.6-by-39.4 ft)
Feature 2: 10-by-4 m (approx. 32.8-by-13.1 ft)

Conclusions

Even though at present it is not possible to state definitively whether Pueblo or Spanish people occupied the historic structures formerly existing on LA 6170, LA 6169, and LA 249 (evidence concerning room size, construction materials, and construction techniques is inconclusive), several other pieces of data, when combined, suggest the likelihood that these sites held the remains of Cochiti Pueblo fieldhouses or ranchos rather than Spanish habitations. According to James Moore (pers. comm., Aug 2001), single-room historic Spanish houses usually had clearly defined floors, definite fire hearths or fire places, and often an accumulation of trash somewhere in the vicinity. Year-round survival depended on a reliable interior source of heat during the winter. Corner fireplaces or *fogons,* raised cobble sills in doorways, and plastered walls whitewashed with gypsum were also quite common as were attached shelters covered with corn stalks and hay, and outside *hornos* (beehive ovens) (Bunting 1976; Snow 1976, Sect. E). Because the historic structures on these three sites included none of the above features, and because Hispanic elders from Peña Blanca stated that Spanish families had never lived on these ridges, as far as they knew, it is unlikely that these were Spanish habitations. Another piece of evidence which adds strength to this hypothesis is the fact that the Spanish were not known to inhabit temporary or seasonal structures lacking thermal features; no descriptions of such structures exist in the literature. The Spanish are known only to have occupied permanent dwellings (Bunting 1976; Pratt and Snow 1988).

On the other hand, evidence, when taken as a whole, strongly suggests the likelihood that these sites represent Cochiti fieldhouses or ranchos, occupied and abandoned at some unknown time in the past. First, Fray Francisco A. Dominguez stated in 1776 that all the important farmland owned by Cochiti was located east of the river, extending both north and south of the pueblo, and that it was watered by deep, wide ditches (Adams and Chavez 1956:159). In 1880, Bandelier recorded information from his informants stating that the Cochiti had ranchos located on the east side of the river and were growing good crops there about 1800 (Lange and Riley 1966:138).

In 1961, archaeologists Ed Dittert and Frank Eddy wrote that the Lt. Governor of Cochiti told them that the Rio Grande terraces once supported numerous fieldhouses that were occupied each year only during the growing season (Ware 1997:28–31, 1998:44–45). In addition, the Hispanic elders of Peña Blanca interviewed by the ethnohistorian in 2001–2002, stated that no Spanish people ever lived on any of the three ridge tops containing the historic sites, and further, their own parents, grandparents, and other friends and relatives had told them that this land, as well as all the other nearby ridges, had always belonged to the Cochitis. Two Peña Blanca residents recalled that as children they saw small Indian houses up on those ridges. The two Cochiti individuals interviewed in 2001 were in agreement with the residents of Peña Blanca as well as with the former Lt. Governor of Cochiti. They stated that the land in question belonged to the Cochitis and that the ridges above the Cochiti agricultural fields east of the river were, in the past, dotted with many small houses where Cochitis spent time during the summers when not working in their fields below. From their statements it appears that two different types of occupation co-existed in this area: (1) daily (summer) utilization of some fieldhouses, and (2) seasonal (summer) utilization of others, in a manner similar to that discussed by J. Moore (1991:25–33). Abandonment of this land and the associated houses began approximately in the 1950s. This would be consistent with the descriptions given below by several archaeologists working in the area on the Cochiti Dam salvage project in the 1960s, probably at a time when a number of these fieldhouses had only recently been abandoned.

In 1961, Dittert and Eddy described a structure they called an historic period farmhouse on LA 6170 (Ware 1997:28–29, 1998:44–45), and another they called a probable "modern" Cochiti farmhouse on LA 6169 (Ware 1997:25). They described both as partially standing structures. Peckham and Wells (1967) who returned to work at LA 6169 several years later (after considerable construction on the adjacent highway had impacted the historic structure), also described it as a possible historic Cochiti farmhouse.

Finally, the archaeological evidence presented earlier in this volume appears to support the temporary or seasonal nature of these three sites. According to James Moore

(1991:25–32; pers. comm. Aug 2001), the following characteristics help define seasonal structures: the informal nature of the floors or their complete absence, the lack of interior thermal features, the absence of ceremonial features (kivas), and the sparse or complete lack of trash anywhere around the structure. According to Bruce Moore, who included a long list of other possible attributes of temporary or seasonal sites, one of the most important was the location of the fieldhouse structure in close visual proximity to the agricultural fields (B. Moore 1979:68–70, 134–135).

The three sites in question, LA 6170, LA 6169, and LA 249, meet most of the above criteria. Floors were very poor or completely absent, no interior fire hearths or fireplaces were present, no kivas or other ceremonial features were found in association with the historic structures, and no trash was found other than the presence of a few Tewa Polychrome sherds. All three sites were located on terraces above Pueblo agricultural fields, with clear sight lines to them. Based on the above evidence, presently it may be hypothesized (until further information proves otherwise) that these historic sites were most likely Cochiti fieldhouses in use at some undefinable time in the past.

Acknowledgements

This report could not have been written without the generous help of several Peña Blanca and Cochiti area residents. Among those who gave freely of their time and knowledge were Father Hillaire, Our Lady of Guadalupe Church, Peña Blanca; and life-long residents of Peña Blanca: Gloria Hurtado, Clodoveo and Mary Hurtado, Margaret Lucero, and Lorraine Ortiz. Discussions with the following people were also quite valuable: Clare Gearhart, Cochiti Lake Librarian; Sandra Selestewa, Sandoval County Senior Center, Peña Blanca; Robert Himmerich y Valencia, former editor of *New Mexico Historical Review;* and Cordelia Snow, State of New Mexico Historic Preservation Division. Several people from Cochiti Pueblo shared childhood memories of this area. They asked not to be identified by name, and this request has been honored.

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Part II

Excavation Results from the Small Sites or Small-scale Investigations

Three sites, LA 249, LA 115862, and LA 115863, were either small sites or only a small portion of the site was within the project corridor and subject to data recovery efforts. LA 249, within the project corridor, consisted of mixed Early Developmental and Classic period components. These components were within a small portion of a much more extensive site with surface manifestations of Classic and Historic period components located outside the project corridor to the east. LA 115862 was primarily a Late Developmental period residential site with a small-scale historic component. Excavation was intensive, but the archaeological components were from single time periods and appeared to have a limited spatial distribution when compared to larger sites, such as LA 265, LA 6169, LA 6170, and LA 6171. LA 115863 had a single feature and a dispersed artifact scatter, probably dating to the Early Developmental period. It was the only nonarchitectural site investigated by the project. The results from these sites are presented in the following sections. The excavation results from the larger sites, LA 265, LA 6169, LA 6170, and LA 6171, are presented in Volumes 2 and 3.

CHAPTER 8
TASHKATZE PUEBLO (LA 249)

Jeanne Schutt

LA 249 is located south of Cochiti Dam and east of Cochiti Pueblo on the opposite side of the Rio Grande. The site consists primarily of a Glaze A period pueblo and associated midden areas. The pueblo is situated east of the highway and fence line, outside the project area. Features present within the right-of-way included a pit structure, a single human burial, and two fire pits.

ENVIRONMENTAL SETTING

LA 249 is located near Cañada de Cochiti on a gravel terrace east of NM 22. Vegetation on the site consists primarily of grasses, snakeweed, prickly pear cactus, and juniper. LA 249, or Tashkatze Pueblo, consists of a Glaze A period adobe and cobble pueblo, a possible kiva, and associated midden areas. Two cobble concentrations near the northwest corner of the pueblo probably represent a later (historic) component. All of the major features identified during previous visits to LA 249 are located east of the highway right-of-way. Within the project area artifacts were present on both sides of a shallow drainage running perpendicular to the edge of the terrace, however no cultural features were visible within the fenced area.

In the project area, the highway passes along and through a series of Pleistocene gravel terraces dissected by drainage channels. The terraces consist of upper and lower deposits of axial Rio Grande gravel and a middle fine-grained overbank deposit (Smith 1996:91). Eolian and redeposited alluvial sand or silt deposits of variable thickness cover the first terrace above the floodplain. Most soils in the area are forming on unconsolidated alluvium of medium to coarse texture containing a high proportion of gravel (Maker et al. 1971). At LA 249, the terrace surface is situated approximately 30 m (100 ft) above the highway.

SITE DESCRIPTION

LA 249 consists of two rectangular adobe and cobble room blocks (see Fig. 8.1). The western unit (Room Block 1) is a low rectilinear mound averaging 6 m wide and surrounding a plaza 30 m to 40 m by 50 m (east-west). The eastern unit (Room Block 2) is similar in both size and shape to Room Block 1. A portion of the eastern structure appears to overlie the northeast corner of Room Block 1, suggesting the western unit was constructed earlier (M. Marshall 1996; Ware 1997). Room Block 2 encloses a plaza measuring 30-by-35 m (east-west). A possible structural feature is visible as a shallow depression inside the west plaza.

Two rectangular cobble concentrations are visible on and near the northwest corner of Room Block 1. The larger concentration (Feature 1) measures 20-by-12 m. A few cobble alignments are visible within the interior of Feature 1. The smaller concentration (Feature 2) is located near the northeast corner of Feature 1. Feature 2 measures 10-by-4 m. No alignments are visible in the interior space. Features 1 and 2 may represent a farmhouse and livestock enclosure associated with a historic occupation of the site area.

Smaller features and artifact concentration occur within a 200-by-100-m area surrounding the principal architectural features. Although no formal trash midden is present at LA 249, a large number of lithic and especially ceramic artifacts occur on the surface within and around the two room blocks. An old road or wagon track divides into two segments east of the pueblo. One of the segments ends near Features 1 and 2 and is probably associated

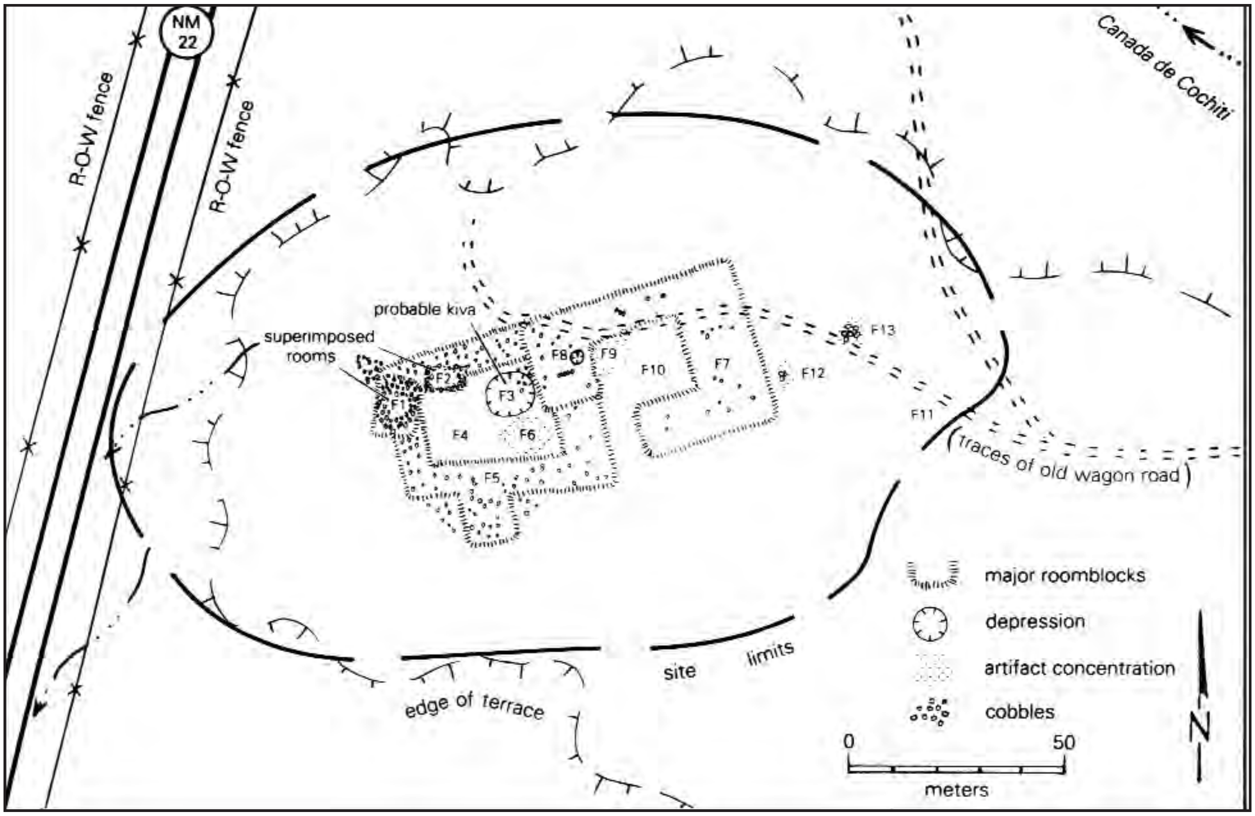


Figure 8.1. LA 249, Room blocks 1 and 2.

with the construction and use of the historic structures.

Previous Research

LA 249 was initially recorded by H. P. Mera in the 1930s (Mera 1940). The site was later revisited in the early 1960s during the Cochiti Dam Archaeological Project (Lange 1968). At Cochiti Pueblo, the site was known as Tashkatze Pueblo, a Keresan word meaning "place of the potsherds" (Lange 1968:318). Archaeologists returned to the site again during the NM 22 survey (S. Marshall 1997).

During the 1960s visit, a sample of 305 ceramic artifacts was collected from LA 249. The materials were later analyzed by Kenneth Honea of the Laboratory of Anthropology. Nearly half of the assemblage consisted of Glaze A period pottery types (e.g., Agua Fria Glaze-on-red). Two percent of the assemblage was composed of later glaze period ceramic materials. Late Developmental and Coalition period ceramic types including Kwahe'e and Santa Fe Black-on-white were more common, yet accounted for only 5 percent of the sample. Three percent of the ceramic assemblage was composed of ceramic types associated with the Tewa Polychrome series. The historic ceramics are probably associated with the construction and use of Features 1 and 2. Warren (1977b) included ceramic data from Tashkatze Pueblo in a discussion of temper types used in glaze-on-red ceramic materials from several Cochiti area sites.

Site Excavation Strategy

Prior to excavation, a site datum and grid system were established at LA 249. The area south of a small drainage running perpendicular to the edge of the terrace was defined as Study Unit 1. The area north of the drainage was defined as Study Unit 2. Study Unit 1 included grid units N90 to N120/E92 to E116. Study Unit 2 included grid units N140 to N158/E92 to E116. The east side of the NM 22 fence line is oriented 3 degrees northeast-southwest of true north.

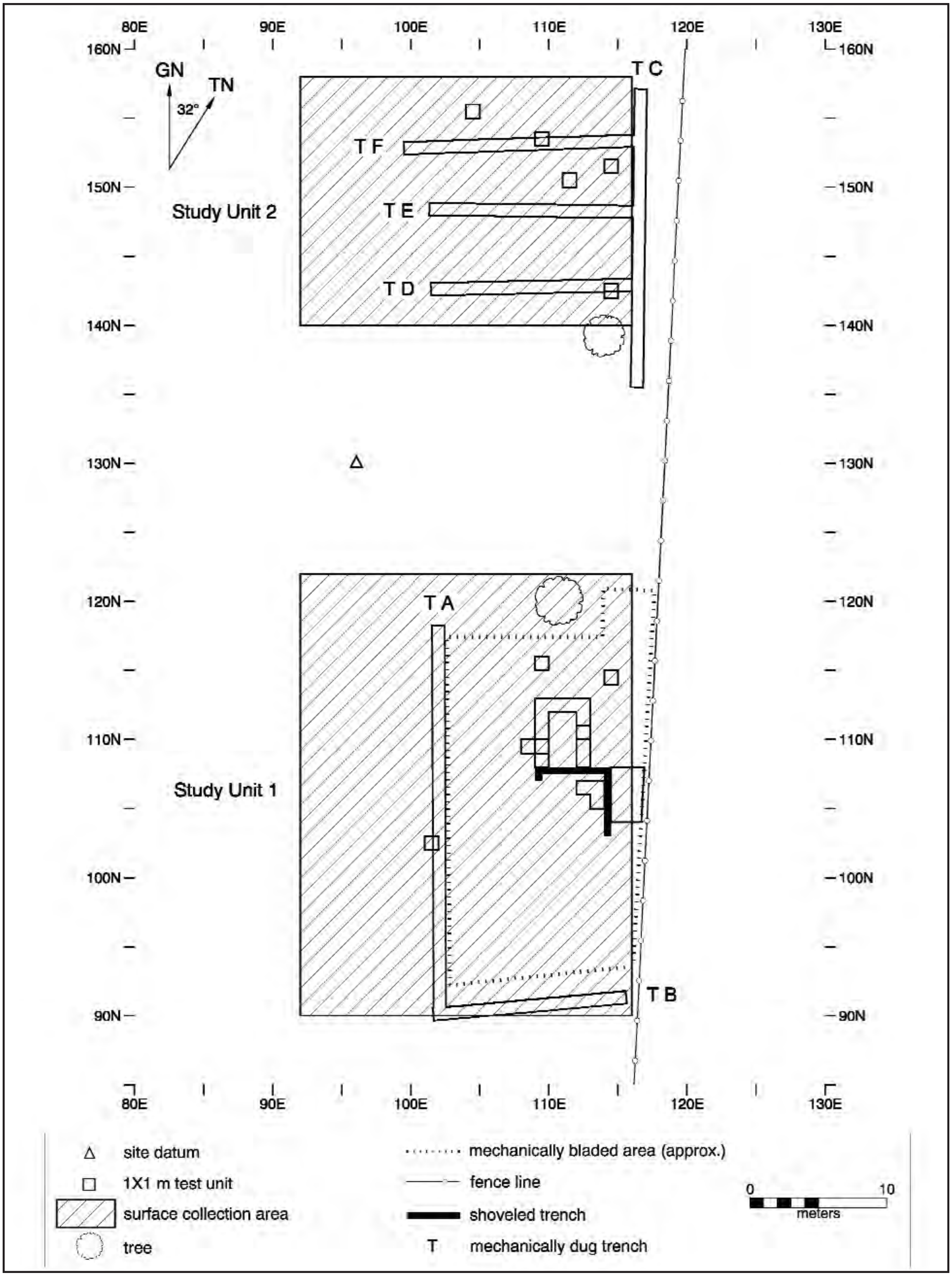


Figure 8.2. LA 249, test units within Study Units 1 and 2.

Surface artifacts were collected in 2-by-2-m grid units. Artifacts were collected from 127 grid units in Study Unit 1 and 61 grid units in Study Unit 2. Grids located in the southeast portion of both Study Units generally contained the highest number of artifacts.

Because no cultural features were visible on the surface within the project area, initial excavation activities consisted of the excavation of five noncontiguous 1-by-1-m test units within both Study Units 1 and 2 (see Fig. 8.2). Only two cultural features were discovered in the tested areas (Features 1 and 2). Feature 2 was defined as midden area, however Feature 2 is situated in an area within which Stratum 2 contained a noticeable amount of charcoal, and the feature boundary could not be defined.

Although the boundaries of Feature 2 are unknown, charcoal and ash seemed to be more common in grids located near the fence line. Subsurface artifact densities also appeared to be higher near the fence line. Assuming Feature 1 might be a small structure, several 1-by-1-m grid units in this area were excavated to a depth of 10 or 20 cm. Feature 1 proved to be a rock concentration of uncertain function, however, during the investigation, a fire pit (Feature 3) was discovered near Feature 1. A shovel test trench excavated near Feature 3 revealed no subsurface cultural deposits.

Excavations continued in the Feature 2 area. By this time, the excavation crew began to suspect that no substantial cultural features were present within the right-of-way. An edge of a possible pit structure (Feature 6) was discovered at the bottom of Level 5. While attempting to determine the limits of this feature, a burial (Feature 4) was encountered nearby. Upon completing excavation of Feature 4, work resumed in the pit structure. All of Feature 6 was excavated except for the eastern portion, which lies outside the fenced area. A few auger holes were excavated just outside the fence in order to determine the complete outline of Feature 6.

After completing five 1-by-1-m exploratory units in Study Unit 2, four backhoe trenches were excavated in this area. No cultural features were observed in three of the trenches. In Trench D, however, a small pit feature was exposed in the north profile of the trench. Feature 5 consisted of a small pit containing a metate.

Heavy equipment was also used to remove Stratum 2 from Study Unit 1 in an effort to locate more features within this area. Another fire pit (Feature 7) was exposed at that time. Two backhoe trenches were also excavated in this area, but no cultural features were found in Trench A or B. A portion of the Trench A profile was examined in detail by McFadden (see Chapter 6).

Site Stratigraphy

At some localities within the project area, including Tashkatze Pueblo, the lowest of four alluvial terrace surfaces is covered by a deposit of El Cajete Pumice (Smith and Kuhle 1998). The primary pumice layer was deposited 60,000 years BP (Reneau et al. 1996), but has since been modified by both alluvial and eolian processes as well as bioturbation. Stratum 5 is composed entirely of El Cajete Pumice and represents intact remnants of the primary pumice layer. The pumice layer is relatively coarse textured and basically white in color. At LA 249, the deposit is a maximum of 25 cm thick.

Stratum 1 and Stratum 2 are essentially reworked or modified pumice deposits containing almost all of the artifacts recovered from LA 249. Stratum 2 and the primary pumice layer overlie alluvial deposits consisting of either a reddish brown silty to clayey alluvium containing little or no rock (Stratum 3) or sandy alluvium containing a large amount of gravel and cobbles (Stratum 4). Stratum 1 was arbitrarily defined as the upper 10 cm level of Stratum 2 and is identical to Stratum 2 except for the frequent presence of grass roots or rootlets. Surface gravel and cobbles were relatively uncommon except in the southern portion of Study Unit 1 and along the small drainage between Study Unit 1 and Study Unit 2.

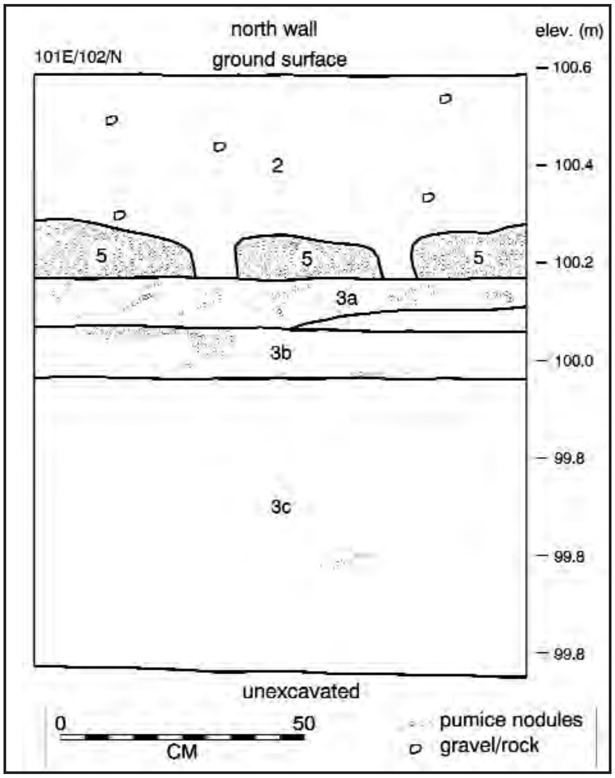


Figure 8.3. LA 249, stratums located in grid unit 102N/101E.

Stratum 4 and Stratum 5 were not present in all excavated units. In grid unit 102N/101E, for example, a 30- to 35-cm-thick deposit of reworked pumice (Stratum 1 and Stratum 2) overlay a nearly continuous layer of El Cajete Pumice (Stratum 5) measuring 8 to 10 cm thick (Fig. 8.3). At least 60 cm of Stratum 3 alluvium lay beneath the primary pumice layer. Only a few artifacts were found in this exploratory unit. Several low mounds of coarse pumice were visible on the ground surface throughout most of Study Unit 1, which most likely represents bioturbation of the primary pumice layer.

In grid unit 114N/114E, 60 to 65 cm of Stratum 1 and Stratum 2 deposits overlay a continuous 15 to 30 cm thick layer of El Cajete Pumice in the south and east profiles of the unit (Fig. 8.4). In a portion of the north and west profiles of the exploratory unit, Stratum 2 overlays a 30-cm-thick deposit of sandy alluvium containing a large amount of gravel and some cobbles (Stratum 4). Stratum 3 alluvium was found below Stratum 4 and Stratum 5. A relatively high number of artifacts were collected from 114N/114E from all levels within Stratum 2.

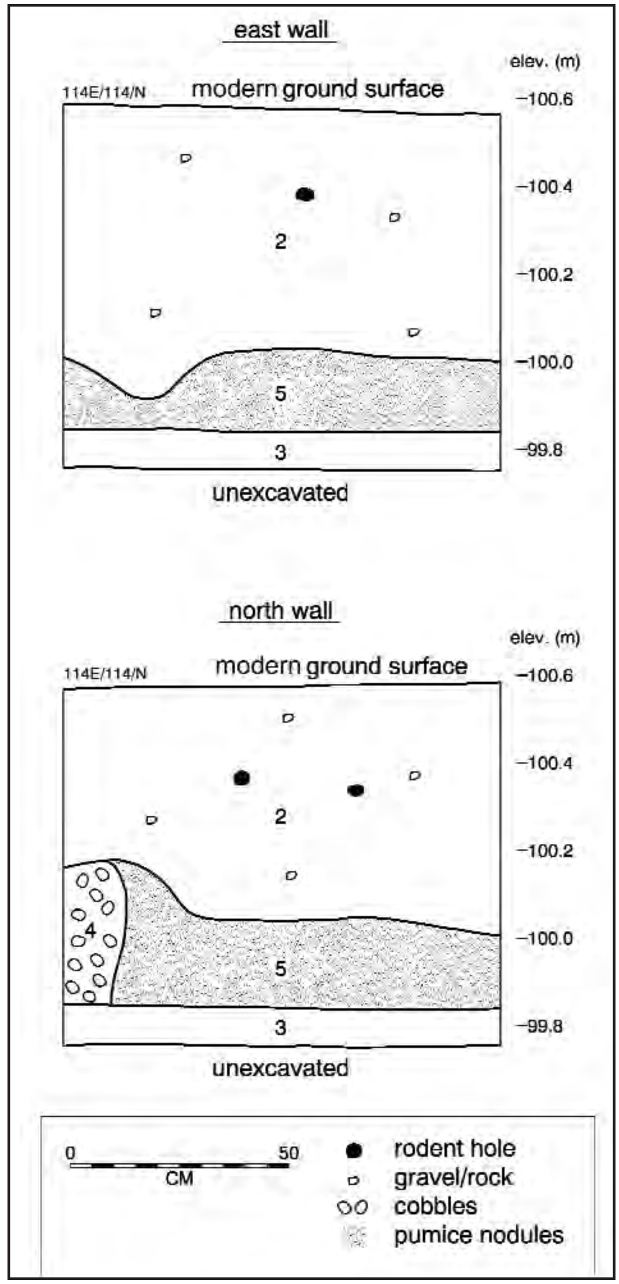


Figure 8.4. LA 249, stratums located in grid unit 114N/114E.

Site Components

Three temporal components are identifiable at Tashkatze Pueblo, a Late Developmental period occupation, a relatively large Glaze A period pueblo and associated midden areas, and a historic component consisting of a possible farmhouse and livestock enclosure. The nature and extent of the earliest component is unclear, but Late Developmental and/or Coalition period ceramic materials occur on both sides of the fence.

Only one major architectural feature (a pit structure) is present within the project area. The pit structure (Feature 6) is somewhat unusual in having a shape more or less typical of a Late Developmental/Early Coalition period structure. Except for a few small and shallow floor pits of uncertain function, none of the interior features commonly found in pit houses and kivas were present in Feature 6.

Five small features were located near Feature 6 within Study Unit 1 (Table 8.1). Feature 1 was a rock concentration of unknown function. Feature 4 was a human burial located west of Feature 6. Feature 3 and Feature 7 were extramural fire pits. Feature 8 most likely represents a natural depression filled with gravel, artifacts, and some ash and charcoal. Feature 2, identified near the pit structure, was an informal midden containing a relatively large amount of charcoal from various sources. Only a small and shallow pit (Feature 5) was present in Study Unit 2.

Major Features—Study Unit 1

The only major architectural feature within the project area was Feature 6, a pit structure located in Study Unit 1. The eastern portion of the structure lies outside the fence and was not excavated.

Feature 6 Excavation Strategy. Feature 6 was located along the east fence line. Approximately one-quarter of the pit structure lies east of the fence, outside the project area. The fill of Feature 6 was removed by individual grid units employing both arbitrary 10-cm levels and stratigraphic designations. Excluding soil samples collected for flotation and pollen analysis, the entire Feature 6 fill was screened. Grid units 104 to 106N/114E and 104 to 106N/115E were excavated and a profile of structure fill along the 116E line was drawn.

