OFFICE OF ARCHAEOLOGICAL STUDIES

DEPARTMENT OF CULTURAL AFFAIRS

THE ACOMITA INTERCHANGE IMPROVEMENTS: Revised Archaeological Research Design and Data Recovery Plan for Four Archaeological Sites at the I-40 Exit 102, Cibola County, New Mexico

By Robert Dello-Russo

Original design and plan authored by
Stephen S. Post and Charles A. Hannaford

With Contributions by:
Nancy J. Akins
Jeffrey L. Boyer
Pamela J. McBride
James L. Moore
Mollie S. Toll
C. Dean Wilson

ARCHAEOLOGY NOTES 393

SANTA FE 2007 NEW MEXICO

ADMINISTRATIVE SUMMARY

This data recovery plan was prepared by the Museum of New Mexico, Office of Archaeological Studies (OAS), at the request of the New Mexico Department of Transportation (NMDOT). It provides cultural-historical, theoretical, and methodological contexts for the archaeological investigation of portions of four archaeological sites, LA 54902, LA 89019, LA 108511, and LA 149868, which occur within the NMDOT preferred design alternative for the proposed I-40 Exit 102 improvement project (Alternative 5-Compressed Diamond Interchange Shifted West, also referred to in the environmental assessment documents as Alternative B; NMDOT Project IM-040-2[58]102). The configuration of Alternative 5, as described in this research design, is essentially the same as that described in an earlier version of this design, produced by OAS in 2005. This includes the slight southward shift in the alignment of Road B so as to minimize impacts or adverse effects to archaeological site LA 108511. However, the current Alternative 5 differs from the original Alternative 5 in the master plan in that it includes roundabout intersections.

The archaeological data recovery project will be located within Section 22 of Township 10 North, Range 7 West, NMPM, and between I-40 Mile Posts (MP) 101.34 and 102.83 in the eastern portion of the Pueblo of Acoma, Cibola County, New Mexico. The project will be funded by the Federal Highway Administration (FHWA), NMDOT, and the Pueblo of Acoma. Initial field surveys were conducted in two phases by archaeologists from Marron and Associates, Inc. of Albuquerque, New Mexico, and OAS gratefully acknowledges Kenneth Brown, Marron and Associates, Inc., for supplying electronic copies of much of the introductory sections and site descriptions that are included in this data recovery plan (Brown and Brown 2005). This data recovery plan conforms to the requirements of New Mexico and federal statutes as they may apply to archaeological investigations conducted on state, Indian, and private lands with federal, state, and Acoma Tribe funding.

LA 54902 is a small site consisting of a Pueblo II period artifact scatter and linear configuration of sandstone slabs that may represent the remains of a fieldhouse or seasonally occupied structure foundation. A field check, combined with interpretation of aerial and spatial imagery, indicates that the Alternative 5 construction may affect the southern portion of the site, which is characterized by a very light surface artifact scatter. Limited hand excavation, augering, and a spatially extensive backhoe excavation program are recommended to determine if deeply buried cultural deposits underlie the surface architectural remains and artifact scatter. Excavation may yield information on the organization of agricultural-based subsistence behaviors between AD 1000 and 1150 in the Acoma Province and the periphery of the San José drainage basin.

LA 89019 is multicomponent with an artifact scatter dating from late Paleoindian to Pueblo II period and a Territorial period foundation with a light scatter of artifacts located within an undulating and intermittently deflated and stable dune/bedrock setting. Alternative 5 will affect 66 percent of the site area including late Paleoindian, Early and Middle Archaic, Pueblo II, and late Territorial period components. Limited hand excavation and augering, along with a backhoe excavation program, are recommended for this site. Excavation may yield information on changing hunting and gathering practices and organization on the margins of a large mammal migratory route along the Rio San José, as well as Acoma Province Anasazi seasonal subsistence patterns centered on agriculture

and foraging. The late Territorial period component reflects a pastoral subsistence pattern within the shifting sociopolitical boundaries of Acoma Pueblo and the community of Cubero.

LA 108511 is a spatially extensive, low density sherd and lithic artifact scatter within an ancient floodplain. The dispersed artifact scatter dating from the Pueblo II period (Pilares phase) appears to result from berm construction, underground utility installation, and borrow pit activities that have brought buried cultural resources to the surface. These surface artifacts may not directly reflect prehistoric activities and behaviors; however, they indicate the presence of subsurface cultural deposits. Pueblo II farmers practiced a land-extensive settlement pattern that provided access to farmlands distant from permanent villages. Construction of an Alternative 5 access road does not affect the surface artifact scatter. However, the potential for subsurface deposits and features from fieldhouse occupations or other seasonal activities may be encountered both within and outside the existing site boundary. A program of subsurface backhoe excavation and subsequent augering and hand excavation of features in the vicinity of LA 108511 may yield data on Pueblo II subsistence technology, settlement, and organization.

LA 149868 is a multicomponent Pueblo II fieldhouse with a sherd and lithic artifact scatter and three historic-era features probably dating from the late Territorial period and associated with activities at LA 89019, which was located only 60 m to the east. Construction of Alternative 5 would affect the north portion of the site, which is primarily a dispersed prehistoric artifact scatter in intermittently stable and deflated dune and sandstone bedrock settings. Cultural deposit depth should be variable and the contextual integrity of the cultural deposits is unknown. Some artifacts may be contemporaneous with the main prehistoric component, while others remain from low intensity, short duration activities. Hand excavation and augering, along with a program of backhoe excavations, are recommended for this site. Excavations may yield data on intermittent, low intensity use of this area for farming and diurnal foraging by Anasazi farmers.

The following research design and data recovery plan provides cultural-historical and environmental contexts, site descriptions, an assessment of data potential of site areas within proposed Alternative 5, and research questions that address issues at both site-specific and regional scales. Field data recovery and laboratory analysis methods link the archaeological site data potential to the appropriate research questions and scales of analysis and interpretation.

MNM Project No. 41.808
NMDOT Project No. IM-040-2(58)102 (I-40/Exit 102 Intrchange Project)
CN 2763
NMCRIS Activity No. 95951

CONTENTS

Figures

Tables

Introduction

This data recovery plan was prepared by the Museum of New Mexico, Office of Archaeological Studies (OAS), at the request of the New Mexico Department of Transportation (NMDOT). It provides cultural-historical, theoretical, and methodological contexts for the archaeological investigation of portions of four archaeological sites, LA 54902, LA 89019, LA 108511, and LA 149868, which occur within the NMDOT preferred design alternative for the proposed I-40 Exit 102 improvement project (Alternative 5-Compressed Diamond Interchange Shifted West, also referred to in the environmental assessment documents as Alternative B; NMDOT Project IM-040-2[58]102). The configuration of Alternative 5, as described in this research design, is essentially the same as that described in an earlier version of this design, produced by OAS in 2005. This includes the slight southward shift in the alignment of Road B so as to minimize impacts or adverse effects to archaeological site LA 108511. However, the current Alternative 5 differs from the original Alternative 5 in the master plan in that it includes roundabout intersections. The project will be funded by the Federal Highway Administration (FHWA), NMDOT, and the Pueblo of Acoma.

The proposed project will be located within Section 22 of Township 10 North, Range 7 West, NMPM, and between I-40 Mile Posts (MP) 101.34 and 102.83 in the eastern portion of the Pueblo of Acoma, Cibola County, New Mexico. Initial field surveys were conducted in two phases by archaeologists from Marron and Associates, Inc. of Albuquerque, New Mexico, and OAS gratefully acknowledges Kenneth Brown, Marron and Associates, Inc., for supplying electronic copies of much of the introductory sections and site descriptions that are included in this data recovery plan (Brown and Brown 2005). This data recovery plan conforms to the requirements of New Mexico and federal statutes as they may apply to archaeological investigations conducted on state, Indian, and private lands with federal, state, and Acoma Tribe funding.

The following research design and data recovery plan provides cultural-historical and environmental contexts, site descriptions, an assessment of data potential of site areas within proposed Alternative 5, and research questions that address issues at both site-specific and regional scales. Field data recovery and laboratory analysis methods link the archaeological site data potential to the appropriate research questions and scales of analysis and interpretation.

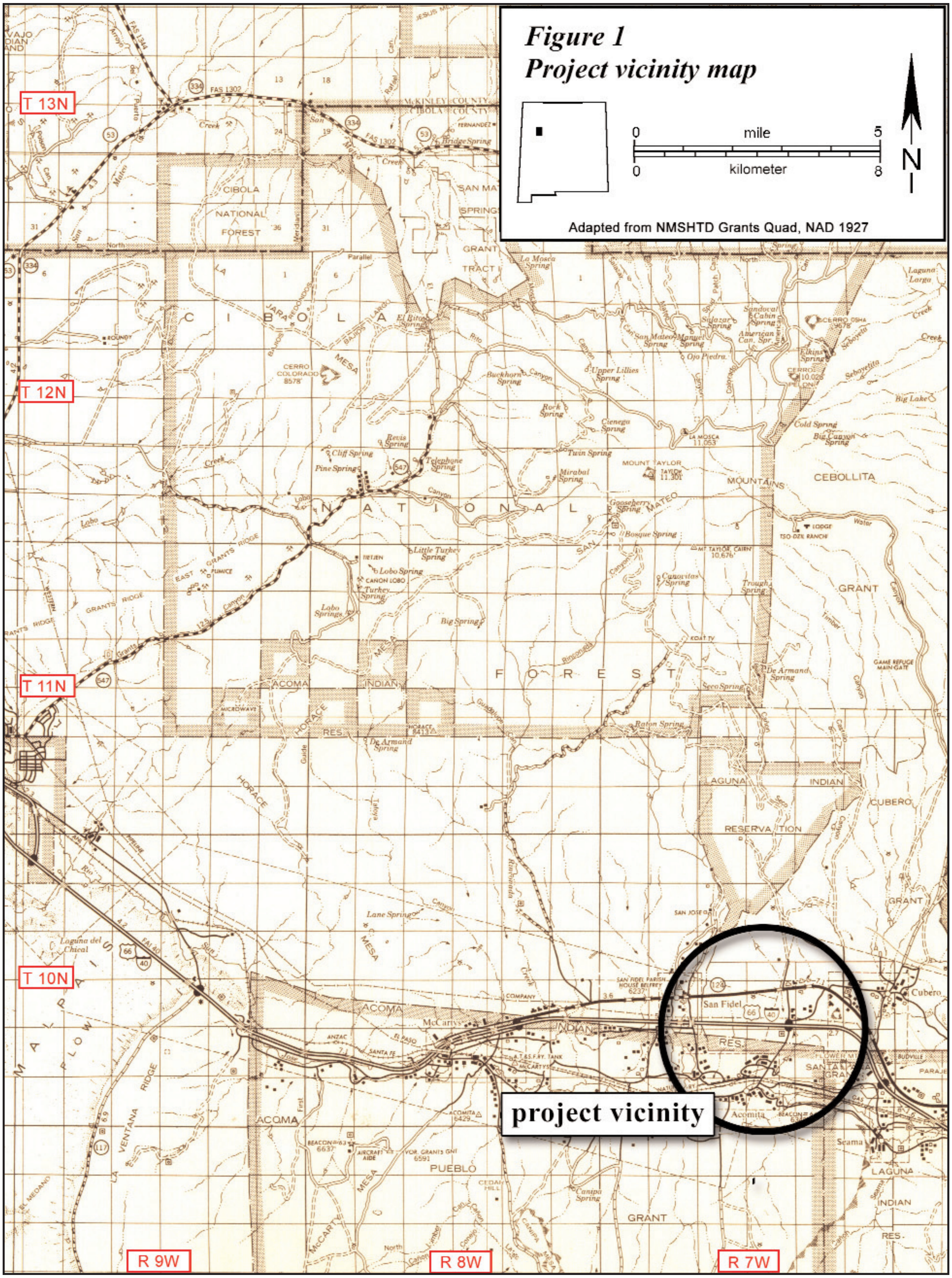
Figure 1
Project vicinity map
0
mile
5
0
kilometer
8
N
Adapted from NMSHTD Grants Quad, NAD 1927
T 13N
T 12N
T 11N
T 10N
R 9W
R 8W
R 7W
project vicinity

PROJECT DESCRIPTION AND LOCATION

The project area is located approximately 457 m west of the existing I-40 interchange between I-40 Mile Posts (MP) 101.34 and 102.83 in the eastern portion of the Pueblo of Acoma, Cibola County, New Mexico (Fig. 1, Appendixes 1 ,2). An enlarged view of proposed design Alternative 5 is shown on Figure 2.

Land ownership in the project area can be briefly summarized for Alternative 5 (Fig. 3). The Alternative 5 corridor encompasses 11.6 ha (38 acres) of which 1.6 ha (4 acres) are Pueblo of Acoma land, 7.3 ha (18 acres) are Town of Cubero Grant land, 2.4 ha (6 acres) are private land, and 4 ha (10 acres) are NMDOT land acquired from private sources (Brown and Brown 2005:2).

The following project descriptions are quoted directly from M. E. Brown and K. L. Brown (2005:3-4).

> Alternative 5, the Compressed Diamond Interchange Shifted West Alternative, would result in the reconstruction of the interchange in a diamond configuration approximately 457 m (1,500 ft) west of the existing (interchange) location (Fig. 2). The interchange would be constructed as an overpass with new on and off ramps. A new cross road would be aligned closely with Road "A" as shown in the master plan. The new cross road would be built approximately 183 m (600 ft) to the north and then connected with Plan Road "B," which would connect traffic back to the east where it would intersect with SP-30. The alignment of master plan Road "B" has been shifted to the south of the location shown in the master plan in an effort to minimize impacts to cultural resource sites. The connection of the new interchange to the south would be completed by constructing a new three-lane road section to an intersection point with SP-130. SP-130 would be realigned with a reverse "S" curve to the north. At the point of intersection between the two roadways, a roundabout intersection would be constructed. A new leg to the east would be built to provide a connection back to SP-30. There would not be any reconstruction of I-40 required with this alternative. SP-30 would remain in service as a local access road. The existing bridge structures would be widened to accommodate new acceleration and deceleration lanes for the eastbound on-ramps and westbound off-ramps. The existing interchange on and off ramps would be removed after completion of the new interchange.
>
> The off-ramps would have deceleration lanes that extend parallel to I-40 prior to the ramps [sic] divergence from the mainline. On-ramps would have acceleration lanes parallel to I-40 to allow for adequate heavy vehicle acceleration onto I-40. The new on and off-ramps would have full access control. The north and south connection roads will have limited access control management, negotiated, and approved by the NMDOT. Road "B" would have its access control designated by the Pueblo of Acoma. Access control along SP-30 will remain limited. Sidewalks would be constructed on both sides of the new cross road. A sidewalk or pedestrian path would be constructed on one side of SP-30 to connect the Acoma businesses with the NMDOT rest area.
>
> Alternative 5 includes one new bridge and utilizes two existing bridges (bridge numbers 6397 and 6398) with one bridge requiring widening. Bridge number 6397 would be widened to accommodate the proposed typical section and alignment in order to carry the transition lane of the new eastbound on-ramp. The new bridge would have two 30 m (100 ft) spans for a total structure length of 61 m (200 ft). It would have MSE retaining walls at the abutments.
>
> The west concrete box culvert would be extended along with construction of a transition structure to collect offsite runoff. An approximate 15 m (50 ft) extension would be

Figure 2. Aerial photograph of Alternative 5.

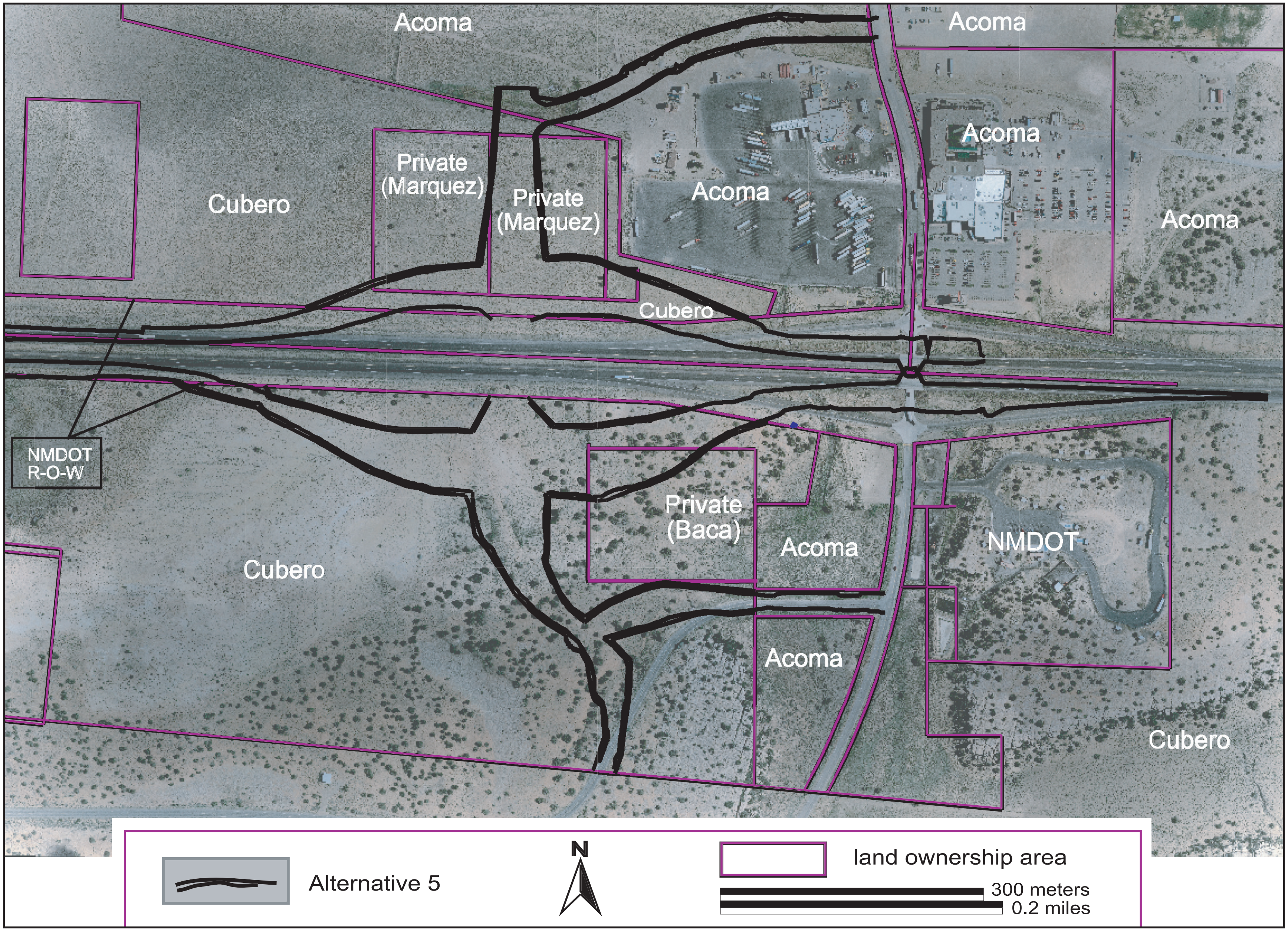

Figure 3. Land status for Alternative 5.

> needed north of I-40 and an additional 36.6 m (120 ft) extension south of I-40. Realignment of drop inlets would be needed to ensure conveyance of drainage from off-site areas. Drainage across Road "A," Road "B," and the new connection to SP-30 and SP-130 would be achieved with circular metal pipe structures. These circular metal pipe structures would be located at various terminus points along existing flow paths. Flows originating from the future overpass crossing of Road "A" would be managed with deck drains and ground swales. Additional drainage improvements would include adding crossing culverts at the new connection to SP-30 and SP-130 and building median and curb drop inlets where roadway curb sections are proposed.

Initial field surveys, which encompassed both Alternative 5 and Alternative 3, were conducted in two phases by archaeologists from Marron and Associates, Inc. of Albuquerque, New Mexico. The inventory identified eleven previously documented and five new archaeological sites. Of the 16 sites, two (LA 89019 and 89020) have Archaic components, four (LA 89019, 104153, 108511, and 108512) have Pueblo I components, seven (LA 54902, 89019, 99628, 108511, 108512, 117550, and 145683) have Pueblo II components, six (LA 89019, 89020, 98452, 145143, 145684, and 149868) have Pueblo II-III) components, two (LA 145685 and 149867) have unknown Puebloan components, and one (LA 89019) has a historic component. From this site inventory, only LA 54902, LA 89019, LA 108511 and LA 146898 require a research design and data recovery plan and project. Data for these four sites are provided in Appendix 1. The locations of these sites are illustrated in Appendix 2 and Appendix 3. Land ownership/management status relative to each of the four sites is illustrated in Appendix 4.

LA 54902 is a small site consisting of a Pueblo II period artifact scatter and linear configuration of sandstone slabs that may represent the remains of a fieldhouse or seasonally occupied structure foundation. A field check, combined with interpretation of aerial and spatial imagery, indicates that the Alternative 5 construction may affect the southern portion of the site, which is characterized by a very light surface artifact scatter. Limited hand excavation and augering, along with a spatially extensive backhoe excavation program, are recommended to determine if deeply buried cultural deposits underlie the surface architectural remains and artifact scatter. Excavation may yield information on the organization of agricultural-based subsistence behaviors between AD 1000 and 1150 in the Acoma Province and the periphery of the San José drainage basin.

LA 89019 is multicomponent with an artifact scatter dating from late Paleoindian to Pueblo II period and a Territorial period foundation with a light scatter of artifacts located within an undulating and intermittently deflated and stable dune/bedrock setting. Alternative 5 will affect 66 percent of the site area including late Paleoindian, Early and Middle Archaic, Pueblo II, and late Territorial period components. Hand excavation and augering, along with a program of backhoe excavation, are recommended for this site. Excavation may yield information on changing hunting and gathering practices and organization on the margins of a large mammal migratory route along the Rio San José, and Acoma Province Anasazi seasonal subsistence patterns centered on agriculture and foraging. The late Territorial period component reflects a pastoral subsistence pattern within the shifting sociopolitical boundaries of Acoma Pueblo and the community of Cubero.

LA 108511 is a spatially extensive, low density sherd and lithic artifact scatter within an ancient floodplain. The dispersed artifact scatter dating from the Pueblo II period (Pilares phase) appears to result from berm construction, underground utility installation, and borrow pit activities that have brought buried cultural resources to the surface. These surface artifacts may not directly reflect prehistoric activities and behaviors; however, they indicate the presence of subsurface cultural deposits. Pueblo II farmers practiced a land-extensive settlement pattern that provided access to farmlands distant from permanent villages. Construction of an Alternative 5 access road does not affect the surface artifact scatter. However, the potential for subsurface deposits and features from fieldhouse occupations or other seasonal activities may be encountered both within and outside the existing site boundary. A program of subsurface backhoe excavation and subsequent hand augering and excavation of features in the vicinity of LA 108511 may yield data on Pueblo II subsistence technology, settlement, and organization.

LA 149868 is a multicomponent Pueblo II fieldhouse with a sherd and lithic artifact scatter and three historic era features probably dating from the late Territorial period and associated with activities at LA 89019, which was located only 60 m to the east. Construction of Alternative 5 would affect the north portion of the site, which is primarily a dispersed prehistoric artifact scatter in intermittently stable and deflated dune and sandstone bedrock settings. Cultural deposit depth should be variable and the contextual integrity of the cultural deposits is unknown. Some artifacts may be contemporaneous with the main prehistoric component, while others remain from low intensity, short duration activities. Excavations may yield data on intermittent, low intensity use of this area for farming and diurnal foraging by Anasazi farmers.

BIO-PHYSICAL CONTEXT

Physiography and Geology

The I-40 Exit 102 improvement project, which is on Pueblo of Acoma, Town of Cubero Grant, NMDOT land acquired from private sources, and private lands, lies within the Acoma-Zuni Section of the Colorado Plateau Physiographic Province in northwestern New Mexico (Hawley 1986:24). This section is the southeastern subdivision of the Colorado Plateau and "is characterized by extensive upper Cenozoic volcanic deposits that form a discontinuous cover on erosional and constructional landforms" (Hawley 1986:25). Prominent features of the Acoma-Zuni Section in the general project vicinity include Mount Taylor, basalt-capped mesas, and the Malpais Lava Field. Mount Taylor is "a composite strato-volcano of Pliocene age" (Hawley 1986:25) that was formed by a series of successive lava and ash flows. The older flows are basalt and the younger are dacite and andesite (Chronic 1987:50). Horace Mesa, just north of the project area, is one of four lava-covered mesas forming Mount Taylor's platform (Robinson 1994:110). An obsidian source on Horace Mesa, which is of better quality than that of East Grants Ridge (Shackley 1999:2), may have been the origin of the obsidian artifacts recorded during the present cultural resource survey. The Malpais Lava Field, just west of the project area, was formed by a series of lava flows originating from small volcanoes 32.2 to 48.3 km (20–30 miles) southwest of I-40. The youngest flow—the McCarty Lava Flow—is about 1,000 years old and forms the eastern portion of the Malpais (Chronic 1987:48–49; Hawley 1986:25).

Locally, the project area is bounded on the southeast by Cubero Mountain (Flower Mountain) and on the south by the Rio San José. The project area is in a broad valley and low uplands. The terrain within the proposed project corridor varies from flat to rolling. Project elevations range from 1,875 to 1,885 m (6,150–6,185 ft).

Soils

The soils of the project area are broadly classified as Rock Land-Torriorthents-Argiustolls (Maker et al. 1978, map). This association occurs on gently to strongly sloping mesa tops, steep to very steep mesa side slopes and escarpments, and gently to strongly sloping alluvial fans and narrow valley bottoms. The more extensive soils of this association are residual, developing from weathered sedimentary rocks, primarily sandstone or interbedded sandstone and shale. As a result, these soils are often shallow and gravelly or rocky. Sandstone and shale outcrops occur along mesa rims and on steep canyon walls and escarpments (Maker et al. 1978:93).

Of the various soil units that occur within the proposed project corridor, five—the Dumps-Pits Complex, the Sky Village-Rock Outcrop-Bond Complex, the Sparank-San Mateo Complex, the Hagerman-Bond Association, and the Penistaja-Oelop Association—are associated with sites recorded during the cultural resource survey. Two of these soil units—the Hagerman-Bond Association and the Penistaja-Oelop Association—are major units within the proposed project area of potential effect (APE). These five soil complexes and associations are described below. Minor soil units in the project APE are not described.

Dumps-Pits Complex (230)

The Dumps-Pits Complex (5 to 90 percent slopes) is on hills and flats. Areas are irregular in shape and are 200 to 1,000 acres in size. They are generally barren of vegetation. Dumps occur as areas of waste rock, mine spoil, and other refuses. Pits consist of open excavations from which soil material and some rocks have been removed (Parham 1993:34).

Sky Village-Rock Outcrop-Bond Complex, 3 to 40 Percent Slopes (251)

The Sky Village-Rock Outcrop-Bond Complex is 40 percent Sky Village sandy loam on 3 to 40 percent slopes, 30 percent Rock Outcrop, and 20 percent Bond sandy loam, 3 to 8 percent slopes. The Sky Village soil is on benches and the lee side of mesas and edges of mesa tops. The Rock Outcrop is on escarpments and the Bond soil is on benches and the edges of mesas. The Sky Village soil is shallow and well drained, having formed in eolian material derived mostly from sandstone. Generally, the surface layer is light yellowish brown sandy loam about 10.2 cm (4 inches) thick. The underlying material is dark yellowish brown sandy loam about 20.3 cm (8 inches) thick. Sandstone is at a depth of about 30.5 cm (12 inches). Permeability is moderately rapid and water capacity is very low, with medium runoff and moderate water erosion (Parham 1993:34–35).

The Rock Outcrop is barren or nearly barren areas of exposed sandstone on benches and escarpments. The Bond soil is shallow and well drained, having formed in eolian material derived mostly from sandstone. Generally, the surface layer is brown sandy loam about 10.2 cm (4 inches) thick. The subsoil is reddish brown sandy clay loam about 15.2 cm (6 inches) thick. Sandstone is at a depth of 25.4 cm (10 inches). Permeability is moderate and water capacity is very low. Runoff is medium and water erosion is moderate. Wind erosion can be severe (Parham 1993:35).

Sparank-San Mateo Complex (257)

The Sparank-San Mateo Complex is comprised of 50 percent Sparank loam with 1 to 5 percent slopes and 40 percent San Mateo loam with 1 to 5 percent slopes. Smaller soil units comprise the remainder 10 percent of the complex (Parham 1993:35).

Sparank soil is deep and well drained. It formed in mixed alluvium. Permeability is slow and available water capacity is very high. Runoff is slow and the water erosion hazard is moderate. The wind erosion hazard is severe. The soil is occasionally flooded for brief periods during the summer unless it is protected or gullied. Typically, the Sparank soil varies with depth from a yellowish brown clay loam (0–5 cm [0–2 inches]) to light yellowish brown and light olive brown silty clay to a depth of 1.52 m (60 inches) (Parham 1993:35).

San Mateo soil is deep and well drained. It formed in mixed alluvium with moderate permeability. Its available water capacity is high. Runoff is medium and the hazard of water erosion is moderate. The hazard of soil blowing is severe. The soil is occasionally flooded for brief periods during the summer unless it is protected or gullied. Typically, the San Mateo soil varies with depth from a light yellowish brown loam (0–5 cm [0–2 inches]) to light olive brown loam and sandy clay loam (5–69 cm [2–29 inches]) to a light olive brown sandy clay loam that has thin strata of sandy loam to silty clay loam to a depth of 1.52 m (60 inches) (Parham 1993:35). None of the 16 sites in the project APE is on Sparank-San Mateo Complex soils.

Hagerman-Bond Association, 1 to 10 Percent Slopes (625)

The Hagerman-Bond Association (1 to 10 percent slopes) is on hills, ridges, mesa tops, and cuestas. This unit consists of 55 percent Hagerman fine sandy loam and 30 percent Bond sandy loam. The former occurs on hills, ridges, mesa tops, and the lower dip slopes of cuestas. The latter occurs on hilltops, ridges, mesa tops, and the upper dip slopes of cuestas. Small areas of other soils represent 15 percent of the unit (Parham 1993:78).

The Hagerman soil formed in eolian and alluvial material derived primarily from sandstone. This soil is moderately deep and well drained. Runoff is medium and the water erosion hazard is moderate. The wind erosion hazard is severe. Typically, the Hagerman soil varies with depth from a brown sandy loam (0–8 cm [0–3 inches]) to a dark brown fine sandy loam (8–15 cm [3–6 inches]) to a brown sandy clay loam (15–58 cm [6–23 inches]) to a strong brown and light brown sandy clay loam (58–86 cm [23–34 inches]). Sandstone occurs at a depth of 86 cm (34 inches) (Parham 1993:78).

The Bond soil formed in eolian material derived primarily from sandstone. This soil is shallow and well drained. Runoff is medium and the water erosion hazard is moderate. The wind erosion hazard is severe. Typically, the Bond soil varies with depth from a brown sandy loam (0–13 cm [0–5 inches]) to a dark brown sandy clay loam (13–38 cm [5–15 inches]) to a strong brown sandy clay loam (38–46 cm [15–18 inches]). Hard sandstone occurs at a depth of 46 cm (18 inches) (Parham 1993:78–79). Three of the four archaeological sites requiring data recovery—LA 54902, LA 89019, and LA 149868—are on the Hagerman-Bond soil association.

Penistaja-Oelop Association, 0 to 5 Percent Slopes (645)

The Penistaja-Oelop Association (0 to 5 percent slopes) is on fan terraces and in swales. This unit consists of 60 percent Penistaja sandy loam and 25 percent Oelop loam. The former occurs on fan terraces. The latter occurs in swales. Small areas of other soils represent 15 percent of the unit (Parham 1993:81).

The Penistaja soil formed in mixed alluvium reworked by wind. This soil is deep and well drained. Permeability is moderate. Runoff is medium and the water erosion hazard is moderate. The wind erosion hazard is severe. Typically, the Penistaja soil varies with depth from a brown sandy loam (0–8 cm [0–3 inches]) to a strong brown sandy clay loam (38 cm [15 inches]) to a light brown and strong brown sandy clay loam to a depth of 1.52 m (60 inches) (Parham 1993:81).

The Oelop soil formed in mixed alluvium. This soil is deep and well drained. Permeability is moderately slow with available water capacity very high. Runoff is medium and the water and wind erosion is moderate. Typically, the Oelop soil varies with depth from a yellowish brown loam (0–8 cm [0–3 inches]) to a brown clay loam (33 cm [13 inches]) thick to a yellowish brown clay loam and loam to a depth of 1.52 m (60 inches) (Parham 1993:81–82). One of the four sites, LA 108511, is on the Penistaja-Oelop soil association.

Climate

The project area has a semiarid continental climate characterized by cold winters and warm summers. The average annual precipitation is 229 to 305 mm (9–12 inches). Most of the precipitation falls from June through October in the form of brief, often heavy, thunderstorms. Occasionally, thunderstorms are accompanied by hail and strong, gusty winds. The Gulf of Mexico is the main source of moisture during this period. During winter, precipitation is provided by eastward-moving Pacific Ocean storms. Most of the moisture, however, is lost in the mountains west of New Mexico. Winter precipitation is usually light. The average annual snowfall ranges from 0.3 to 1.2 m (1–4 ft) and falls from November through March. In general, precipitation varies from month to month and from year to year (Parham 1993:2–3).

The average annual temperature ranges from 54ºF (12ºC) at lower elevations to 47ºF (8ºC) at higher elevations. The average annual temperature at Grants is 50ºF (10ºC). The average number of days with freezing temperatures ranges from 150 to 200. The average frost-free season ranges from 110 days at El Morro National Monument to 156 days at Laguna. Winds are light throughout most of the year, averaging 16 km (10 miles) per hour at Acomita, with March as the windiest month. Winds are primarily from the west (Parham 1993:3, 170).

Surface Water

The project area is east of the Continental Divide, in the upper portion of the Rio San José basin. The Rio San José, the nearest perennial stream, is 1,524 m (5,000 ft) southwest of the I-40 Exit 102 overpass. The river has its headwaters in the Zuni Mountains and drains much of the Acoma-Zuni Section before emptying into the Rio Puerco. The Rio San José is the Rio Puerco's major tributary, but the former itself has few perennial reaches (Hawley 1986:25). "Most narrow, deeply entrenched valleys of the Rio San José system are south and east of the Mount Taylor volcanic field" (Hawley 1986:25). Just north of the river, springs and seeps are present along the base of Horace Mesa. The project area itself, however, is dissected by intermittent drainages.

Vegetation

The project area lies within the Upper Sonoran Zone (Bailey 1913:27). The vegetation of the project area is variously classified as Plains-Mesa Grassland and Juniper Savanna (Dick-Peddie 1993a, 1993b:86, 102) and Plains and Great Basin Grassland and Great Basin Conifer Woodland (Brown and Lowe 1994). The Plains–Mesa Grassland is the most extensive grassland community in New Mexico. As a result of grazing, farming, and urbanization, most of the areas in New Mexico historically occupied by this plant community have changed to juniper savanna at the high boundaries and to desert grassland at the low boundaries. In climax condition, Plains-Mesa Grassland consists almost entirely of grasses. Transitional areas from grassland to desert grassland vegetation are subtle and extensive. Grasses include grama (*Bouteloua* spp.), three-awn (*Aristida* spp.), dropseed (*Sporobolus* spp.), muhly (*Muhlenbergia* spp.), buffalograss *(Buchloe dactyloides),* and Indian ricegrass *(Oryzopsis hymenoides).* Major shrubs include four-wing saltbush *(Atriplex canescens),* rabbitbrush *(Chrysothamnus nauseosus),* broom snakeweed *(Gutierrezia sarothrae),* sagebrush (*Artemisia* spp.), cholla and prickly pear (*Opuntia* spp.), and yucca (*Yucca* spp.). Forbs include prairie clover (*Petalostemum* spp.), prairie coneflower *(Ratibida tagetes),* and globemallow (*Sphaeralcea* spp.) (Dick-Peddie 1993b:104, 113–115). Vegetation noted in the project area during the recent cultural resource survey includes various grasses (e.g., dropseed, grama), rabbitbrush, snakeweed, cholla, prickly pear, four-wing saltbush, widely scattered juniper *(Juniperus),* and an occasional piñon *(Pinus).*

Juniper Savanna, an ecotone between woodland and grassland, is broad and extensive in New Mexico. "The transition from woodland to grassland involves a marked decrease in the density of trees, accompanied by reduction to a single tree species, usually a juniper" (Dick-Peddie 1993b:91). In New Mexico, the juniper species of the Juniper Savanna is usually the one-seed juniper *(J. monosperma).* Although most of the Juniper Savanna in the state has little or no shrub component, there are areas in northwestern New Mexico where sagebrush or shadscale *(Atriplex confertifolia)* are dominant shrubs (Dick-Peddie 1993b:91). Shrubs noted within the Juniper Savanna portion of the project area during the cultural resource survey include rabbitbrush, snakeweed, prickly pear, cholla, barrel cactus, narrowleaf yucca, and banana yucca *(Y. baccata).* Juniper is the dominant tree but piñon is also present.

Fauna

The project area and vicinity contain, or formerly contained, a variety of vertebrate fauna (e.g., Findley et al. 1975). This includes various mice, rats, hawks, owls, lizards, snakes, and carnivores. The mule deer *(Odocoileus hemionus),* wapiti *(Cervus elaphus),* pronghorn *(Antilocapra americana),* bighorn sheep *(Ovis canadensis),* white-tailed prairie dog *(Cynomys gunnisoni),* cottontail (*Sylvilagus* spp.), black-tailed jackrabbit *(Lepus californicus),* woodrat (*Neotoma* spp.), and turkey *(Meleagris gallopavo)* were important meat resources for the prehistoric and early historic inhabitants of the area. Many animals—bears (*Ursus* sp.), wolves *(Canis lupus),* coyotes *(Canis latrans),* bobcats *(Felis rufus),* striped skunks *(Mephitis mephitis),* gray foxes *(Urocyon cinereoargentus),* eagles, hawks, ravens *(Corvus corax),* turkeys, and various perching birds—were also procured as raw material sources (e.g., pelts, hides, feathers, bones) for tools, clothing, ornaments, and ceremonial uses. Animals noted in the project area during the recent cultural resource survey include cottontail and jackrabbit.