Partial grid units 104 to 106N/116E were excavated next. Another profile of the structure fill near the fence was also completed. Once all of the fill material inside the fence and floor features was removed, the crew excavated into the Stratum 3 alluvium to make sure no other features were present. Finally, a few auger holes were excavated just outside the right-of-way to aid in determining the complete shape of Feature 6.

Feature 6 Description. Feature 6 measured 3.2-by-2.6-m wide (Fig. 8.5). The structure consisted of a relatively shallow (0.6 m deep) subrectangular pit excavated into Stratum 3 alluvium. No evidence of a plaster coating was observed on either the walls or floor of the structure. In addition, no definite postholes were found inside or just outside the structure. Finally, no evidence of a ventilator tunnel or shaft was observed in the visible portion of the

Table 8.1. LA 249, Study Unit 1 Feature Summary

Feature No.	Feature Type	Location (grid centerpoint)	Dimensions (L x W x D) m	Shape	Fill	Comments
1	Rock concentration	N 109.00 E 109.20	1.2 x 0.6	Linear	Stratum 2	Unknown function
3	Fire pit	N 111.92 E 110.15	0.45 x 0.45 x 0.08	Circular basin	Ash and fire-cracked	Extramural
4	Burial pit	N 106.36 E 113.50	0.95 x 0.5 x 0.35	Oval basin	Stratum 2/30	Female, age 40 to 50, no burial goods
6	Pit structure	N 105.50 E 115.60	3.2 x 2.6 x 0.6	Rounded rectangle	Upper fill, Stratum 2/30; lower, silt, pumice, charcoal, with or without adobe	Floor features limited to oval and circular basins and adobe ridge; no hearth or vent shaft
7	Fire pit	N 108.50 E113.50	0.45 x 0.35 x 0.12	Oval basin	Ash and fire-cracked	Extramural
8	Depression	N 101.88 E 112.69	0.95 x 0.6 x 0.15	Egg-shaped basin	Rock (some fire-cracked, ash pockets or Stratum 2/3 mix	Probably natural depression filled with rock and artifacts (two pieces of ground stone)

interior or exterior of the structure.

Excavated floor features were limited to small and shallow pit features of uncertain function or origin. Identifying the floor level was sometimes difficult given the lack of plaster or preparation of any kind. Evidence of a possible feature was observed in the unexcavated portion of the structure, which consisted of a low ridge of adobe barely visible at floor level in the fill profile. A radiocarbon date on corn recovered from the structure fill (Stratum 50) suggests the structure was abandoned prior to AD 1250 and perhaps as early as AD 1000.

Late Developmental period ceramic assemblages appeared more frequently within the lower fill deposits of the pit structure (Table 8.2). In contrast, ceramic assemblages from the uppermost stratigraphic deposits were assigned to a Classic period with a Late Developmental period group. Utility wares in the ceramic assemblage from Feature 6 consisted primarily of plain gray body sherds and smeared and unsmeared plain corrugated and indented corrugated gray ware. Although Glaze period ceramic materials were present inside Feature 6, the structure itself appears to be associated with a Late Developmental period occupation.

A total of 1,378 lithic artifacts were recovered from the Feature 6 fill consisting of Stratums 29, 29a, 29b, 29c, 30, and 50 (Tables 8.3–8.8). Chalcedony was the primary material type, although chert, quartzite, Jemez obsidian, and nonvesicular igneous and "other" materials were present. Formal and informal chipped stone tools and all stages of reduction were present as well.

Eighty-four lithic artifacts were recovered from the floor (Stratum 60) in Feature 6 (Table 8.9). The most common materials were chalcedony and chert, although low frequencies of nonvesicular igneous materials and Jemez obsidian were also recovered. Unutilized flakes and small angular debris made up the majority of the lithic assemblage. Two chipped stone tools, manufactured from nonvesicular igneous materials, and a single multiplatform chert core were identified. A fine-grained rhyolite expedient handstone was also recovered.

Flotation samples (see Toll, McBride, and Badner, Chapter 23) from the feature fill contained cultural plant remains consisting of corn kernels, cupules, glumes cobs, and stalk fragments along with wood. Feature 6 floor contained goosefoot seeds, yucca fiber, and corn as well as juniper wood. Few bone artifacts were recovered from the pit structure fill and floor (Table 8.10).

Feature 6 Stratigraphy. Several different fill levels were identified inside the structure. The upper fill of Feature 6 generally consisted of Stratum 2/30 deposits measuring 5 to 15 cm thick. Stratum 30 was designated whenever the modified pumice layer contained relatively high amounts of charcoal. Feature 6 also consisted of Stratum 29b, which was similar to Stratum 2, but contained a large amount of ash and charcoal, and Stratum 29c, which generally consisted of mixed pumice and Stratum 3 deposits. Very little charcoal and ash were present in Stratum 29c. In certain areas within the structure fill, Stratum 29c contained pebbles and some gravel.

Stratum 50 was generally similar to Stratum 2/30 and 29b, but contained a moderate to large amount of adobe. The adobe fragments appeared to have been partially burned, but none were oxidized reddish orange or red. No charred roof posts were present in this level. Stratum 29d consisted of subfloor deposits similar to Stratum 3 or 4. Some rocks and rock fragments were found in all levels.

The fill in the unexcavated portion of the structure was somewhat different. A deposit similar to Stratum 50 constituted the upper fill level and Stratum 29c was thicker and more prominent in this area. Stratum 50, as defined in the excavated area (west of the E116 line) was reduced to a small area near the center of the structure. Stratum 2/30 covered the entire structure, both inside and outside the project area.

Intramural Features. Six floor features were identified within the structure (Table 8.11). Five of the floor features were shallow pits (Features 9-11 and Features 13 and 14). Feature 15 consisted of a low ridge of adobe barely visible in the fill profile near the fence. The adobe ridge was the only evidence for any

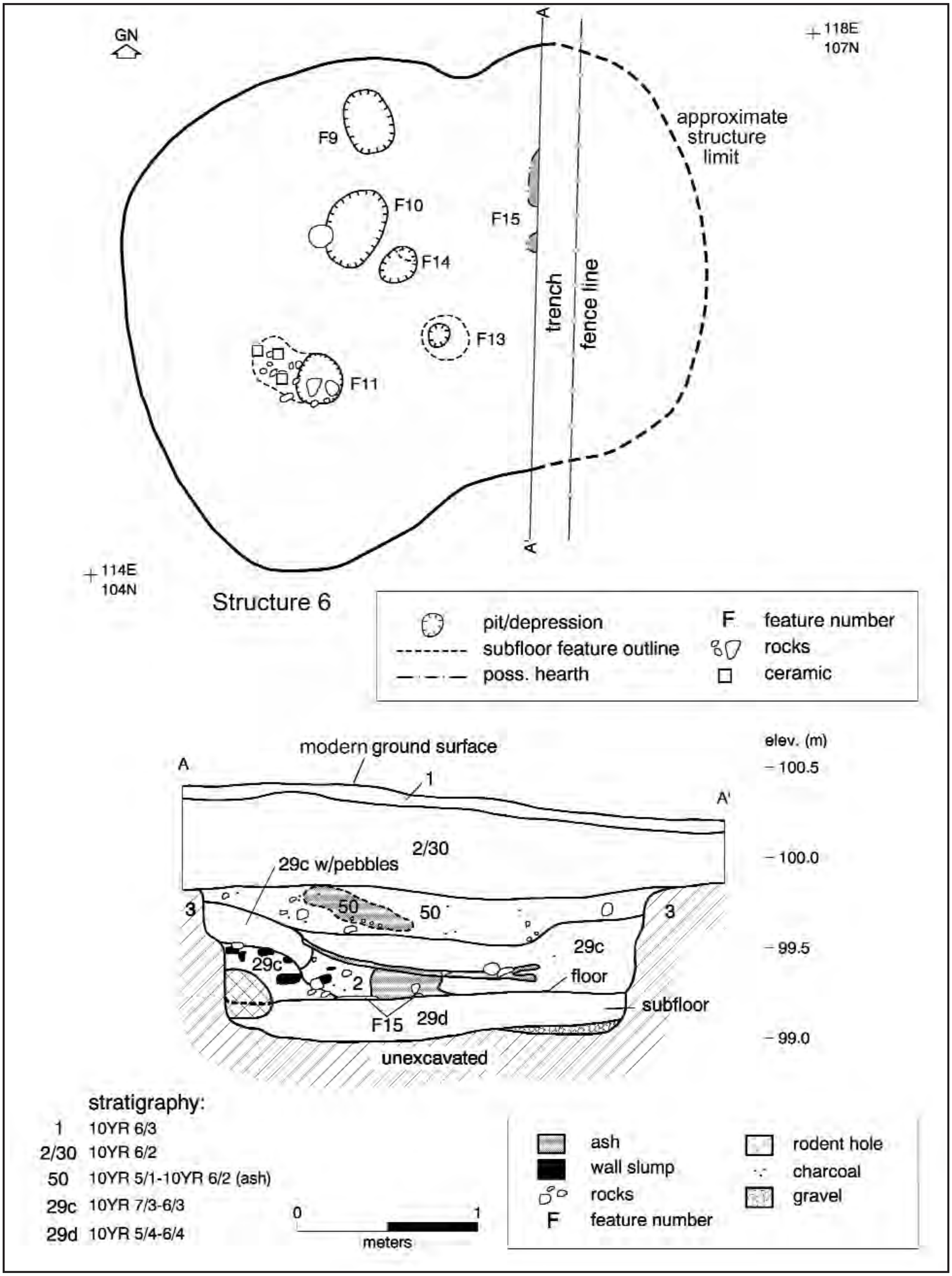


Figure 8.5. LA 249, Feature 6, plan and profile.

Table 8.2. Distribution of Ceramic Types at LA 249 Assigned to Late Developmental with Classic Components

Pottery Type	Structure 6 Fill, Stratum 29b	Structure 6 Fill, Stratum 29c	Structure 6 Fill, Stratum 50	Structure 6 Floor, Stratum 60	Total
Mineral paint undifferentiated	-	-	1	-	1
	-	-	0.90%	-	0.50%
Unpainted undifferentiated	3	-	7	10	20
	7.70%	-	6.40%	20.40%	9.50%
NRG Mineral paint (undifferentiated)	1	1	2	2	6
	2.60%	7.70%	1.80%	4.10%	2.90%
Kwahe'e Black-on-white (solid designs)	-	-	3	-	3
	-	-	2.80%	-	1.40%
Kwahe'e Black-on-white (hatchured designs	1	-	1	-	2
	2.60%	-	0.90%	-	1.00%
Kwahe'e Black-on-white (solid and hatchure	-	-	1	-	1
	-	-	0.90%	-	0.50%
Kwahe'e Black-on-white	-	-	1	3	4
	-	-	0.90%	6.10%	1.90%
NRG Plain rim	1	-	3	-	4
	2.60%	-	2.80%	-	1.90%
NRG Plain body	12	2	25	4	43
	30.80%	15.40%	22.90%	8.20%	20.50%
NRG Indented Corrugated	2	2	14	5	23
	5.10%	15.40%	12.80%	10.20%	11.00%
NRG Plain Corrugated	5	-	11	2	18
	12.80%	-	10.10%	4.10%	8.60%
NRG Smeared Plain Corrugated	5	8	15	10	38
	12.80%	61.50%	13.80%	20.40%	18.10%
NRG Smeared Indented Corrugated	2	-	5	2	9
	5.10%	-	4.60%	4.10%	4.30%
NRG Mudware	-	-	1	-	1
	-	-	0.90%	-	0.50%
NRG Plain rim	1	-	2	-	3
	2.60%	-	1.80%	-	1.40%
RG Plain body	3	-	8	1	12
	7.70%	-	7.30%	2.00%	5.70%
Keres Utility Ware	1	-	2	1	4
	2.60%	-	1.80%	2.00%	1.90%
Glazed red (unpainted)	2	-	2	-	4
	5.10%	-	1.80%	-	1.90%
Glaze yellow/cream slipped (unpainted)	-	-	-	1	1
	-	-	-	2.00%	0.50%
Glaze brown/tan (unpainted)	-	-	2	2	4
	-	-	1.80%	4.10%	1.90%
Glaze-on-red (undifferentiated)	-	-	1	3	4
	-	-	0.90%	6.10%	1.90%
Glaze-on-yellow cream	-	-	1	1	2
	-	-	0.90%	2.00%	1.00%
Glazed-on-brown/tan	-	-	1	2	3
	-	-	0.90%	4.10%	1.40%
Total	39	13	109	49	210
	100.00%	100.00%	100.00%	100.00%	100.00%

NRG = Non-Rio Grande
RG = Rio Grande

Table 8.3. LA 249, Feature 6 Fill, Stratum 29 Lithic Assemblage

	Chalcedony		Chert		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%
Angular Debris	5	55.6	2	22	.	.	2	22.2	9	13
Flake	38	70.4	2	3.7	6	11.1	8	14.8	54	81
Angular Debris, Marginal Retouch	1	100	.	.	.	.	.	.	1	1
Flake, Marginal Retouch	1	100	.	.	.	.	.	.	1	1
Biface	.	.	.	.	1	100	.	.	1	1
Total	45	68.2	4	6.1	7	10.6	10	15.2	66	100

Table 8.4. LA 249, Feature 6 fill, Stratum 29a Lithic Assemblage

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesi-cular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	30	73.2	7	17.1	.	.	2	4.9	2	4.9	41	10
Flake	253	82.1	22	7.1	1	0.3	13	4.2	19	6.2	308	80
Flake, Bifacial Thin	1	100	.	.	.	.	.	.	.	.	1	<1
Tested Rock	6	100	.	.	.	.	.	.	.	.	6	1
Core, Multiplatform	13	86.7	1	6.7	.	.	.	.	1	6.7	15	3
Core, Single Platform	1	100	.	.	.	.	.	.	.	.	1	<1
Chopper, Unifacial	1	100	.	.	.	.	.	.	.	.	1	<1
Flake, Utilized	3	100	.	.	.	.	.	.	.	.	3	<1
Flake, Marginal Retouch	3	75	1	25	.	.	.	.	.	.	4	1
Projectile Point	.	.	.	.	.	.	1	100	.	.	1	<1
Biface	.	.	.	.	.	.	.	.	1	100	1	<1
Uniface	1	100	.	.	.	.	.	.	.	.	1	<1
Total	312	81.5	31	8.1	1	0.3	16	4.2	23	6	383	100

Table 8.5. LA 249, Feature 6 fill, Stratum 29b Lithic Assemblage

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular debris	14	70	2	10	.	.	.	.	4	20	20	8
Flake	153	78.1	10	5.1	1	1	8	4.1	24	12.2	196	84
Core, Multiplatform	9	90	.	.	.	.	1	10	.	.	10	4
Core, Bifacial	.	.	1	100	.	.	.	.	.	.	1	<1
Flake, Marginal Retouch	4	80	1	20	.	.	.	.	.	.	5	2
Biface	1	100	.	.	.	.	.	.	.	.	1	<1
Total	181	77.7	14	6	1	0	9	3.9	28	12	233	100

Table 8.6. LA 249, Feature 6 Fill, Stratum 29c Lithic Assemblage

	Chalcedony		Chert		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%
Flake	15	83.3	2	11	1	5.6	18	85
Tested Rock	1	100	.	.	.	.	1	4
Hammerstone	.	.	.	.	1	100	1	4
Grooved Axe	.	.	.	.	1	100	1	4
Total	16	76.2	2	9.5	3	14.3	21	100

Table 8.7. LA 249, Feature 6 Fill, Stratum 30 Lithic Assemblage

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Other Local		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Angular debris	6	66.7	2	22.2	.	.	.	.	1	11	.	.	9	5
Flake	97	64.2	9	6	1	0.7	10	6.6	33	22	1	0.7	151	87
Flake, Bifacial Thin	.	.	1	100	.	.	.	.	.	.	.	.	1	<1
Tested Rock	2	100	.	.	.	.	.	.	.	.	.	.	2	1
Core, Multiplatform	1	50	.	.	1	50	.	.	.	.	.	.	2	1
Core, Bifacial	.	.	.	.	.	.	.	.	1	100	.	.	1	<1
Flake, Utilized	1	33.3	.	.	.	.	.	.	2	67	.	.	3	1
Flake, Marginal Retouch	1	50	.	.	.	.	1	50	.	.	.	.	2	1
Biface	1	100	.	.	.	.	.	.	.	.	.	.	1	<1
Total	109	63.4	12	7	2	1.2	11	6.4	37	22	1	0.6	172	100

Table 8.8. LA 249, Feature 6 Fill, Stratum 50 Lithic Assemblage

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular debris	32	78	4	9.8	1	2	.	.	4	9.8	41	11
Flake	230	76.7	38	13	4	1	8	2.7	20	6.7	300	81
Flake, Bifacial Thin	1	50	.	.	.	.	1	50	.	.	2	<1
Tested Rock	.	.	1	100	.	.	.	.	.	.	1	<1
Core, Multiplatform	11	91.7	.	.	.	.	.	.	1	8.3	12	3
Chopper, Bifacial	1	100	.	.	.	.	.	.	.	.	1	<1
Flake, Utilized	2	100	.	.	.	.	.	.	.	.	2	<1
Flake, Marginal Retouch	3	100	.	.	.	.	.	.	.	.	3	<1
Projectile Point	.	.	1	100	.	.	.	.	.	.	1	<1
Biface	1	50	.	.	.	.	1	50	.	.	2	<1
Expedient handstone	.	.	.	.	.	.	.	.	1	100	1	<1
Grooved Axe	.	.	.	.	.	.	.	.	1	100	1	<1
Total	281	76.6	44	12	5	1	10	2.7	27	7.4	367	100

Table 8.9. LA 249, Feature 6 Floor, Stratum 60 Lithic Assemblage

	Chalcedony		Chert		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%
Angular debris	12	80	2	13.3	.	.	1	6.7	15	17
Flake	46	71.9	11	17.2	4	6.3	3	4.7	64	76
Core, Multiplatform	.	.	1	50	.	.	1	50	2	2
Flake, Utilized	.	.	.	.	.	.	1	100	1	1
Biface	.	.	.	.	.	.	1	100	1	1
Expedient handstone	.	.	.	.	.	.	1	100	1	1
Total	58	69	14	16.7	4	4.8	8	9.5	84	100

major floor feature inside the structure. Feature 15 may represent a hearth or possibly an adobe deflector. No evidence of oxidation due to fire was observed on Feature 15. Rodent tunnel openings were observed in the sides of two floor features.

Feature 9 was located near the north wall of Feature 6 under a layer of eroded and collapsed pit wall material (Stratum 3). The curved edge of the eroded wall material suggested the presence of a second pit structure wall and was initially defined as Feature 12. However, upon further investigation, Feature 12 was eliminated. Portions of the deposit, however, lay on top of structure fill. Feature 9 consisted of a shallow oval pit measuring 37 cm by 25 cm and 9 cm deep. Feature 9 was filled with material similar to Stratum 2. No artifacts were observed while excavating the feature. The entire Feature 9 fill was collected for flotation, however the samples were not selected for analysis.

Feature 10, a shallow oval pit, was located near the center of the structure floor and measured 44 cm by 30 cm and 8 cm deep. Feature 10 was also filled with material similar to Stratum 2, although very little charcoal was present. No artifacts were observed in the fill. The entire Feature 10 fill was collected for flotation.

Feature 11 was also located near the middle of the structure floor. Feature 11 consisted of a very shallow pit containing ash, some gravel, and few small cobbles. The depression measured 22 cm in diameter and 2 to 5 cm in depth. Three indented corrugated jar sherds were found in the feature. An area of ashy soil and gravel occurred adjacent to the west edge of the depression. None of the rocks appeared burned or fire-cracked. Similarly, no evidence of intense heat was observed in the depression. The entire Feature 11 fill was collected for flotation, however the samples were not selected for analysis.

Feature 13 was a small pit feature measuring 24 cm in diameter at floor level. The pit contracted to a diameter of 12 cm below the floor level and extended 10 cm below the floor. Feature 13 was filled with material similar to Stratum 2. Half of the Feature 13 fill was collected for flotation analysis. No artifacts were found in the screened portion.

Feature 14 is located adjacent to Feature 10 and consisted of a small pit feature measuring 24 cm by 19 cm, and 10 cm deep. The feature fill was similar to Stratum 2. The entire fill was collected for flotation. A rodent tunnel was observed in the pit wall beginning 5 cm below floor level.

Feature 15 consisted of what appeared to be a low ridge of adobe barely visible in the fill profile at floor level. Feature 15 was situated along the fence line and measured 40 cm long and 8 cm in depth. A smaller ridge of adobe was observed 10 cm farther south. The adobe ridges were in direct contact with the floor surface, suggesting the presence of a possible feature in the unexcavated portion of the structure. The ridges may represent an adobe hearth collar and deflector.

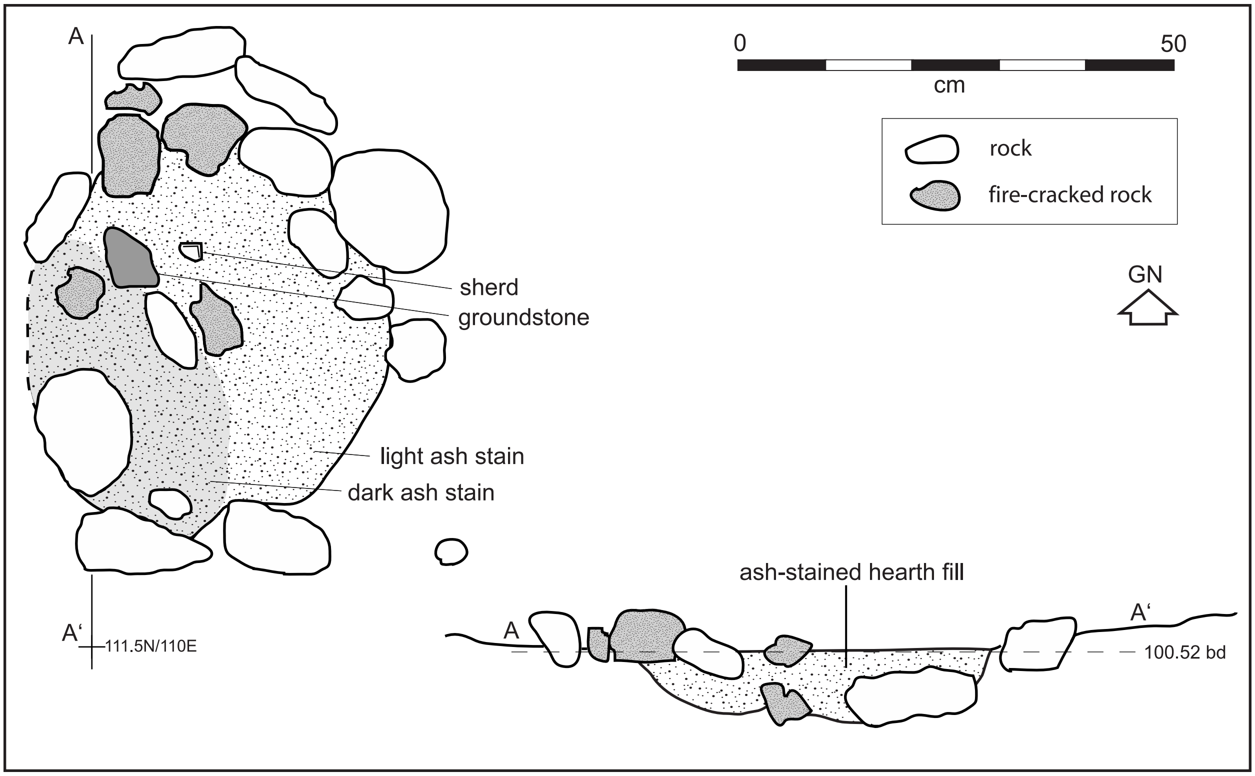


Figure 8.6. LA 249, Feature 3 plan and profile.

Minor Features – Study Unit 1

Five features were present near the pit structure in Study Unit 1. The features present consisted of a rock concentration (Feature 1), a human burial (Feature 4), and two fire pits (Features 3 and 7). Also encountered was Feature 8, which appears to represent a natural depression filled with gravel and some ash and charcoal. Features 1 and 3 occur within Stratum 2. Features 4 and 7 were excavated into Stratum 3.

Feature 1 was a rock concentration occurring in Stratum 2 (Levels 2 and 3). Feature 1 consisted of approximately 30 igneous rocks and small cobbles concentrated in an area measuring 1.2 m by 0.6 m. Most of the stones were relatively small cobbles measuring 10 cm or less. However, some igneous rocks measuring 20 to 25 cm were noted. The smaller pieces may not have been part of the feature since small cobbles were also found in other nearby grid units. The function of Feature 1 is unknown.

Feature 1 yielded 25 artifacts. There were 15 lithic artifacts. The majority were chalcedony flakes (n=11) and a multiplatform core, which represented primary core reduction as well as secondary stages of core reduction. A single chalcedony flake was retouched unidirectionally. Ten ceramic sherds analyzed from Feature 1 were assigned to Classic with Late Developmental components.

Feature 2 was defined as a midden area. However, the feature was situated within an area in which Stratum 2 contained a noticeable amount of charcoal and ash. Although the limits of Feature 2 are uncertain, the charcoal and ash content of Stratum 2 was higher near Feature 6. Whenever the modified pumice layer contained a relatively high amount of charcoal, the deposits were designated as Stratum 30.

Feature 3 was a small fire pit consisting of a circular rock concentration measuring 65-by-50-cm (Fig. 8.6). Several of the rocks were fire-cracked. The stones were found adjacent to a small 45-cm-diameter circular pit, as well as in the fill of Feature 3. In addition to some fire-cracked rock, the pit also contained ash,

Table 8.10. LA 249, Summary of Fauna Recovered from Structure 6

	Stratum 29		Stratum 29a		Stratum 29b		Stratum 29c		Stratum 50		Stratum 60		Total	
	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %
S mammal/M-L bird	-	-	1	1.70%	-	-	-	-	1	1.10%	-	-	2	1.00%
Small mammal	1	16.70%	6	10.30%	3	16.70%	3	15.00%	18	18.90%	3	37.50%	34	16.60%
M-L mammal	1	16.70%	36	62.10%	3	16.70%	2	10.00%	10	10.50%	-	-	52	25.40%
Large mammal	-	-	6	10.30%	1	5.60%	2	10.00%	9	9.50%	-	-	18	8.80%
Botta's pocket gopher	-	-	-	-	2	11.10%	1	5.00%	3	3.20%	-	-	6	2.90%
Yellow-faced pocket gopher	1	16.70%	-	-	-	-	-	-	6	6.30%	2	25.00%	9	4.40%
Ord's kangaroo rat	-	-	-	-	-	-	-	-	1	1.10%	-	-	1	0.50%
Banner-tailed kangaroo rat	-	-	-	-	1	5.60%	-	-	-	-	-	-	1	0.50%
Beaver	-	-	-	-	-	-	-	-	3	3.20%	-	-	3	1.50%
Woodrats	-	-	-	-	-	-	-	-	2	2.10%	-	-	2	1.00%
Desert cottontail	-	-	3	5.20%	1	5.60%	5	25.00%	7	7.40%	-	-	16	7.80%
Black-tailed jack rabbit	2	33.30%	-	-	3	16.70%	2	10.00%	4	4.20%	2	25.00%	13	6.30%
Medium artiodactyl	-	-	2	3.40%	1	5.60%	-	-	7	7.40%	-	-	10	4.90%
Mule deer	1	16.70%	2	3.40%	2	11.10%	2	10.00%	5	5.30%	1	12.50%	13	6.30%
Pronghorn	-	-	-	-	1	5.60%	-	-	-	-	-	-	1	0.50%
Bighorn sheep	-	-	-	-	-	-	-	-	1	1.10%	-	-	1	0.50%
Large bird	-	-	-	-	-	-	-	-	1	1.10%	-	-	1	0.50%
Eggshell	-	-	-	-	-	-	1	5.00%	15	15.80%	-	-	16	7.80%
Hawks	-	-	-	-	-	-	1	5.00%	-	-	-	-	1	0.50%
Painted turtle	-	-	2	3.40%	-	-	-	-	-	-	-	-	2	1.00%
Horned lizards	-	-	-	-	-	-	1	5.00%	-	-	-	-	1	0.50%
Plains or Woodhouse's toad	-	-	-	-	-	-	-	-	0	2.10%	-	-	2	1.00%
Total	6	100.00%	58	100.00%	18	100.00%	20	100.00%	95	100.00%	8	100.00%	205	100.00%
Immature	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Burned	2	33.30%	8	13.80%	3	16.70%	3	15.00%	12	12.60%	1	12.50%	27	15.20%
Complete	1	16.70%	-	-	-	-	3	15.00%	10	10.50%	1	12.50%	15	7.30%
>75% complete	1	16.70%	-	-	1	5.60%	-	-	1	1.10%	-	-	3	1.50%
25-50% complete	-	-	3	5.20%	7	38.90%	6	30.00%	13	13.70%	-	-	29	14.10%
<25% complete	4	66.70%	55	94.80%	10	55.60%	11	55.00%	71	74.70%	7	87.50%	158	77.10%

Table 8.11. LA 249 Pit Structure Floor Feature Summary

Feature No.	Feature Type	Location (Grid Centerpoint)	Dimensions (L x W x D) cm	Shape	Fill	Comments
9	Pit	N 106.52 E 115.52	37 x 25 x 9	Oval basin	Stratum 2	Post-occupation
10	Pit	N 105.93 E 115.45	44 x 30 x 8	Oval basin	Stratum 2	Post-occupation
11	Pit	N 105.12 E 115.26	22 x 22 x 5	Circular basin	Ash, gravel	Post-occupation
13	Pit	N 105.33 E 115.96	24 x 24 x 12	Circular basin	Stratum 2	Post-occupation
14	Pit	N 105.73 E 115.70	24 x 19 x 10	Oval basin	Stratum 2	Post-occupation

pumice, and few artifacts.