CULTURE-HISTORICAL CONTEXT

The following brief overview of the culture history of the project area is based in part on Tainter and Gillio (1980) and on Stuart and Gauthier (1984). Reports by Broster and Harrill (1982), Wase et al. (2000), and others are also used. This culture history was adapted from the inventory report by M. E. Brown and K. L. Brown (2005).

Paleoindian Period (10,000–5500 BC)

The earliest substantiated cultural manifestation in the Southwest, the Paleoindian period, can be divided into three sub-periods or complexes—Clovis (10,000–9000 BC), Folsom (9000–8000 BC), and Plano (8000–5500 BC)—each named for different cultural groupings. The name Plano has generally fallen into disuse and has been replaced more recently by the term late Paleoindian. Stylistically distinct projectile points associated with now-extinct late Pleistocene and early Holocene megafauna characterize these complexes. In addition, Paleoindian sites are typically identified by lithic assemblages that exhibit a very refined and standardized technology. Clovis components are characterized by large lanceolate spear points with a single short basal flute on both faces. The Clovis toolkit also includes spurred endscrapers; large, unifacially flaked side scrapers; keeled scrapers on large blades; flake knives; backed, worked blades; gravers; perforators; shaft straighteners; and bone points and foreshafts (Gunnerson 1987:10). Folsom assemblages are characterized by the presence of small, finely made diagnostic lanceolate projectile points with a single flute on each face, extending almost the entire length of the point. Technologically, the Folsom point is thought to have developed from the preceding Clovis point form. Plano complexes are characterized by a variety of projectile point types that include laterally thinned, indented base, and constricted base series. Late Paleoindian projectile points lack flutes and consist, instead, of large lanceolate forms with basal grinding and large parallel flaking (Wheat 1972; Wormington 1957). The Plainview complex contains laterally thinned points—Midland, Plainview, Meserve, Milnesand, and Frederick—and is generally considered the earliest of the late Paleoindian complexes. The Midland point, however, may be contemporary with the Folsom point. A later series includes Firstview, Alberta, and Cody complex points, such as Eden and Scottsbluff. Agate Basin and Hell Gap points comprise part of the constricted base series (Cordell 1979a:21).

The basic adaptive strategy recognized for the Paleoindian period was a subsistence economy that focused on the procurement of a limited number of key resources, especially megafauna (e.g., mammoth, mastodon). Because the locations of residential camps probably depended on the location and size of game herds, Paleoindian groups were undoubtedly highly mobile. Although most excavated Clovis sites are kill sites in which Clovis points are associated with mammoth bones, the bones of much smaller animals—bison, horse, camel, cervids, canids, pronghorn, jackrabbit, birds—have also been recovered from Clovis processing localities. It has been suggested that Clovis hunters may have been scavengers of mammoth and hunters of bison and other diverse species (Cordell 1979a:19–20). The meat diet was probably supplemented with nuts, berries, tubers, and seeds. Due to climatic change and/or overkill, mammoth became extinct and were replaced by bison as an important meat source for Paleoindian populations. Folsom points have been found in association with a now-extinct form of late Pleistocene bison—*Bison antiquus.* Pronghorn, canid, and rabbit bones have also been recovered from Folsom sites (Frison

1978, 1991). The earliest evidence for communal hunting occurs with Folsom assemblages. These communal hunts required greater social organization and control than that evidenced in Clovis sites (Frison 1978:243–250, 1991:276–288). Folsom assemblages are indicative of a hunting and gathering subsistence economy that focused on the seasonal availability of animal and plant resources. Although many recorded late Paleoindian sites in the Western United States represent mass bison kills, campsites have also been reported. The earliest late Paleoindian complexes were frequently associated with now-extinct forms of bison, but by 7000 BC, only modern fauna were available (Cordell 1979a:20, 1997; Judge 1982:48–49).

Paleoindian remains in the general project area are represented primarily by isolated diagnostic projectile points. Folsom points have been found in the Grants area, northwest of the current project area (Mabry et al. 1996:156). Points representing the various Paleoindian complexes have also been reported for Cebolleta Mesa, just southwest of the project area (Broster 1982:74–81). In addition, Judge (1973:28, 63) recorded Paleoindian sites along the Rio San José, 16 to 24 km (10–15 miles) east of Cebolleta Mesa. A basal fragment from a probable Midland point was observed at LA 89019 and its presence suggests that a recognizable Paleoindian component may be found at LA 89019 or nearby.

The paucity of recorded Paleoindian sites in the region is partly due to low visibility resulting from more recent soil deposition that has covered Pleistocene deposits. This is the case of a site, west of Cebolleta Mesa, which Dittert (1959:516) reported as having a buried Paleoindian component. Many known Paleoindian sites occur in areas of severe erosion (Cordell 1979a:133), thus underscoring the probability that many Paleoindian sites remain buried. In addition, the low number of known Paleoindian sites has probably resulted from the difficulty in recognizing such sites from lithic scatters of other cultural periods. Both Paleoindian and Archaic sites are difficult to distinguish in the absence of diagnostic artifacts, primarily projectile points. Undoubtedly, some Paleoindian manifestations lacking diagnostic artifacts have been mistakenly attributed to the Archaic period or have been recorded as "unknown" lithic scatters.

Paleo-environmental data suggest the Paleoindian period was marked by fluctuating climatic changes that generally trended, over time, toward a regime of decreased effective moisture. It has been argued by some that by 5500 BC, as a result of the cumulative effect of these changes, the environment of northwestern New Mexico was less able to support large herds of herbivores, such as bison. Paleoindian groups, therefore, probably abandoned the area (Irwin-Williams 1973:4; Irwin-Williams and Haynes 1970). Because no generic connection was discerned between the late Paleoindian and Early Archaic occupations of the region, Irwin-Williams (1973:4–5) postulated a hiatus. Judge (1982:49), however, contends Early Archaic phases (e.g., Jay and Bajada) represent a basically Paleoindian (i.e., focal) hunting adaptation to essentially modern faunal and floral resources. If Judge is correct, the Early Archaic artifact assemblages of northwestern New Mexico may reflect technological adjustments to a changing resource base by Paleoindian groups present in the area, rather than indicating an influx of new peoples (Cordell 1979a:25–26; Stuart and Gauthier 1984:33). In such a situation, it is possible that the adapting late Paleoindian groups in New Mexico may have reflected technology and settlement patterns similar to the Foothills-Mountain tradition identified in Wyoming and Colorado (Dello-Russo 2006).

It is now thought, by some, that the western landscape was simultaneously utilized by several different hunter-gatherer groups (co-traditions) during the end of the Pleistocene and the early Holocene geological epochs. It is now argued that the late Paleoindians exhibited both Plains adaptations and Foothills-Mountain adaptations (Frison 1991; Jodry 1999; Pitblado 2003), the latter of which were characterized by a variety of lanceolate, stemmed, and fishtail bifaces that were flaked in a parallel-oblique pattern and utilized as projectile points and/or knives. These tools were generally made of locally available raw materials and were associated with the hunting of mountain sheep and mule deer. The Plains adaptation, in contrast, focused more on communal bison hunting and was characterized by Agate Basin, Hell Gap, Cody and James Allen point styles.

Archaic Period (5500 BC–AD 400)

During the Archaic period, the subsistence pattern shifted from a focus on large mammal procurement to the hunting of smaller mammals and to an increased focus on the gathering of wild plant foods. In other words, the main Archaic adaptation was a "diffuse" economy in which a wide variety of plant and animal resources were exploited (Judge 1982:49). Consequently, the Archaic settlement pattern was reflected in the reoccupation of areas where the distribution and density of key plant resources could be predicted on a seasonal basis.

Maize horticulture first appeared in the Southwest between 1900 and 1000 BC (Cordell 1997:129, Huber 2006). Although maize was not a dominant component of the Late Archaic subsistence strategy, Huckell (1995:15–16) has proposed replacing the term Late Archaic with the name Early Agricultural period. This new designation recognizes the most important cultural development in the Southwest between 1900 BC and AD 200—the appearance and spread of agriculture.

Archaic sites are usually identified as lithic artifact scatters with fire-cracked rock, hearths, specific projectile point types, and ground stone tools—basin metates, cobble manos. Pottery is absent. The presence of fire-cracked rock and the concomitant absence of pottery are commonly used to identify Archaic sites that lack diagnostic projectile points. The Archaic is also associated with a biface-oriented flaked stone technology and a diversity of lithic raw materials (Lintz et al. 1988:135).

The Oshara Tradition is the most commonly used cultural-temporal framework for the Archaic in the project area. Defined by Irwin-Williams (1973) on the basis of work in the Arroyo Cuervo area, southwest of San Ysidro, between the Rio Puerco and Jemez River, the Oshara Tradition is the hunter-gatherer predecessor of the Puebloan period. The Oshara Tradition is divided into five Archaic phases—Jay (5500–4800 BC), Bajada (4800–3200 BC), San José (3200–1800 BC), Armijo (1800–800 BC), and En Medio (800 BC–AD 400). The En Medio phase spans most of the Basketmaker II period (AD 1–500), which is considered transitional between the Late Archaic and early Puebloan periods. The Oshara phases are probably indicative of successive adaptations to fluctuating climatic conditions, population size, and subsistence emphasis. "The Jay and Bajada phases may reflect generalized hunting and foraging strategies by small groups; the San José, Armijo, and En Medio phases may represent increasingly heavy reliance on plant foods by larger groups in an increasingly crowded landscape" (Wase et al. 2000:1.21). Limited horticulture was adopted during the Armijo phase, although maize actually arrived in New Mexico at the end of the San José phase.

Although the Oshara sequence is often applied unquestioningly to Archaic manifestations in the region, many Archaic projectile points found in the area are types reflecting Archaic sequences, such as the Cochise Tradition or the Great Basin Stemmed Tradition (Elyea et al. 1994:7). The two Archaic projectile points found during the recent survey—a Jay-like point (LA 89019) and an En Medio-like point (LA 89020)—are types associated with the Oshara Tradition. A third dart point basal fragment (LA 89020) is too small to assign to a type. Except for these points, no other Archaic cultural material was found during the survey. Based on previous surveys in the project area, both LA 89018 and LA 89019 have Early Archaic and Middle Archaic components and LA 89020 has a Late Archaic component.

Puebloan Period (100 BC–AD 1540)

Although maize, and perhaps other cultigens, were introduced into the Southwest during the end of the Middle Archaic and dispersed during the Late Archaic, agriculture was not the basis of a major subsistence strategy. The Puebloan period, however, was an era of increasing dependence on cultigens—maize, beans, squash—and of concurrent changes in sedentism and residence patterns. The phases described in the following section are those of the sequence defined by Dittert (1959) for the Cebolleta Mesa area of the Acoma Cultural Province. Of the 16 sites identified during the recent survey, four (LA 89019, 104153, 108511, and 108512) have Pueblo I components, six (LA 89019, 99628, 108511, 108512, 117550, and 145683) have Pueblo II components, seven (LA 54902, 89019, 89020, 98452, 145143, 145684, and 149868) have Pueblo II-III components, and two (LA 145685 and 149867) have unknown Puebloan components.

Basketmaker II (100 BC–AD 400)

Basketmaker II is considered transitional between the Late Archaic and early Puebloan periods. Several trends originating in the Late Archaic became more pronounced during Basketmaker II. These continuing trends included longer seasonal and probable year-round occupation of various locales, construction of storage units and more permanent habitations, and a greater dependence on cultigens, especially maize and squash grown in floodplain settings. The subsistence economy also included the continued exploitation of wild plants and animals. Archaic technology that carried over into Basketmaker II included the spear thrower (i.e., atlatl), cobble manos, basin metates, and basketry. Brown ware pottery appeared from the south late in the period (Reed et al. 2000; Vivian 1990:91; Wilson and Blinman 1994). Late Basketmaker II pottery includes Adamana Brown (Goetze and Mills 1993:89) and Lupton Brown.

Basketmaker III (AD 400–700)

Basketmaker III is the earliest Puebloan period. Major cultural changes included greater sedentism, more permanent architecture, an increased reliance on cultigens, production of reduction-fired pottery, and use of the bow and arrow. Local population densities increased during this period. Climatic changes favored greater sedentism and expanded horticulture. "Increased precipitation made zones that were formerly marginal for horticulture more productive, though at the same time areas at higher elevations became more precarious for farming because of colder temperatures and shorter frost-free periods" (Vivian 1990:112). Increased relative moisture, rising water tables, and aggrading alluvium allowed horticultural expansion into non-floodplain areas. In addition, wild plant foods increased in habitat area and density. Thus, it was possible to produce larger food surpluses (Vivian 1990:112).

More permanent Basketmaker III architecture in the Acoma area included pit structures, surface structures, and slab-lined cists. The greater abundance of ground stone tools suggests an increased emphasis on plant food processing. Although the data are limited, the presence of marine shell and non-local lithic material is indicative of trade. Characteristic Basketmaker III pottery types include Lino Gray, Fugitive Red, La Plata Black-on-white, White Mound Black-on-white, Alma Plain, and San Marcial Black-on-white (Goetze and Mills 1993:89; Vivian 1990:131).

Dittert's (1959:523–524) White Mound phase (AD 700–800) is transitional between Basketmaker III and Pueblo I. Site types range from small villages of circular pit house structures and slab-lined storage pits to low-density sherd scatters representing special activity sites and agricultural sites (Dittert 1959:523).

Sites were located in a variety of topographic settings, but a definite shift toward arable dunes and valley bottoms is evident as agriculture became increasingly important (Irwin-Williams 1973:15–16; Wozniak 1981:19). Some Basketmaker III sites occurred in apparent defensive locations. Some researchers interpret these defensive locations as evidence of competition for resources between Archaic foragers and the emerging farmers (Ruppé 1966:325; Tainter and Gillio 1980:67).

Associated ceramic types consist mainly of Lino Gray and White Mound Black-on-white, with intrusive types including Alma Plain and Alma Neckbanded (Dittert 1959:523–524). San Marcial Black-on-white occurs on the eastern edge of the province. The difficulty in distinguishing White Mound Black-on-white from similar types induced recent investigators of Cebolleta Mesa (Decker, in Broster and Harrill 1982:119) to group all unpolished gray sherds with typical early designs in mineral paint with La Plata Black-on-white. These researchers proposed that the early end of the phase be modified to correspond with dates associated with La Plata Black-on-white (AD 600 to 800). This difference in interpretation between recent investigators and Dittert and Ruppé may reflect a shift in the temporal range within the White Mound phase. In this way, differentiation between polished and unpolished varieties of White Mound and San Marcial coincides with Hurst's classification for the Middle Rio Puerco (Hurst 2003).

Pueblo I (AD 700–900)

The Pueblo I period was characterized by a number of social and technological changes including more permanent architecture, larger storage facilities, population dispersal, greater standardization in pottery production, and increased trade. Deteriorating environmental conditions—decreased regional moisture, a probable temperature increase, lower groundwater levels, and alluvial degradation—triggered adaptational responses by Pueblo I populations. In early Pueblo I, horticulture had expanded into non-floodplain areas with high water tables, good alluvium, and associated wild plant foods. However, as climatic and environmental conditions began worsening in the mid-eighth century, previously dispersed populations aggregated on floodplains and a major episode of erosion and arroyo cutting forced groups to keep moving ahead of the headward entrenchment of streams. Rapid fluctuation in rainfall made farming more precarious and curtailed the stockpiling of surpluses (Vivian 1990:135–136).

Populations in some areas were more mobile, with a segment leaving seasonally and returning for the winter and/or summer (Schmader 1994). Dispersed settlement occurred near or on alluvial flats. In the Acoma area, there was a move to higher benches and mesa tops after AD 800. Pueblo I habitation sites generally consisted of a linear arrangement of four to ten contiguous surface rooms with one to three deep pit structures to the south or southeast. The surface rooms were usually one room deep and rarely curved (Vivian 1990:149). A renewed importance of surplus food storage "is reflected in the more frequent use of masonry for aboveground store rooms and essentially equal space being devoted to living and storage in room blocks" (Vivian 1990:146).

Although most aggregated settlements were dependent on maize-based agriculture, wild plant foods and hunting were probably still very important in years when precipitation did not permit excess agricultural production to last through the winter. Food remains from excavated sites indicate mixed reliance on horticulture, gathering, and hunting (Vivian 1990:136, 150, 152).

Changes in pottery technology occurred during Pueblo I. Neckbanding on culinary vessels appeared early in the period and eventually culminated in totally corrugated vessels. The latter treatment increased heat shock resistance while the former decreased incidence of boil over (Pierce 1999). The production of decorated white wares increased (Vivian 1990:146), and regional patterns of scattered specialized production appeared. These patterns are expected to apply to the Acoma area (Wilson and Blinman 1995). Characteristic early Pueblo I (AD 700–800) pottery types include Lino Gray, Fugitive Red, Kana'a Neckbanded, La Plata Black-on-white, and White Mound Black-on-white. Late Pueblo I (AD 800–900) pottery types include Kana'a Neckbanded, Narrow Neckbanded, White Mound Black-on-white, Kiatuthlanna Black-on-white, and Red Mesa Black-on-white (Goetze and Mills 1993:89).

Trade with, or an intrusion of, Mogollon peoples to the south fluctuated during the period. There is ample evidence of cultural networks in the early Pueblo I, with a later retraction or decrease in these networks (Vivian 1990:148–149).

The Kiatuthlanna phase (AD 800 to 870) is characterized by a continued emphasis on agriculture and nearly full sedentism. Pithouses were the dominant architectural form, with the addition of jacal surface structures arranged in a crescent-shaped plan (Ruppé 1966:326). Sites are found on secondary benches, mesa tops, and sandy slopes of tributary drainages. Associated ceramics consist mostly of Kiatuthlanna Black-on-white, Kana'a Gray, Lino Gray, and intrusive sherds of San Juan Red Ware, Alma Plain, and Alma Neckbanded (Dittert 1959:528). Distinguishing Kiatuthlanna Black-on-white from Red Mesa Black-on-white, the diagnostic type of the next phase, can be difficult and may result in erroneous phase designations (Decker, in Broster and Harrill 1982:120). The transition to aboveground structures during the Kiatuthlanna phase coincides with architectural trends in the Middle Rio Puerco, while the Albuquerque District still shows an emphasis on subterranean structures.

Pueblo II (AD 900–1100)

The Pueblo II period is marked by greater sedentism, increased reliance on cultigens, and the greater dispersion of peoples (Vivian 1990:167). Pueblo II peoples built small, linear, above-ground habitation structures or room blocks but still retained the pit structure form as an auxiliary habitation or religious structure (i.e., kiva). Initially, there was a trend for aggregated settlements to be at higher elevations in riverine settings. By AD 1000, in nearly all areas of New Mexico, there was a reversal in this trend. Higher elevation sites were abandoned in favor of lower elevation basin settings (Stuart and Gauthier 1984:412).

The development of Chacoan communities began, marked by the construction of planned, multi-storied "Great Houses" and large "Great Kivas." There was also a continuation of small house sites with linear pueblos associated with subterranean kivas (Vivian 1990:203–206). The population concentrated into communities centered on monumental architechture. Subsistence resource shortfalls may have become more common and maize-based farming may have become more intensive, with water control and conservation features becoming more common (Vivian 1990:214–215). An extensive road system was built, extending in a general radial pattern from Chaco Canyon to the margins of the San Juan Basin (Nials et al. 1983) but also serving local ritual access needs (Roney 1992). Candelaria Ruin (formerly Las Ventanas), just west of the project area, on the eastern edge of the malpais, is a Chacoan outlier. The Dittert site (LA 11723), another Chacoan outlier, is south of the project area (Robinson 1994:80, 82–83).

Red Mesa phase (AD 870–950) subsistence focused on agriculture supplemented by hunting and gathering. Jacal architecture continued early in the phase, with the addition of coursed-masonry rooms. Later in the phase, masonry structures received greater emphasis and consisted of straight, double-tiered room blocks and crescentic and L-shaped units (Dittert 1959:534). Occupation of higher topographic settings decreased and site concentrations are found just above the points where canyons constrict. Other site locations include knolls and low benches on the sides of canyons, and open valley floors. Site types include habitation sites ranging from 1 to over 15 rooms and limited artifact scatters suggesting task-specific activities. Ceramic assemblages consist of Red Mesa Black-on-white, Socorro Black-on-white, Kana'a Gray, and exuberant corrugated. Intrusive types include Wingate Black-on-red, Alma Scored, San Francisco Red, Forestdale Smudged, and plain brown (Dittert 1959:536). Pilares Banded, a brown ware, appeared late in the phase.

Socorro Black-on-white makes its appearance during this phase; however, Ruppé (1966:326) feels that the type was derived from Kiatuthlanna Black-on-white rather than Red Mesa Black-on-white. He describes an early variety of Socorro Black-on-white that displays the blue-gray finish and hard, homogeneous paste characteristic of the better known, later variant. The absence of follow-up data for the inception of the Socorro Black-on-white type has kept later investigators from recognizing it earlier than AD 1050 in adjacent areas (Burns 1978; Warren 1982; Lang 1982). Decker (Broster and Harrill 1982:120) contends that more up-to-date tree-ring data on the chronological distribution of types make it unlikely that Socorro Black-on-white and Wingate Black-on-red can be considered diagnostic of the Red Mesa phase. Decker argues that the design styles of these types are more typical of phases postdating AD 1050.

Ruppé (1966:326) believes that Red Mesa phase sites in the Cebolleta Mesa area are similar to those of the Red Mesa Valley, 74 km to the northwest. He interprets the mixed building forms and influx of brown ware ceramics as evidence for three groups of people: indigenous Lobo Complex populations, immigrant Mogollon peoples, and immigrant northerners (Tainter and Gillio 1980:60). Similarly, but for a later time period, Beal (1976) sees a dichotomy in the Malpais areas west of Cebolleta Mesa between jacal structures with 1 to 15 rooms and masonry structures of over 15 rooms. Jacal structures produced assemblages yielding higher frequencies of southern (Socorro Black-on-white), northwestern (Red Mesa and Gallup Black-on-whites), and southern (brown wares) ceramics, while masonry structures yielded assemblages with higher frequencies of southwestern ceramics (Cebolleta and Tularosa Black-on-whites and St. Johns and Wingate Black-on-reds). Beal interprets this pattern as evidence of sociocultural distinctions, while Tainter and Gillio (1980:60) suggest that the ceramic distributions reflect different economic ties of the inhabitants. Another interpretation would be that they are temporally distinct architectural and material cultural expressions.

In the Acoma Province, the Cebolleta phase (AD 950–1100) marks a transition to larger residential sites. Common architecture includes masonry room blocks with the long axis running north and south and a plaza and kivas on the east side (Dittert 1959:541). Jacal structures are sometimes present within a group of contiguous masonry rooms, and specialized grinding rooms have been recorded. Site locations are similar to those of the Red Mesa phase, with a marked increase in the occupation of "mountain meadows" and a slight decline of occupation on flat-topped mesas (Dittert 1959:540).

Late Cebolleta phase ceramic assemblages are composed of Cebolleta Black-on-white, Socorro Black-on-white, Northern Gray Corrugated, and Pilares Banded; intrusive types include Gallup, Escavada, and Puerco varieties of Puerco Black-on-white, Reserve Black-on-white, Kwahe'e Black-on-white, Wingate Black-on-red, and Puerco Black-on-red (Dittert 1959:542–543).

Dittert (1959:543–545) and Ruppé (1966:327) interpret the wide range of intrusive pottery types as evidence of extensive exchange with surrounding areas. An increase in brown wares, especially on the southern portion of Cebolleta Mesa, is viewed by these researchers as a Mogollon intrusion. Ruppé (1966:327) reported assemblages dominated by Socorro Black-on-white, often associated with Los Lunas Smudged and Upper Gila Corrugated, in the Los Veteados area (southern Cebolleta Mesa) throughout the Cebolleta and Pilares phases.

In the northern district, ceramic assemblages contain higher frequencies of sherds from the north (Chaco area) and west (Cibola and eastern Arizona). Dittert (1959:545) suggested that the diffusion of traits from the west along the San José travel route contributed to similarities between the Acoma Province and the Cibola region. Along these lines, Tainter and Gillio (1980:60) argue that intrusive ceramics may represent processes other than the intrusion of populations, such as changing trade patterns.

To the east along the Middle Rio San José, late Cebolleta phase ceramic assemblages, which could date to AD 1140, are composed of a combination of Gallup, Puerco-Escavada, Socorro, and Cebolleta Black-on-whites. This mix of types suggests that the Rio San José was used by groups that maintained contact with people from a variety of pottery-producing areas. Increasing numbers of Socorro Black-on-white and associated banded brown wares suggest increased contact between residents of the Middle Rio San José and the groups of the Socorro District to the south. Presence of southern pottery reflects the position of the Middle Rio San José on the northern border of the "Anasazi-Mogollon" contact zone (Danson 1957; Mera 1935).

Pueblo III (AD 1100–1300)

The Pueblo III period was one of great change in the Southwest. As the Chacoan system began disintegrating in the early twelfth century, Puebloan development emerged on the edges of the greater San Juan Basin in several highland areas—Mesa Verde, Zuni-Cibola, and Acoma—by the thirteenth century (Vivian 1990:331). "The twelfth century was, therefore, in many respects a transitional time between two periods of intense population aggregation and concentration of cultural energy in the long sequence of Puebloan cultural growth" (Vivian 1990:331).

The period was one of population expansion and growth. The Pueblo III period also witnessed a growth in artistic development and intensive local specialization in artifact production (Dart 1982:43). In the Cebolleta Mesa area, the Early Pueblo III is marked by the first indications of occupation on a year-round basis. Villages occur along major drainages and on mesa tops (Ruppé 1966:328). An increase in site frequency during the Late Pueblo III suggests migration into the area from elsewhere. Sites were generally near good farmland, indicating intensive maize agriculture (Dittert 1959).

Within the Cebolleta Mesa area, the Pueblo III is represented by the Pilares (AD 1100–1200) and Kowina (AD 1200–1400) phases. During the Pilares phase, site density in higher topographic settings declined. Sites were concentrated at canyon mouths, above and below canyon constrictions, and on low benches in lower canyons with easy access to arable land. Occupations at higher elevations decreased, and settlement shifted to flat-topped mesas by the end of the phase (Dittert 1959:548). Continued population aggregation resulted in a dichotomy between larger residential communities and small seasonally occupied fieldhouse sites (Wozniak 1981:20; Ruppé 1966:329). Typical residential sites consist of masonry room blocks containing two rows of rooms. Some sites have an east-to-west long axis with a plaza on the south, and other sites have a north-to-south long axis with a plaza and kiva on the east (Dittert 1959:548). Adobe construction appears to be more common in the southern district (Ruppé 1966:329). The village of Acoma was established during the Pilares phase.

Common ceramic types include Cebolleta Black-on-white, Tularosa Black-on-white (Acoma variety), Tularosa Black-on-white (Tularosa variety), Socorro Black-on-white, Northern Gray Corrugated, St. Johns Polychrome, Pilares Banded, Pilares Fine Banded, and Los Lunas Smudged; intrusive types consist of Puerco Black-on-red, Snowflake Black-on-white, and possibly Tularosa Black-on-white (Tularosa variety) and St. Johns Polychrome (Dittert 1959:550). The number of intrusive ceramic types and the number of sites with trade wares drops sharply during the Pilares phase (Ruppé 1966:328). However, the areas of contact are similar to those of the Cebolleta phase.

Looking east between AD 1100 and 1150, the Middle Rio San José ceramic assemblages were similar to those of the late Cebolleta phase. A dramatic decrease in Chaco series, Cibola White Wares (Windes 1981), and a corresponding increase of Socorro Black-on-white and associated plain and smudged brown wares can be found in assemblages from this period. The type most indicative of the end of the Classic Bonito phase, Chaco-McElmo Black-on-white, is absent from Middle Rio San José sites. Whatever Chacoan influence or contact had previously existed had appreciably waned by this time (Post n.d.), a pattern that occurred in Middle Rio

Puerco ceramic assemblages as well (Burns 1978; Baker and Durand 2003). Sites that are considered to postdate AD 1150 have ceramic assemblages dominated by Socorro Black-on-white, Los Lunas Smudged, Pitoche and Pilares Banded, and sherd-tempered gray indented corrugated. Only a very limited range of intrusive types from the Middle and Northern Rio Grande were present (Post n.d.). Use of the Middle Rio San José by Socorro District populations after AD 1150 is suggested. A similar trend, with southern populations moving north into the Albuquerque area after AD 1100, is suggested by Lang (1982) and Warren (1982).

LA 2639 and LA 2640 are examples of smaller-scale residential sites that were excavated along Interstate 40, 12 miles west of Cubero. Typical of this period, these house blocks lacked associated kivas but had living and storage rooms, suggesting seasonal occupation and social interaction with larger, aggregated villages. Only 4 km north of the project area is Cubero Ruin (LA 494), which may have been a permanent residential village from which households established seasonal field residences along the Rio San José and its tributaries. An example of such a seasonal structure is LA 149867, which was recorded during the Acomita Exit 102 interchange inventory (Brown and Brown 2005).

During the Kowina phase, the population aggregated into large sites on high mesas and in wooded areas. Large defensive sites were built. These large villages have 200 or more rooms and they also have Great Kivas. Key pottery types consist of Tularosa Black-on-white, Kowina Black-on-white, St. Johns Polychrome, and other polychromes (Dittert 1959:553–554).

Pueblo IV (AD 1300–1540)

"Pueblo IV in the Southwest was characterized by a constriction of the area occupied (by), and a general deterioration from the cultural peak of, the Pueblo III" (Dart 1982:43). Within the Cebolleta Mesa area, the Pueblo IV period is characterized by population aggregation into a few large villages and by frequent abandonment of these communities (Cordell 1979b:146). Small sites overlook the confluence of tributaries with the Rio San José. In addition, small shelters were built against low cliffs along the Rio San José (Dittert 1959:564).

The Pueblo IV period of the Cebolleta Mesa area is represented by the later part of the Kowina phase (AD 1200–1400) and by most of the Cubero phase (AD 1400–1600). During the early Pueblo IV, there was a general abandonment of the area, with some parts being occupied longer than others (Dittert and Ruppé 1951:121). In general, however, few sites survived from the Kowina phase. During the Cubero phase, the population was concentrated at the village of Acoma. Farming sites, however, occurred along the Rio San José. Pottery from the Hopi, Zuni, and Rio Grande areas was introduced at Acoma during the Cubero phase. In addition, local glaze wares were produced. Key pottery types consist of Pinnawa and Kwakina Glaze wares (Dittert 1959:564–566).

Historic Period (AD 1540–Present)

The Historic period begins with the first mention of Acoma in Spanish documents in 1539. Only LA 89019 and LA 149868 have Historic period occupations and these were late Territorial period components reflecting pastoral subsistence patterns within the shifting sociopolitical boundaries of Acoma Pueblo and the community of Cubero.

Pueblo of Acoma

The earliest reference to Acoma in Spanish documents occurred in 1539 when Fray Marcos de Niza returned from his expedition. Although he had not personally visited the "Kingdom of Acus" (Acoma), he had heard of its existence from informants while traveling toward the Seven Cities of Cibola (Zuni). "They [messengers] told me that beyond those seven cities there were other kingdoms named Marata, Acus [Acoma] and Totonteac"

(Barclay et al. 1994:49). Upon his return to Mexico City, Fray Marcos "declared that I took possession there of all the seven cities and of the kingdoms of Totonteac and Acus [Acoma] and Marata, and that I did not go to them, in order that I might return to give an account of what I had done and seen" (Barclay et al. 1994:54).

The first documented Spanish entry into Acoma happened in 1540 during the entrada of Francisco Vásquez de Coronado. Hernando de Alvarado, one of Coronado's captains, was sent east from Zuni and reached Acuco (Acoma) five days later. Alvarado described Acoma as "one of the strongest places that we have seen, because the city is on a very high rock, . . . The houses have three or four stories; the people are the same sort as those of the province of Cibola; they have plenty of food, of corn and beans and fowls like those of New Spain" (Winship 1933:129). Pedro de Castañeda, another member of Coronado's entrada, provides a fuller description of Acoma.

> Captain Alvarado started on this journey & in five days reached a village which was on a rock called Acuco [Acoma], having a population of about 200 men. . . . The village was very strong, because it was up on a rock out of reach, having steep sides in every direction, and so high that it was a very good musket that could throw a ball as high. There was only one entrance by a stairway built by hand, which began at the top of a slope which is around the foot of the rock. There was a broad stairway for about 200 steps, then a stretch of about 100 narrower steps, and at the top they had to go up about three times as high as a man by means of holes in the rock, in which they put the points of their feet, holding on at the same time by their hands. There was a wall of large and small stones at the top, which they could roll down without showing themselves, so that no army could possibly be strong enough to capture the village. On the top they had room to sow and store a large amount of corn, and cisterns to collect snow and water. . . . They made a present of a large number of [turkey] cocks with very big wattles, much bread, tanned deerskins, pine [piñon] nuts, flour [corn meal], and corn. (Winship 1933:24)

The Rodriguez-Chamuscado expedition visited the pueblo in 1581 (Bolton 1921:167). Antonio de Espejo stayed at Acoma for three days in 1582 and noted the presence of irrigated agricultural fields in the Rio San José Valley (Bolton 1916:183, 1921:168). "These people have their fields two leagues from the pueblo on a river of medium size whose water they intercept for irrigating purposes, as they water their fields with many partitions of water near this river, in a marsh" (Bolton 1916:183).

After establishing the first Spanish settlement in New Mexico in 1598, Juan de Oñate demanded that the Acoma submit to Spanish rule. Later that same year, the Acoma revolted and killed several Spanish soldiers, including Oñate's nephew, Juan de Zaldívar. After crushing the revolt in early 1599, Oñate exacted a severe punishment upon the Acoma and their allies, including amputation of feet and hands (Minge 1991:14). Neglecting to mention this punishment in a letter to the viceroy, Oñate did tell of the pueblo's destruction. "As punishment for its crime and its treason against his Majesty, to whom it had already rendered submission by a public instrument, and as a warning to the rest, I razed and burned it completely" (Barclay et al. 1994:141). The Spanish forced the surviving Acoma to settle in the valley below the mesa. The Acoma, however, soon returned to the top of the mesa. The pueblo was rebuilt and repopulated between 1599 and 1620 (Garcia-Mason 1979:457).

As of 1621, the Acoma were still unconverted. Father Gerónimo de Zárate Salmerón reportedly initiated conversion of the Acoma between 1623 and 1626, but these efforts were unsuccessful and had been abandoned by 1629. At that time, Estevan de Perea assigned Fray Juan Ramírez to the Acoma. Ramírez remained at the pueblo for 20 years and either he, or a successor, built a church—San Esteban—which still stands on top of the mesa, between 1629 and 1664 (Kubler 1990:92, 94).

Responding to Spanish suppression of their native religious beliefs and practices, the

Acoma joined the Pueblo Revolt of 1680, killing their Franciscan padre, Fray Lucas de Maldonado. Rather than taking an active role in the fighting, however, the Acoma primarily provided asylum to fugitives from other pueblos. In late 1692, Diego de Vargas accepted the peaceful submission of the Acoma. The latter, however, participated in a second revolt in 1696, once again harboring fugitives. Eventually, the Acoma made peace overtures. Governor Pedro Rodriguez Cubero, Vargas's successor, performed the Act of Obedience at Acoma in 1699 (Garcia-Mason 1979:457–458; Minge 1991:23–32).

"After the reconquest, Acoma apparently returned to the old ways. . . . Increasing drought made farming more difficult and the population dwindled as the result of disease" (Minge 1991:32). As indicated by oral history, the Acoma reestablished seasonal farming camps along the Rio San José at McCartys and Acomita. Adobe dwellings increased in size and were built closer to the fields (Garcia-Mason 1979:458). When Fray Andres Varo visited Acoma as part of a mission inspection in 1749, he reported that "the Acoma had to go seven leagues from the pueblo to irrigate their fields along the river [the Rio San José]" (Minge 1991:34). The Acoma also had fields, which depended on rain, in the Cañada de la Cruz 4 leagues to the north (Minge 1991:34). In 1776, despite three years of drought, the Acoma had agricultural fields on arable level ground in cañadas to the northwest, north, east, and south of the pueblo. These fields were completely dependent on rain. The Acoma at Cubero, however, irrigated their fields on both sides of the Rio San José with water from the river. As a result, they had a good harvest. In addition, the Acoma had livestock corrals on a chain of mesas—probably the Cebolleta Mesa area—to the west and southwest (Adams and Chavez 1956:189, 194).

In general, the Acoma had peaceful relations with the Spaniards during the late Spanish Colonial period (AD 1700–1821). In 1768, the Acoma had numbered 1,114 but by 1776, as reported during an inspection of the mission by Fray Francisco Atanasio Domínguez, the population had fallen to 530 (Adams and Chavez 1956:195).

> The reason for this great decrease is that many have died since then [1768], some from natural causes in epidemics or from other diseases, others at the hands of Apaches so insolent that if this pueblo were not by nature defensible, perhaps nothing would now remain of it. The present missionary father also states that still others are wandering about and that some have fled to Moqui for fear of the famines and wars they have suffered in a few years. (Adams and Chavez 1956:195)

After the 1780–1781 smallpox epidemic, the mission headquarters was moved to Laguna because the population of Acoma had decreased tremendously (Garcia-Mason 1979:458).

When ordered by Spanish and later by Mexican authorities, the Acoma participated in official expeditions against Apache and Navajo raiders. The earliest known Spanish campaign with Acoma allies was against the Navajo in 1774. Navajo raids centered on the Rio San José and along the Middle Rio Grande from Bernalillo to Socorro (Minge 1991:37–38). "By joining with the Spanish expeditions, the lines of battle were drawn between Ácoma and her Apache and Navaho neighbors" (Minge 1991:38). Navajo and Apache raids continued through the Mexican period (AD 1821–1846) and into the U.S. Territorial period (AD 1846–1912).