Feature 4 was a human burial. A female 40 to 50 years of age was interred in a pit excavated into Stratum 3 beneath Stratum 30. The burial pit measured 95-by-50 cm wide and 35 cm deep. The burial pit was oriented northwest-southeast. The woman was laid on her back with her head to the southeast. The legs were flexed and turned to the left. No burial goods were present. Most of the left hand bones were found in the lower fill of the pit structure, suggesting the burial is not associated with Feature 6 (which contradicts the faunal analyst's opinion). At least three ribs exhibited carnivore damage.

Twenty pieces of debitage were recovered from Feature 4. Because the burial pit was excavated into sterile ground it is likely that these lithics were introduced to the fill when the burial was back-filled and represent artifacts associated with the occupation surface around the burial. The chalcedony angular debris (n = 2) and flakes (n = 12) indicate an emphasis on later stages of secondary core reduction but lacks evidence of utilization. Two pieces of Jemez obsidian were also recovered, one of which exhibited unidirectional marginal retouch.

Feature 7 was a fire pit located near the pit structure (Feature 6). Feature 7 was discovered while using heavy equipment to remove Stratum 2 and expose all of Feature 6. The fire pit was similar in size and shape to Feature 3. Feature 7 consisted of an oval pit measuring 50-by-40 cm and 12 cm deep (Fig. 8.7). Feature 7 was filled with fire-cracked rock and ash. One burned rhyolite mano was found in Feature 7, however no lithic or ceramic artifacts were recovered from the fire pit.

Feature 8 was an egg-shaped depression located southwest of Feature 6. The depression measured 95-by-60 cm and 15 cm deep. The upper portion of the fill contained gravel, cobbles, and rock fragments. Gravel and river cobbles were also abundant in the area around Feature 8. The lower fill consisted of mixed Stratum 2 and 3 deposits. Small pockets of ash, some charcoal, and two pieces of ground stone were also present in the fill. Feature 8 may not

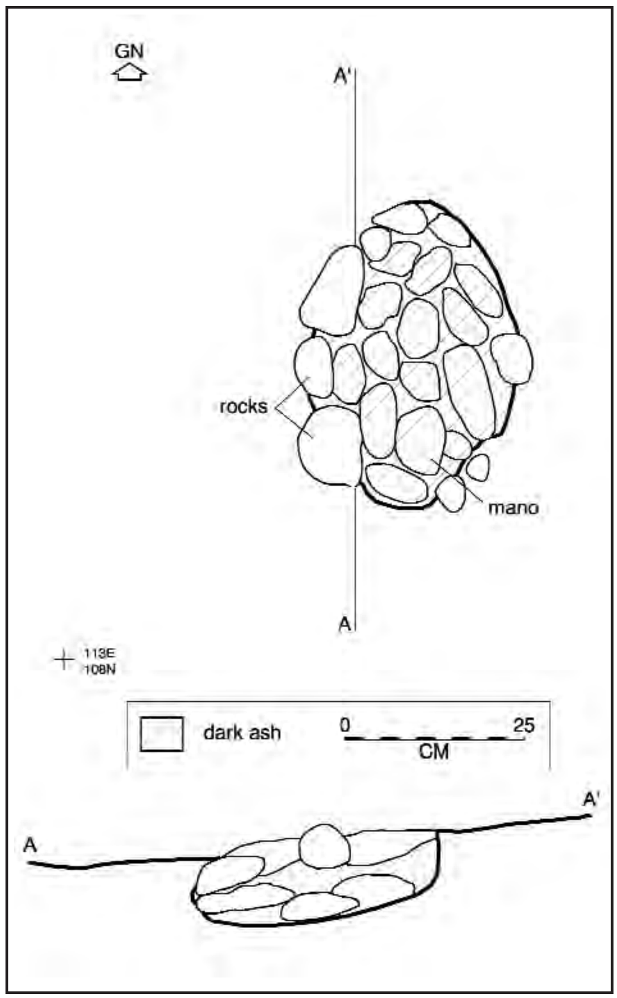


Figure 8.7. LA 249, Feature 7 plan and profile.

have been a cultural feature, but merely a natural depression within Stratum 3 filled with rock, ash, and few artifacts.

Study Unit 2

Five 1-by-1-m exploratory units and four test trenches were excavated in this area in an effort to expose subsurface cultural deposits. Feature 5, a small pit containing a metate, was the only feature found in Study Unit 2. Soil stratigraphy in Study Unit 2 was essentially identical to Study Unit 1. Surface artifacts were collected in 2-by-2-m units prior to excavation.

All five units were excavated to sterile soil. As in Study Unit 1, artifacts were found in all or most levels within Stratum 2. Artifacts were occasionally present in Stratum 4, however the materials appear to be intrusive.

Four test trenches measuring 14 m to 21 m long were excavated using heavy equipment in this area. Trench C was oriented north-south and located near the east highway fence line. Trench D, Trench E, and Trench F were all oriented east-west and spaced approximately 5 m apart. The eastern ends of Trenches D, E, and F

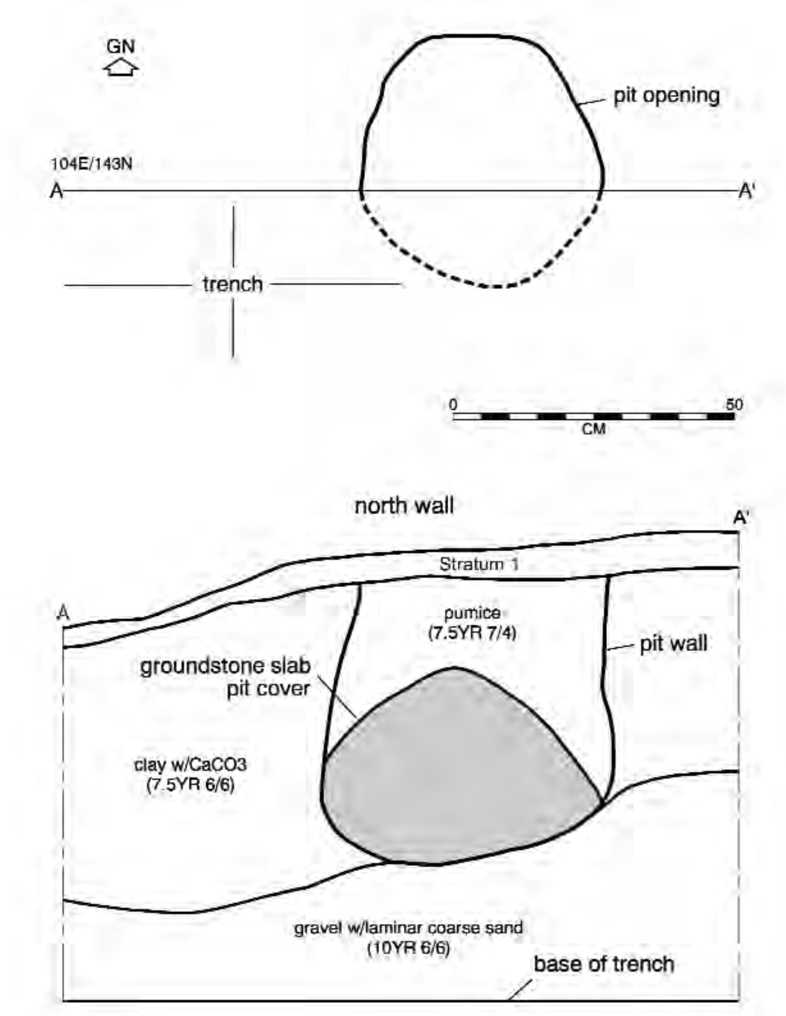


Figure 8.8. LA 249, Feature 5 plan and profile.

intersected Trench C. Feature 5 was exposed in the north profile of Trench D. All four trenches were also excavated down the sterile soil.

Feature 5. Feature 5 consisted of a small pit measuring 52 cm deep (Fig. 8.8). The pit was probably circular and measured 40 cm in diameter. An informal metate was exposed at the bottom of the pit while excavating Trench D. The metate consisted of a large basalt river cobble that had been ground on one side. Ceramic artifacts were also present, and included 199 sherds assigned to Classic with Late Developmental components. The remaining portion of the Feature 5 fill consisted of Stratum 2. The pit appears to have been intentionally excavated into Stratum 3 judging by the smooth shape and side walls.

Artifacts

A subset of individual ceramic and faunal material collection units (identified by field specimen number) was selected for analysis. Sampling areas or units included a percentage of the surface-collected grid units, one of the fire pits (Feature 3), stratigraphic units within the pit structure, and two exploratory units in Study Unit 2. Fewer collection units were selected for pollen and macrobotanical analyses.

Ceramic Artifacts

A total of 1,049 ceramic artifacts were examined from LA 249 (Table 8.12). The ceramic assemblages recovered from most excavated areas within LA 249 are mixed and derived from Late Developmental and Classic period components (see Chaper 16 by C. D. Wilson). Two distinct temporal groups were distinguished based on the dominant decorated types. Assemblages associated with a Late Developmental component are identified primarily by the occurrence of Kwahe'e Black-on-white sherds. Ceramics associated with the Classic period are identified by high frequencies of glaze ware and biscuit ware types. Ceramic assemblages from different contexts were assigned one of two distinct dating groups based on the dominance of decorated types associated with the two occupational periods.

Late Developmental period ceramic assemblages appeared more frequently within the lower fill deposits of the pit structure. Of the 210 sherds assigned to the Late Developmental with a Classic component, 17.1 percent consisted of ceramics that were most likely derived from Kwahe'e Black-on-white (Table 8.2), while those sherds derived from glaze ware types comprised 10.5 percent of the assemblage. In contrast, ceramic assemblages from the uppermost stratigraphic deposits were assigned to a Classic period with a Late Developmental period group (Table 8.13). Assemblages from these areas contained a higher frequency of decorated types associated with the Classic period. Utility wares in the ceramic assemblage from Feature 6 consisted primarily of plain gray body sherds and smeared and unsmeared plain corrugated and indented corrugated gray ware.

The relative abundance of earlier ceramic types in the lower fill of Feature 6 indicates that this structure was probably constructed during the Late Developmental period (AD 1000 to 1200). As previously noted, the radiocarbon date from the structure indicated Feature 6 had been abandoned no later than the mid-1200s. The presence of glaze period pottery in all contexts suggests contamination of earlier deposits. A single San Marcial Black-on-white sherd was also recovered from LA 249, suggesting some use of the site area during the Early Developmental period.

Lithic Artifacts

Sixty-six lithic artifacts were recovered from Test Unit 107N/114E in Study Unit 1 (Table 8.14). A temporal affiliation was not assigned to this unit. Chalcedony (68 percent) and nonvesicular igneous materials (15 percent) made up the majority of the assemblage. Low frequencies of Jemez obsidian (n = 7) and chert (n = 4) were also recovered.

The chalcedony assemblage indicates both early and late stages of secondary core reduc-

Table 8.12. Distribution of Ceramic Types from Dated Components at LA 249

Pottery Type	Ceramic Date: Mainly Late Developmental with Classic	Ceramic Date: Classic with Late Developmental	Total
Unpainted (undifferentiated white)	-	2	2
	-	0.20%	0.20%
Indeterminate mineral paint undifferentiated	1	2	3
	0.50%	0.20%	0.30%
Unpainted undifferentiated	20	10	30
	9.50%	1.20%	2.90%
NRG mineral paint (undifferentiated)	6	5	11
	2.90%	0.60%	1.00%
Kwahe'e B/w (solid designs)	3	-	3
	1.40%	-	0.30%
Kwahe'e B/w (thin parallel line)	-	1	1
	-	0.10%	0.10%
Kwahe'e B/w (thick parallel lines)	-	2	2
	-	0.20%	0.20%
Kwahe'e B/w (hatchured designs)	2	1	3
	1.00%	0.10%	0.30%
Kwahe'e B/w (solid and hatchure)	1	-	1
	0.50%	-	0.10%
Kwahe'e B/w	4	1	5
	1.90%	0.10%	0.50%
Biscuit Ware unpainted	-	6	6
	-	0.70%	0.60%
Biscuit Ware painted unspecified	-	1	1
	-	0.10%	0.10%
Biscuit A (Abiquiu B/g)	-	7	7
	-	0.80%	0.70%
Biscuit B (Bandelier B/g)	-	1	1
	-	0.10%	0.10%
NRG Plain rim	4	8	12
	1.90%	1.00%	1.10%
NRG Plain body	43	99	142
	20.50%	11.80%	13.50%
NRG Wide neckbanded	-	1	1
	-	0.10%	0.10%
NRG Clapboard neck	-	1	1
	-	0.10%	0.10%
NRG Indented corrugated	23	101	124
	11.00%	12.00%	11.80%
NRG Plain corrugated	18	20	38
	8.60%	2.40%	3.60%
NRG Smeared plain corrugated	38	21	59
	18.10%	2.50%	5.60%
NRG Smeared indented corrugated	9	26	35
	4.30%	3.10%	3.30%
NRG Mudware	1	-	1
	0.50%	-	0.10%

Table 8.12. Continued.

Pottery Type	Ceramic Date: Mainly Late Developmental with Classic	Ceramic Date: Classic with Late Developmental	Total
MRG Plain rim	3	2	5
	1.40%	0.20%	0.50%
MRG Plain body	12	97	109
	5.70%	11.60%	10.40%
MRG Indented corrugated	-	5	5
	-	0.60%	0.50%
MRG Plain corrugated	-	10	10
	-	1.20%	1.00%
MRG Smeared plain corrugated	-	5	5
	-	0.60%	0.50%
MRG Smeared indented corrugated	-	5	5
	-	0.60%	0.50%
MRG Unpainted undifferentiated	-	4	4
	-	0.50%	0.40%
San Marcial B/w	-	1	1
	-	0.10%	0.10%
Keres Utility Ware	4	59	63
	1.90%	7.00%	6.00%
Glazed red (unpainted)	4	149	153
	1.90%	17.80%	14.60%
Glaze yellow/cream slipped (unpainted)	1	28	29
	0.50%	3.30%	2.80%
Glaze brown/tan (unpainted)	4	12	16
	1.90%	1.40%	1.50%
Glaze-on-red (undiff)	4	79	83
	1.90%	9.40%	7.90%
Glaze-on-white slipped (undiff)	-	1	1
	-	0.10%	0.10%
Glaze-on-yellow cream	2	18	20
	1.00%	2.10%	1.90%
Glazed-on-brown/tan	3	15	18
	1.40%	1.80%	1.70%
Unpainted Glaze A Yellow	-	1	1
	-	0.10%	0.10%
Unpainted red rim	-	2	2
	-	0.20%	0.20%
Agua Fria Glaze A	-	24	24
	-	2.90%	2.30%
Cieneguilla Glaze-on-yellow	-	3	3
	-	0.40%	0.30%
Largo Glaze-on-yellow	-	1	1
	-	0.10%	0.10%
Socorro B/w	-	2	2
	-	0.20%	0.20%
Total	210	839	1049
	100.00%	100.00%	100.00%

NRG = Northern Rio Grande; MRG = Middle Rio Grande; B/w = Black-on-white; B/g = Black-on-gray

Table 8.13. Distribution of Ceramic Types for Assemblages Assigned to Classic with Late Developmental Components from LA 249

Pottery Type	Surface	Midden	Surface Strip	Feature 1 Rock Concen- tration	Feature 3, Hearth	Feature 5, Midden	Feature 4, Burial	Feature 6 Fill, Stratum 29a	Feature 6, Floor Feature 11	Test Grid, N142 E114	Test Grid, N151 E114	Total
Unpainted (undifferentiated white)	2	-	-	-	-	-	-	-	-	-	-	2
	0.90%	-	-	-	-	-	-	-	-	-	-	0.20%
Indeterminate Mineral paint undifferentiated	2	-	-	-	-	-	-	-	-	-	-	2
	0.90%	-	-	-	-	-	-	-	-	-	-	0.20%
Unpainted undifferentiated	3	4	2	-	-	-	-	1	-	-	-	10
	1.40%	2.70%	1.70%	-	-	-	-	1.50%	-	-	-	1.20%
NRG Mineral paint (undifferentiated)	1	-	1	-	-	2	-	1	-	-	-	5
	0.50%	-	0.80%	-	-	1.00%	-	1.50%	-	-	-	0.60%
Kwahe'e B/w (thin parallel line)	-	1		-	-	-	-	-	-	-	-	1
	-	0.70%		-	-	-	-	-	-	-	-	0.10%
Kwahe'e B/W (thick parallel lines)	-	1	1	-	-	-	-	-	-	-	-	2
	-	0.70%	0.80%	-	-	-	-	-	-	-	-	0.20%
Kwahe'e B/w (hatchured designs)	-	1	-	-	-	-	-	-	-	-	-	1
	-	0.70%	-	-	-	-	-	-	-	-	-	0.10%
Kwahe'e B/w	-	-	-	-	-	-	-	1	-	-	-	1
	-	-	-	-	-	-	-	1.50%	-	-	-	0.10%
Biscuit Ware Unpainted	-	-	4	-	-	2	-	-	-	-	-	6
	-	-	3.40%	-	-	1.00%	-	-	-	-	-	0.70%
Biscuit Ware Painted Unspecified	-	-	1	-	-	-	-	-	-	-	-	1
	-	-	0.80%	-	-	-	-	-	-	-	-	0.10%
Biscuit A (Abiquiu B/G)	1	-	3	-	-	2	-	-	-	1	-	7
	0.50%	-	2.50%	-	-	1.00%	-	-	-	1.70%	-	0.80%
Biscuit B (Bandelier B/G)	-	1	-	-	-	-	-	-	-	-	-	1
	-	0.70%	-	-	-	-	-	-	-	-	-	0.10%
NRG Plain rim	1	2	1	-	-	-	-	2	-	-	2	8
	0.50%	1.40%	0.80%	-	-	-	-	3.00%	-	-	9.10%	1.00%
NRG Plain body	8	16	22	-	-	28	-	16	1	4	4	99
	3.80%	10.90%	18.50%	-	-	14.10%	-	24.20%	33.30%	6.90%	18.20%	11.80%
NRG Wide Neckbanded	-	1	-	-	-	-	-	-	-	-	-	1
	-	0.70%	-	-	-	-	-	-	-	-	-	0.10%
NRG Clapboard Neck	-	1	-	-	-	-	-	-	-	-	-	1
	-	0.70%	-	-	-	-	-	-	-	-	-	0.10%
NRG Indented Corrugated	12	6	16	-	-	59	2	3	2	1	-	101
	5.70%	4.10%	13.40%	-	-	29.60%	100.00%	4.50%	66.70%	1.70%	-	12.00%

Table 8.13. Continued.

Pottery Type	Surface	Midden	Surface Strip	Feature 1 Rock Concen-tration	Feature 3, Hearth	Feature 5, Midden	Feature 4, Burial	Feature 6 Fill, Stratum 29a	Feature 6, Floor Feature 11	Test Grid, N142 E114	Test Grid, N151 E114	Total
NRG Plain Corrugated	3	6	1	1	-	5	-	3	-	1	-	20
	1.40%	4.10%	0.80%	10.00%	-	2.50%	-	4.50%	-	1.70%	-	2.40%
NRG Smeared Plain Corrugated	1	5	1	6	-	7	-	1	-	-	-	21
	0.50%	3.40%	0.80%	60.00%	-	3.50%	-	1.50%	-	-	-	2.50%
NRG Smeared Indented Corrugated	2	3	10	-	-	6	-	5	-	-	-	26
	0.90%	2.00%	8.40%	-	-	3.00%	-	7.60%	-	-	-	3.10%
MRG Plain rim	-	1	1	-	-	-	-	-	-	-	-	2
	-	0.70%	0.80%	-	-	-	-	-	-	-	-	0.20%
MRG Plain body	19	27	10	-	-	16	-	12	-	11	2	97
	9.00%	18.40%	8.40%	-	-	8.00%	-	18.20%	-	19.00%	9.10%	11.60%
MRG Indented Corrugated	2	2	-	-	-	-	-	1	-	-	-	5
	0.90%	1.40%	-	-	-	-	-	1.50%	-	-	-	0.60%
MRG Plain Corrugated	3	3	-	-	1	2	-	-	-	1	-	10
	1.40%	2.00%	-	-	100.00%	1.00%	-	-	-	1.70%	-	1.20%
MRG Smeared Plain Corrugated	4	1	-	-	-	-	-	-	-	-	-	5
	1.90%	0.70%	-	-	-	-	-	-	-	-	-	0.60%
MRG Smeared Indented Corrugated	-	1	1	-	-	2	-	1	-	-	-	5
	-	0.70%	0.80%	-	-	1.00%	-	1.50%	-	-	-	0.60%
MRG Unpainted undifferentiated	1	-	1	-	-	-	-	1	-	1	-	4
	0.50%	-	0.80%	-	-	-	-	1.50%	-	1.70%	-	0.50%
San Marcial B/w	-	1	-	-	-	-	-	-	-	-	-	1
	-	0.70%	-	-	-	-	-	-	-	-	-	0.10%
Keres Utility Ware	11	4	12	1	-	24	-	2	-	2	3	59
	5.20%	2.70%	10.10%	10.00%	-	12.10%	-	3.00%	-	3.40%	13.60%	7.00%
Glazed red (unpainted)	52	32	14	-	-	19	-	7	-	22	3	149
	24.50%	21.80%	11.80%	-	-	9.50%	-	10.60%	-	37.90%	13.60%	17.80%
Glaze yellow/cream slipped (unpainted)	17	3	1	-	-	3	-	3	-	-	1	28
	8.00%	2.00%	0.80%	-	-	1.50%	-	4.50%	-	-	4.50%	3.30%
Glaze brown/tan (unpainted)	3	1	2	-	-	4	-	-	-	1	1	12
	1.40%	0.70%	1.70%	-	-	2.00%	-	-	-	1.70%	4.50%	1.40%
Glaze-on-red (undiff)	37	16	4	2	-	9	-	1	-	7	3	79
	17.50%	10.90%	3.40%	20.00%	-	4.50%	-	1.50%	-	12.10%	13.60%	9.40%
Glaze-on-white slipped (undiff)	1	-	-	-	-	-	-	-	-	-	-	1
	0.50%	-	-	-	-	-	-	-	-	-	-	0.10%
Glaze-on-yellow cream	10	2	3	-	-	1	-	-	-	-	2	18
	4.70%	1.40%	2.50%	-	-	0.50%	-	-	-	-	9.10%	2.10%

Table 8.13.Continued.

Pottery Type	Surface	Midden	Surface Strip	Feature 1 Rock Concen-tration	Feature 3, Hearth	Feature 5, Midden	Feature 4, Burial	Feature 6 Fill, Stratum 29a	Feature 6, Floor Feature 11	Test Grid, N142 E114	Test Grid, N151 E114	Total
Glaze-on-yellow cream	10	2	3	-	-	1	-	-	-	-	2	18
	4.70%	1.40%	2.50%	-	-	0.50%	-	-	-	-	9.10%	2.10%
Glazed-on-brown/tan	6	1	1	-	-	3	-	-	-	4	-	15
	2.80%	0.70%	0.80%	-	-	1.50%	-	-	-	6.90%	-	1.80%
Unpainted Glaze A Yellow	1	-	-	-	-	-	-	-	-	-	-	1
	0.50%	-	-	-	-	-	-	-	-	-	-	0.10%
Unpainted Red Rim	1	-	-	-	-	1	-	-	-	-	-	2
	0.50%	-	-	-	-	0.50%	-	-	-	-	-	0.20%
Aqua Fria Glaze A	6	4	6	-	-	2	-	4	-	1	1	24
	2.80%	2.70%	5.00%	-	-	1.00%	-	6.10%	-	1.70%	4.50%	2.90%
Cienequilla Glaze-on-yellow	1	-	-	-	-	2	-	-	-	-	-	3
	0.50%	-	-	-	-	1.00%	-	-	-	-	-	0.40%
Largo Glaze-on-yellow	1	-	-	-	-	-	-	-	-	-	-	1
	0.50%	-	-	-	-	-	-	-	-	-	-	0.10%
Socorro B/w	-	-	-	-	-	-	-	1	-	1	-	2
	-	-	-	-	-	-	-	1.50%	-	1.70%	-	0.20%
Total	212	147	119	10	1	199	2	66	3	58	22	839
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 8.14. LA 249, Study Unit 1 Test Grid (107N/114E) Lithic Assemblage

	Material Group								Grouped Material Totals	
	Chalcedony		Chert		Jemez Obsidian		Nonvesicular Igneous			
	N	%	N	%	N	%	N	%	N	%
Angular Debris	5	55.6	2	22.2	-	-	2	22.2	9	13
Flake	38	70.4	2	3.7	6	11.1	8	14.8	54	81
Angular Debris, Marginal Retouch	1	100	-	-	-	-	-	-	1	1
Flake, Marginal Retouch	1	100	-	-	-	-	-	-	1	1
Biface	-	-	-	-	1	100	-	-	1	1
Total	45	68.2	4	6.1	7	10.6	10	15.2	66	100

tion as well as formal tool manufacture. Secondary core reduction is indicated by whole flakes lacking dorsal cortex (76 percent) and whole flakes with partial dorsal cortex (19 percent). Two chalcedony flakes exhibit retouched platforms indicating formal tool manufacture. No cores were recovered.

Unutilized flakes (71 percent) and unutilized small angular debris (13 percent) are most common in the assemblage. Three tools were recovered from this provenience. A flake and piece of small angular debris, manufactured from chalcedony, exhibit unidirectional marginal retouch. Scraping wear typical of use on hard media like bone or wood was identified on the flake. The functional edge was not complete and it is likely that it was broken during use and discarded. The small angular debris lacked evidence of use but exhibited a complete functional edge with an edge angle consistent with scraping activities (78 percent). An obsidian biface fragment exhibited incomplete functional edges and lacked evidence of utilization. It is likely that the biface is a manufacturing failure.

Thirty lithic artifacts were recovered from Test Unit 142N/114E (Table 8.15). Artifacts recovered from this unit within Study Unit 2 are associated with the Classic period. Material categories represented were chalcedony (n = 17), nonvesicular igneous materials (n = 8), and chert (n = 2) with quartzite, Jemez obsidian, and "other" igneous material groups represented by a single artifact.

All stages of core reduction are indicated for the chalcedony group. It consisted of one primary flake with 100 percent dorsal cortex, one secondary flake that exhibits partial dorsal cortex and eleven that lack dorsal cortex. A single chalcedony multiplatform core was also recovered. Low counts in other material categories prohibit further discussion.

Unutilized flakes (n = 22) and unutilized small angular debris (n = 3) made up the majority of the assemblage. Tools included a chalcedony marginally retouched flake and a chalcedony biface. The expedient flake tool exhibited unidirectional marginal retouch with unidirectional rounding and striations on a concave edge. This type of use wear is consistent with prolonged scraping on bone or wood. The tool exhibited a complete functional edge indicating that it was discarded when it no longer functioned for its intended task. The biface lacked evidence of use wear although functional edges were described as complete. The tool is complete and it is likely that wear patterns are not visible at low power magnification. An indeterminate ground stone fragment made of "other " igneous material was also recovered.

Eighty-two lithic artifacts were recovered from the midden (Feature 2) in grid unit 107N/115E. The artifact assemblages recovered from this unit are associated with Late Developmental and Classic periods. The majority was manufactured from chalcedony (68 percent) and nonvesicular igneous materials (23 percent). Low frequencies of Jemez obsidian (n = 5) and chert (n = 2) were also recovered.