During an examination of New Mexico for the U.S. military in 1846–1847, Lieutenant Abert noted the presence of large flocks of sheep, herds of cattle, and droves of horses in the valley below Acoma Pueblo. About 1.2 km (0.75 miles) from the pueblo, where Abert and his party camped for the night, the Acoma had dug holes that provided a constant source of water (Abert 1962:88). By 1850, the Acoma had irrigated and dry-farmed agricultural lands north and south of Grants, eastward along the Rio San José, west of the lava flow, along the northern boundary of the Acoma Grant, and in the Cebolleta Mesa area (Garcia-Mason 1979:459–460). "In 1864 Acoma was described in the same manner as it was in 1540, with houses in parallel rows, ladders used for ingress and egress to the dwellings, low arch formation for doorway passages, and window plates of crystallized gypsum (selenite)" (Garcia-Mason 1979:459). As Navajo raiding decreased, the pueblo began to function primarily as a summer encampment. Smaller settlements were dispersed throughout the Acoma Valley and along the Rio San José (Arany 1982:52).

Land disputes with Laguna Pueblo, officially established in 1699, were an on-going problem. The Acoma and Laguna land boundaries were determined in 1857. At that time, Acoma's territory was to include the area recognized in 1848, when New Mexico was ceded to the United States with the signing of the Treaty of Guadalupe Hidalgo at the end of the Mexico War. Congress confirmed the Acoma land claims in 1858 (Garcia-Mason 1979:459). This, however, did not end the boundary disputes and land claims. The Acoma Reservation was created in 1928. At that time, the size of the original grant was increased. The reservation also increased in size in the 1930s and 1940s with the withdrawal of lands—including portions of Cebolleta Mesa—from the public domain (Arany 1982:54–55).

Since that time, the Acoma Pueblo has been reacquiring aboriginal lands as they become available. Acoma purchases since 1972 have more than doubled the size of the reservation. The Baca Ranch, of which a portion of the present project corridor is a part, was purchased from Pete Baca, Jr., in 1982 (Minge 1991:139, 142). The old ranch, adjacent to the western side of the reservation, "had two tracts for a total of 291.84 acres and all mineral rights, water rights, a submersible water pump with capacity for 30 gallons per minute, a concrete water storage tank, well, boundary fences, and more" (Minge 1991:142). At present, the Pueblo of Acoma consists of approximately 966 sq km (600 sq mi), mostly south of I-40, in Cibola County, New Mexico. The 2000 Census indicates the Acoma Pueblo has 4,712 enrolled tribal members, of which 2,802 reside on the reservation. The principal Acoma communities are Sky City (southern), Acomita (eastern), McCartys (central), and Anzac (western), but several subdivisions and scattered homes are also present. Sky City, the old Pueblo, has few primary residences and is used primarily for cultural activities. The northern portion of Acomita is a commercial area that includes a casino, hotel, and conference center (Indian Health Service 2002:1). The present I-40 Exit 102 improvement project is associated with economic development at Acoma Pueblo.

Navajo

The Navajo homeland during this early historic period, however, was probably in the upper San Juan drainage, in the vicinity of Canyon Largo and Gobernador Canyon—the Dinetah area (Pratt and Scurlock 1990:39, 43). This area remained the Navajo homeland until 1692, when documentary evidence placed them farther west. Prior to the Pueblo Rebellion, the Navajo raided south to Jemez. After the Rebellion, the Navajo began to raid farther southward and came into increasing contact, friendly or otherwise, with the Apache and various Pueblo groups (Schroeder 1963:6–7). "The Navajo were beginning to emerge from isolation and establish relations with their neighbors to the south and east" (Schroeder 1963:10). Navajo raiders attacked the Western pueblos, including Acoma, and settlements along the lower Rio Grande.

Navajo raids stopped abruptly in 1713, but not as the result of Spanish actions. In 1713, the Ute had advanced into Navajo territory. Consequently, the Navajo were forced into a defensive attitude resulting in the cessation of raids to the east. Although some Navajo took up fortified positions on mesa tops and among mountain crags, others migrated toward the south. By 1730, the Navajo were within 5 leagues of Jemez (Schroeder 1963:10). "In 1754, the governor of New Mexico reported that the Navajos in large part had abandoned their homes and fled south to Cebolleta, near Laguna, and to the vicinity of Zuni" (Schroeder 1963:10).

Fray Miguel de Menchero reportedly converted more than 500 Navajos to Christianity at Cebolleta (Seboyeta) in 1746. As a result of this success and in an attempt to stop Navajo raiding, Menchero decided to settle the Navajos in villages on Acoma lands. Spanish missions, therefore, were established for the Navajos at Cebolleta and Encinal, northeast of the project area, in 1748 and 1749 (Hackett in Minge 1991:32–33). Unfortunately, disputes arose between the Navajo and Acoma concerning possessions, territories, waters, and pastures. In 1750, the Navajo at Cebolleta and Encinal rebelled and drove out their missionaries. Stating that they did not want to live in settlements like Christians, they returned to their former homes along the eastern slopes of Mount Taylor (Minge 1991:33–34).

By the 1770s, the Navajo range had stabilized. Many Navajos settled in the vicinity of Laguna and Zuni, the southern boundary of the new Navajo homeland. Canyon Largo—formerly in the heart of Navajo territory—formed the northern border and was the dividing line between the Navajo and Ute ranges. For the first time, the Navajo and southern Apache came into direct contact. In 1785, the Rio San José was established as the boundary between the Navajo and Apache (Schroeder 1963:10–11).

By 1772, the Navajo and Apache had formed an alliance. Raiding parties of each or both were aimed at the Rio Grande pueblos and Spanish frontier settlements. As a result, Spanish settlements on the Rio Puerco were abandoned in 1774. Finally, the Spanish broke the alliance in 1785 and forged an alliance solely with the Navajo. From 1785 to 1796, the Navajo and Apache were alternately at war and peace. A new alliance between both groups was formed in 1796 and lasted until 1807 or 1808, when hostilities between both the Navajo and Apache resumed (Schroeder 1963:11–12).

In the 1820s and 1830s, after Mexico gained its independence from Spain, New Mexican troops focused on ending Navajo raids. Consequently, the Navajo and Apache were allied once again but, before the alliance ended in 1852; the Americans became the new common enemy (Schroeder 1963:12). "In 1852 reports reached Santa Fe that the Navajos had begun to retreat northward toward Ojo Caliente, Canyon de Chelly, and even the San Juan River country. The reason given was fear of Apaches" (Schroeder 1963:12).

The late 1850s and 1860s was a period of great stress and change for the Navajo. They were attacked repeatedly by the Ute. In addition, the U.S. Army—aided by Ute warriors—conducted campaigns against the Navajo in 1858–1859 and 1860–1861. Kit Carson led an invasion of Navajo territory during the winter of 1863–1864. Although there were few direct encounters between the troops and the Navajos, the invasion was very successful because Carson focused on destruction of the Navajo economy—sheep and crops—and on keeping the Navajo constantly on the move. As a result, nearly 10,000 Navajos had surrendered by the end of 1864 and were forced to walk—the "Long Walk"—to Bosque Redondo at Fort Sumner on the Pecos River. Many died along the way and many died at the Bosque. A number of Navajos, however, eluded capture and were joined by escapees from Bosque Redondo (Schroeder 1963:13–14).

The confinement at Fort Sumner was a disaster for a number of reasons—poor management, internal strife between the Navajos and Apaches, alkaline soils, and drought resulting in repeated crop failures (Kelley 1982:32–33; Schutt et al. 1997:23). The Treaty of 1868 ended the Bosque Redondo "experiment" and the Navajos were allowed to return to a portion of their former territory. The treaty also established a reservation for the Navajos. Government officials, however, recognized the Navajo need for more land. Over the succeeding years, therefore, the Navajo Reservation expanded several times to its present size. Some Navajos violated the 1868 treaty by returning to their former homes east of Mount Taylor, along the Rio Puerco. Eventually, this group was assigned its own reservation, now known as To'hajiile (formerly Cañoncito), northeast of the project area.

Euroamerican Settlement

Although Spanish settlers made repeated attempts to settle west of the Rio Grande in the mid-1700s, the Navajos usually drove back the settlers. After the settlement of Navajos at Cebolleta (Seboyeta) failed, Spanish settlers moved into the area, but the settlement was raided frequently. As protection, the Spanish established a military outpost there from 1804 to 1808. The settlement was also protected by a 3-m (10-ft) high wall. By the mid-1800s, the settlement was reportedly a hangout for Mexican traders dealing in whiskey, guns, and slaves (Julyan 1996:329). In 1849, the U.S. military built an outpost at Cebolleta to try to halt the illegal trade, but this effort proved unsuccessful. Consequently, the outpost was abandoned in 1851 and the troops were transferred to Laguna. As with the previous post, the Laguna Post's efforts to control illegal trade failed. The post was abandoned in 1852 and the troops were transferred to Fort Defiance, Arizona (Giese 1995:5).

Eventually, the U.S. military, which seized New Mexico in 1846, subdued the Navajo. Prior to the confinement of the Navajo at Bosque Redondo, which ended Navajo raids, the local Spanish population continually shifted back and forth between the Rio Puerco area and the Rio Grande Valley. After removal of the Navajo in 1864, Hispanic holdings expanded. In addition, Anglos moved into the area and established ranches and trading posts.

The coming of the railroad to the San José Valley in 1880–1881 brought economic and social changes to the area, tying it to the national economy. In 1880, the Atchison, Topeka, and Santa Fe Railway (AT&SF) and the St. Louis and San Francisco Railway (SL&SF) agreed to build the Atlantic and Pacific Railroad (A&P) from A&P Junction (Isleta) toward the Pacific Coast. When the route was surveyed in the Laguna Pueblo area, the Laguna found it entertaining to pull up the survey stakes. Later, they hopped trains, coming and going, as part of their firewood gathering routine. By late spring of 1881, the line extended into Arizona and on August 9, 1883, the line—also known as the Thirty-fifth Parallel Trans-Continental Line—was finished. In 1902, the A&P was absorbed by the AT&SF (Myrick 1990:17–20). In 1995, the Burlington Northern Santa Fe Corporation (BNSF) was created "from the merger of Burlington Northern Inc. (parent company of Burlington Northern Railroad) and Santa Fe Pacific Corporation (parent company of the Atchison, Topeka and Santa Fe Railway)" (Burlington Northern Santa Fe 2004).

Historically, the primary economic activity in the project vicinity has been livestock grazing, first of sheep and then of cattle. In the 1890s and early 1900s, some of the largest flocks of sheep on Horace Mesa were maintained by the Acoma. In the 1920s, sheep herding began to give way to cattle grazing. The latter was less labor-intensive than the former. In addition, the national taste shifted towards a preference for beef (Wase et al. 2000:1.29). The project area is currently used for cattle grazing.

Village of San Fidel

In about 1868 Baltazar Jaramillo and his family settled at what is now San Fidel. An early name for the locality was La Vega de San José, "the meadow of St. Joséph." This was a reference to the Rio San José that was just to the south of the community. A tiny residential community about 1.6 km (1 mile) north of present San Fidel still is called San José and may be the community sometimes referred to as Old San José. Another early name for the community was Rinconada, "box canyon, or junction." The post office took the name Ballejos, a variant of the Spanish family name Vallejos. The post office later changed its name to San Fidel, honoring the saint, a name said to have been suggested by the pastor of the church, Fr. Robert Kalt, O.F.M. (Julyan 1996:312). Today the community is dominated by a church complex (Fugate and Fugate 1989:369).

Village of Cubero

The name of this small community refers to Pero Rodriguez Cubero, who succeeded Diego de Vargas as governor of New Mexico and who served from 1697 to 1703. Cubero passed through the area in 1697 on an expedition to Zuni. It is possible the name originated then, or it's also possible the name is from a local family, but no one of that name has lived there in recent memory. The village appears as Cubera on Bernardo Miera y Pacheco's map of the Domínguez-Escalante Expedition of 1776, but as Cubero on most subsequent maps. The village was located on an Indian trail and was a hangout for Mexican traders in slaves, whiskey, and guns. Indian attacks were frequent and in the eighteenth and nineteenth centuries, Cubero was a Spanish military outpost and American troops later were stationed here. Villa de Cubero, 1.6 km (1 mile) west on former U.S. Route 66, is an abandoned outlying community. The Navajo name for Cubero means "water in the crevice," which refers to a trickling spring here (Julyan 1996:102–103).

Town of Cubero Grant

The Town of Cubero Grant was originally granted by the Mexican government about the year 1834 (Bowden 1969:1515–1522). The grant was made to Juan Chaves and the original grantees, who numbered about 61 heads of family, on condition that they purchase the interest of Francisco Baca, a Navajo Indian living on the premises. The inhabitants of the Town of Cubero Grant petitioned Surveyor General William Pelham on April 2, 1856 seeking possession of the land that had been granted to their ancestors. The petitioners described the grant as a tract of land bounded on the north by the San Mateo Hill, on the east by a long range of hills, on the south by the stone mountains with crosses on them and on the west by the San José Hills. The grantees claimed that in the year 1833 Governor Francisco Sarracino granted the described tract, which contained an estimated 11 square leagues of land. The grant was surveyed in July 1896 by George W. Pradt as 16,490.94 acres and was patented on August 27, 1900, although overlaps were subsequently contested by both Laguna and Acoma Pueblos.

CULTURE-HISTORICAL SUMMARY FOR THE PROJECT AREA

Table 1 summarizes archaeological sites within a radius of 1.6 km of the recent survey project and listed in the New Mexico Cultural Resources Information System (NMCRIS) files of the Archeological Records Management Section, Historic Preservation Division in Santa Fe. This records search was completed in advance of the Acomita Exit 102 inventory (Brown and Brown 2005) to identify previously recorded sites within the vicinity of the proposed project area. Sites LA 54902, LA 89019, and LA 108511 overlap the APE of Alternative 5 and were documented by one or more previous inventories. Site LA 149868 is also within the APE of Alternative 5 and was newly identified by the recent Acomita Exit 102 inventory.

Table 2 summarizes archaeological site data from the NMCRIS files for the Cubero 7.5' Quadrangle, for which the project area is roughly in the center. These summarized data provide additional settlement context and an understanding of the range of temporal and functional site types that may contribute archaeological material to the project area. Some 63 projects have been conducted within the Cubero Quadrangle beginning with the pipeline archaeology surveys and salvage excavations of the 1950s (Wendorf et al. 1956). The 63 projects have recorded 96 sites that represent 109 temporal components. No Paleoindian manifestations have been previously recorded on the Cubero Quadrangle and the Archaic period is represented by only six (5.5 percent) components. However, diagnostic projectile points found on these sites reflect the entire temporal range of the Archaic period. The sites are mainly special activity sites probably centered on hunting activities, but four components have thermal features in the form of hearths or fire-cracked rock concentrations suggesting a wider range of resource procurement, processing, and consumption activities.

The Anasazi period, as described in the NMCRIS database, is characterized by the highest frequency of components and the widest range of site types and features. Just over half (n=55) of the recorded components manifest Anasazi occupations probably centered around farming activities along the Rio San José floodplain and surrounding tributaries. Few Basketmaker III and Pueblo I period sites have been recorded on the Cubero Quadrangle. Evidence of these earlier occupations usually appears as diagnostic sherds appearing with ceramics from later time periods and producing ambiguous long-term Basketmaker III to Pueblo II artifact scatters. Two nearby sites have Pueblo I occupations and are recorded as artifact scatters with features, apparently representing ephemeral shelters. Both sites also have later Pueblo II components. LA 104153 is represented by a wall in a rockshelter situated along the sandstone escarpment about 550 m south of the project area. LA 108511 contains an area of burned sandstone slabs and is located in the flats about 600 m north of the main portion of the project area in the vicinity of Road B.

The majority of the Anasazi settlements and land use date to the Pueblo II period from AD 900 to 1200. The smaller artifact scatters and artifact scatters with features probably represent short-term resource procurement sites. The single residence sites usually have at least one visible masonry, jacal, or adobe room that indicates more substantial occupations and may be broadly characterized as seasonal fieldhouses. Nine sites have masonry room blocks that may be characterized as full-year multi-household structures. LA 117549, the largest site, has an estimated 12 rooms with an AD 1050 to 1100 occupation. This site is located about 800 m north of the project area. Four sites have kivas suggesting the presence of more complicated ceremonial, or

Table 1. Summaries of Previously Recorded Sites within 1.6 km of the APE

LA Number	NMCRIS Temporal/Cultural Affiliation Categories	National Register Eligibility	Reference	NMCRIS No.
688	Puebloan A.D. 1539-1993		Marshall 1990	31903
873	Anasazi A.D. 900-1300			None
1342	Anasazi A.D. 1-1600		Marshall 1990	31903
2632	Anasazi A.D. 900-1100		Wendorf et al. 1956	36
5593	Unknown Prehistoric 9500 B.C.-A.D. 1100-1300			None
6031	Anasazi A.D. 900-1100		Winkler and Davis 1961	37
54902	Anasazi A.D. 900-1100	Yes, D	Moore 1986; Marshall 1995	12794; 48418
89018	Archaic 3000 B.C.-A.D. 900	Yes, D	Marshall 1992; Polk 2000	39824; 70890
89019	Archaic 3000-1800 B.C.; Anasazi A.D. 700-1300	Yes, D	Marshall 1992, 1995; Polk 2000	39824; 48418; 70890
89020	Archaic 1800 B.C.- A.D. 200	Yes, D	Marshall 1992; Polk 2000	39824; 70890
98452	Anasazi A.D. 1100-1300	Yes, D	Marshall 1995	48418
99628	Anasazi A.D. 900-1100	Yes, D	Condie 1993; Marshall 1995; Michalik 1998	41514; 48418; 62831
104151	Puebloan A.D. 1950-1994		McKenna 1994; Michalik 1998	45335; 62831
104152	Anasazi A.D. 1050–1150; Puebloan A.D. 1945-1963		McKenna 1994; Michalik 1998	45335; 62831
104153	Anasazi A.D. 700-850; Puebloan A.D. 1950-1963		McKenna 1994; Michalik 1998	45335; 62831
106385	Late Archaic 1500 B.C.-A.D. 500; Historic Pueblo A.D. 1945-1970	Yes, D	McKenna 1994	47210
108506	Puebloan A.D. 1880-1920		Marshall 1995	48418
108507	Anasazi A.D. 950-1000		Marshall 1995	48418
108508	Anasazi A.D. 900-1100	Yes, D	Marshall 1995	48418
108509	Anasazi A.D. 1000-1100	Yes, D	Marshall 1995	48418
108510	Anasazi A.D. 1000-1050	Yes, D	Marshall 1995	48418
108511	Anasazi A.D. 800-900; Anasazi A.D. 1000-1100		Marshall 1995	48418
108512	Anasazi A.D. 900-950; Anasazi A.D.1050-1100	Yes, D	Marshall 1995	48418
114476	Anasazi A.D. 1000-1150		Marshall n.d.; Marshall 1997	53230; 56663
117547	Anasazi A.D. 1000-1050		Marshall 1997	56663
117548	Anasazi A.D. 1000-1125		Marshall 1997	56663
117549	Anasazi A.D. 105-1100		Marshall 1997	56663
117550	Anasazi A.D. 900-1100; Euroamerican A.D. 1920-1940		Marshall 1997	56663
117551	Archaic 5500 B.C.-A.D. 200		Marshall 1997	56663

Table 1. Continued.

LA Number	NMCRIS Temporal/Cultural Affiliation Categories	National Register Eligibility	Reference	NMCRIS No.
117552	Archaic 3000-1800 B.C.		Marshall 1997	56663
117553	Euroamerican A.D. 1884-1998		Marshall 1997	56663
131410	Historic Pueblo A.D. 1945-1950		McKenna 2001	72380
131411	Historic Pueblo A.D. 1945-1950		McKenna 2001	72380
140935	Reserved		Kenward 2003	85306
145143	Anasazi A.D. 1-1600; Historic Pueblo A.D. 1945-1950		McKenna 2004; Resrved (Marron n.d.)	89778; 94806

Table 2. Recorded Site Components on the Cubero Quadrangle

Component	Number	Percent
ARCHAIC		
Artifact scatter (5500 B.C.-A.D. 200)	1	0.9
Artifact scatter (3000-1800 B.C.)	1	0.9
Artifact scatter (3000 B.C.-A.D. 900	1	0.9
Features and artifact scatter (5500-3000 B.C.)	1	0.9
Features and artifact scatter (1800 B.C.-A.D. 200)	1	0.9
Features and artifact scatter (1500 B.C.-A.D. 500)	1	0.9
TOTAL	6	5.5
ANASAZI		
Artifact scatter (A.D. 500-1100)	9	8.3
Artifact scatter (A.D. 1300-1500)	1	0.9
Features and artifact scatter (A.D. 700-900)	2	1.8
Features and artifact scatter (A.D. 900-1200)	8	7.3
Features and artifact scatter (A.D. 1325-1430)	2	1.8
Anasazi single residence (A.D. 900-1150)	6	5.5
Anasazi single residence (A.D. 1375-1400)	1	0.9
Anasazi multiple residence (A.D. 900-1200)	8	7.3
Anasazi residential complex/community (A.D. 700-1100)	1	0.9
Anasazi Unknown (A.D. 500-700)	1	0.9
Anasazi Unknown (A.D. 900-1100)	9	8.3
Anasazi Unknown (A.D. 1100-1300)	7	6.4
TOTAL	55	50.5
HISTORIC PUEBLO		
Artifact scatter (A.D. 1935-1979)	3	2.8
Simple features (A.D. 1945-1950)	3	2.8
Features and artifact scatter (A.D. 1870-1970	7	6.4
Ranching/agricultural (A.D. 1880-1970)	8	7.3
Residential complex/community (A.D. 1880-1960)	1	0.9
Single residence (A.D. 1870-1980)	6	5.5
Unknown (A.D. 1692-1821)	1	0.9
Unknown (A.D. 1539-1993)	2	1.8
TOTAL	31	28.4
NAVAJO		
Unknown (A.D. 1500-1993)	1	0.9

Table 2. Continued.

Component	Number	Percent
HISPANIC		
Residential complex/community (A.D. 1821-1940)	1	0.9
Artifact Scatter (A.D. 1917-1920)	1	0.9
TOTAL	2	1.8
ANGLO/EUROAMERICAN		
Simple features (A.D. 1884-1998)	2	1.8
UNKNOWN		
Artifact Scatter (9500 B.C.-1539)	2	1.8
Unknown (9500 B.C.-1993)	9	8.3
Unknown (A.D. 1539-1993)	1	0.9
TOTAL	12	11
GRAND TOTAL	109	100

social integrative structures. LA 98452 is the nearest recorded site with a kiva. The site is about 400 m south of the project area and has a broad occupation date of AD 1100 to 1300. The number of kivas ranges from one to six. LA 110240 has six recorded kivas and dates to AD 1050 to 1200. This site is located about 6 km north of the project area. LA 494, the Cubero ruin, is recorded as an Anasazi residential complex/community dating to AD 700–1100. The site is about 4 km north of the project area and was originally recorded by Bandelier and later by Mera in the 1930s. The site contains at least one kiva in a room block, an additional L-shaped room block, and adobe rubble. Seven components show P III occupations (AD 1100 to 1300), but the components are all coded as Anasazi Unknown. Lastly, four sites comprised of artifact scatters, two artifact scatters with features, and a single residence show post AD 1300 occupations. Two sites have apparent masonry structures, but all of the sites are about 4 km north of the project area.

The high number of sites with historic Pueblo components attests to the proximity of Acoma Pueblo. A total of 31 (28 percent) components attest to historic Acoma land use and settlement with site types including artifact scatters, ranching and agricultural features, and single residences. Most of the historic Pueblo components date from around 1880 to the present.

A few Navajo, Hispanic, and Euroamerican components have been recorded on the Cubero Quadrangle. LA 55998 is a Hispanic residential complex/community dating from 1821 associated with the Town of Cubero Grant. The site is located near the town of Cubero about 3 km northeast of the project area. LA 117553 is a Euroamerican ranch complex dating from 1884 and located about 800 m north of the project area. The remaining sites have unknown temporal affiliations and are represented mainly by flaked stone scatters with no temporal indicators.

TRADITIONAL CULTURAL PROPERTIES

Because this undertaking involves Pueblo of Acoma lands and has NMDOT and FHWA funding, Marron contacted Janet E. Spivey, the NMDOT Native American Coordinator, regarding Traditional Cultural Property (TCP) consultation with concerned tribal entities. The NMDOT has conducted and evaluated the TCP consultations.

The Pueblo of Acoma Historic Preservation Office (AHPO) conducted a cultural resource survey in early 2005 for cultural resources within the proposed Exit 102 project APE (Pueblo of Acoma Historic Preservation Office 2005). Emphasis was on documenting and establishing areas of potential effect on TCPs. The AHPO identified the presence of one TCP on the southern end of the project area. No other TCPs were encountered during the survey. Alternative 5 has the potential to adversely affect 10 percent of the associated TCP area indirectly through proposed drainage systems and vehicle traffic. The AHPO has recommended that the associated TCP be avoided and monitored by AHPO staff during construction on the Exit 102 interchange. No other protective measures will be instituted so as to avoid any unwanted attention (Pueblo of Acoma Historic Preservation Office 2005:1–3).

ARCHAEOLOGICAL SITE DESCRIPTIONS

Four archaeological sites, LA 54902, LA 89019, LA 108511, and LA 149868 are within the proposed limits or rights-of-way for I-40 Exit 102, Acomita Interchange Alternative 5. The amount of affected site area depends on the proposed limits of Alternative 5. For most sites, less than 25 percent of the site area occurs within the design. Complete descriptions of each site are provided below as context for the research design and data recovery plan that follow. These descriptions were provided by Marron and Associates, Inc. (Brown and Brown 2005).

LA 54902

Description: LA 54902 is a rubble mound with a small, medium-density sherd and flaked stone artifact scatter on an open plain. The site was originally recorded in 1986 by Quivira Research Associates (J. Moore 1986). The site is on Town of Cubero Grant land north of the I-40 north right-of-way, between the north right-of-way fence and a property fence bordering the south side of the paved semi-truck parking lot for the Sky City Casino (Fig. 4). The southern edge of the site is 23 m (75 ft) north of the I-40 north right-of-way fence. The site measures 34-by-22 m (112-by-72 ft). A drainage ditch is to the east and a gentle slope is on the west. A man-made concentration of large sandstone boulders, probably associated with the construction of I-40, is near the southwestern edge of the site. The site is eroded and artifacts are visible in eroded areas. The local plant community includes grasses, snakeweed, prickly pear cactus, and juniper. Ground visibility is 75 percent. The soil, a fine sandy loam, is classified as the Hagerman-Bond Association, 1 to 10 percent slopes (Parham 1993:78–79, Sheet No. 31).

When the site was recorded in 1986, a single-room structure, consisting of a low (10–20-cm [4–8-inches] high) mound and a scatter of rock, was identified in the northern portion of the site. A fence and a drainage ditch were immediately to the north. A sherd and lithic artifact scatter, primarily to the south and east, was associated with the structure. A small portion of the site extended north of the fence and ditch (J. Moore 1986:5–6). The site was described as "a small farmstead of limited occupational duration" (J. Moore 1986:5). Cibola Research Consultants (M. Marshall 1995) revisited the site in 1995 and declared the site's condition unchanged and the 1986 inventory record accurate. The new site map, however, showed a hearth in the southeast portion of the site but no description was provided (Marshall 1995:11, Fig. 5). No evidence of the hearth was discerned during the present project and no artifacts were found north of the fence.

Disturbances include wind and water erosion, a former drainage ditch, and a paved truck parking lot. Marshall (1995:11) indicated the site was 100 m (328 ft) north of I-40. As recorded during the present project, the northern portion of the site is less than 60 m (197 ft) north of the I-40 north right-of-way fence. In addition, the northern edge of the site corresponds to the property fence along the south side of the truck parking lot. This suggests the portion of the site north of the fence was removed during the construction of the present parking lot. Artifacts are visible in eroded areas. The rubble mound suggests the presence of intact subsurface cultural material, which may extend 40 cm (16 inches) below the surface. An estimated 90 percent of the site remains intact.

Features: A single feature, a low rubble mound representing a single-room structure, was identified when the site was first recorded (J. Moore 1986:5). The rubble mound,

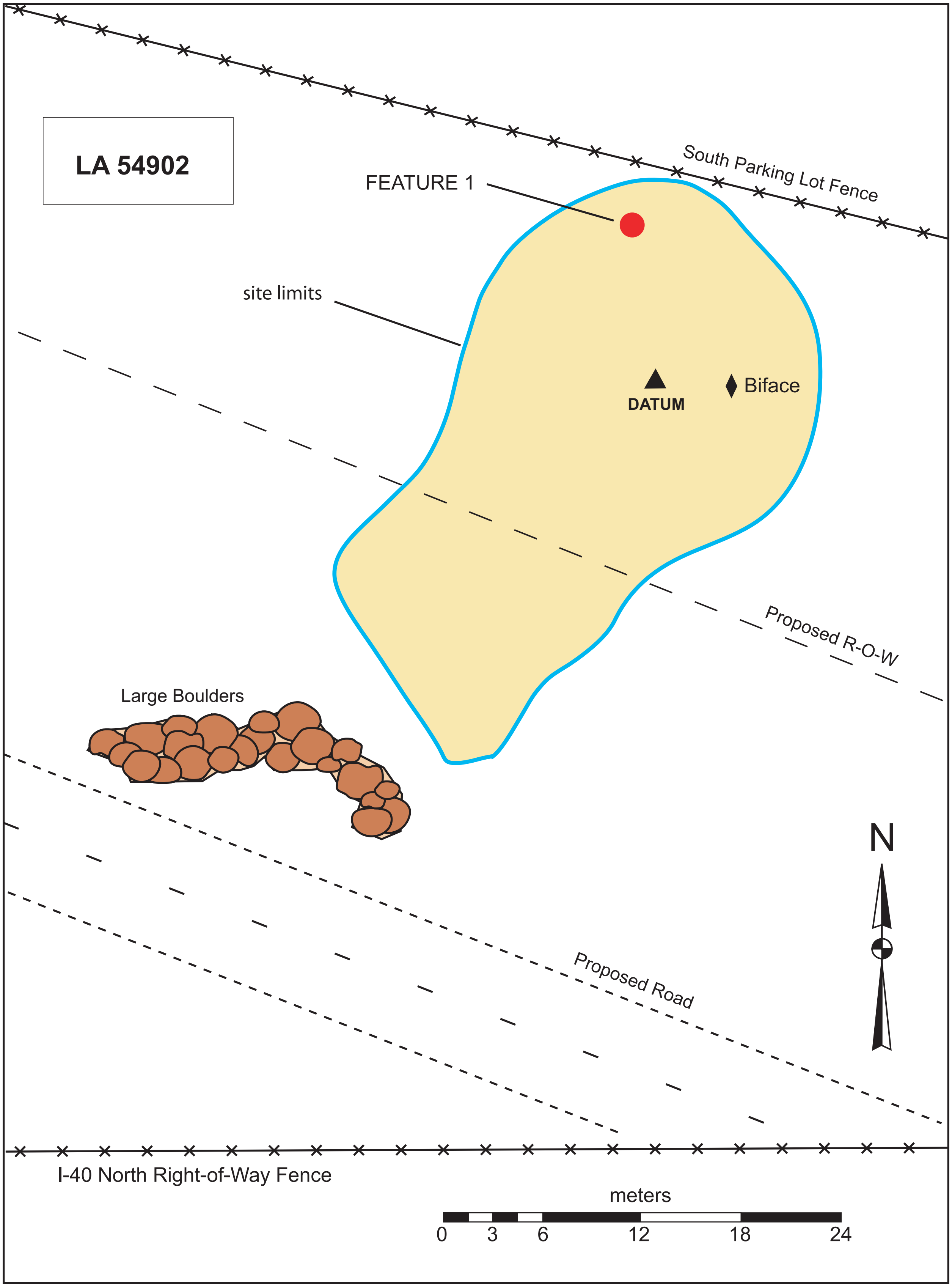

Figure 4. LA 54902 site map.

which is immediately south of the property fence, was relocated during the present project. It primarily consists of sandstone but also contains limestone. In addition, rocks are scattered around the immediate area. The mound is 1.7 m (5.6 ft) in diameter and 10 to 20 cm (4–8 inches) high.

Artifacts: Chalcedony, basalt, and obsidian debitage; plain and corrugated gray ware sherds; and probable Gallup Black-on-white sherds were noted when the site was first recorded. Based on the latter, a Pueblo II component, dating from AD 900 to 1100, was identified (Moore 1986:5).

Table 3. Surface Artifact Assemblage, LA 54902.

Description	Total
Chalcedony biface, fragment	1
Chalcedony uniface, fragment	1
Basalt core, multidirectional, complete	1
Chalcedony flakes	15
Basalt flakes	12
Quartzite flakes	7
Chert flakes	2
Chalcedony angular debris	1
Basalt angular debris	1
Socorro Black-on-white body sherds	2
Cebolleta Black-on-white body sherd, bowl	1
Cebolleta Black-on-white body sherd	1
Gallup Black-on-white body sherd, bowl	2
Indeterminate white ware body sherds, bowl	3
Indeterminate white ware body sherds, jar	4
Indeterminate white ware body sherds, plain	5
Indented corrugated gray ware body sherds	15
Plain gray ware body sherds	4
Plain brown ware body sherd	1
Total	79

LA 54902 contains a small, medium-density sherd and flaked stone artifact scatter. All artifacts observed on the surface of the site (n=79) were recorded during the present project (Table 3). No artifacts were collected. The flaked stone assemblage (n=41) consists primarily of debitage (n=38, 92.7 percent) but also contains a biface fragment, a uniface fragment, and a complete multidirectional core. No ground stone or diagnostic flaked stone tools were found. Identified raw material types consist of chalcedony, chert, basalt, and quartzite. All are available locally. The sherd assemblage (n=38) includes Socorro, Cebolleta, and Gallup Black-on-white sherds indicative of a Pueblo II component.

Preliminary Evaluation: LA 54902 contains a rubble mound and a small, medium-density sherd and flaked stone artifact scatter with pottery indicative of a Pueblo II occupation. Although it is likely that the northern portion of the site was removed during the construction of the paved truck parking lot immediately to the north, the rubble mound and most of the associated artifact scatter still remain. The rubble mound suggests intact subsurface cultural material is present. The site, therefore, is likely to provide important information concerning the Pueblo II occupation of the area. LA 54902 has been determined eligible for inclusion on the *National Register of Historic Places* (NRHP) under Criterion D, information potential (HPD Log 48689).

Project Impact: Alternative 5 will have an adverse effect on the site.

LA 89019

Description: LA 89019, which is a large, medium-density sherd and lithic artifact scatter on a gentle south-facing slope, was originally recorded in 1992 for the NMDOT (S. Marshall 1992). The site is within the I-40 south right-of-way and extends north onto state land managed by the NMDOT (just beyond right-of-way fence along Exit 102 eastbound exit ramp) and south onto Town of Cubero Grant and private land. Most of the site is on Town of Cubero Grant land. The site is bounded on the south and east by sandstone outcrops (Fig. 5). Large areas of sandstone bedrock occur throughout the site. Low dune areas are also present. Artifacts occur on the dunes and on the bedrock. A small drainage is on the east, below the sandstone outcrop. The site measures 190-by-110 m (623-by-361 ft). The local plant community includes juniper, grasses, snakeweed, prickly pear cactus, globemallow,

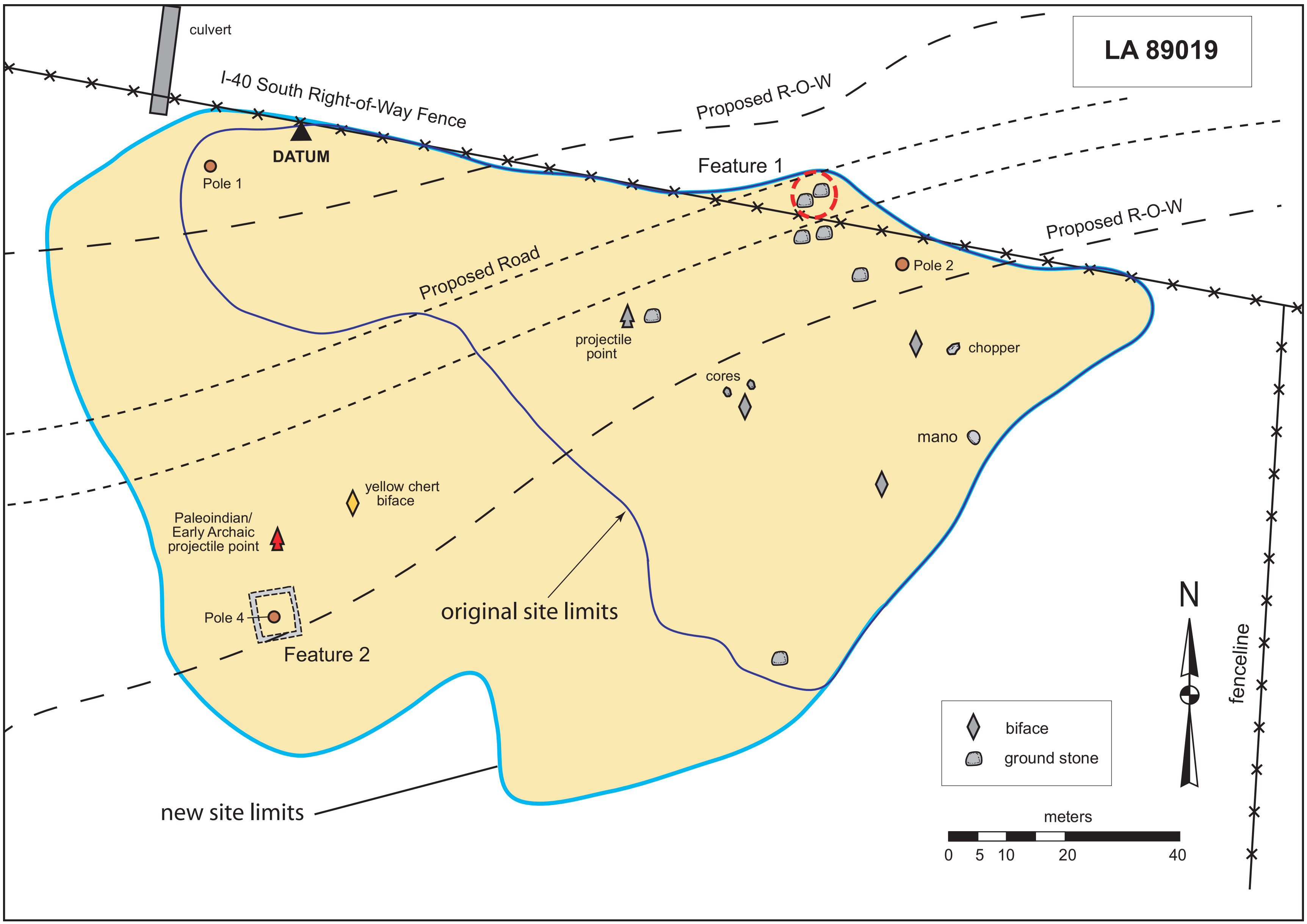

Figure 5. LA 89019 site map.

narrowleaf yucca, aster, and fleabane. Ground visibility is 95 percent. The soil, a fine sandy loam, is classified as the Hagerman-Bond Association, 1 to 10 percent slopes (Parham 1993:78–79, Sheet No. 31).