The assemblage indicates an emphasis on secondary reduction with 76 percent of whole

Table 8.15. LA 249, Study Unit 2 Test Grid (142N/114E) Lithic Assemblage

	Material Group													
	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Other Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	2	66.7	1	33.3	.	.	.	.	.	.	.	.	3	10
Flake	12	54.5	1	4.5	1	4.5	1	4.5	7	31.8	.	.	22	73
Core, Multiplatform	1	50	.	.	.	.	.	.	1	50	.	.	2	6
Flake, Marginal Retouch	1	100	.	.	.	.	.	.	.	.	.	.	1	3
Biface	1	100	.	.	.	.	.	.	.	.	.	.	1	3
Unknown Ground Stone	.	.	.	.	.	.	.	.	.	.	1	100	1	3
Total	17	56.7	2	6.7	1	3.3	1	3.3	8	26.7	1	3.3	30	100

Table 8.16. LA 249, Surface Strip Lithic Assemblage

	Material Group											
	Chalcedony		Chert		Quartzite		Jemez		Nonvesicular		Grouped	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	10	71.4	3	21.4	.	.	.	.	1	7.1	14	10
Flake	54	52.4	17	16.5	2	1.9	4	3.9	26	25.2	103	80
Tested Rock	1	50	1	50	.	.	.	.	.	.	2	1
Core, Multiplatform	5	83.3	.	.	.	.	.	.	1	16.7	6	4
Flake, Utilized	1	100	.	.	.	.	.	.	.	.	1	<1
Flake, Marginal Retouch	1	50	1	50	.	.	.	.	.	.	2	1
Total	72	56.3	22	17.2	2	1.6	4	3.1	28	21.9	128	100

flakes lacking dorsal cortex and 21 percent exhibiting partial cortex. Seventy percent of all platforms were single-faceted. A single obsidian flake exhibited a retouched platform indicative of bifacial tool manufacture. No cores were identified.

Unutilized flakes (86 percent) and unutilized small angular debris (10 percent) made up the majority of the assemblage. No expedient flake tools or formal tools were identified in this provenience. An indeterminate ground stone fragment manufactured from andesite was recovered.

One hundred and twenty-eight lithic artifacts were recovered from a surface-stripped area on the site (Table 8.16). Diagnostic artifacts recovered from this area are affiliated with the Classic period. The majority of the assemblage was made up of chalcedony (56 percent), nonvesicular igneous materials (22 percent), and chert (17 percent). Low frequencies of obsidian (n = 4) and quartzite (n = 2) were also recovered.

All stages of core reduction and tool manufacture are indicated for the chalcedony assemblage. Whole flakes lacking dorsal cortex make up 70 percent of the assemblage and flakes with partial cortex represent 24 percent of the assemblage. Two chalcedony primary flakes exhibit 100 percent dorsal cortex and a single flake with a retouched platform indicates that bifacial tool manufacture occurred. The other materials indicate an emphasis on secondary core reduction with limited primary decortication. Five chalcedony multiplatform cores and a nonvesicular igneous multiplatform core were also recovered from this provenience.

Unutilized flakes (80 percent) and unutilized small angular debris (10 percent) compose the majority of the assemblage. Two complete marginally retouched flakes, one made of chalcedony and the other chert, exhibit unidirectional retouch but lack evidence of utilization. The retouched edges appear complete—it is likely that they were used but the use-wear is not visible at low power magnification. A distal fragment of a utilized chalcedony flake exhibits unidirectional wear typical of scraping on hard media like bone or wood. No ground stone was recovered.

One hundred and eleven lithic artifacts were recovered from the midden (Feature 2) in grid unit 106N/112E. No temporal affiliation was assigned to this grid unit. The majority was manufactured from chalcedony (59 percent) and nonvesicular igneous materials (20 percent). Low frequencies of Jemez obsidian (n = 12), chert (n = 11), and quartzite (n = 1) were also recovered.

The assemblage indicates an emphasis on both early and later stages of core reduction. Eighty percent of whole flakes lack dorsal cortex and 16 percent exhibit only partial cortex. Single-facet platforms are most common, representing 73 percent of all platforms. These platforms are consistent with secondary core reduction. Obsidian is the only material category that exhibits flakes representing all stages of core reduction (primary and secondary) and formal tool manufacture (tertiary). Three chalcedony multiplatform cores and a chalcedony single-platform core were also recovered.

Unutilized flakes (88 percent) and unutilized small angular debris (6 percent) make up the majority of the assemblage. One complete utilized flake exhibits bidirectional wear typical of use on hard media like bone or wood. A second flake exhibits unidirectional marginal retouch but lacks evidence of wear. The functional edge on this artifact was complete and it is likely that the tool was used but did not produce wear patterns that are identifiable using low-power magnification.

Eighty-eight lithic artifacts were recovered from the midden (Feature 2) in grid unit 106N/113E. The artifact assemblages recovered from this grid unit are associated with the Classic period. The majority of lithic artifacts consisted of chalcedony (59 percent) and nonvesicular igneous materials (24 percent). Low frequencies of chert (n = 8), Jemez obsidian (n = 5), and "other" local material (n = 2) were also recovered.

The assemblage indicates an emphasis on secondary reduction. Seventy-nine percent of whole flakes lack dorsal cortex and 18 percent exhibit partial dorsal cortex. Seventy-five percent of flakes with platforms were single-faceted. No primary flakes were recovered. A single Jemez obsidian bifacial thinning flake had a retouched platform typical of bifacial tool manufacture. Three chalcedony multiplatform cores were also recovered.

Unutilized flakes (80 percent) and unutilized small angular debris (9 percent) make up the majority of the assemblage. Both expedient and formal tools were recovered. The expedient tools were manufactured from chalcedony. One distal portion of flake with unidirectional wear typical of scraping on hard media like bone or wood does not exhibit a complete utilized edge—it is likely that this tool was broken during use and discarded. Two flakes with unidirectional marginal retouch lack evidence of utilization but exhibit complete functional edges—these tool may exhibit use-wear patterns that cannot be identified using low-power magnification. A chalcedony uniface and a Jemez obsidian biface were also recovered. The uniface is whole and exhibits a complete functional edge with unidirectional wear consistent with scraping on hard media like bone or wood. This tool was used then discarded once it was no longer useful for its intended use. One biface fragment exhibited bidirectional wear on an edge that was not functionally complete. It is likely that this tool was used, broken, and discarded.

Two hundred and two lithic artifacts were recovered from the fill in Feature 6 (Table 8.3). A temporal affiliation was not assigned. The vast majority was manufactured from chalcedony (83 percent), and low frequencies consisted of nonvesicular igneous materials (n = 18), chert (n = 10), Jemez obsidian (n = 6), and quartzite (n = 1).

All stages of core reduction and formal tool manufacture are evident from the chalcedony chipped stone assemblage. Four flakes with 100 percent dorsal cortex indicate primary decortication. Twenty-one flakes with partial cortex and 98 flakes with no dorsal cortex indicate both early and later stages of secondary core reduction. A flake with a retouched platform represents bifacial tool manufacture. Debitage in the other material categories indicate an emphasis on later stages of secondary core reduction. Five chalcedony multiplatform cores and two chalcedony tested rocks were also recovered. One flake made of nonvesicular igneous material had a retouched platform also representing bifacial tool manufacture.

Unutilized flakes (84 percent) and unutilized small angular debris (10 percent) comprise the majority of the assemblage. A chalcedony uniface fragment, an obsidian biface fragment, and two utilized flake tools made of chert and nonvesicular igneous material were recovered from the fill in Feature 6. The uniface fragment exhibits unidirectional wear consistent with wear patterns resulting from scraping on hard media like bone and wood. The functional edge was incomplete indicating that the tool probably broke during use and was discarded. The biface fragment lacks evidence of wear and does not exhibit a complete functional edge, indicating the tool broke during manufacture. The two flake tools exhibit unidirectional wear typical of scraping on hard media like bone or wood. Both tools exhibit complete functional edges indicating that they were used until they were no longer functional then discarded.

Three hundred and eighty-three lithic artifacts were recovered from the fill (Stratum 29a) in Feature 6 (Table 8.4). The artifact assemblages recovered from this stratum were associated with Classic with Late Developmental components. The majority of the assemblage was chalcedony (86 percent) with low frequencies of chert (n = 31), nonvesicular igneous materials (n = 23), Jemez obsidian (n = 16), and quartzite (n = 1).

The overall assemblage exhibits an emphasis on later stages of secondary core reduction with 80 percent of whole flakes lacking dorsal cortex. Sixteen percent exhibit partial dorsal cortex. Seventy-two percent of all platforms are either single-faceted or collapsed (22 percent) and are also consistent with secondary core reduction. The chalcedony debitage, on the other hand, represents all stages of core reduction and formal tool manufacture. Seven primary flakes exhibit 100 percent dorsal cortex and a bifacial thinning flake with a retouched platform represents bifacial tool manufacture. The only other material category with evidence of formal tool manufacture is nonvesicular igneous materials, which also exhibits a flake with a retouched platform. Decortication of chert, obsidian, and nonvesicular igneous materials is not represented in this assemblage. Fifteen multiplatform cores were manufactured from chalcedony (n = 13), chert (n = 1), and nonvesicular igneous materials (n = 1). A chalcedony single platform core was also recovered.

Unutilized flakes (80 percent) and unutilized small angular debris (10 percent) composed the majority of lithic artifacts recovered from this provenience. Ten chipped stone tools, seven expedient, three formal tools, and a chalcedony chopper, were recovered from Stratum 29a in Structure 6. Three expedient flake tools, manufactured from chalcedony, were complete and exhibited both unidirectional (n = 1) and bidirectional (n = 2) wear typical of both scraping and cutting on hard media like bone or wood. The functional edges were complete and it is likely that these tools were utilized and discarded when they were no longer functional for the intended task. Four additional marginally retouched flakes, one chert and the others chalcedony, all exhibited unidirectional retouch suggesting use for scraping activities. Three of these tools have complete functional edges but show no evidence of utilization. However, because the functional edges are complete, it is likely that these tools exhibit use wear that cannot be identified using low power magnification. One marginally retouched tool lacking use wear did not exhibit complete functional edges, which may represent a manufacturing failure. A chalcedony uniface exhibited three incomplete bidirectionally utilized edges, indicating it was utilized, broken, and discarded. A nonvesicular igneous biface is whole and exhibits unidirectional wear. Its used edge was functionally complete so it is likely the tool was used up and discarded. The proximal base of an obsidian projectile point was also recovered. It lacked complete functional edges and may have been broken in manufacture.

Two hundred and thirty-three lithics were recovered from the Stratum 29b fill in Feature 6 (Table 8.5). The artifact assemblages recovered from this stratum are assigned to Late Developmental and Classic components. The majority of lithic artifacts present consisted of chalcedony (78 percent) and nonvesicular igneous materials (28 percent). Material categories represented by fewer artifacts were chert (n = 14), Jemez obsidian (n = 9), and quartzite (n = 1) were also recovered.

The lithic debitage indicates an emphasis on early and later stages of secondary core reduction—78 percent of whole flakes lack dorsal cortex and 20 percent exhibit only partial dorsal cortex. Most platforms are either single-faceted (68 percent) or collapsed (21 percent). Obsidian is the only material group that may indicate primary reduction (n = 1). There was no evidence of formal tool manufacture in the assemblage.

Unutilized flakes (84 percent) and unutilized small angular debris (8 percent) comprised the majority of the assemblage. Five marginally retouched tools were recovered, all were whole and exhibited complete functional edges. Two exhibited unidirectional use typical of scraping on hard media like bone or wood, one bidirectionally retouched flake lacked evidence of use but had a complete functional edge indicating that it may have been used but wear patterns could not be identified using low-power magnification. A single chalcedony biface fragment exhibits an incomplete functional edge with bidirectional use wear typical of cutting on hard media like bone or wood. Its second edge also exhibits similar wear but the edge is functionally complete. This tool appears to have been used, broken, and discarded.

Twenty-one lithic artifacts were recovered from Stratum 29c in the fill of Feature 6 (Table 8.6). The artifact assemblages recovered from this stratum are assigned to Late Developmental and Classic components. The assemblage was composed of chalcedony (n = 16), nonvesicular igneous materials (n = 3), and chert (n = 2).

The lithic assemblage indicates an emphasis on secondary core reduction: twelve whole flakes lack dorsal cortex and three exhibit only partial dorsal cortex. One chalcedony primary flake, with 100 percent dorsal cortex was also recovered. Unutilized flakes (n = 18) made up the majority of the assemblage. No chipped stone tools were identified. A ground andesite axe fragment was recovered.

One hundred and seventy-two lithic artifacts were recovered from the Stratum 30 fill in Structure 6 (Table 8.7). Diagnostic artifacts were not recovered from this stratum. The majority of lithic artifacts were comprised of chalcedony (63 percent) and nonvesicular igneous materials (22 percent). Other material categories with low frequencies were chert (n = 12), Jemez obsidian (n = 11), quartzite (n = 2), and "other" local material (n = 1).

The chalcedony assemblage exhibits debitage representing all stages of core reduction and formal tool manufacture. Five primary flakes exhibit 100 percent dorsal cortex. Whole flakes lacking dorsal cortex (79 percent) and flakes with partial dorsal cortex (12 percent) evidence both early and later stages of secondary core reduction. Two flakes exhibit retouched or prepared platforms indicative of bifacial tool manufacture. Although the obsidian assemblage is small (n = 7), the debitage reflects secondary reduction (n = 6) and formal tool manufacture (n = 1). Ninety percent of the whole flakes from nonvesicular igneous materials lack dorsal cortex, indicating an emphasis on later stages of secondary core reduction.

Unutilized flakes (87 percent) and unutilized small angular debris (5 percent) comprise the majority of the assemblage. Four expedient tools and one formal tool were also recovered. A chalcedony utilized flake fragment exhibited bidirectional wear consistent with cutting or sawing on bone or wood. The utilized functional edge is broken so it is likely that the tool was used, broken, and discarded. A second utilized flake manufactured from nonvesicular igneous material was whole and exhibited two edges with unidirectional rounding and striations. This type of wear is consistent with wear patterns resulting from prolonged scraping on bone or wood. One marginally retouched flake exhibited unidirectional wear patterns but lacked evidence of use. The edge is described as functionally complete and may exhibit wear patterns that cannot be identified with low-power magnification. A second marginally retouched flake exhibits unidirectional rounding with striations and wear pattern consistent with prolonged scraping on hard media like bone or wood. One chalcedony biface fragment lacked evidence of utilization and did not exhibit a complete functional edge—it is likely that it was discarded before completion.

Three hundred and sixty-seven lithics were recovered from the Stratum 50 fill in Feature 6 (Table 8.8). The artifact assemblages recovered from this stratum are assigned to Late Developmental and Classic components. The majority of lithic artifacts consisted of chalcedony (77 percent), chert (12 percent), and nonvesicular igneous materials (7 percent). Low frequencies of Jemez obsidian (n = 10) and quartzite (n = 5) were also present.

The chalcedony debitage reflects all stages of core reduction and formal tool manufacture. Eight primary flakes exhibit 100 percent dorsal cortex. Flakes lacking dorsal cortex (78 percent) and flakes with partial dorsal cortex (17 percent) indicate both early and later stages of secondary core reduction. A flake with a retouched platform indicates bifacial tool manufacture. Formal tool manufacture is also indicated for obsidian, which is also represented by a bifacial thinning flake. The nonvesicular igneous assemblage provides evidence of primary and secondary reduction but lacks evidence of formal tool manufacture. Twelve multiplatform cores were recorded, eleven were manufactured from chalcedony and one was made of nonvesicular igneous material.

Unutilized flakes (87 percent) and unutilized small angular debris (5 percent) made up the majority of the assemblage. Nine tools were recovered from this provenience: five were expedient and four were formal. The two chalcedony flake tools exhibit unidirectional wear patterns typical of scraping on hard media like bone or wood. One tool exhibits a complete functional edge indicating that it was used then discarded when no longer functional. The second flake tool had a broken use edge and is likely that this tool broke during use and was discarded. Two flakes exhibit unidirectional marginal retouch and lack evidence of use. The tools are both whole and exhibit complete functional edges. Two bifaces and a projectile point were also recovered. The chalcedony biface was whole and exhibited complete functional edges but lacked evidence of utilization. It is likely that this tool may have been used for tasks that produced wear patterns that cannot be identified using low-power magnification. The obsidian biface lacked evidence of utilization also but did not exhibit complete functional edges and it was broken, suggesting this tool was broken in manufacture. A bifacial chopper, manufactured from chalcedony was also recorded. Finally, a single chert projectile point basal fragment exhibited no evidence of use. An expedient hand stone and a ground axe fragment, manufactured from fine-grained rhyolite, were also recovered.

Eighty-four lithic artifacts were recovered from the floor (Stratum 60) in Feature 6 (Table 8.9). The artifact assemblage recovered from this stratum are assigned to Late Developmental and Classic components. The most common materials were chalcedony (69 percent) and chert (17 percent). Low frequencies of nonvesicular igneous materials (n = 8) and Jemez obsidian (n = 4) were also recovered.

The debitage recovered from the floor in Feature 6 indicates an emphasis on both early and later stages of secondary core reduction. Eighty-five percent of the whole flakes lack dorsal cortex and 12 percent exhibit partial dorsal cortex. No evidence of bifacial tool manufacture was recovered. A single multiplatform core, manufactured from chert was also recovered.

Unutilized flakes (81 percent) and unutilized small angular debris (11 percent) made up the majority of the lithic assemblage. Two chipped stone tools, manufactured from nonvesicular igneous materials were identified, and consisted of a utilized flake fragment and a whole biface. The flake tool exhibited unidirectional wear typical of scraping on hard media like bone or wood. As it did not exhibit a complete functional edge, it is likely that the tool was broken during use and discarded. The biface also exhibited unidirectional wear on a complete functional edge, suggesting it was used until it no longer functioned for the task at hand. A fine-grained rhyolite expedient handstone was also recovered.

One hundred and four lithic artifacts were recovered from the midden deposit that was isolated within Stratum 2 (Table 8.17). The artifact assemblage recovered from this midden deposit is associated with the Classic period. Chalcedony (73 percent) and nonvesicular igneous materials (17 percent) composed the majority of the lithic assemblage. Material groups with few artifacts were chert (n = 6) and Jemez obsidian (n = 4).

The debitage recovered from this midden indicates an emphasis on early and later stages of secondary core reduction. Seventy-seven percent of the whole flakes lack dorsal cortex and 21 percent exhibit partial dorsal cortex. A single chalcedony flake provides evidence for formal tool manufacture. Four chalcedony multiplatform cores were also present.

Unutilized flakes (84 percent) and unutilized small angular debris (8 percent) compose the majority of the assemblage. A utilized chalcedony flake and two bifaces, one chalcedony and the other Jemez obsidian, were the only tools recovered. The expedient flake tool exhibited unidirectional wear typical of wear patterns resulting from scraping on hard media like bone or wood. The obsidian biface fragment exhibited bidirectional wear consistent with cutting on a hard medium. The functional edge was broken and it is likely that the tool broke during use and was discarded. The chalcedony biface fragment lacked evidence of wear but exhibited complete functional edges.

Macrobotanical Remains

Eighteen flotation samples from LA 249 were examined for macrobotanical materials (see Toll, McBride, and Badner, Chapter 23). Sampled areas included the fill and floor fill from the pit structure (Feature 6), two subfloor features within Feature 6 (Features 10 and 13), different levels from two grid units excavated in the midden area (Feature 2), both extramural hearths (Feature 3 and 7), and a burial (Feature 4).

Cultural plant remains from the pit structure (Feature 6) fill consisted of corn kernels, cupules, glumes, cobs, and stalk fragments, along with wood. Juniper was the most commonly identified wood in flotation samples and in samples examined prior to submission for radiocarbon dating. Cottonwood/willow was the next most common wood recovered and traces of Mormon tea, piñon, rose family, and saltbush/greasewood were also present. Flotation samples from the Feature 6 floor con-

Table 8.17. LA 249, Isolated Midden Deposit Lithic Assemblage

	Chalcedony		Chert		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%
Angular Debris	7	77.8	1	11.1	.	.	1	11.1	9	8
Flake	63	71.6	5	5.7	3	3.4	17	19.3	88	84
Core, Multiplatform	4	100	.	.	.	.	.	.	4	3
Flake, Utilized	1	100	.	.	.	.	.	.	1	<1
Biface	1	50	.	.	1	50	.	.	2	1
Total	76	73.1	6	5.8	4	3.8	18	17.3	104	100

tained goosefoot seeds, yucca fiber, corn, and juniper wood.

Carbonized dropseed and goosefoot seeds found in an extramural hearth (Feature 7) represented the only evidence of grass exploitation recovered from LA 249. Juniper was the most commonly identified wood from all proveniences. Ponderosa pine was also present in Feature 7 and from an exploratory unit in the midden area. Corn cupules, cottonwood/willow, piñon, Mormon tea, and saltbush/greasewood were also identified from the midden. Fragments of corn stalk were the only carbonized materials recovered at this site. Corn cupules, glumes, and a cob were recovered from the burial pit fill (Feature 4).

Pollen

Seven pollen samples, including one control sample from the surface, were submitted for analysis. Four of the samples were from the floor of Feature 6 and one was from Feature 3. The remaining sample was from the top of Stratum 3 below the midden area and was submitted by mistake. The samples from the pit structure (Feature 6) are described as typical (see Chapter 24) in containing low amounts of ponderosa and piñon pine pollen along with some juniper and oak. However, the relatively low counts of juniper from the feature samples seem odd considering the abundance of juniper wood in the macrobotanical samples. Few economic pollen types were identified in the samples (only corn and cactus).

Faunal Remains

Faunal materials were relatively uncommon at LA 249, both within the pit structure (Table 8.10) and in the extramural areas and features (Table 8.18). Indeterminate small mammal, medium or large mammal, and large mammal accounted for half (n = 104, 50.8 percent) of all bone in the sample (n = 205). Identified species included cottontail, jackrabbit, mule deer, several species of small rodents, horned lizard, and Plains or Woodhouse's toad.

It appears that the majority of rodents and reptiles present were most likely intrusive and may have been the primary agent responsible for the apparent mixing of deposits, as reflected by the ceramic assemblages. Similarly, nine bones from the Feature 4 burial were found in the fill of the lower pit structure (Feature 6).

Only 23 specimens were present in the sample from the extramural features and areas. Nearly half of the materials were eggshell (n = 11, 48.8 percent). Six pieces of eggshell were found in the burial pit fill along with a gopher bone. Only eggshell was present in the Feature 7 hearth. The low occurrence of faunal remains from the midden area may be unusual, however the sample represents materials recovered from only six 10-cm levels in two 1-by-1-m grid units. Only one bone from the extramural features and areas had been burned.

A few bone artifacts were also recovered from the pit structure fill and floor. Bone bead or tube fragments manufactured with small mammal long bones were found in Stratum 29a and Stratum 50. A medium artiodactyl bone awl was found on the floor and another bone awl was recovered from Stratum 29b.

Conclusions

Excavations at LA 249 focused on an extramural or peripheral area of the substantial Classic period room block mound located beyond the construction corridor. Limited to a narrow corridor, excavations revealed a cluster of features including a Late Developmental period pit structure and human burial, three small pit features, and a midden deposit. Artifact assemblages within deposits that overlie the buried cultural features are a mix of Late Developmental and Classic period materials reflecting long term colluvial and eolian deposition on the terrace.

The Late Developmental period component dated between AD 1000 and 1200 from one radiocarbon sample and ceramics is atypical of residential occupations described for the Cochiti/Peña Blanca area. The pit structure has limited floor space with minor floor features and no distinct thermal or ventilation features, unless

Table 8.18. LA 249, Summary of Midden and Surface Strip Fauna

	Surface Strip		Hearth, Feature 7		Midden, Feature 2, N106/E112		Midden, Feature 2, N106/E113		Feature 4, Human Burial		Isolated Midden		Midden Area, Feature 5		Total	
	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %
Medium to large mammal	.	.	.	.	.	.	.	.	.	.	.	.	1	100.0%	1	4.3%
Large mammal	.	.	.	.	.	.	.	.	2	20.0%	.	.	.	.	2	8.7%
Botta's pocket gopher	.	.	.	.	.	.	.	.	1	10.0%	.	.	.	.	1	4.3%
Desert cottontail	.	.	.	.	1	100.0%	1	100.0%	1	10.0%	1	25.0%	.	.	4	17.4%
Black-tailed jack rabbit	1	25.0%	.	.	.	.	.	.	.	.	.	.	.	.	1	4.3%
Medium artiodactyl	.	.	.	.	.	.	.	.	.	.	2	50.0%	.	.	2	8.7%
Mule deer	.	.	.	.	.	.	.	.	.	.	1	25.0%	.	.	1	4.3%
Eggshell	3	75.0%	2	100.0%	.	.	.	.	6	60.0%	.	.	.	.	11	47.8%
Total	4	100.0%	2	100.0%	1	100.0%	1	100.0%	10	100.0%	4	100.0%	1	100.0%	23	100.0%
Immature	.	.	.	.	1	100.0%	1	100.0%	1	10.0%	.	.	.	.	3	13.0%
Burned	.	.	.	.	.	.	.	.	.	.	1	25.0%	.	.	1	6.3%
> 75% complete	1	25.0%	.	.	.	.	1	100.0%	.	.	.	.	.	.	2	8.7%
25-50% complete	.	.	.	.	1	100.0%	.	.	2	20.0%	1	25.0%	.	.	4	17.4%
< 25% complete	3	75.0%	2	100.0%	.	.	.	.	8	80.0%	3	75.0%	1	100.0%	17	73.9%

they occupied the unexcavated eastern one-quarter of the structure. Few floor artifacts provide no information on intramural activities. Floor fill contains little information on superstructure and roof construction. The artifact assemblage is typical of small-scale, short duration residential occupation. Dominated by utility ware jar sherds suggest limited daily storage needs and consumption stored foods. Recovery of the full complement of corn plant parts indicates that corn was grown nearby and consumed at the site, rather than brought to the site in a processed form. Hunting focused on a broad spectrum of field species. Ground stone artifacts were rare suggesting that corn was consumed from the cob, rather than as meal. Lithic artifacts reflect expedient tool production and use with almost no evidence of tool manufacture or maintenance related to hunting needs. The Late Developmental component was small-scale and probably seasonal. It is possible that the buried adult female was resident at the structure at the time of death. Her death may have precipitated abandonment and a short occupation.

Extramural features may date to Late Developmental or Classic period occupation. Excavations at the other NM 22 sites demonstrate that the terraces were intensively and extensively occupied, although LA 249 has the most abundant evidence of Classic period occupation. Classic period extramural features and use would be indistinguishable from earlier periods, unless pottery was recovered from discrete deposits or locations. This is not the case for LA 249, where the majority of the Classic period artifacts are in mixed eolian and colluvial deposits. Therefore, activities related to the occupation of the main pueblo may have occurred within the highway right-of-way, but they cannot be associated with any of the excavated features.

CHAPTER 9
LA 115862

Byrd Bargmann

LA 115862 is an Early Developmental period site situated on a Pleistocene terrace, 100 m east of the Rio Grande floodplain at an elevation of 1,610 m. It is situated south of the confluence of the Santa Fe River and the Rio Grande. The modern vegetation includes forbs of rabbitbrush, Bigelow sagebrush, winterfat, and broom snakeweed, which is representative of the Plains-Mesa Grassland (Brown 1994). The grasses consist of blue and sideoats grama, galleta, ring muhly, Indian ricegrass, and sacaton/dropseed. An archaeomagnetic sample, AM 1150, taken from the pit structure hearth assigned a date range of AD 775–815.

DESCRIPTION

The site covers an area measuring 20-by-30 m, which encompasses a large pit structure, an extramural activity area, four burials, and a cluster of historic surface fires (Fig. 9.1). The structure houses 14 internal features. The activity area consists of two roasting pits, one hearth, and two diffuse thermal features. The four historic surface fires present are thought to be associated with the religious procession of the Virgin of Guadalupe celebrated on December 12.

PREVIOUS WORK

In October 1996, Sandra Marshall of the NMSHTD initially recorded LA 115862. This was during the preliminary survey for the current highway project. It was described as a small lithic and sherd scatter with associated cobble features (Marshall 1997). In preparation for data recovery, the OAS staff revisited the site in 1997. Ware (1997:36) found a small sherd and lithic scatter measuring 30-by-20 m. The cobble concentrations were considered not particularly diagnostic and were located outside of the project area. The fluvial terrace surface and minimal amount of soil suggested substantial buried features or cultural deposits were unlikely.