Disturbances consist of wind and water erosion, highway construction and maintenance, and grazing livestock. The northern portion of the site was removed during the construction of I-40, and portions may lie under the I-40 eastbound exit ramp at Exit 102. Much of the site is deflated. Although most of the cultural material is surficial, as evidenced by the presence of sandstone bedrock at or just below the surface, the dunes may retain integrity. Cultural material may extend to a depth of 30 cm (12 inches) in these areas. An estimated 75 percent of the site remains intact.

Features: A previous survey by SWCA (Polk 2000:38) identified one feature, a fire-cracked rock concentration, in the north-central portion of the site. The feature is about 4 m (13 ft) in diameter and was interpreted as a roasting pit. Feature 1 was relocated during the present project.

The original survey identified two artifact concentrations, a lithic concentration in the eastern portion of the site and a sherd concentration in the western (1992 site form). A later site visit by Cibola Research Consultants (M. Marshall 1995) did not discern any changes. The survey by SWCA identified three artifact concentrations (Polk 2000:38). Concentrations 1 and 3 may correspond to the western and eastern concentrations, respectively, of the 1992 survey. During the present project, because the artifact scatter is continuous across the site, the designation of concentrations was considered subjective, arbitrary, and therefore meaningless. Consequently, no concentrations were identified.

During the reconnaissance of LA 89019 by OAS for this research design, a previously unrecorded historic structure designated Feature 2 was discovered and included as a component of LA 89019 (Fig. 6). The historic component is located at Telephone Pole 4, which has been set essentially in the center of a square masonry structure. The structure was constructed of locally available unshaped sandstone. Some larger stones measure around 50 cm long by 30 cm wide, but most average around 20-by-20 cm. The square or rectangular structure measures 6.80 m (north-south) by 6.50 m (east-west). The stones are probably foundation remnants, since no coursing was evident. Also, no evidence of the superstructure remains. The south wall is more scattered and less intact. A hole-in-top can and a fragment of purple glass suggest a ca. 1880–1912 date. Associated refuse is very sparse suggesting a seasonal farmstead rather than a full-time domestic occupation. The absence of Acoma pottery may suggest a Hispanic occupation related to the town of Cubero. The structure is located on a stabilized dune with some depth at this locality. The depth of interior fill is unknown, but exposed bedrock in the immediate area suggests a maximum depth no more than 50 cm. The terrain slopes to the south and immediate vegetation consists of snake weed, mixed grasses, and juniper. A low-density scatter of flaked stone artifacts from the prehistoric component surrounds the locality and a probable Paleoindian point base was found about 9 m north of the structure. The entire historic structure is within the planned area of Alternative 5.

Artifacts: Artifacts noted during the original survey consisted of debitage; two cores, one of which was subsequently used as a scraper; a mano fragment; and five sherds, of which three were Gallup Black-on-white. Lithic artifact raw material types consisted of obsidian, a variety of cherts, quartzite, and sandstone. Based on the Gallup Black-on-white sherds, LA 89019 was identified as a possible Pueblo III (AD 1200s) camp (S. Marshall 1992:5; 1992 site form). The later site visit by Cibola Research Consultants (M. Marshall 1995:10) identified the site as a Pueblo II to III cultural manifestation.

The visit by SWCA identified 56 flaked stone artifacts, including a projectile point, a

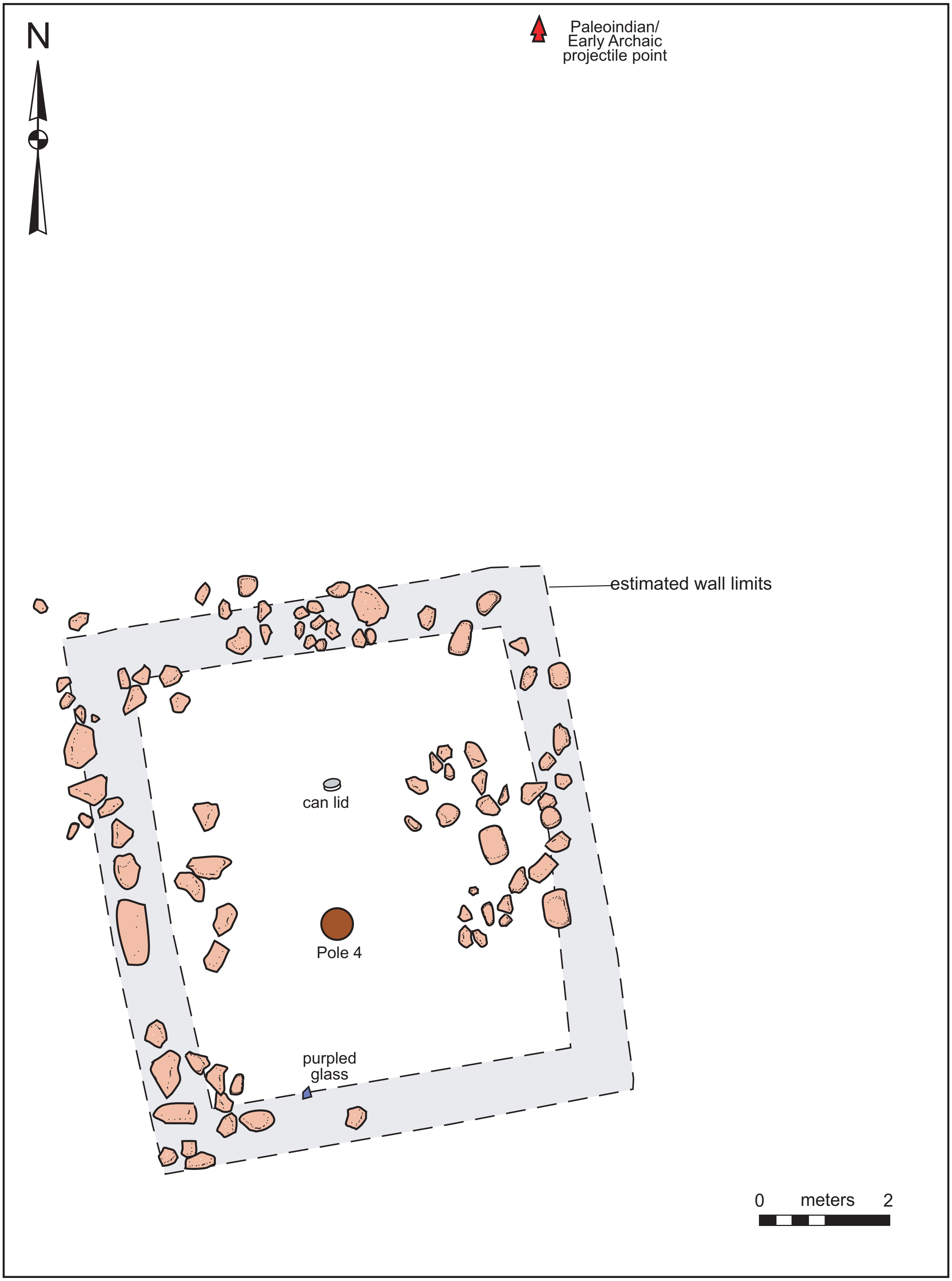

Figure 6. LA 89019 historic structure plan map.

biface, a uniface, a retouched flake, and three utilized flakes. Ground stone artifacts included two sandstone slab metates and a quartzite mano fragment. The recorded pottery assemblage consisted of three Gallup Black-on-white (local style) sherds and five unidentified local white ware sherds. The projectile point, identified as San José Stemmed dating from 3200 to 1800 BC, suggested the presence of a Middle Archaic component. The sherds were indicative of a late Pueblo II to early Pueblo III, AD 1000 to 1125, component (Polk 2000:38).

During the reconnaissance of LA 89019 by OAS for this research design, a 21 mm long by 20 mm wide by 5 mm thick, fine-grained white quartzite Paleoindian point base was observed on the surface of LA 89019, 9 m north of the historic structure in the expanded west-southwest site area. The point base exhibited parallel marginal and basal pressure flake scars. Both of the edges of the point stem were ground flat. The base was slightly concave with rounded ears. The absence of fluting, the convex base, parallel sides, and lateral grinding suggest that the base could be from a Midland or Plainview style point. Alternately, the base could have come from a late Paleoindian point, such as a James Allen or Dalton/Sierra Vista type. Generally, these Plainview and other late Paleoindian points are assigned date ranges of 8000 to 6600 BC. Midland points, however, are thought to be contemporary with Folsom points and are assigned slightly older date ranges of 9000 to 8000 BC (NMCRIS Users Guide).

LA 89019 contains a large, medium-density prehistoric artifact scatter. Due to the large quantity of surface artifacts, only an arbitrary representative sample was recorded during the present project (Table 4). No artifacts were collected. The recorded flaked stone assemblage (n=254) primarily consists of debitage (n=245, 96.5 percent) but also contains a projectile point, a complete chopper, three biface fragments, a scraper fragment, a uniface fragment, and two unidirectional cores (Table 4). One of the latter is conical and complete. Many flakes are small, suggestive of the later stages of flaked stone tool production and of tool maintenance. The projectile point is a complete Jay-like dart point (Turnbow 1997:170–172). The specimen, made of Chinle chert, is 53 mm long and 36 mm wide. It has a contracting stem with a convex base and slight shoulders. The blade is triangular with convex edges and has been resharpened. The Jay-like point is suggestive of an Early Archaic component (5500 to 4800 BC), although it too may represent a late Paleoindian component. The flaked stone assemblage represents a variety of activities, including stone tool production and maintenance, hunting, animal carcass processing

Table 4. Recorded Artifact Sample, LA 89019

Description	Total
Chinle chert Jay-like dart point, complete	1
Chalcedony chopper, complete	1
Opaque obsidian biface, fragment	1
Chert biface, fragment	1
Chalcedony biface, fragment	1
Chalcedony scraper, fragment	1
Chert uniface, fragment	1
Chert core, unidirectional, conical, complete	1
Chert core, unidirectional, fragment	1
Opaque obsidian biface thinning flake	1
Opaque obsidian flakes	89
Chalcedony flakes	73
Chert flakes	32
Smoky obsidian flakes	12
Quartzite flakes	10
Basalt flakes	8
Chinle chert flakes	2
Banded obsidian flake	1
Silicified wood flake	1
Quartz flake	1
Chert angular debris	3
Chalcedony angular debris	2
Smoky obsidian angular debris	1
Opaque obsidian tested pebbles	2
One-hand sandstone mano, complete, 1 use surface	1
Basalt mano fragment, 2 use surfaces	1
Sandstone metate fragments, 1 use surface	5
Kiatuthlanna Black-on-white rim sherd, bowl	1
Kiatuthlanna Black-on-white body sherds, bowl	4
Red Mesa Black-on-white body sherd, bowl	1
Gallup Black-on-white body sherds	3
Cibola White Ware body sherd, plain	2
Indeterminate black-on-white body sherds, narrow lines	2
Indeterminate black-on-white body sherd, solid	1
Indeterminate white ware body sherd, eroded	1
Clapboard corrugated gray ware body sherds	3
Indented corrugated gray ware body sherd	1
Plain gray ware body sherds	10
Total	283

(i.e., butchering), and hide processing.

A variety of raw material types—opaque, smoky, and banded obsidians; chalcedony; Chinle and other cherts; quartzite; basalt; silicified wood; and quartz—are represented in the recorded flaked stone assemblage (Table 4). The smoky obsidian contains fine white and black inclusions that give it a smoky gray or cloudy look. The smoky and banded obsidians and the Chinle chert—a yellow-brown spotted chert (Vierra 1993:163)—are exotics. The smoky obsidian is probably from the Polvadera Peak area of the Jemez Mountains and the Chinle chert is from the Lookout Mountain area in the Zuni Mountains. The presence of exotic lithic materials suggests trade networks or seasonal rounds, or both.

The recorded ground stone assemblage (n=7) contains manos and metate fragments (Table 4). Except for a basalt mano fragment, all of the ground stone is sandstone. The complete one-hand mano exhibits a single use surface and the mano fragment has use-wear on two faces. All of the metate fragments exhibit use-wear on one surface. The metate types could not be determined. The ground stone tools represent plant processing.

The incidence of pottery visible on the surface of the site is low. Compared to the rest of the recorded artifact assemblage, the sherd assemblage is small (n=29, 10.2 percent) (Table 4). The Kiatuthlanna and Red Mesa sherds represent bowls. The presence of Kiatuthlanna Black-on-white, Red Mesa Black-on-white, and Gallup Black-on-white is suggestive of a Pueblo I to early Pueblo III component.

OAS noted a single piece of purple glass and a hole-in-top can fragment associated with an historic structure. The artifacts suggest a date of around 1880 to 1912.

In summary, the LA 89019 surface artifact assemblage indicates the presence of late Paleoindian/Early Archaic (Plainview-like and Jay-like dart points), Middle Archaic (San José Stemmed point), Pueblo I to early Pueblo III (Kiatuthlanna, Red Mesa, and Gallup Black-on-white sherds) components, and late Territorial (purple glass, hole-in-top can) components. In addition, previous research in the Acoma area (Prince 1982:99-100) suggests that a preponderance of obsidian artifacts, as seen at this site, reflects Archaic occupations. The intensive use of obsidian by Archaic groups may have been a function of high mobility (Prince 1982:100).

Preliminary Evaluation: LA 89019 is a large, medium-density sherd and lithic artifact scatter with diagnostic artifacts indicative of late Paleoindian/Early Archaic, Middle Archaic, Pueblo I to early Pueblo III, and late Territorial period components. Although the northern portion of the site has been disturbed or removed by the construction of I-40, most of the site is probably intact, and the low dune areas may contain buried cultural deposits. The site, therefore, is likely to provide important information concerning late Paleoindian/Archaic, Puebloan, and historic occupations of the area. The site has been determined eligible for inclusion on the *National Register of Historic Places* under Criterion D, information potential (HPD Log Nos. 48689 and 61423).

Project Impact: Alternative 5 will have an adverse effect on the site.

LA 108511

Description: LA 108511—a multicomponent, low-density sherd and lithic artifact scatter on an open plain—was originally recorded in 1995 by Cibola Research Consultants (M. Marshall 1995). The site, which is entirely on Pueblo of Acoma land, is 400 m (1,312 ft) north of I-40 and 180 m (590 ft) west of SP 30 (Fig. 7). A gas pipeline borders the site on the south and a gravel road lies along the southeastern edge of the site. A drainage ditch and ditch embankment cut through the site's southern portion. The terrain is flat and the site is open on all sides. The site measures 108-by-84 m (354-by-276 ft). The local plant community includes grasses, snakeweed, fourwing saltbush, aster, and Russian thistle. Ground visibility is 80 percent. The soil, a sandy loam, is classified as the Penistaja-

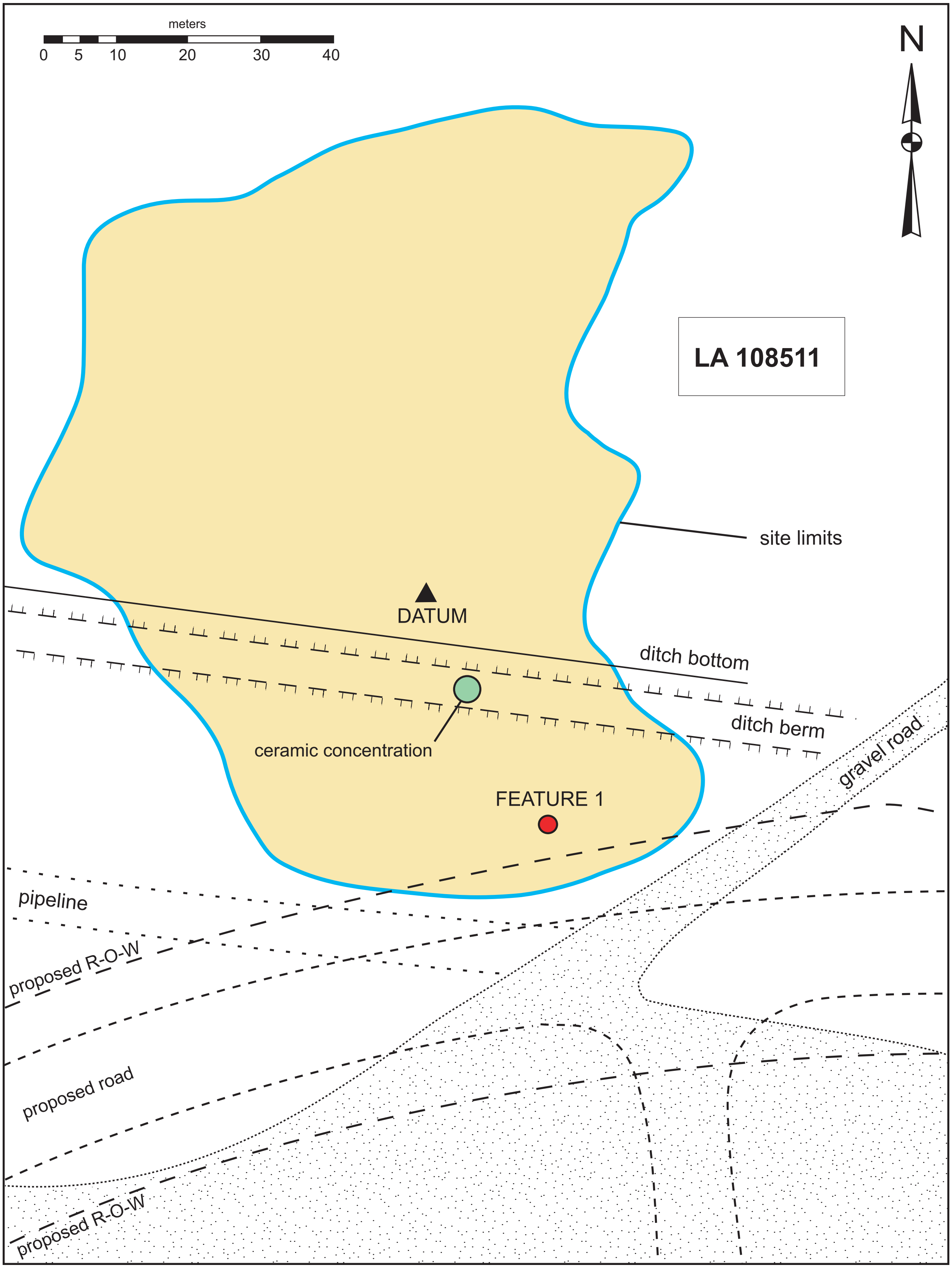

Figure 7. LA 108511 site map.