SITE EXCAVATION STRATEGY

Initial investigation focused on relocating the artifacts recorded during the 1996 survey and subsurface testing for buried cultural deposits within the highway work corridor. A 20-by-20 m surface collection was conducted across the site. Transit location was also used for artifacts located down slope outside of the grid. This produced 34 ceramics and 164 lithic artifacts. Eight preliminary test pits (10 sq m) were hand excavated. These were placed in areas of possible deposition, unusual rock concentrations, and surface staining. Test Pit 1, positioned in an obvious depression on the site, developed into a large pit structure with 14 internal features. The remainder of the site was either mechanically trenched (53.3 sq m) or surface scraped (448.50 m). These activities located an extramural processing area and a cluster of historic religious fires, all of which were located northeast of the structure. Four burials were also identified southwest of the structure.

All features were excavated using standard procedures. Vertical and horizontal controls were established. Prior to excavation, a plan view was drawn and photographs were taken. Each feature was bisected. The fill of the first half was screened and a profile and photographs were taken. The remaining portion was used for samples (e.g., flotation, pollen) and screened if necessary. Upon completing the excavation, a final map, photographs, and paperwork were completed.

SITE STRATIGRAPHY

LA 115862 is located in an area of multiple episodes of channel and fluvial activity along

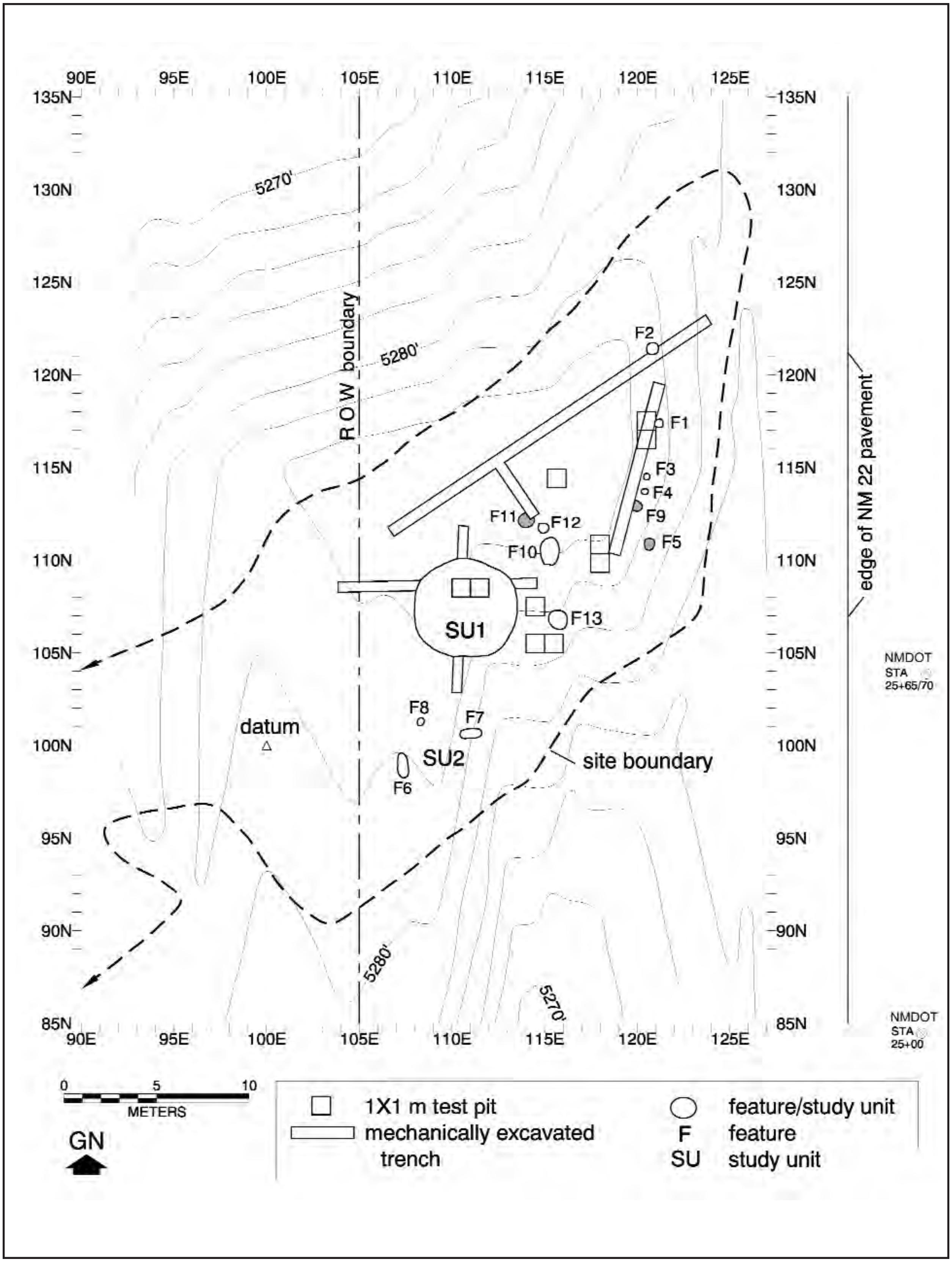


Figure 9.1. LA 115862, site plan.

the Rio Grande corridor. Only a thin cap of fine sediment is found above a deposit of unconsolidated, oxidized sand and gravel within this site. Sand bar deposits of silty clay, into which the floor of the pithouse was dug, underlies this. Below we find loose rose-colored gravel.

Study Unit 1

Study Unit 1, a roughly circular pit structure, measured 6.05 m (northwest-southeast) by 5.55 m (26.37 sq m), with a depth at floor of 2 m below the modern terrace surface (Fig. 9.2). It contained 13 floor features and had a minimal assemblage of artifacts (Fig. 9.3). Evidence of remodeling was not visible. The structure was dismantled at the time of abandonment and had not been burned. The structure was centrally located with an activity area to the northeast and a burial area to the southwest. An archaeomagnetic sample, AM 1150, taken from the pit structure hearth, and the presence of San Marcial Black-on-white have an assigned date range of AD 775–815. This placed the structure in the Early Developmental period.

Excavation

A 1-by-1-m test unit (Test Unit 1) was located in a minor depression on the site. It was excavated down 50 cm and auger tested 40 cm to end in sterile rose-colored gravel. The unit was then expanded to a 1-by-2-m test unit. This was excavated down almost a meter and contained minor amounts of staining and charcoal in the lower levels.

Mechanically excavated trenches were then employed for deeper investigation and stratigraphic information. The north-south trench used the original west wall of Test Unit 1 as a guide. The east-west trench extended from the east and west ends of expanded Test Unit 1. These cross trenches were placed in an effort to bisect a potential structure. This trenching program continued to approximately 1.75 m below ground surface. The strata in the trenches were primarily a natural deposit. The artifacts were minimal; trash-dumping episodes were not apparent, and burned materials were only present in thin laminate lenses. Charcoal was present, however, only in heavy clays in the lowest stratum.

Hand-excavation continued the investigation. Initially unburned closing materials from the structure's roof, and eventually the floor, were encountered within the lowest 25 cm. Once identified, the floor was cleared in all four trenches to the wall remnants. Profiles of both sides of the northeast and southwest quadrants were drawn. This resulted in full north-south and east-west profiles of the structure fill, minus the width of the backhoe bucket. A 1-by-1-m control unit was established in the northeast quadrant of the structure. This sampled depth, density, and diversity of artifacts in the structure fill from modern ground surface to floor. Nineteen 10-cm levels were excavated. A second control unit was established in the southwest quadrant. This was excavated and sampled by strata. A flotation and pollen column was collected. After sampling was completed, the structure fill was mechanically removed by quadrant to 25 cm above the floor. The remaining fill was manually removed by quadrant to the floor.

Stratigraphy

Four major strata were noted in the structure (Fig. 9.4). They appear to be post abandonment because distinct cultural episodes are not present. The natural fill of the pithouse appeared to be a series of colluvial episodes mixed with the terrace gravels, alluvial activity illustrated in the puddling and pooling lens of silts and clay, and an eolian signature in the multiple sand layers.

Stratum 1 was assigned to the upper 1.0 to 1.5 m of the structure fill. This was a sandy loam with minor charcoal flecks and light staining. It appeared alluvial and colluvial in composition with a few artifacts, and rocks ranging from pea gravel to pebbles (6-by-4-by-2 cm). Puddling was evident near the middle of the depression. Minor pockets of ash and clay were noted. The highest amount of charcoal was found at the bottom of this stratum. Trash-dumping episodes and burned material

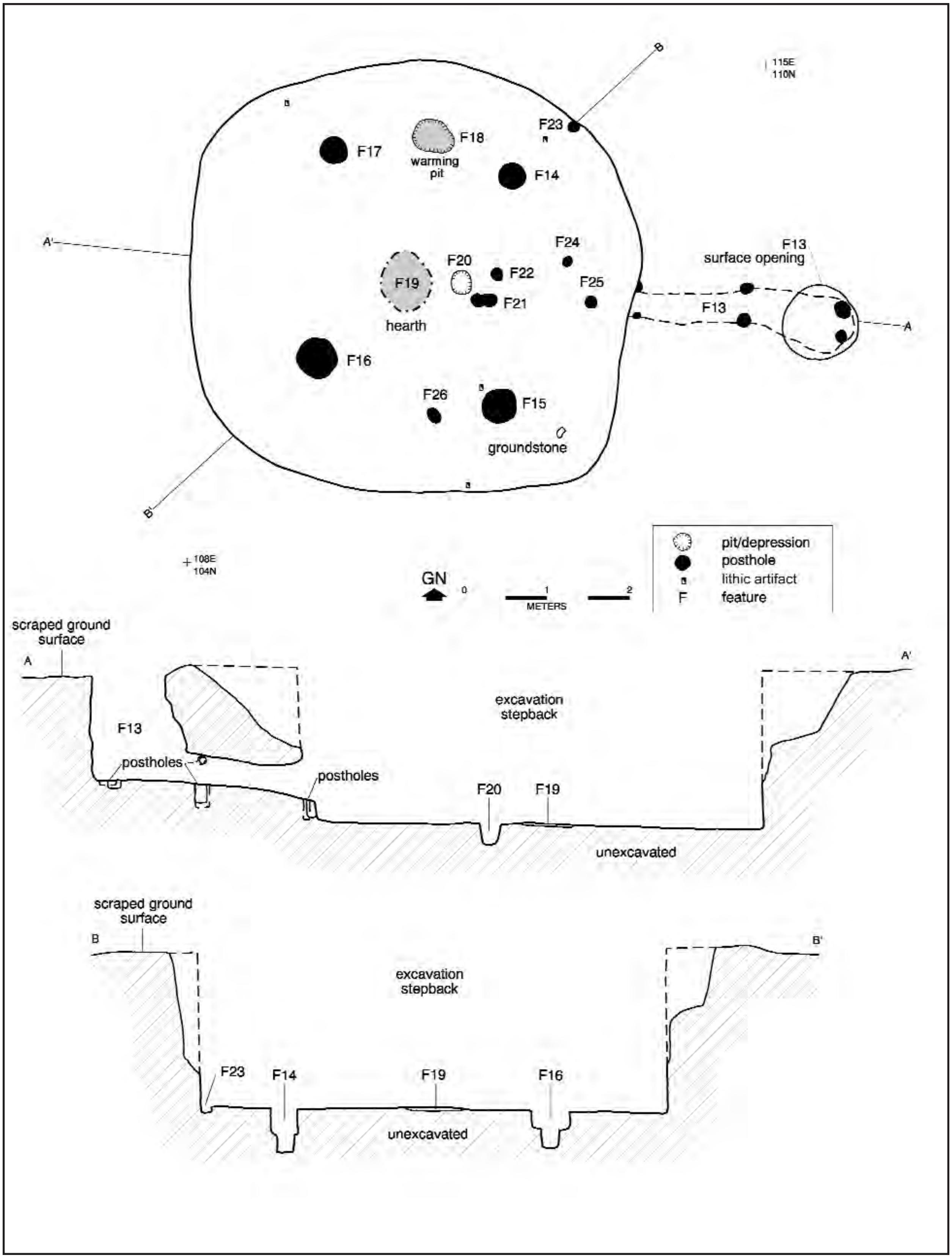


Figure 9.2. LA 115862, plan and profile of Study Unit 1.

Figure 9.3. LA 115862, Study Unit 1.

were not present.

Stratum 2 was primarily sand with minor amounts of clay, small gravel, and charcoal flecks. Various episodes of wind and water-laid sands made up the bulk of this 60-cm layer. Although charcoal was present, artifacts were not.

Stratum 3 consisted of closing material (unburned roof fall), large cobbles, calcium carbonate, wall slump, and chunks of adobe. A minimal but constant presence of charcoal flecks was also visible.

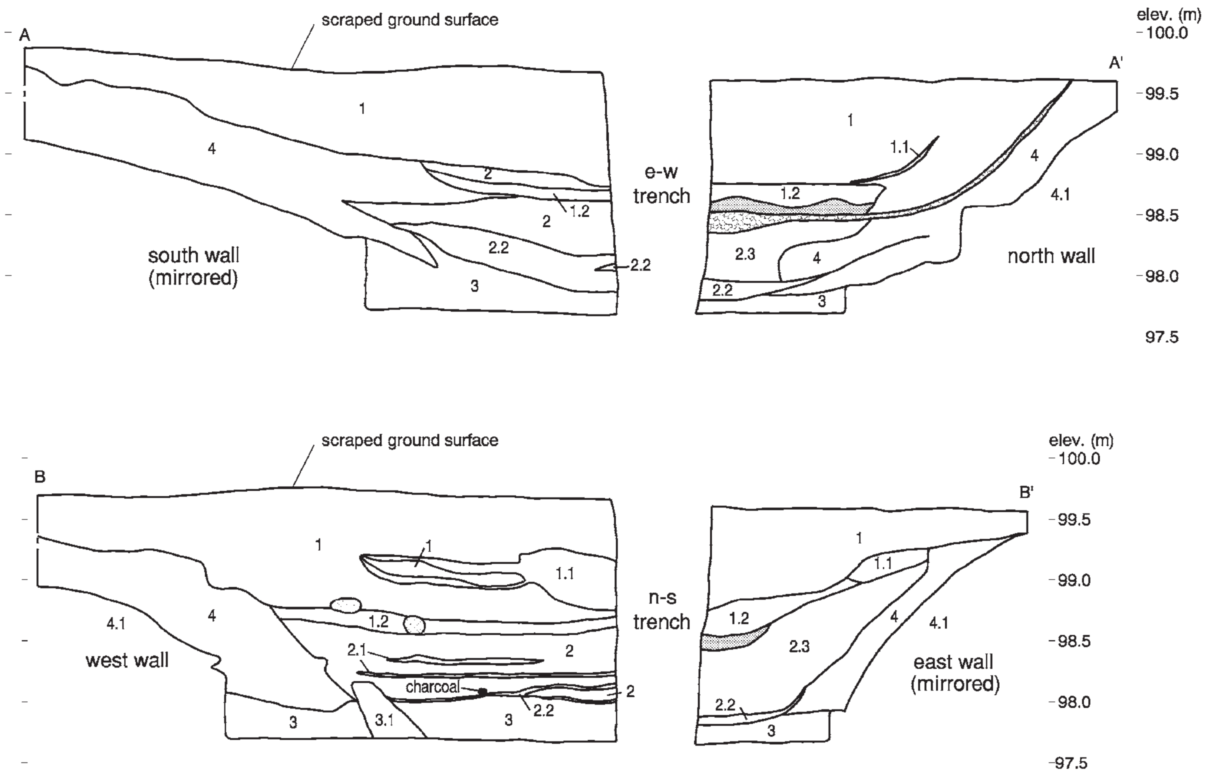
Stratum 4 was the interface between structure fill and the terrace gravel found on site. It was comprised of cobbles, gravel, calcium carbonate coated rocks, and the oxidized gravel found in the general non-cultural soils surrounding the structure. In some areas, it was mixed with the silty clay of which the floor and lower walls were constructed.

Construction

The undertaking necessary to build this structure was massive. The structure was located on a ridge covered by loose axial Rio Grande gravel. These were highly unconsolidated soils for a building site. This was underlain by very compact silty clay. Gravel removal or clearing of the area would be necessary to allow for construction without constantly fighting back the onslaught of shifting gravel. The prepared area would need to be a minimum of 6 m in diameter and 2 m deep. An initial catchment system was probably employed as a major barrier during construction. This would also minimize the initial stress on the structure as well.

The structure was roughly circular measuring 6.05 m (northwest-southeast) by 5.55 m. The interior circumference of the structure appeared to be a circle with flattened sides. This was very evident in the east, west, and south walls.

The base of the structure was excavated approximately 50 cm into the lower strata of silty clay with carbonates. Subsequently, the floor and walls were of the same dense materi-



stratigraphy

1.0 brown sandy loam w/light staining, charcoal flecks, occasional artifacts (10YR 5/3)

1.1 yellowish brown clay lens w/ash pockets, pea gravels, pebbles (10YR 5/4)

1.2 pale brown interface between strats 1&2, major rodent disturbance, charcoal (10YR 6/3)

2.0 light brown sand w/minor amount of clay, sm. gravel, charcoal flecks, occasional artifacts (7.5YR 6/4)

2.1 eolian sand lens w/charcoal flecks

2.2 alluvial laminates w/charcoal flecks

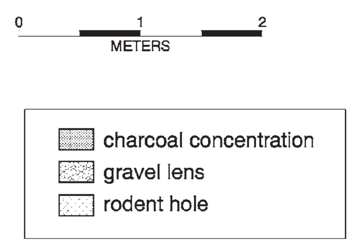
2.3 brown sand mixed w/river cobbles (10YR 5/3)

3.0 light brown closing materials of clay, adobe chunks, lg. rocks, lenses & pieces of CaCO3 (7.5YR 6/4)

3.1 light yellowish brown adobe melt & closing material w/lg. amount of CaCO3 (10YR 6/4)

4.0 yellowish brown terrace gravels & medium-sized cobbles (10YR 5/4)

4.1 pale pinkish brown oxidized terrace gravels, sized coarse to medium cobbles w/high CaCO3 content (10YR 6/3)



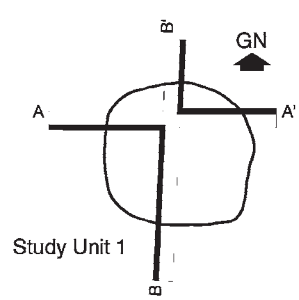


Figure 9.4. LA 115862, trench profile and soil key.

al. The floor, covering an area of 26.37 sq m, was not formally prepared but appeared to have a smooth "floated" finish. This was achieved by repeatedly wetting and lightly stroking the surface, allowing the fine particles to redistribute, creating a smooth surface (Shepard 1956:191). This process however was carefully executed as the floor actually sloped up the wall. A seam was not evident in many areas of the floor-wall interface, suggesting a float extending up the lower portion of the wall. The floor encompassed most of the structure and was not burned. The floor was also well cleared during abandonment, as only five artifacts were noted on the surface. These consisted of four flakes and one ground stone fragment. Sub-floor investigation documented a 2 to 3 cm thick, well-floated surface.

The lower portion of the wall was intact, ranging from 40 to 61 cm in height. This was excavated through the lower stratum of silty clay. The structure walls were at almost a 90 degree angle to the floor. In the southern portion of the structure, furrows or digging stick marks were apparent on the wall surface. Some areas of the walls had a smooth floated surface while others did not. Various quantities of calcium carbonate could be seen leaching from the wall.

In the southern portion of the structure, four adobe slabs were mudded into place on top of the wall (Fig. 9.5). The adobes were clay slabs used as plaster over the terrace gravels. This plastered section appeared to serve as a retaining wall, stabilizing the local terrace deposits. Impressions of the terrace gravels were evident on the back of the adobes. The slabs ranged in size from 36-by-30-by-8 cm to 26-by-18-by-6 cm. Organic binders, such as grass, straw, and roots, were not observed. The adobe slabs did not appear sun-baked, but were probably allowed to become "leather-hard" before installation on the wall. This occurs when a clay body achieves a degree of hardness that will not allow the fingertips to easily impress the surface. The adobe slabs

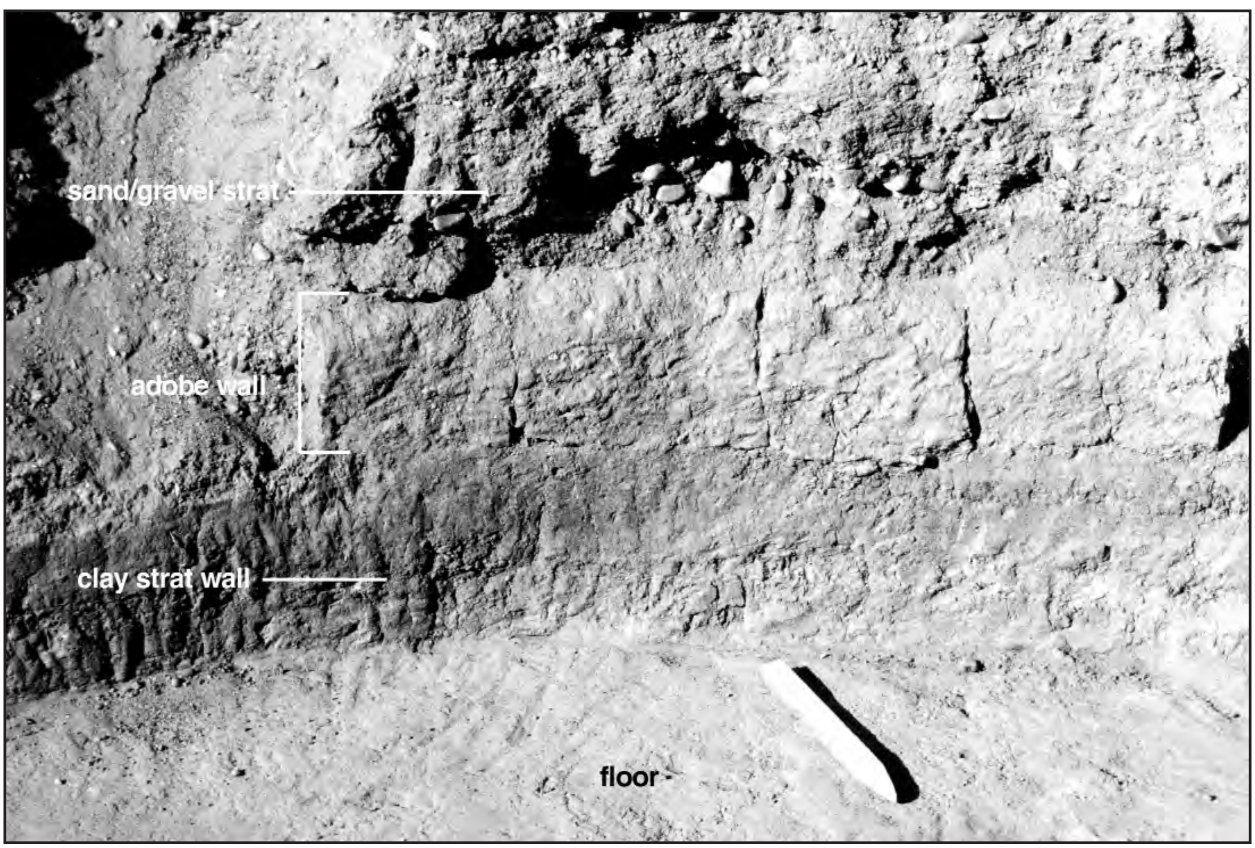


Figure 9.5. LA 115862, adobes on wall.

seemed very resilient to withstand the stress of being set on edge and mudded in place. A solitary block was also noted in an up-ended position in the northwest side of the structure. It apparently gave way, collapsing into the gravel. A possible wall fragment was also noted in the west wall profile of the structure fill. The large amount of melted adobe and chunks of adobe associated with the floor are probably the remnants of other portions of this wall. One of the adobe slabs was collected for further investigation.

Roof

The roof was most likely constructed of mud and wood covering a superstructure and supported by a four-post system. The large posts were set from 45 to 60 cm into the structure floor. Once set, the postholes were packed with extra clay creating a solid foundation. In this structure, the upper postholes were 10 to 20 cm larger in diameter than the bottom of post molds. These posts formed a large central square. Stringers joined the tops of the posts forming a rectangular plate, on which were laid the horizontal roof timbers. Smaller posts were then leaned against the stringers or eaves of the flat part of the roof, their butts placed on the ground surface around the edge of the pit, or on a bench or rarely on the floor at the base of the walls. Across this framework, latillas, thatching, and closing materials and grasses were laid. The entire structure was then covered with some form of earth (Bullard 1962:128). The entrance was probably centrally located in the roof and accessible by ladder.

Floor and Wall Features

Study Unit 1 housed 13 internal features (Table 9.1). The thermal complex contained an informal hearth (Feature 19), an ash pit (Feature 20), and two deflector postholes (Features 21 and 22) (Fig. 9.6). The postholes in the structure consisted of four large support postholes (Features 14–17) and four small postholes (Feature 23 and Feature 26). Also located within the structure were a basin-shaped warming pit (Feature 18) and ventilator system (Feature 13).

Feature 19, a shallow informal hearth, was centrally located in the structure and measured 74 cm by 63 cm by 3.5 cm. The feature fill consisted of a thin lens of homogeneous gray ash with chunks of charcoal. Once the ash was removed, a moderately burned oval area was noted on the floor surface. Two lithic artifacts were also recovered from the edges of the ash. A low frequency of carbonized goosefoot and corn cupules were identified from the flotation sample. A single archaeomagnetic set of eight specimens, AM 1150, was collected from the floor. The individual specimen directions were very coherent, resulting in an extremely tight reading. The sample was assigned a date range of AD 775–815.

Feature 20, a circular ash pit, was situated east of Feature 19 and measured 28-by-24-by-26 cm. The walls and floor were nicely smoothed and moderately oxidized. Two distinct strata of occupational fill were seen in the feature. The upper stratum was a dry powdery ash with chunks of charcoal. The lower level contained tan sand with ash and charcoal chunks. Mid-way through the lower level, the ash decreased, charcoal increased and chunks of oxidized adobe, sand, and gravel were seen. Fire-cracked rock was also present.

A substantial artifact assemblage and various samples were recovered from Feature 20. The south half of the ash pit feature was collected for a flotation sample, which yielded carbonized remains of corn kernels and cupules. The wood identified was predominantly juniper with a small amount of cottonwood-willow from the river. The north half was screened and produced 1 ceramic artifact, 111 lithics, and a ^{14}C, pollen, and botanical sample. Of the 83 thinning flakes found only in association with the structure floor, 67 were recovered from this pit. The prevalent material type, representing 80 percent, was obsidian.

Two postholes (Features 21 and 22) were located between the ash pit and the ventilator opening in the structure wall. The location of

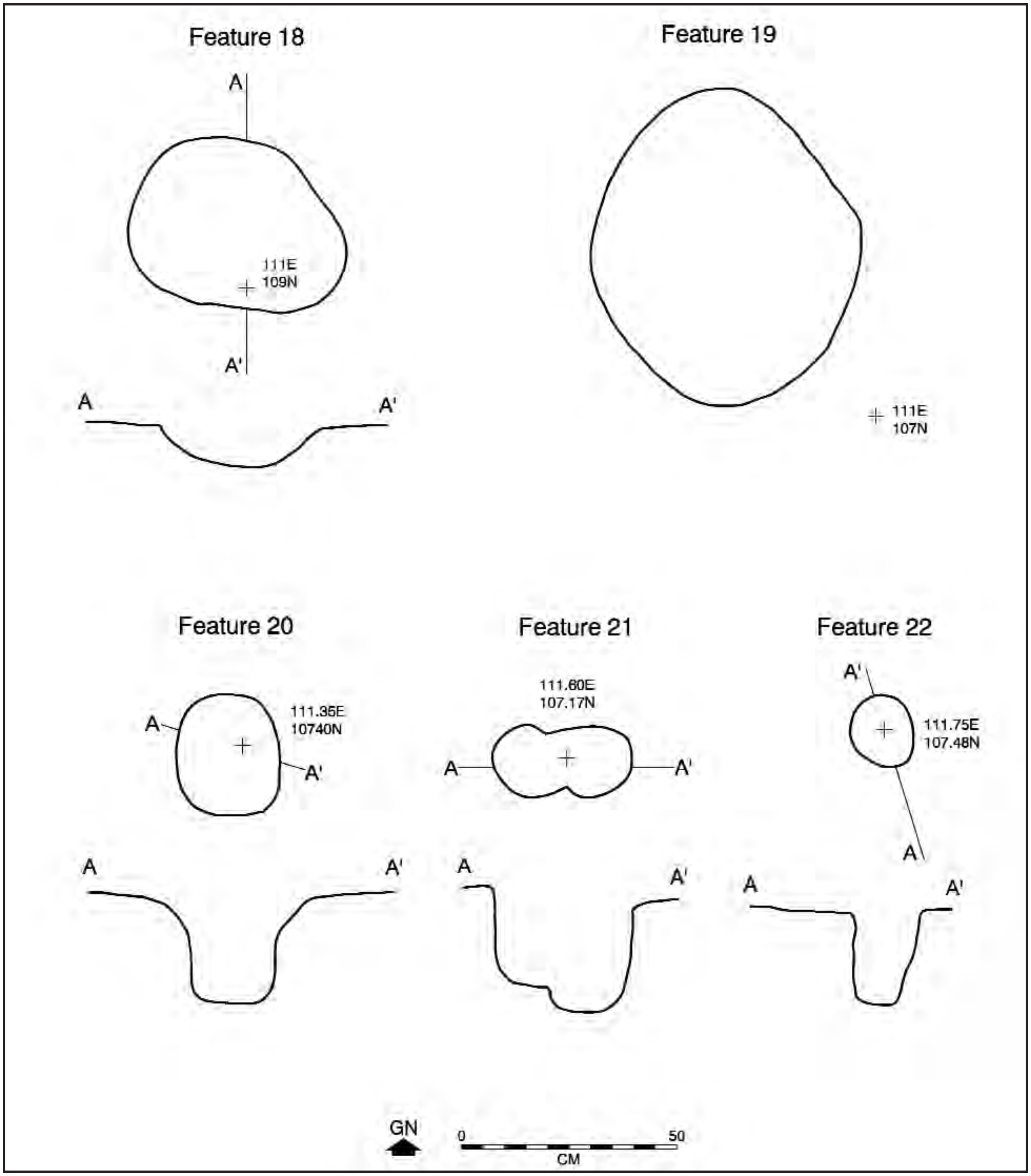


Figure 9.6. LA 115862, plans and profiles of Features 18 through 22.

Features 21 and 22 suggest that these could be part of a post/core adobe deflector (Lange 1968:23) or possibly the support posts for a large slab of rock or hides utilized as a deflector. Whatever the original function, they appeared related to the function of the ventilator.

Evidence of remodeling was apparent in one of these two postholes. The northern posthole (Feature 22) measured 15 cm in diameter and 21 cm deep. The fill was silty clay with small pebbles and charcoal. The southern posthole (Feature 21) had been remodeled, creating

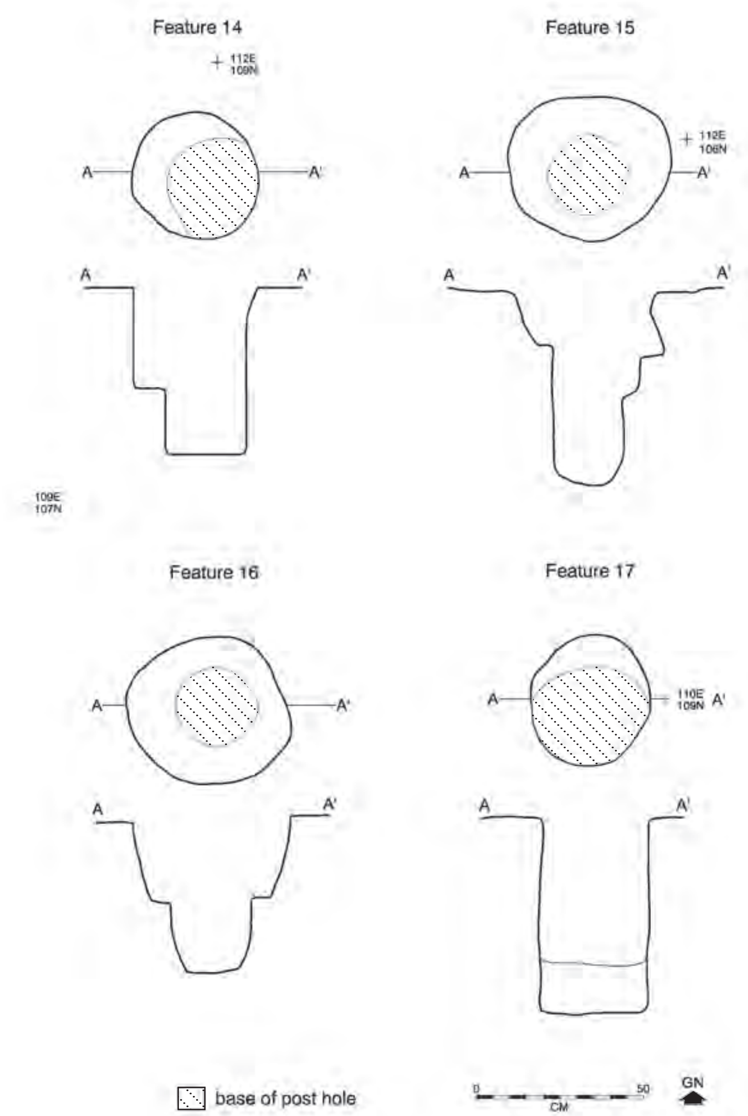


Figure 9.7. LA 115862, plans and profiles of support posts.

a double socket in the floor. The western area was 15 cm in diameter and 21 cm deep. The eastern area was 16 cm in diameter and 28 cm deep with a large plug of adobe in the bottom. The fill of the double post was similar in both sides. It contained pockets of sand, chunks of adobe, charcoal, ten lithic artifacts, and eight small mammal bone fragments. The west half, closer to the hearth, had a high amount of ash. It is not known which of the twin posts was original. The repositioning of the post probably involved the effectiveness of the deflector. The wood identified was primarily juniper, but included some cottonwood-willow from the river corridor and a small amount of saltbush-greasewood from the floodplain and terraces.

The four support posts (Features 14–17) were located in each of the quadrants of the structure (Fig. 9.7). They were placed in holes in the floor, ranging in depth from 45 to 60 cm. The upper portions of the postholes were larger in diameter, ranging from 35 to 45 cm, than the lower portion, which averaged 25 cm. Once the posts were set, the postholes were packed with extra clay creating a solid foundation. The interface of the packing material and the posthole was very evident during investigation. The fill in the postholes consisted of eolian sand with chunks of adobe, charcoal, gravel, and small cobbles. Oxidation was not present. The wood identified in ^{14}C and macrobotanical samples was primarily juniper, but included some cottonwood-willow and a small amount of saltbush-greasewood.

It appears the preferred building material for Peña Blanca Early Developmental structures was cottonwood, owing to the high amounts of cottonwood found in post molds. This undoubtedly reflects the local abundance and ready acquisition of cottonwood in this area. The absence of posts suggests the support superstructure was most likely dismantled and removed. The post-occupational fill within the post molds that accumulated while the structure was open consists primarily of sand, terrace gravel, and minor debris.

Four miscellaneous postholes were also present in the floor features. Three of these postholes (Features 23–25) were very shallow, 4 to 7 cm deep, and had diameters ranging from 10 to 15 cm. They were located in the northeastern quadrant of the structure and were possible secondary support posts. The placement of Feature 23 along the wall strongly suggests this usage. The fourth posthole (Feature 26) was located between two main support posts, Features 15 and 16. It was much larger and deeper than the others, capped with clay, and measured 20 cm in diameter and 20 cm deep. This may have been another main support post rather than an ancillary support post. Fine sand with charcoal flecks was noted in all of the small postholes.

Feature 18, an oval pit measuring 40-by-50 cm and 8 cm deep, was located in the northern half of the structure between two main support posts. The basin was capped with 3 to 4 cm of clay. The fill consisted of sand with charcoal, 18 bone fragments, and 3 lithic artifacts. Most of the bone fragments recovered were unidentifiable. Owing to the presence of slight oxidation on the upper western and northeastern edges of the pit, Feature 18 may have been used as a warming pit.

Feature 13, a "trench-type" ventilator system (Lange 1968:19), was located in the southeast wall of the structure with an orientation of 96 degrees east of grid north. A trench was excavated into the lower wall of the pit structure. This created the tunnel of the ventilator system. A wooden framework supported by wood posts was the internal support. The pole framework was probably covered in clay to seal and strengthen the tunnel. The interior of the tunnel had a nicely prepared clay surface. The remainder of the trench was then filled with gravel. A similar wooden framework was employed in building the intake shaft as well.

Three paired sets of postholes were identified in the ventilator complex (Fig. 9.8). One set was at the bottom of the vertical shaft (Postholes 3 and 4). One set was at each end of the tunnel (the structure wall [Postholes 7 and 8]) and shaft/tunnel juncture (Postholes 1 and 2). The last set was in the tunnel wall above the shaft-tunnel juncture (Postholes 5 and 6).

The ventilator measured 2.73 m in length and ranged from 0.31 m (internal tunnel measurement) to 1.3 m (vertical intake shaft) in height. The orifice in the structure measured 0.41 m in diameter and was located 0.25 m above the floor. The circular external orifice was 0.90 m in diameter. The support post molds of the internal framework ranged from 10 to 16 cm in diameter and were from 6 to 28 cm in depth.

The ventilator shaft contained 57 lithic artifacts, 13 ceramic artifacts, and 105 bone fragments primarily from cottontail rabbit and small mammal. Curiously, there were very few artifacts on site. At the juncture of tunnel and shaft, a vesicular basalt metate fragment had been placed trough side down covering the vent tunnel. This appears deliberate and is possibly part of a closing ritual connected with the planned abandonment of this site.

Extramural Activity Area

The activity area northeast of the structure encompassed two roasting pits (Features 9 and

Table 9.1. LA 115862, Study Unit 1 Features

Feature No.	Feature type	Location/ Center-point	Dimensions (L x W x D) cm	Shape	Fill	Comments
14	Main roof support	108.66N/111.93E	43 x 52 24 dia (post mold)	Circular	10YR 6/4 light yellowish brown sand with charcoal	Post-occupational fill, NE quad
15	Main roof support	105.89N/111.76E	47 x 43 x 60 25 dia (post mold)	Circular	10YR 6/3 pale brown sand with charcoal flecks and adobe chunks	Post-occupational fill, lithics, SE quad
16	Main roof support	106.46N/109.55E	45 dia x 46 25 dia (post mold)	Circular	10YR 6/4 light yellowish brown sand with charcoal, and adobe chunks	Post-occupational fill, lithics, SW quad
17	Main roof support	108.96N/109.77E	35 x 35 x 59 18 dia (post mold)	Circular	10YR 4/3 brown sand with charcoal and small rocks	Post-occupational fill, NW quad
18	Warming pit	109.14N/110.98E	50 x 40 x 8	Oval	10YR 6/3 pale brown sand, with charcoal	Occupational fill, lithics and bone; capped with clay
19	Hearth	107.40N/110.66E	74 x 63 x 3.5	Circular	10YR 5/1 gray ash with charcoal	Occupational fill, informal lithics
20	Ash pit	107.40N/111.53E	28 x 24 x 26	Circular	10YR 5/2 grayish brown ash, sand and charcoal, 10YR 6/2 light grayish brown, sand, charcoal, ash, and gravel	Occupational fill,70 obsidian thinning flakes two distinct episodes of fill
21	Deflector posts	107.17N/111.60E	15 dia x 21 16 dia x 28	Circular	10YR 6/4 Light yellowish brown;10YR 6/2 light brownish gray, ash, charcoal, and small rocks	Post-occupational fill, remodeling visible, double posthole adobe plug in east side
22	Deflector posts	107.48N/111.75E	15 dia x 21	Circular	10YR 5/4 yellowish brown silty clay	Post-occupational fill
23	Unknown post	109.28N/112.6E	15 dia x 7	Circular	10YR 5/4 yellowish brown fine sand, charcoal flecks	Post-occupational fill
24	Unknown post	107.63N/112.60E	13 dia x 4	Circular	10YR 5/4 yellowish brown fine sand, charcoal flecks	Post-occupational fill
25	Unknown post	107.14N/112.87E	15 dia x 6	Circular	10YR 5/4 yellowish brown fine sand, charcoal flecks	Post-occupational fill
26	Unknown post	105.77N/110.99E	20 dia x 20	Circular	10YR 5/4 yellowish brown fine sand, charcoal flecks	Post-occupational fill, main support post?

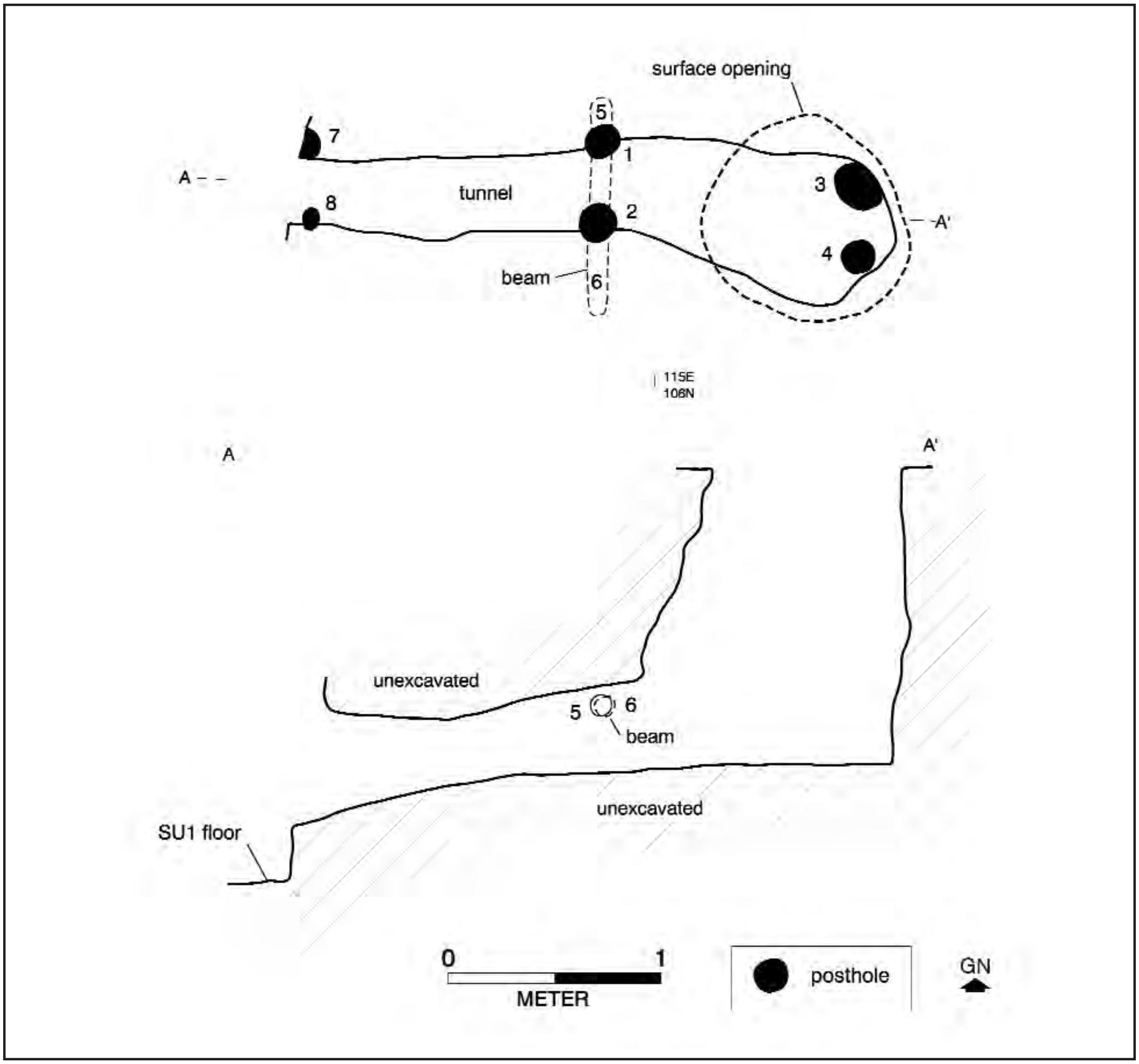


Figure 9.8. Ventilator shaft, plan and profile.

Table 9.2. LA 115862, Extramural Activity Area Features

Feature No.	Feature Type	Location/ Centerpoint	Dimensions (L x W x D) cm	Shape	Fill	Contents
5	Hearth	110.85N/120.65E	50 x 45 x 15	Circular	10YR 4/2 dark grayish brown, ashy sand	Occupational fill, two distinct strata
9	Roasting pit	113.00N/120.00E	50 x 44 x 45	Oval	10YR 3/1 very dark gray sand organics, chunks of charcoal	Occupational fill, plant processing facility, slightly belled, artifacts
10	Ash feature	110.50N/115.20E	140 x 95 x 23	Oval	10YR 3/2 very dark grayish brown sand with ash	Occupational fill, major staining, warming pit for rocks
11	Roasting pit	112.10N/114.00E	75 dia x 46	Circular	10YR 4/1 dark gray fine sand with soot charcoal flecks	Occupational fill, plant processing facility, slightly belled, many artifacts
12	Ash feature	111.75N/114.95E	50 dia x 8	Circular	10YR 4/2 grayish brown sand	Occupational fill

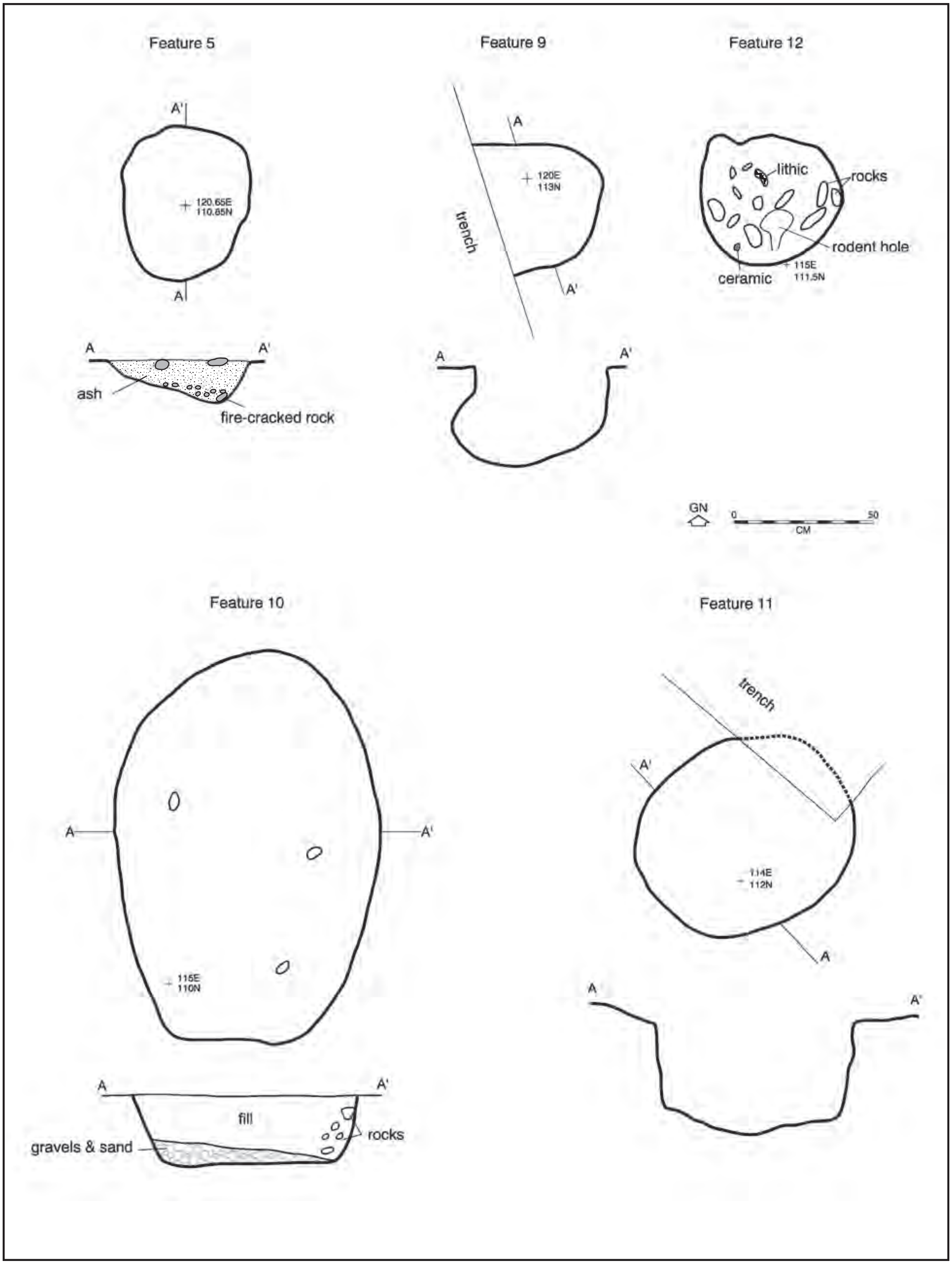


Figure 9.9. LA 115862, plans and profiles of extramural activity area features.

11), one hearth (Feature 5), and two diffuse ash features (Features 10 and 12) (Fig. 9.9 and Table 9.2). These features were located during mechanical surface scraping and exploratory trenching.

Feature 9, a roasting pit measuring 50-by-44 cm and 45 cm deep, was located in the east side of the activity area. The actual dimensions were unknown because a mechanical trench bisected the feature, roughly north to south, leaving only the eastern portion intact. The pit was a modest bell shape, measuring 60 cm at its widest point. Slightly oxidized soil and calcareous terrace gravel formed the boundaries. Oxidation was found on the upper 8 cm of the internal orifice of the pit and possibly one of the main factors that strengthened the neck of the pit. The roasting pit was lined with three to four courses of quartz and basalt cobbles that extended from the base of the pit to the oxidized neck.

A great deal of rock was present within Feature 9. Three distinct large pieces of basalt were observed in the upper 10 cm of fill, extending from the feature walls. They appeared to be a support or capping device. The interior of the feature was filled with an assortment of quartz and basalt cobbles and angular fire-cracked rock, which appeared to be feature related. Also present was fine black-stained sand with large chunks of charcoal and burned organics.

The rock lining of the roasting pit (Feature 9) was removed and consisted of 31 kg of quartz and basalt cobbles and fire-cracked rock. The lower pit contained a layer of burned sand, organics, and charcoal. Nine Middle Rio Grande Plain jar sherds, five lithic artifacts, and a projectile point fragment were recovered from the upper 10 cm of fill. The flotation sample yielded carbonized remains of Cheno-ams and *Zea mays* cupules. The only wood data available from the extramural proveniences came from this feature. Juniper is the predominant wood in both flotation (87 percent by weight) and macrobotanical (99 percent by weight) samples.

Another roasting pit (Feature 11), measuring 75 cm in diameter and 46 cm deep, was located on the west side of the activity area. Feature 11 was distinctively different from Feature 9. It was circular in plan view and slightly bell shaped in profile. The boundary rocks did not line the walls in a carefully stacked manner and the rocks in this pit were much larger with numerous spalls present. Feature 11 was full of quartz and basalt cobbles and fire-cracked rock. Quartz was the predominant material type, outnumbering basalt 2 to 1.

The fuel within Feature 11 was totally consumed leaving fine soot, burned sand, and minimal tiny charcoal flecks. The boundaries were oxidized sand and rose-colored terrace gravel. Thirteen sherds including twelve Middle Rio Grande Plain wares and one Alma Plain type, three lithic artifacts, and a two-handed mano fragment were recovered from within the sooty fill. The flotation sample yielded carbonized remains of *Portulaca* and *Zea mays* cupules and glumes.

Feature 5, a small circular basin, was located on the west side of the activity area with Feature 9 and measured 50-by-45 cm and 15 cm deep. The basin was lined with small cobbles, rocks, and fire-cracked rock. The fill was dark, ashy sand. The north end of the basin was deeper than the south end. The flotation sample yielded carbonized remains of *Zea mays*. This was possibly an informal roasting pit, related to the activity of the larger roasting facility.

Feature 12 and Feature 10 were diffuse, stained pits on the east side of the activity area probably associated with Feature 11, a large roasting pit. These pits were informal, with indistinct boundaries and had fill consisting of darkly stained sand and gravel.

The oval stain (Feature 10) measured 1.4-by-0.95 m and 0.23 m deep. The flotation sample yielded a diverse assemblage of economic flora remains. These included carbonized wild seeds of pigweed (*Amaranthus*), goosefoot (*Chenopodium*), and bullrush (*Scirpus*). Four lithic artifacts were also recovered from this pit.

Feature 12, a smaller circular stain, measured 50 cm in diameter and was 8 cm deep.

The fill consisted of ash with charcoal. The flotation sample yielded carbonized remains of *Zea mays* fragments. This appears to be a secondary deposit of ash from one of the pits in this area. Two lithic artifacts were noted.

The extramural activity area was possibly the cooking and processing area associated with the pit structure. Schmader (1994) observed exterior versus interior cooking at Mural House (Pit Study Unit 11) in the River's Edge Project. Most of the exterior pits within 30 m of the structure appeared to be fire pits or rock-heating pits, but not storage pits. The interior features of the structure included a poorly constructed central hearth and probable storage cists. The majority of heating and cooking appeared to have occurred outside, rather than inside the structure.

Several attributes from this area support this hypothesis. The samples from this area produced the greatest diversity and amount of economic floral remains on site. The artifacts, including gray ware jars and ground stone, suggested food preparation. The pits were ideal for various activities, such as roasting, parching, boiling, and baking. They also functioned in an open or buried/closed condition.

Study Unit 1, on the other hand, had an informal, minimally used hearth. There was no evidence of processing or storage. Only a small amount of *Zea mays* evidence was present, suggesting possible plant parts for fuel. In short, the activity of food preparation within the structure appeared very minimal.

Historic Thermal Features

Four thermal features (Features 1–4) were located during a mechanical surface scrape of the eastern portion of the site (Table 9.3). The basins were roughly circular, shallow, and contained fill consisting of dark, ashy, sand and minor charcoal (Fig. 9.10). They were located in the general vicinity of the activity area, but appeared recent in comparison to the processing pits. A horse or burro bone, with ax-cut scars, was identified from the surface collection conducted in this area, indicating historic use. These fires were positioned on the edge of the hill above the road leading into Peña Blanca.

It was suggested these thermal features were associated with the Catholic religious procession of Our Lady of Guadalupe celebrated on December 12 (A local Santo Domingo parishioner, pers. comm.). The *luminarios* or surface fires illuminate the path for the procession carrying the statue of Our Lady of Guadalupe on her route from the church, through the village, and back to the church. Symbolically, the *luminarios* eternally light the path for Our Lady to find her way to the local parish. A question regarding the starting point of the procession arose. Was it from the Penitente morada located 200 m south of the

Table 9.3. LA 115862, Historic Thermal Features

Feature No.	Feature Type	Location/ Centerpoint	Dimensions (L x W x D) cm	Shape	Fill	Contents
1	Hearth	117.40N/121.15E	40 dia x 16.5	Circular	10YR 2/1 black ashy, coarse sand	Lithic
2	Hearth	121.43N/120.80E	43 x 43 x 20.5	Circular	10YR 5/2 grayish brown, ashy, coarse sand with charcoal	Lithic
3	Hearth	114.50N/120.50E	27 x 27 x 8	Circular	10YR 5/2 grayish brown, coarse sand and ash	
4	Hearth	113.70N/120.40E	30 x 24 x 5.5	Oval	10YR 4/2 dark grayish brown, coarse sand and gravel	

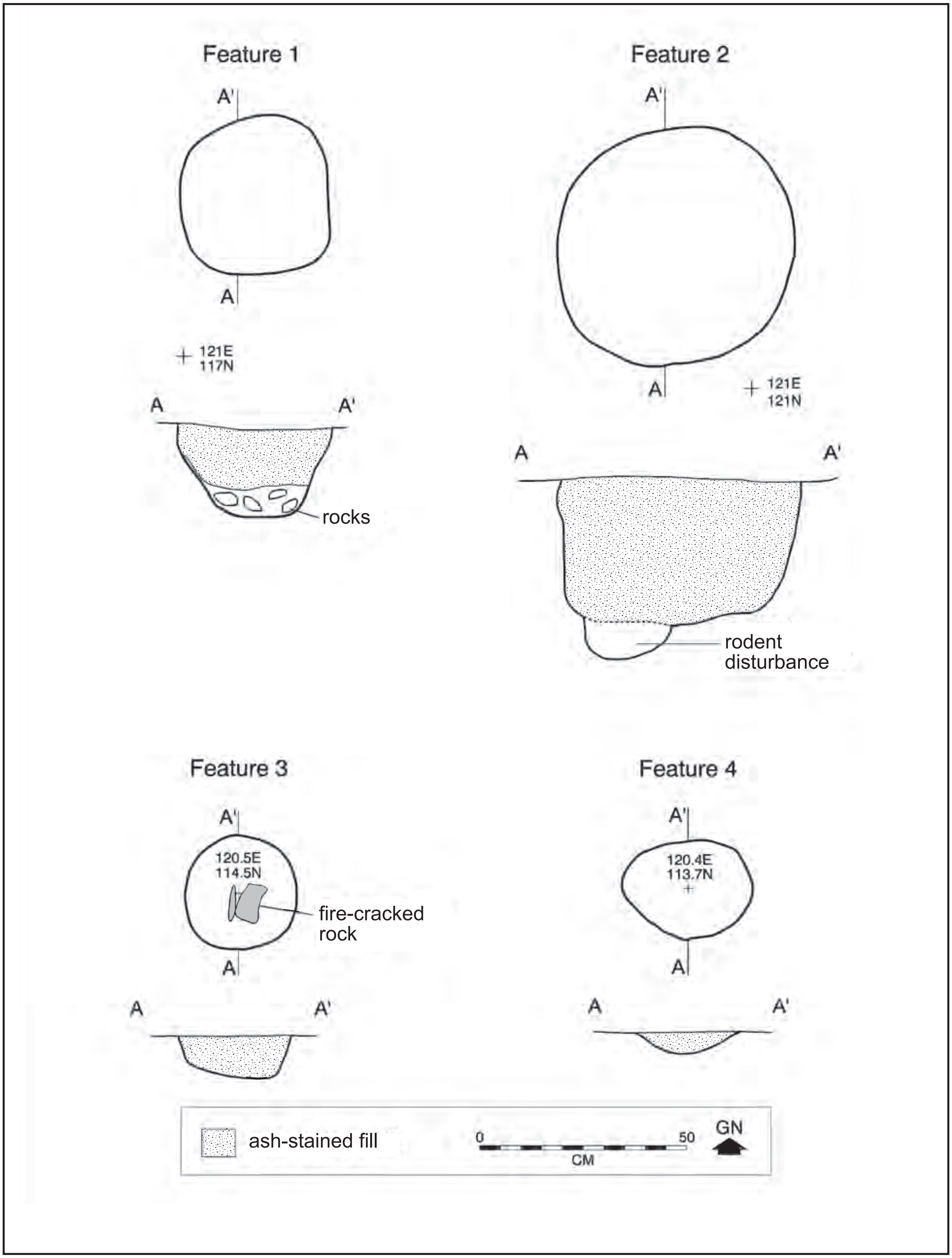


Figure 9.10. LA 115862, plans and profiles of historic thermal features.

site or the local Catholic church in Peña Blanca? We were informed that the Christmas procession is conducted from the local Catholic church in the area and does not involve the *morada*. During the Lenten or Easter season, the processions hail from the *morada* (Mrs. Trujillo, pers. comm.).

Study Unit 2

This area south and southeast of the structure contained four burials. Feature 6 was the extended burial of an adult female, 35 5 years with a near-term fetus in utero. They were buried approximately 4.5 m southwest of the structure and oriented north-south on the floor of an informal oval pit with sloping walls. The shallow basin was roughly excavated into Rio Grande terrace gravel and measured 1.80 m by 0.70 m and 0.75 m in depth. The slight flexing of the subject's legs was probably necessary to fit in the basin. Multiple grave goods were identified with the subjects. In the upper fill of the pit, one San Marcial Black-on-white bowl, two associations of San Marcial Black-on-white body sherds, and one Middle Rio Grande Plain Gray pitcher were documented. In the lower pit, the subject cradled a San Marcial hanging seed jar in her left arm. An unusually high amount of large to medium mammal bone fragments was present in this feature.

Feature 7 was the extended burial of an adult female, 18–19 years, with multiple grave goods. This burial was located 3.5 m east of Feature 6 and oriented east-west. The informal oval pit measured 1.65 m (east-west) by 0.55 m and 0.40 m in depth. The assemblage of funerary wares consisted of one Middle Rio Grande Plain Gray gourd jar with a fugitive red slip, one plain gray cooking-storage jar, one plain gray ware seed jar, one local Mogollon Red-on-brown bowl with exterior red dots below the rim, and 47 olivella spire-lopped beads. The clusters of the shell beads on various areas of the rib cage suggest they were sewn on clothing rather than being incorporated into necklaces or bracelets (Bradley 2000).

Feature 8 was the burial of an infant, 6-9 months of age, of indeterminate sex and located approximately 2 m from the other burials. It was situated in an oval pit measuring 42 cm by 37 cm and 44 cm in depth. The pit had straight walls, a flat bottom, no oxidation, and no fire-cracked rock. The fill was a dark sandy loam with gravel. The flotation sample yielded the carbonized remains of goosefoot (*Chenopodium*) and cottonwood-willow from the river corridor. This is the only incident where there is exclusively non-coniferous wood in the feature matrix. Perhaps a woven basket or mat of Salicaceae was placed in the pit with the infant. Artifacts noted were ten flaked lithics and eight plain gray ceramics. This feature resembled a small trash-filled pit, not a prepared funerary feature. It was not identified until the faunal analysis had been completed.

Artifacts

The volume of the artifact assemblage on this site was minimal. Discrete trash accumulations were not identified and only a minimal presence of secondary trash episodes was noted. The floor of the structure had been meticulously cleaned, leaving only four flakes and a small piece of ground stone in 26.37 sq m of internal space. The various strata in the structure did contain a small assemblage, however this appeared to be from the redeposition of artifacts by erosional activity, as the structure stood open. The processing pits in the agricultural area and the ventilator shaft had residual trash in the upper fill of the features. These also did not appear to be dumping episodes but erosional residue.

Ceramics

The 389 sherds and eleven vessels recovered during recent investigations at LA 115862 indicate an occupation dating exclusively to the Early Developmental period (Table 9.4). The majority (70.7 percent) of these sherds was assigned to gray ware types. Almost all of this pottery represents sand-tempered Middle Rio Grande Plain Gray ware forms. An unusually

Table 9.4. Distribution of Ceramic Types from LA 115862

Pottery Type	Surface Collection	Structure Fill	Structure Floor, Features 14-26	Vent System, Feature 13	Activity Area, Features 9-12	Burial, Feature 7	Burial, Feature 6	Burial, Feature 8
MRG Plain rim	1	3	1	.	1	1	7	1
	2.90%	4.10%	3.20%		3.60%	2.00%	5.60%	12.50%
MRG Plain body	27	63	25	12	26	37	41	7
	79.40%	85.10%	80.60%	92.30%	92.90%	74.00%	32.80%	87.50%
MRG Unpainted undifferentiated	.	2	1	1	.	2	9	.
		2.70%	3.20%	7.70%		4.00%	7.20%	
MRG Mineral Paint (undiff)	1	.	.	.	.	.	.	.
	2.90%							
San Marcial B/w	2	3	2	.	.	.	66	.
	5.90%	4.10%	6.50%				52.80%	
Local red-on-brown	.	.	.	.	.	10	.	.
						20.00%		
Jornada Brown body	2	2	2	.	.	.	2	.
	5.90%	2.70%	6.50%				1.60%	
Mimbres white ware (unpainted)	1	.	.	.	.	.	.	.
	2.90%							
Alma Plain rim	.	1	.	.	.	.	.	.
		1.40%						
Alma Plain body	.	.	.	.	.	.	.	.
					3.60%			
Total	34	74	31	13	28	50	125	8
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

MRG = Middle Rio Grande

high frequency (26.2 percent) of sherds from this site, as compared to those from other Early Developmental components, was assigned to white ware types. The great majority of these sherds are from San Marcial Black-on-white vessels. Red ware types are represented in much lower frequencies (0.5 percent) by early (Tallahogan) red slipped forms. A total of 2.6 percent of all sherds consist of brown ware types including a local red-on-brown form, Jornada Brown Ware, and various Mogollon brown ware types. Overall pottery distributions from all contexts including that from a structure and several burials all exhibit similar associations of types reflecting an occupation during the Early Developmental period.

Similar distributions are associated with the nine vessels recovered from two burials at this site. Those from Burial 1 included one plain gray pitcher, one San Marcial hanging seed jar, two associations of San Marcial Black-on-white body sherds, and one San Marcial Black-on-white bowl. Those from Burial 3 include one plain gray gourd jar, one local Mogollon Red-on-brown bowl, one plain gray cooking storage jar, and one plain gray ware seed jar.

The ceramic-based Early Developmental assignment is well supported by the archaeomagnetic date from the pit structure hearth of AD 775–815. This date is very similar to that noted for Early Developmental contexts from other sites investigated during the Peña Blanca Project. While the higher frequency of white wares noted at this site could be interpreted as indicating these occupations were slightly later than at other Early Developmental period components, it is much more likely that this frequency simply represents the influences of sherds from white vessels recovered from the burials at this site.

Chipped Stone Artifacts

The analysis of 728 lithic artifacts identified 4 bifacial tools, 12 retouched flakes, 13 cores, and 699 pieces of debitage in one form or another. The raw materials consisted of chalcedony, basalt, obsidian, chert, and rhyolite. Chalcedony and basalt were the prevalent materials.

Seventy lithic artifacts were recovered from test pits on the site (Table 9.5). The majority of the materials were chalcedony (74 percent) and nonvesicular igneous materials (20 percent). Low frequencies of Jemez obsidian (n = 2) and quartzite (n = 1) were also recovered.

The chalcedony assemblage exhibits evidence of all stages of core reduction and formal tool manufacture. Three flakes with 100 percent dorsal cortex indicate primary reduction. Both early and later stages of core reduction are indicated by whole flakes with partial dorsal cortex (n = 14) and flakes lacking dorsal cortex (n = 12). Thirty-six percent of all platforms were cortical. Assemblages that lack evidence of primary reduction often exhibit higher numbers of single-facet platforms. Two flakes with retouched and prepared platforms indicate that formal tool manufacture also occurred. Unutilized flakes (78 percent) and unutilized small angular debris (14 percent) make up the majority of the assemblage. Three utilized

Table 9.5. LA 115862, Lithic Artifacts from Test Pits

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	10	100	.	.	.	.	.	.	.	.	10	14
Flake	39	70.9	1	1.8	1	1.8	.	.	14	25.5	55	78
Tested Rock	1	100	.	.	.	.	.	.	.	.	1	1
Flake, Utilized	1	33.3	.	.	.	.	2	66.7	.	.	3	4
Flake, Marginal Retouch	1	100	.	.	.	.	.	.	.	.	1	1
Total	52	74.3	1	1.4	1	1.4	2	2.9	14	20	70	100

flakes and one marginally retouched tool were recovered. A chalcedony flake fragment exhibited bidirectional rounding and striations typical of prolonged cutting or sawing on hard media like bone or wood. One utilized flake manufactured from obsidian exhibited both unidirectional and bidirectional use-wear on two edges. The wear again reflects cutting and scraping on hard media. A third utilized flake exhibited three functional edges with unidirectional wear resulting from scraping. And finally, a marginally retouched chalcedony flake exhibited unidirectional rounding and striations typical of prolonged scraping use.

Ninety-six lithics were recovered from the fill in Study Unit 1 (Table 9.6). The majority of artifacts were manufactured from chalcedony (60 percent) and nonvesicular igneous materials (32 percent). A single artifact represented each of the following material types: chert, quartzite, and Jemez obsidian.

The chalcedony assemblage indicates that both early and later stages of secondary core reduction occurred at the site. Chalcedony exhibited similar percentages of secondary debitage with partial dorsal cortex (40 percent) and without cortex (51 percent). The relative lack of dorsal cortex on flakes suggests that decortication occurred at another locale. Three multiplatform cores and one bifacial core of nonvesicular igneous material were recovered from the provenience.

Unutilized flakes (78 percent) and unutilized small angular debris (13 percent) made up the majority of the lithic assemblage. Tools recovered from the structure fill represent a variety of functions. A projectile point manufactured from Jemez obsidian exhibited bidirectional wear on both lateral edges (bidirectional wear is consistent with use as a projectile point). A chert flake exhibited unidirectional marginal retouch and use-wear indicating use as a scraper on hard media like bone or wood. A pecking stone of igneous rock was used either as a ground stone sharpener or to shape slabs.

Two hundred and seventy-three lithics were recovered from Features 14–26 and 10 cm to floor in Study Unit 1 (Table 9.7). All the materials are locally available with the majority manufactured from chalcedony (48 percent) and Jemez obsidian (27 percent). These materials were followed in frequency by nonvesicular igneous materials (n = 60), chert (n = 2), quartzite (n = 2), and sandstone (n = 1).

Dorsal cortex indicates an emphasis on later stages of secondary core reduction for chalcedony and obsidian: 69 percent of whole chalcedony flakes and 62 percent of the Jemez obsidian flakes lack dorsal cortex. Formal bifacial tool manufacture is indicated by retouched or prepared platforms for both chalcedony (n = 4) and Jemez obsidian (n = 19). Single-faceted platforms make up (50 percent) of chalcedony flakes with platforms. Only three cores were recovered from this assemblage, one multiplatform core manufactured from chalcedony and two others from nonvesicular igneous material.

Unutilized flakes (72 percent) and unutilized small angular debris (10 percent) made up the majority of the assemblage. Both expedient and formal tools were recovered from this provenience. Three expedient flake tools, manufactured from obsidian, exhibit unidirectional rounding and striations typical of prolonged scraping on hard media like bone or wood. Two of these flake fragments did not exhibit complete functional edges and were probably broken during use and discarded. A marginally retouched chalcedony flake exhibited unidirectional wear typical of scraping on hard media like bone or wood. Formal tools include a medial portion of a chalcedony drill and an obsidian projectile point fragment.

Fifty-eight lithic artifacts were recovered from the ventilator system (Feature 13) in Study Unit 1 (Table 9.8). The majority of these artifacts were manufactured from chalcedony (62 percent) and nonvesicular igneous materials (29 percent). Low frequencies of Jemez obsidian (n = 4) and vesicular igneous material (n = 1) were also recovered.

All stages of core reduction and formal tool manufacture are represented in the lithic assemblage. Eighty-five percent of whole flakes have partial dorsal cortex (40 percent) or lack dorsal cortex (45 percent). Forty-three per-

Table 9.6. LA 115862, Lithic Artifacts from Structure Fill

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	8	61.5	1	7.7	.	.	.	.	4	30.8	13	13
Flake	49	65.3	1	1.3	1	1.3	2	2.7	22	29.3	75	78
Core, Multiplatform	1	33.3	.	.	.	.	.	.	2	66.7	3	3
Core, Bifacial	.	.	.	.	.	.	.	.	1	100	1	1
Pecking Stone	.	.	.	.	.	.	.	.	1	100	1	1
Flake, Marginal Retouch	.	.	1	100	.	.	.	.	.	.	1	1
Projectile Point	.	.	.	.	.	.	1	100	.	.	1	1
Shaped Stone	.	.	.	.	.	.	.	.	1	100	1	1
Total	58	60.4	3	3.1	1	1	3	3.1	31	32.3	96	100

Table 9.7. LA 115862, Lithic Artifacts from Structure Floor and Features 14-26

	Chalcedony		Chert		Quartzite		Jemez Obsidian		Nonvesicular Igneous		Sandstone		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Angular Debris	10	33.3	2	6.7	.	.	1	3.3	17	56.7	.	.	30	10
Flake	110	55.8	4	2	2	1	41	20.8	40	20.3	.	.	197	72
Flake, Bifacial Thin	.	.	.	.	.	.	1	100	.	.	.	.	1	<1
Flake, Sharpening	2	10	.	.	.	.	18	90	.	.	.	.	20	7
Flake, Uniface Resharp	2	16.7	.	.	.	.	9	75	1	8.3	.	.	12	4
Tested Rock	3	100	.	.	.	.	.	.	.	.	.	.	3	1
Core, Multiplatform	1	33.3	.	.	.	.	.	.	2	66.7	.	.	3	1
Flake, Utilized	.	.	.	.	.	.	3	100	.	.	.	.	3	1
Flake, Marginal Retouch	1	100	.	.	.	.	.	.	.	.	.	.	1	<1
Projectile Point	.	.	.	.	.	.	1	100	.	.	.	.	1	<1
Drill	1	100	.	.	.	.	.	.	.	.	.	.	1	<1
Unknown Ground Stone	.	.	.	.	.	.	.	.	.	.	1	100	1	<1
Total	130	47.6	6	2.2	2	0.7	74	27.1	60	22	1	0.4	273	100

Table 9.8. LA 115862, Lithic Artifacts from Ventilator System, Feature 13

	Chalcedony		Jemez Obsidian		Nonvesicular Igneous		Vesicular Igneous		Grouped Material Totals	
	N	%	N	%	N	%	N	%	N	%
Angular Debris	3	50	.	.	3	50	.	.	6	10
Flake	31	67.4	2	4.3	13	28.3	.	.	46	79
Flake, Uniface Resharp	1	100	.	.	.	.	.	.	1	1
Chopper, Unifacial	.	.	.	.	1	100	.	.	1	1
Angular Debris, Marginal Retouch	1	100	.	.	.	.	.	.	1	1
Flake, Utilized	.	.	2	100	.	.	.	.	2	3
Metate, Unknown	.	.	.	.	.	.	1	100	1	1
Total	36	62.1	4	6.9	17	29.3	1	1.7	58	100

cent of the flakes with platforms are single-faceted. Formal tool manufacture is indicated by retouched or prepared platforms for both chalcedony (n = 1) and Jemez obsidian (n = 2). Unutilized flakes (79 percent) and unutilized small angular debris (10 percent) make up the majority of the assemblage. A chalcedony piece of small angular debris exhibited three marginally retouched and utilized edges (a straight edge, a sharp tip, and a concave edge). All exhibited unidirectional wear patterns typical of scraping or incising bone or wood. Two obsidian flake fragments exhibited unidirectional wear also typical of scraping on hard media-like bone or wood.

Ground Stone Artifacts

Four ground stone fragments were identified in the assemblage. A two-hand rhyolite mano fragment was recovered from the largest roasting pit, Feature 11. A sandstone slab fragment was one of the few artifacts in situ on the floor. A shaped sandstone slab was associated with the floor. A large basalt trough metate fragment was identified upside down at the shaft and tunnel juncture in the ventilator. This practice was also noted at LA 6170. The placement of this metate appeared deliberate, suggesting a closing ritual.

Fauna

The surface collection and Study Unit 2 features produced very little fauna (see Table 9.9). The amount of burned bone in Feature 6 is unusually high, higher than the ash pit in the structure. Burned specimens are from small mammals (n = 2), medium to large mammals (n = 2), and large mammals (n = 1). Almost all of the bone is in small fragments. Bone from Features 7 and 8 are highly pitted (66.7 percent) from soil conditions. The equid is checked (from exposure), as are two pieces from Feature 6. The only processing recorded is a chop on the horse or burro phalanx, which appears to be an ax cut and indicates historic use of the site area.

The ventilator system (Feature 13) produced most of the bone within Study Unit 1, while very little was found in the fill with the floor association (Table 9.10). Cottontail and small mammal remains comprise much of the vent bone. A wide range of body parts were found, and at least three cottontail rabbits are represented by maxillary and scapula parts. Bone from the structure fill is all pitted or checked and that from the ventilator is largely pitted (82 percent). One piece of bone from the ventilator shaft has a carnivore tooth puncture. Two fine point awls were also recovered, one from the structure fill and one from the floor. Both were made from deer metacarpals.

The majority of the fauna from the floor fill/contact and the features are fragmented and little of the bone from the features is identifiable (Table 9.11). A good portion (11 of 23) of those from Feature 18 were recovered from a flotation sample. Burning is high in the ash pit sample and almost as high in the deflector posthole. In both, the burning is heavy or calcined. The cow or bison located near the floor is a fragment of a mandibular molar or premolar that cannot be identified to species. The depth suggests it could be bison B, however it is not wise to underestimate burrowing rodents. When excavating the large structure at LA 6170, a live pocket gopher was observed in a nest just above the floor, indicating rodents go that deep. Also, the transport of small items, such as a tooth fragment, can occur.

As observed in the ventilator, cottontail rabbits are the most common taxon with a wide range of parts found. Three of the cottontail floor fill/contact bones are burned and two of these are light scorches near the distal end, the type of burning that results from roasting. While two cottontails could be represented by the parts, these could be the same rabbits as found in the ventilator (i.e., when the two samples are combined there are still only three rabbits represented by the parts).

Preservation was similar to the rest of the site and generally poor. Most of the floor fill/contact bone is pitted (77.1 percent) and a few were root etched (10.4 percent). The same

Table 9.9. LA 115862, Summary of Fauna from Surface Collection and Study Unit 2 Burial Features

	Surface Collection		Burial, Feature 7		Burial, Feature 6		Burial, Feature 8		Total	
	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %
Small mam/med-lrg bird	-	-	-	-	1	12.50%	-	-	1	6.70%
Small mammal	-	-	1	33.30%	2	25.00%	-	-	3	20.00%
Medium to large mammal	-	-	-	-	3	37.50%	1	33.30%	4	26.70%
Large mammal	-	-	-	-	1	12.50%	-	-	1	6.70%
Desert cottontail	-	-	1	33.30%	1	12.50%	1	33.30%	3	20.00%
Black-tailed jack rabbit	-	-	-	-	-	-	1	33.30%	1	6.70%
Medium artiodactyl	-	-	1	33.30%	-	-	-	-	1	6.70%
Horse, burro	1	100.00%	-	-	-	-	-	-	1	6.70%
Total	1	100.00%	3	100.00%	8	100.00%	3	100.00%	15	100.00%
Immature	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Burned	-	-	1	33.30%	5	62.50%	-	-	6	40.00%
>75% complete	1	10.00%	-	-	-	-	-	-	1	6.70%
25-50% complete	-	-	1	33.30%	1	12.50%	-	-	2	13.30%
<25% complete	9	90.00%	2	66.70%	7	87.50%	3	100.00%	21	80.00%

Table 9.10. LA 115862, Summary of Fauna from the Pit Structure

	Fill		Floor and Features		Ventilator, Feature 13		Total	
	Count	Col %	Count	Col %	Count	Col %	Count	Col %
Small mammal/med to lrg bird	.	.	.	.	1	1.00%	1	0.50%
Small mammal	.	.	19	19.60%	43	41.00%	62	29.70%
Medium mammal	.	.	.	.	1	1.00%	1	0.50%
Medium to large mammal	2	28.60%	29	29.90%	4	3.80%	35	16.70%
Large mammal	.	.	4	4.10%	1	1.00%	5	2.40%
Ord's kangaroo rat	.	.	1	1.00%	.	.	1	0.50%
Woodrats	.	.	1	1.00%	.	.	1	0.50%
Medium to large rodent	.	.	1	1.00%	.	.	1	0.50%
Desert cottontail	1	14.30%	23	23.70%	45	42.90%	69	33.00%
Black-tailed jack rabbit	.	.	14	14.40%	10	9.50%	24	11.50%
Artiodactyl	.	.	1	1.00%	.	.	1	0.50%
Medium artiodactyl	2	28.60%	2	2.10%	.	.	4	1.90%
Mule deer	1	14.30%	1	1.00%	.	.	2	1.00%
Cow or bison	.	.	1	1.00%	.	.	1	0.50%
Flicker	1	14.30%	.	.	.	.	1	0.50%
Total	7	100.00%	97	100.00%	105	100.00%	209	100.00%
Immature	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Burned	.	.	17	17.50%	4	3.80%	21	10.00%
Complete	.	.	3	3.10%	7	6.70%	10	4.80%
>75% complete	.	.	2	2.10%	1	1.00%	3	1.40%
50-75% complete	2	28.60%	5	5.20%	3	2.90%	10	4.80%
25-50% complete	.	.	11	11.30%	20	19.00%	31	14.80%
<25% complete	5	71.40%	76	78.40%	74	70.50%	155	74.20%

is true of the features where 60.9 percent of the bone from Feature 18 is pitted, 41.2 percent of that from Feature 20 is pitted, 62.5 percent of that from Feature 21 is pitted, and the specimen from Feature 22 is pitted. Feature 18 also has single bones that are checked and root etched.

Macrobotanical Remains

Floral remains recovered from LA 115862 are highly consistent with other project sites of this period (see Toll, McBride, and Badner, Chapter 23). Carbonized cultural plant debris is scant within the pit structure and consists of low-frequency goosefoot in the informal hearth (Feature 19), and corn kernels, cupules, and glumes in the floor fill, a basin-shaped pit (Feature 18), and ash pit (Feature 20). Wood is predominantly juniper in both the ash pits and several postholes, however, some cottonwood/willow from the river corridor, and bits of saltbush/greasewood from the floodplain and terraces are present as well (see Toll, McBride, and Badner, Chapter 23).

The extramural activity area thermal features produced a considerably more diverse assemblage of economic floral remains. Carbonized wild seeds included the usual weedy annual suspects (goosefoot, pigweed, purslane) as well as bulrush. Corn remains were found in every feature, including a hearth (Feature 5), roasting pits (Features 9, 11), and charcoal or ash stains (Features 10, 12). The only wood data available from the extramural proveniences came from Feature 9; juniper is the predominant element in both flotation and macrobotanical wood samples (87 percent and 99 percent by weight, respectively). Feature 8, a small trash-filled pit southwest of the pit

Table 9.11. LA 115862, Summary of Fauna from Floor Fill/Contact and Floor Features

	Floor Fill and Contact		Pit, Feature 18		Ash Pit, Feature 20		Deflector Posthole, Feature 21		Deflector Posthole, Feature 22		Total	
	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %	Count	Col %
Small mammal	8	16.70%	6	26.10%	2	11.80%	3	37.50%	.	.	19	19.60%
Medium to large mammal	2	4.20%	13	56.50%	8	47.10%	5	62.50%	1	100.00%	29	29.90%
Large mammal	4	8.30%	.	.	.	.	.	.	.	.	4	4.10%
Ord's kangaroo rat	1	2.10%	.	.	.	.	.	.	.	.	1	1.00%
Woodrats	1	2.10%	.	.	.	.	.	.	.	.	1	1.00%
Medium to large rodent	.	.	.	.	1	5.90%	.	.	.	.	1	1.00%
Desert cottontail	21	43.80%	2	8.70%	.	.	.	.	.	.	23	23.70%
Black-tailed jack rabbit	6	12.50%	2	8.70%	6	35.30%	.	.	.	.	14	14.40%
Artiodactyl	1	2.10%	.	.	.	.	.	.	.	.	1	1.00%
Medium artiodactyl	2	4.20%	.	.	.	.	.	.	.	.	2	2.10%
Mule deer	1	2.10%	.	.	.	.	.	.	.	.	1	1.00%
Cow or bison	1	2.10%	.	.	.	.	.	.	.	.	1	1.00%
Total	48	100.00%	23	100.00%	17	100.00%	8	100.00%	1	100.00%	97	100.00%
Immature	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Burned	5	10.40%	1	4.30%	8	47.00%	3	37.50%	.	.	17	17.50%
Complete	1	2.10%	1	4.30%	1	5.90%	.	.	.	.	3	3.10%
>75% complete	2	4.20%	.	.	.	.	.	.	.	.	2	2.10%
50-75% complete	4	8.30%	1	4.30%	.	.	.	.	.	.	5	5.20%
25-50% complete	11	22.90%	.	.	.	.	.	.	.	.	11	11.30%
<25% complete	30	62.50%	21	91.30%	16	94.10%	8	100.00%	1	100.00%	76	78.40%

structure, contained carbonized goosefoot, cheno-am, and goosefoot family seeds and corn cupules. Site occupants appear to have focused on a restricted number of weedy annuals that mature in late summer.

Abandonment

LA 115862 appears to be a planned abandonment. The structure was unburned and carefully dismantled, most likely to reuse the posts at a new site. The structure's floor and floor features were void of trash deposits. The amount of adobe on the floor suggests an uncovered structure enduring multiple episodes of rain, which melted the walls and closing materials. The inhabitants may have abandoned the loose terrace gravel for the sand a little farther north. The two women and two infants buried here are possibly one more factor in the short period of occupation. Absorption of the family unit into a larger community farther north is also a possibility.

Summary

LA 115862 is a single component site assigned to the Early Developmental period (Basketmaker III-Early Pueblo I, AD 600–900). The site included one pit structure housing 14 features, an extramural activity area dedicated to agricultural processing, and a funerary area.

Both absolute and relative dating techniques were used in interpreting this site. A single archaeomagnetic set of eight specimens, AM 1150, was collected from Feature 19, a hearth situated on the floor of the pit structure. The individual specimen directions were very coherent, resulting in an extremely tight reading and assigned a date range of AD 775–815.

The ceramic artifacts present indicated an Early Development period assemblage (Wilson 2001). Middle Rio Grande Plain Gray wares dominated the assemblage. San Marcial Black-on-white vessels associated with funerary goods were also recovered (Mera 1935). Early (Tallahogan) red slipped wares, a local red-on-brown variant, Jornada Brown Ware, and various Mogollon brown wares were present as well.

Study Unit 1, a pit structure, was the only domicile present at LA 115862. The presence of a single pithouse generally suggests a single or nuclear family unit occupied the site. The amount of available dwelling space and volume of food can be used to calculate and determine the number of people in the unit. However, owing to the lack of storage facilities, calculating the volume of food is not possible.

Naroll's (1962) study of pre-industrial societies states the dwelling unit can be determined by taking one-tenth of the total floor area of the roofed dwelling. The pit structure has a total floor area of 26.73 sq m. According to Naroll's formula, the population would have been 2.63 or from 2 to 3 individuals. Casselberry's (1974) formula of one-sixth the total roofed area would have been 4.39 or 4 to 5 people. Yet Bullard (1962) suggests only 1.5 m of surface is required for a sleeping adult. This would imply 17.58 or 17 to 18 people in the one dwelling. The paucity of domestic evidence on this site makes population interpretation difficult.

LA 115862 is probably contemporaneous with LA 265, a larger Early Developmental community that shared the same terrace and consisted of multiple structures, processing areas, and storage facilities. LA 265 was located approximately 300 m north of this site. The short distance from LA 265 suggests that LA 115862 was a possible satellite facility utilized for specialty activities, such as processing specific cultivator or wild taxa. LA 115862 is positioned on the first terrace above the riparian bottomland and would be ideal for field locations. Owing to the lack of facilities, storage would have been located elsewhere. The minimal floor features observed within the structure would leave abundant room for a gathering of multiple individuals for specialized tasks. Evidence of minimal internal thermal activity within the structure and the presence of a restricted number of weedy annuals that mature in late summer, suggests that processing would have occurred during late summer or fall, negating the need for internal fires for warmth.

LA 115862 could also represent a very limited occupation by a single-family unit. Abandonment of the site could center on the four individuals in three graves. Absorption into the larger community, LA 265, is also possible.

The occupants of LA 115862 were involved to some degree in prehistoric farming, gathering, hunting, and local resource acquisition. Botanical analysis identified various wild taxa and corn. Although low in frequency, carbonized plant remains of corn and goosefoot were present in the floor features of the structure. The extramural activity area produced a considerably more diverse assemblage of economic floral remains. Weedy annuals of goosefoot, pigweed, purslane, and bulrush were recovered. Corn was present in every feature within the extramural activity area.

The variety of taxa shows the exploitation of the riparian and piñon/juniper vegetation zones. Flotation and macrobotanical samples from the extramural activity area indicated juniper as the predominant wood. Cottonwood-willow from the river corridor and saltbush-greasewood from the floodplain and terraces were also utilized. The presence of cultivated and weedy annuals suggests a mixed agricultural-gathering subsistence strategy for plant food resources.

The presence of nonhuman bone indicates that the faunal population was exploited. Most of the bone observed is in poor condition and is generally highly pitted or checked and unidentifiable. Cottontail rabbits and small mammals dominate the assemblage of identifiable bone, indicating garden hunting typical of early agriculturists. A few large mammal bones and two fine-pointed deer metacarpal awls were recovered illustrating big game procurement as well.

The majority of lithic artifacts present indicate the occupants were utilizing locally available materials consisting primarily of chalcedony, basalt, chert, rhyolite, and obsidian. These materials are available within the local Rio Grande terrace gravels or within a reasonable distance from the site. The raw materials used in the grinding tools were also locally obtainable.

The Middle Rio Grande Plain Gray wares dominated the ceramic assemblage. These are locally produced gray wares with sand temper. It is not known if these were actually produced on site, however they were produced in the associated community. The presence of non-local ceramics suggests extra-regional relationships occurred. The ceramics include a San Marcial Black-on-white hanging seed jar, one San Marcial Black-on-white bowl, assorted sherds from like vessels, and Mogollon brown wares. In this collection of ceramics, a locally produced Mogollon Red-on-brown bowl was also present. This may reflect interaction with groups in the Mogollon Highlands. This also could be the manifestation of the San Marcial phase employed by the local occupants. Forty-seven spire-lopped shell beads used for clothing adornment were documented as funerary goods in two female burials. These items appear to be from the Sea of Cortez, further indicating long-distance trade.

Chapter 10
LA 115863

John Ware and Jessica Badner

LA 115863 was a multiple component sherd and lithic scatter recorded by Sandra Marshall of the NMSHTD in November 1996 during field reconnaissance along the NM 22 right-of-way north of Peña Blanca (Fig. 10.1). Artifact density at LA 115863 was substantially lower than other nearby terrace sites along NM 22 (LA 6169, LA 6170, and LA 6171). The site was not previously recorded by Dittert and Eddy in December 1961 during highway salvage work, nor by Peckham and Wells in 1967 during archaeological investigations associated with the construction of Cochiti Dam.

Setting

LA 115863 is on a Pleistocene gravel terrace overlooking the east bank of the Rio Grande floodplain approximately 100 m north of LA 6169, at an elevation of 1,607.4 m (5,270 ft). Local vegetation included junipers on slopes to the east and west of the site and an understory of grama grass, snake weed, Russian thistle, and several species of cactus. The NM 22 road cut bisects the site.

Site Description

LA 115863 was a low density lithic and ceramic scatter covering a 1,144 sq m area. The cultural materials were eroding from the base of a low dune deposit that blanketed most of the terrace surface with eolian and redeposited alluvial sand and silt from 1 to 3 m deep. Unlike other terrace top sites in the project area, there were no obvious cobble alignments at LA 115863. However, occasional cobbles dispersed across the surface were recorded as possible disarticulated remains of cobble features by Marshall in 1996.

Excavation Strategy

Fieldwork at LA 115863 began on January 14, 1998, under the direction of Stephen Lentz of the Office of Archaeological Studies, with a crew of three assistants and three laborers. The site was divided into halves along NM 22. The western portion of the site was designated Area 1, the eastern half Area 2. A north-south oriented base line was established in Area 1, where a controlled surface collection was conducted in 1-by-1-m units. After surface collections were complete, exploratory excavations were initiated on the west side of the highway (Area 1, see Fig. 10.1). Eleven 1-by-1-m excavation units (Fig. 10.1) were placed in areas of higher than average surface artifact density. Four units (139 to 140N/104 to105E) were placed along the western road cut to examine eroding cultural deposits later designated Feature 1. Grid unit 140N/100E was also excavated along with five auger holes to locate evidence of any continuing cultural surface or deposits. None was identified.

Excavation of 139 to 140N/104 to105E exposed Feature 1, an oval roasting pit and associated possible cultural surface. Artifact frequencies in the rest of the excavation were low and no intact cultural deposits or subsurface features were identified. An extensive backhoe trenching operation focused on exposing deeply buried cultural features or deposits not found during the hand excavation. Backhoe trenches in Area 1 were excavated in a rough ladder pattern. Two long, parallel, north-south running trenches (Backhoe Trenches 3 and 4) intersected seven east-west running trenches (Backhoe Trenches 6 through 17) that were spaced 10 to 15 m apart. Area 2 trenches (Backhoe Trenches 13 and 14) ran parallel north to south. Trenches were faced and

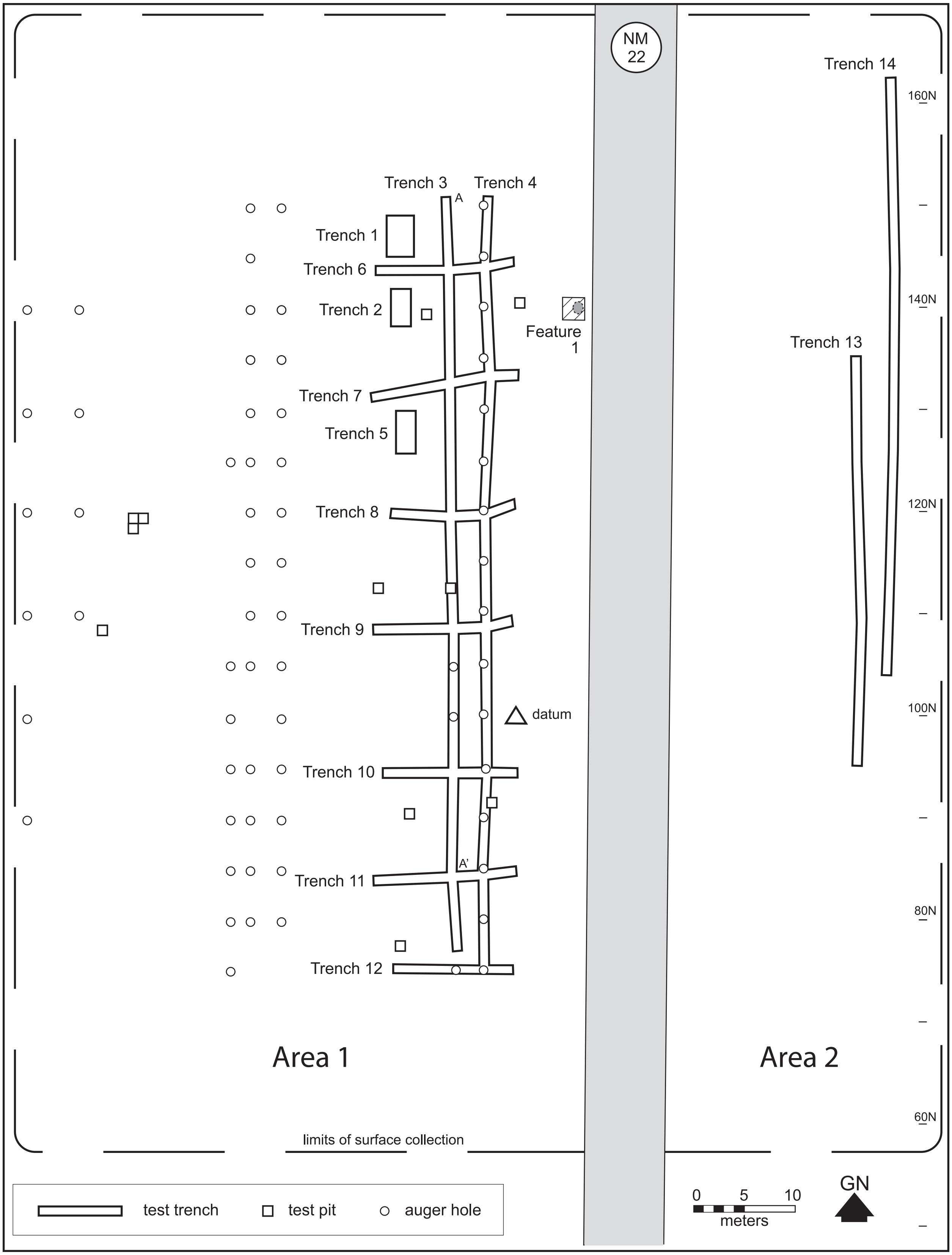


Figure 10.1. LA 115863 site map.

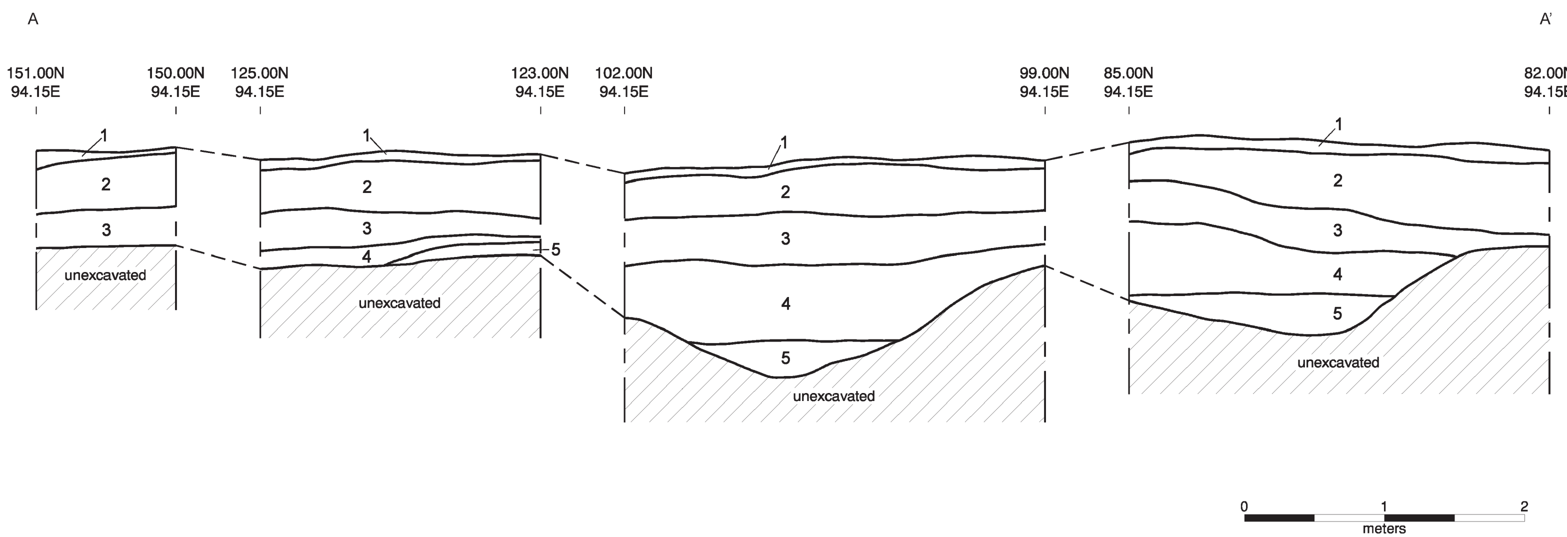


Figure 10.2. Backhoe Trench 3, east wall profile.

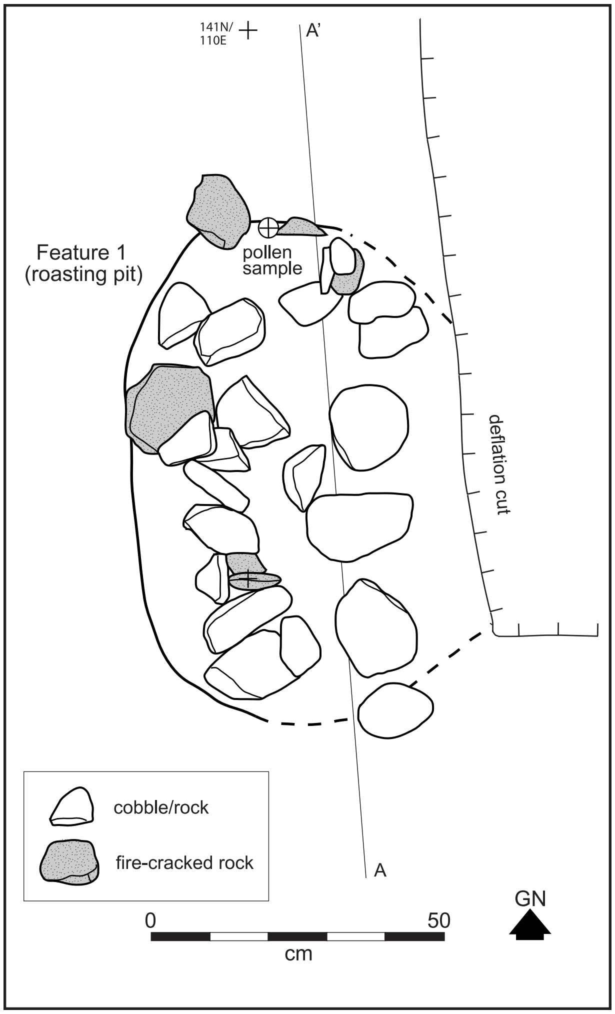


Figure 10.3. Feature 1.

selected trench segments were profiled. Figure 10.2 illustrates the Trench 3 east wall profile. No evidence of subsurface cultural features or deposits was noted. A series of 73 auger holes were also excavated (Fig. 10.1), none of which encountered cultural strata. As a result, no further excavations were conducted at the site.

Site Stratigraphy

Five natural strata were recorded in backhoe trench profiles at LA 115863 and are illustrated in Figure 10.2. No cultural strata were observed in backhoe trenches.

Stratum 1 was a 6- to 12-cm layer of 10YR 5/4 yellowish brown colluvial or eolian loose sandy loam that covered the site. Stratum 2 was a 20- to 52-cm-thick layer of 10YR 4/4 alluvial/colluvial sandy loam. Stratum 3 was a 0- to 36-cm-thick layer of pale brown silt loam (10YR 6/3) mixed with caliche not present on the northern end of the site. Stratum 4 was a 4- to 54-cm layer of light yellowish brown (10YR 6/4) sandy loam. Stratum 5 was a light olive brown (2.5Y 5/3) sandy clay that underlaid all other site strata and appeared to overlay Stratum 4 in the northern portion of the site.

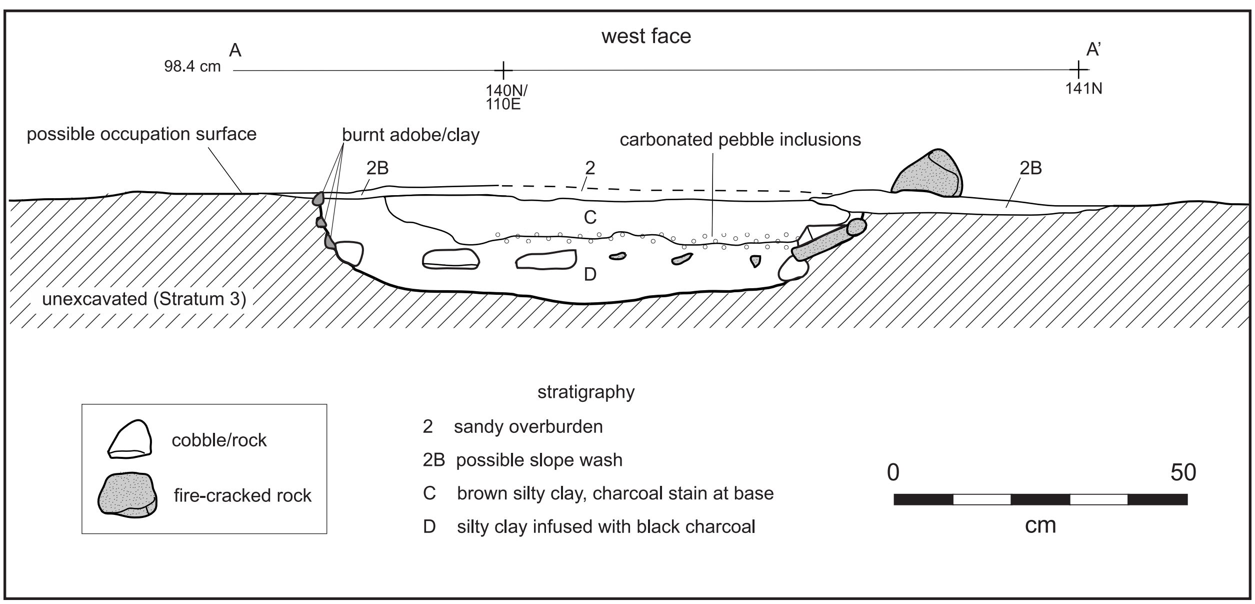


Figure 10.4. LA 1158563, Feature 1, profile.

Features

Feature 1

Feature 1 was the only cultural feature encountered at LA 115863. The feature was a cobble-filled roasting pit covered by 0 to 42 cm of sandy overburden (Stratum 2) located near the northern edge of the LA 115863 terrace, along the edge of the NM 22 highway embankment. Feature 1 was visible on the slope of the embankment as a large diffuse charcoal and ash stain. Several burned cobbles were also observed eroding from the steep embankment slope.

Excavation revealed a partially deflated pit measuring 101 cm in diameter north to south, 72 cm in diameter east to west, and 18 cm deep. The top of the pit was reduced by mechanical blading of the embankment slope, but the western portion of the feature appeared to be intact. Feature 1 was excavated into Stratum 3. One large fire-cracked rock sitting at the top of Stratum 3 and charcoal staining in 139N/105E suggest that this may have been an occupation surface. However embankment blading (Fig. 10.3) near the feature significantly impacted the area and it is possible that cultural strata had been disturbed or jumbled explaining the presence of fire-cracked rock at the stratum break.

Feature fill consisted of two strata capped by a mixture that may have been slope wash (Fig. 10.4). The upper fill, Stratum C, was yellowish brown silty clay. The lower fill, Stratum D, was moderately compacted black charcoal and sandy clay with numerous fire-cracked rock inclusions ranging in size from less that 5 cm to over 20 cm. The floor of the pit was lined with cobbles, including four large (20 to 30 cm) blackened cobbles that appear to have been deliberately set in place and one tabular cobble underlying these not visible in the profile. In all, 52 individual pieces (26 kg) of fire-cracked rock were recovered from the feature. Unfortunately, the walls of the pit were insufficiently oxidized to yield a reliable archaeomagnetic sample and insufficient charcoal was recovered for radiocarbon dating.

Table 10.1. LA 15863, Ceramic Tradition by Ware for Entire Site

		Gray Ware	White Ware	Red Ware	Plain Brown	Total
Indeterminate	Count	2	-	-	-	2
	% within tradition	100.00%	-	-	-	100.00%
	% within ware	3.30%	-	-	-	2.90%
	% of total	2.90%	-	-	-	2.90%
Rio Grande (Prehistoric)	Count	-	4	-	-	4
	% within tradition	-	100.00%	-	-	100.00%
	% within ware	-	50.00%	-	-	5.70%
	% of total	-	5.70%	-	-	5.70%
Middle Rio Grande (Cibola	Count	58	4	-	-	62
	% within tradition	93.50%	6.50%	-	-	100.00%
	% within ware	96.70%	50.00%	-	-	88.60%
	% of total	82.90%	5.70%	-	-	88.60%
Northern Jornada Mogollon (Jornada)	Count	-	-	-	1	1
	% within tradition	-	-	-	100.00%	100.00%
	% within ware	-	-	-	100.00%	1.40%
	% of total	-	-	-	1.40%	1.40%
Mogollon Highlands	Count	-	-	1	-	1
	% within tradition	-	-	100.00%	-	100.00%
	% within ware	-	-	100.00%	-	1.40%
	% of total	-	-	1.40%	-	1.40%
Total	Count	60	8	1	1	70
	% within tradition	85.70%	11.40%	1.40%	1.40%	100.00%
	% within ware	100.00%	100.00%	100.00%	100.00%	100.00%
	% of total	85.70%	11.40%	1.40%	1.40%	100.00%

Artifacts

Surface collections and excavations at LA 115863 yielded 42 pieces of chipped stone, 70 ceramic fragments, and eight ground stone artifacts. No faunal material was recovered from the site.

Ceramics

Ceramics recovered from LA 115863 are summarized in Tables 10.1 through 10.3. Ceramics represented Early and Late Developmental components. The majority (82.9 percent) was made up of Middle Rio Grande Plain wares, typical of Developmental sites along NM 22. Kwahe'e Black-on-White, Middle Rio Grande mineral paint (undifferentiated), Jornada Brown body, San Francisco Red, and indeterminate utility wares made up the remainder of the assemblage. Of these, only 30 percent (n = 21) were recovered from below the surface. Ceramics in Level 1 were recovered from grid units 90N/89E, 91N/97E, 118 to 119N/72E and 139N/91E. One was an indeterminate utility ware. The rest were Middle Rio Grande Plain body fragments. Seven ceramics were recovered from Level 2, 118N/72E. All were Middle Rio Grande mineral paint (undifferentiated) with sand temper.

Chipped Stone

The entire lithic assemblage was made up of forty-three lithic artifacts and is summarized in Table 10.4. The majority were manufactured

Table 10.2. LA 115863 Distribution of Vessel Form by Ware for Entire Site

		Gray Ware	White Ware	Red Ware	Plain Brown	Total
Bowl body	Count	1	5	1	-	7
	% within vessel form	14.30%	71.40%	14.30%	-	100.00%
	% within ware	1.70%	62.50%	100.00%	-	10.00%
	% of total	1.40%	7.10%	1.40%	-	10.00%
Jar neck	Count	11	-	-	1	12
	% within vessel form	91.70%	-	-	8.30%	100.00%
	% within ware	18.30%	-	-	100.00%	17.10%
	% of total	15.70%	-	-	1.40%	17.10%
Jar body	Count	48	3	-	-	51
	% within vessel form	94.10%	5.90%	-	-	100.00%
	% within ware	80.00%	37.50%	-	-	72.90%
	% of total	68.60%	4.30%	-	-	72.90%
Total	Count	60	8	1	1	70
	% within vessel form	85.70%	11.40%	1.40%	1.40%	100.00%
	% within ware	100.00%	100.00%	100.00%	100.00%	100.00%
	% of total	85.70%	11.40%	1.40%	1.40%	100.00%

Table 10.3. LA 115863, Distribution of Ceramic Types for trhe Entire Site

	Frequency	Percent	Valid Percent	Cumulative Percent
Indeterminate Utility Ware	2	2.9	2.9	2.9
NRG Kwahe'e B/w (solid designs)	3	4.3	4.3	7.1
NRG Kwahe'e B/w (thin parallel lines)	1	1.4	1.4	8.6
MRG Plain Body	58	82.9	82.9	91.4
MRG Mineral Paint (undifferent)	4	5.7	5.7	97.1
MH Jornada Brown Body	1	1.4	1.4	98.6
MH San Francisco Red	1	1.4	1.4	100.0
Total	70	100.0	100.0	

Table 10.4. LA 115863, Material Group by Lithic Type

	Chalcedony		Jemez Obsidian		Nonvesicular Igneous		"Other" Local		Totals	
	N	%	N	%	N	%	N	%	N	%
Angular Debris	-	-	-	-	7	100.0	-	-	7	16.0
Flake	3	8.8	3	8.8	27	79.4	1	2.9	34	79.0
Core, Multiplatform	-	-	-	-	1	100.0	-	-	1	2.0
Utilized Core Fragment	-	-	-	-	1	100.0	-	-	1	100.0
Total	3	7	3	7	36	83.7	1	2.3	43	100.0

from nonvesicular igneous materials (84 percent). Other material categories represented by few artifacts are Jemez obsidian (n = 3), chalcedony (n = 3), and an "other" local material (n = 1) (Table 10.4).

Although the lithic assemblage is small, artifacts indicate an emphasis on secondary stages of core reduction. The majority of whole flakes lacked dorsal cortex (73 percent) or exhibited partial dorsal cortex (21 percent). Among flakes with platforms, 48 percent were single faceted. A multiplatform core and a utilized core fragment of nonvesicular igneous materials were also recovered. There was no evidence of expedient or formal tool manufacture. No bifacial thinning flakes or flakes with retouched platforms were identified.

Unutilized flakes (79 percent) and unutilized small angular debris (16 percent) represent the majority of the artifacts recovered. No chipped stone or ground stone tools were recorded.

Subsistence

One flotation sample was processed from Feature 1. Juniper and coniferous unidentified wood were the only taxa recovered.

Summary

Site location and presence of a low density, but extensive artifact scatter would seem to predict substantial subsurface cultural deposits and tangible evidence of prehistoric occupation in the form of intact cultural features. In light of these expectations, it was surprising to discover a single cultural feature at the site and very little evidence of subsurface cultural deposits. Nearly 400 m of exploratory backhoe trenches were excavated within the project area, and the majority of these trenches were culturally sterile. The ceramic assemblage from LA 115863 was tentatively dated to the Late Developmental period and it is also possible that a portion of the low density artifact scatter at LA 115863 was associated with sheet midden from LA 6169, a multicomponent site with a Late Developmental occupation and high density sheet midden located one terrace to the north (100 m). This possibility, however, does not address the presence of Feature 1, and it is likely that if there were substantial prehistoric remains at LA 115863, they are either outside the current project boundary or they were removed during the construction of the present NM 22 roadbed in the early 1960s.

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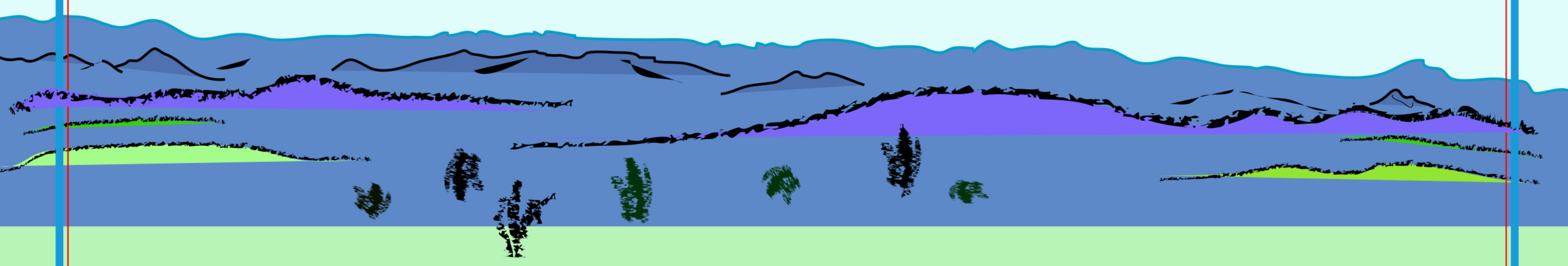

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