Oelop Association, 0 to 5 percent slopes (Parham 1993:81, Sheet No. 31).

As originally mapped, the drainage ditch and embankment formed the northern boundary of LA 108511 (M. Marshall 1995:18). The site consisted of a hearth with an associated artifact scatter (southeast), a concentration of about 20 sherds from a reconstructible Kana'a Neckbanded pot on the ditch embankment (north-central), and a diffuse sherd scatter (west). Spatially, two distinct components were identified. The hearth and pot drop, both relocated during the present survey, represent a Pueblo I (or possibly early Pueblo II) component and the pottery scatter in the western portion of the site is associated with a Pueblo II component. During the present project, a low-density artifact scatter, primarily sherds, was found north of the ditch and the site boundary was extended to incorporate this scatter. The presence of the reconstructible pot on the embankment dirt excavated from the drainage ditch suggests that substantial and intact cultural materials may be below the present surface. This also raises the possibility that the site boundary as defined by surface observations will be incomplete when subsurface data are available.

Disturbances include wind and water erosion, grazing livestock, and the drainage ditch. Although just outside the site limits, the gravel road and gas pipeline are also possible site disturbances. No cultural deposits are visible in the ditch, but the pottery concentration on the ditch embankment and the hearth suggest the presence of intact subsurface cultural deposits. The vertical extent of cultural material, however, is unknown. An estimated 80 percent of the site remains intact.

Features: A single feature, a hearth (Feature 1), was identified in the southeast portion of LA 108511 during the 1995 survey (M. Marshall 1995:17) and was relocated during the present project. The hearth, a burned area with a concentration of 15 pieces of fire-cracked sandstone and basalt, is 1.5 m (5 ft) in diameter and about 15 m (49 ft) north of the intersection of the gas pipeline and gravel road. No ash or charcoal is visible. A low-density artifact scatter surrounds the hearth.

Artifacts: LA 108511 contains a low-density sherd and lithic artifact scatter. The lithic assemblage recorded during the 1995 survey consisted of a chalcedony flake, a quartzite flake, and a ground sandstone slab. The recorded pottery assemblage included plain and exuberant corrugated gray ware, Kana'a Neckbanded, Gallup Black-on-white, and unidentified white ware sherds. The Kana'a sherds, representing three vessels-including the reconstructible vessel-are indicative of a Pueblo I (AD 800–900) component. The Gallup Black-on-white sherds in the western portion of the site represent a Pueblo II (AD 1000–1100) component (M. Marshall 1995:18). No artifacts were recorded during the present site visit.

Preliminary Evaluation: LA 108511 is a multicomponent-Pueblo I and Pueblo II-low-density sherd and lithic artifact scatter with a hearth (Feature 1) and pot drop. Although no cultural deposits are visible in the drainage ditch, the pot drop on the ditch embankment and the hearth suggest the presence of intact subsurface cultural deposits. The vertical extent of cultural material, however, is unknown. Because the existence of buried cultural deposits remains unverified, testing is necessary to determine the site's nature and extent. As part of the review of the 1995 survey report (Marshall 1995), the BIA has required testing to confirm the eligibility of LA 108511 for inclusion on the *National Register of Historic Places.* Currently, the eligibility status remains undetermined.

Project Impact: Alternative 5 may have a direct or indirect adverse effect on the site, given its proximity to the apparent site boundary and the likelihood of more extensive subsurface deposits.

LA 149868

Description: LA 149868, a multicomponent prehistoric and historic structural site, is on an east-facing ridge slope southwest of I-40 Exit 102 (Fig. 8). The site, which is on both Town of Cubero Grant and private land, is 200 m (656 ft) south of I-40. Most of the site is on private land. The southwest corner of the private property fence passes through the southern and western portions of the site. Small, shallow drainages dissect the site. The site is open on the east. Eolian deposits blanket portions of the site. The site measures 130-by-30 m (426-by-98 ft). The local plant community includes juniper and a relatively sparse understory of grasses, snakeweed, rabbitbrush, and four-wing saltbush. Ground visibility is 90 percent. The soil, a sandy loam, is classified as the Hagerman-Bond Association, 1 to 10 percent slopes (Parham 1993:78–79, Sheet No. 31).

The prehistoric component consists of a dense concentration of rock rubble in the west-central portion of the site, near the west fence line, and a very low-density sherd and lithic artifact scatter across the site. The historic component is in the southern portion of the site and consists of a sandstone rock foundation and a small pond or reservoir. A rock concentration near the probable house foundation is most likely associated with the historic component as well.

Disturbances include wind and water erosion and construction of the fence. The former has exposed, displaced, and buried cultural material. Artifacts are visible in eroded areas. Rocks from the prehistoric structure are eroding downslope. Intact subsurface cultural deposits may extend 50 cm (20 inches) below the surface. Overall, the site appears to be in good condition. An estimated 95 percent of the site remains intact.

Features: LA 149868 contains four identified features, of which one, a dense concentration of rock rubble (Feature 1), is prehistoric and three, a sandstone foundation (Feature 2), a small reservoir (Feature 3), and a small rock concentration (Feature 4), are historic. Feature 1, the remains of a prehistoric structure, consists of a dense concentration of sandstone rubble in eolian deposits on the upper portion of the ridge slope, just east of the west fence line. The feature also contains basalt cobbles. The main portion of the concentration is 11.5 m (38 ft) long northeast-southwest and 9.4 m (31 ft) wide. Most of the sandstone is about 10 cm (4 inches) or less in size. A shallow drainage is on the north and south and rubble eroded from the feature is in both drainages. Artifacts are scattered throughout the area. Feature 1 probably represents the remains a multiroom jacal, or jacal-masonry structure.

Feature 2, a rectangular sandstone foundation in the southeastern portion of the site, is associated with the historic component. The foundation is 4.9 m (16 ft) long and 3 m (10 ft) wide. Except for the southwest corner which is two courses high, the foundation consists of a single course of unshaped sandstone slabs, the largest of which is 50 cm (20 inches) long and 30 cm (12 inches) wide.

Feature 3, a small reservoir formed by a low earthen berm that is open on the southwest, is west of the foundation (Feature 2). The reservoir is 6.1 m (20 ft) long northeast-southwest and 5.9 m (19 ft) wide. The berm is 20 to 25 cm (8–10 inches) high. The reservoir contains an L-shaped area with mud cracks, suggesting it still holds water occasionally.

Feature 4, a circular concentration of unmodified sandstone, is northwest of the foundation (Feature 1). The concentration, which is partially obscured by a juniper, is 4.5 m (15 ft) in diameter. The function of Feature 4 is unknown but it is most likely historic.

Artifacts: The prehistoric component of LA 149868 contains a diffuse, very low-density sherd and lithic artifact scatter, with a concentration in the vicinity of Feature 1. A 20 percent arbitrary representative sample (n=48) was recorded in the field (Table 5). No artifacts were collected. The recorded flaked stone artifact assemblage (n=17) consists primarily of debitage (n=12; 71 percent) but also includes a complete corner-notched chert projectile point, three choppers, and a core fragment. The projectile point has a triangular blade with straight edges, a broad neck, broad corner notches, and a broad expanding stem

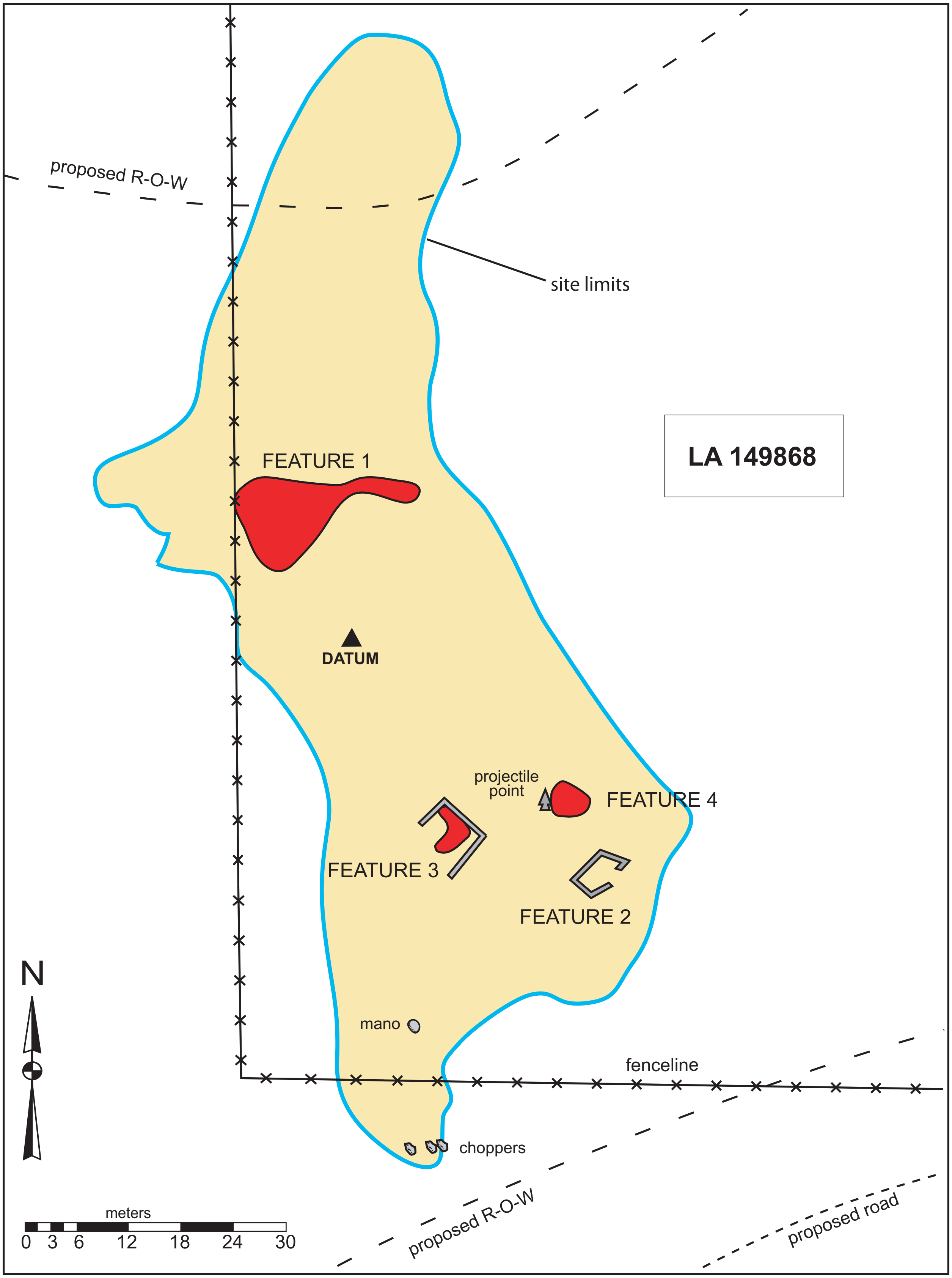

Figure 8. LA 149868 site map.

Table 5. Surface Artiface Assemblage, LA 149868.

Description	Total
Chert projectile point, complete	1
Basalt choppers	3
Chert core fragment	1
Chalcedony flakes	4
Obsidian flakes	2
Basalt flakes	2
Chert flakes	2
Quartzite flakes	2
Quartzite mano	1
Unidentified ground stone, sandstone	1
Gallup Black-on-white body sherd, jar	1
Tularosa Black-on-white body sherd, jar	1
Indeterminate white ware sherds, bowl	2
Indeterminate white ware sherds, jar	2
Indented corrugated gray ware body sherds	20
Clapboard corrugated gray ware body sherds	2
Plain gray ware body sherds	1
Total	48

with a slightly convex base. The choppers are near the south edge of the site. The sample contains a variety of raw material types—chalcedony, chert, basalt, obsidian, and quartzite. Except for the obsidian, which may be exotic, the various lithic material types are available locally. The recorded ground stone assemblage (n=2) consists of a quartzite mano and a ground sandstone fragment. Although limited, the recorded lithic artifacts represent a variety of activities, including stone tool production and maintenance, hunting, animal carcass processing (i.e., butchering), and plant processing. The recorded pottery assemblage (n=29) primarily consists of indented corrugated gray ware sherds (n=20, 69 percent) and includes Gallup Black-on-white and Tularosa Black-on-white sherds indicative of a Pueblo II to early Pueblo III component.

The historic artifact assemblage is very small, consisting of two pieces of unidentified metal, a can fragment, and a flattened can. The latter is probably a small matchstick filler-type (milk) can. The chronological indicators are extremely limited and only indicate that the historic component dates after 1905. The absence of the building, represented by Feature 2, on the 1957 USGS 7.5-minute Cubero quadrangle suggests building abandonment prior to 1957.

Preliminary Evaluation: LA 149868 is a multicomponent site. The prehistoric component consists of a dense concentration of rock rubble—a probable multiroom jacal or jacal-masonry structure (Feature 1)—and an associated very low density sherd and lithic artifact scatter representing a Pueblo II to early Pueblo III occupation. The historic component—a sandstone foundation, small reservoir, and a sandstone concentration (Features 2–4)—probably dates to the first half of the twentieth century. Eolian deposits blanket portions of the site and cultural material is eroding downslope. The presence of prehistoric structural remains suggests the presence of intact subsurface cultural deposits. The site, therefore, is likely to provide important information concerning the Pueblo II to early Pueblo III and early twentieth-century settlement of the Acomita area. In addition, ceramic and lithic artifact analyses may provide important information regarding pottery and tool technology and trade networks. LA 149868 is recommended eligible for inclusion on the *National Register of Historic Places* under Criterion D, information potential.

Project Impact: Alternative 5 may have a direct or indirect adverse effect on the site, given its proximity to the north edge of Road B.

RESEARCH DESIGN

Four archaeological sites, LA 54902, LA 89019, LA 108511, and LA 149868 are within the proposed limits or rights-of-way for I-40 Exit 102, Acomita Interchange Alternative 5. The amount of affected area for each site depends on the proposed limits of Alternative 5. For most sites, less than 25 percent of the site area occurs within the limits proposed for design Alternative 5. The following research design and data recovery plan are divided into an introduction and probable scope of work, research design, data recovery field methods, artifact and sample analyses and research issues. The intent of the data recovery plan is to propose field investigations and analyses consistent with the data potential of those portions of the sites that will be affected by design Alternative 5. Research directions will focus on those site-specific and regional issues that are relevant to the data recovered at each site.

Site information used in this research design and data recovery plan is derived from surface observations made by multiple archaeologists over the last nineteen years. No testing or subsurface observations have been conducted. Various commercial and transportation-related developments in the project area have changed, removed, or obscured some of the surface indications and exposed new remains. This plan is based on the most recent information provided in the inventory report completed by Marron and Associates, Inc. (Brown and Brown 2005) and on site visits by OAS staff in October 2005. The four sites are briefly summarized below relative to the area of each site that may be affected by design Alternative 5.

Relationships between Site Locations and Area of Potential Effect

LA 54902 is located west of and along the north right-of-way limit of the current Acomita Interchange Exit 102. The site covers a 606 sq m area, of which 202 sq m or 33 percent of the site area will be affected by Alternative 5. The site area within Alternative 5 is south of the main artifact concentration and possible structure foundation (Fig. 5). The pottery types, including Cebolleta, Gallup, and Socorro Black-on-whites, suggest a Pueblo II or Cebolleta phase (AD 1000–1150) occupation. These surface components are near the existing right-of-way fence that bounds the site on the north. Within the Alternative 5 limit, the site consists of a very dispersed artifact scatter with fewer than 10 sherd and lithic artifacts observed during the OAS site visit. The surface indications suggest that LA 54902 may contribute to research focused on Pueblo II or Cebolleta phase occupation of the middle Rio San José. However, the nature and extent of subsurface deposits within the site area within Alternative 5, and their potential to contribute to research, is unknown.

LA 89019 is the largest and temporally most complex site in the project area. The elongated site exhibits high density lithic artifact concentrations in deflated or blow-out areas and dispersed low density artifact distributions in the more stable dune areas. There are temporally diagnostic projectile point styles from late Paleoindian and Early and Middle Archaic periods. Pueblo I and Pueblo II pottery types include Kiatuthlanna, Red Mesa, and Gallup Black-on-whites, emphasizing the Cibola Ware tradition, rather than an Acoma Province tradition. A hole-in-top can and purple-glass bottle fragment are associated with a sandstone slab foundation that probably dates to the late nineteenth or early twentieth century. Soil and cultural deposit depth and the condition of the cultural deposit may be highly variable depending on the intensity, extent, and frequency of dune deflation/stabilization over the last 8,000 years. Ground stone artifacts and scattered oxidized sandstone slabs suggest that plant or thermal processing of foodstuffs or raw materials occurred at various times. Alternative 5 will affect 8,030 sq m of the 12,230 sq m site area within the north half of the site limit (Fig. 6). This area combines deflated and stabilized areas that do not encompass the majority of the ground stone or pottery identified during the inventory and OAS site visit. Given the size of LA 89019, Alternative 5 excavations will encounter artifact distributions, features, and possible structure remains from seasonally occupied Archaic base camps, possible late Paleoindian manifestations, seasonally occupied small-scale Pueblo I-II limited activity or fieldhouse sites, and seasonal historic pastoral or ranching activities.

LA 108511 is a multicomponent, Pueblo I and Pueblo II, low density sherd and lithic artifact scatter with a hearth (Feature 1) and Kana'a Gray vessel fragments that may have been unearthed from an intact subsurface context. The site is located north of the Sky City Casino parking lot. A narrow section of the site limit may be affected by construction of Road B in Alternative 5 (Fig. 7). LA 108511 covers 7,170 sq m, of which 40 sq m, or less than 1 percent, is within Alternative 5. Field observations indicate that the majority of LA 108511 consists of buried cultural deposits. The low-lying setting and potential for alluvial soil accumulation reinforce this observation. Therefore, the surface artifact distribution may not indicate the full extent of the site. Hand augering and backhoe trenching within the planned access road right-of-way are recommended with at least one trench location passing through or near the LA 108511 south site limit. The potential buried cultural deposits may remain from seasonal use of this area. Small pit rooms or structures are commonly located in potential agricultural locations during Pueblo II and III periods. It is expected that LA 108511 or the adjacent non-site areas may have the remains of limited activity or seasonal residential components from the Pueblo I and II periods.

LA 149868 is an elongated multicomponent feature and artifact distribution within intermittently stable and deflated dunes. The site is located west of the current Acomita Interchange Exit 102 Interchange along the south I-40 right-of-way. Observed components include a Pueblo II-early Pueblo III rubble and artifact concentration (possibly a deflated field house) and three historic era foundations. The northern site limit of LA 149868 is crossed by the planned eastbound on-ramp for Alternative 5. Approximately 284 sq m of a 3,656 sq m area, or 8 percent of the site area, is within Alternative 5 (Fig. 8). The majority of the artifact distribution and all structural features are outside the construction zone. The site area within Alternative 5 is generally stable but shallow dunes in that area may encase or cover buried cultural deposits. An excavation plan consisting of exploratory and data recovery phases may yield artifacts and features from Pueblo II-Pueblo III seasonal occupation of this area. Earlier components may be hidden that will provide additional data for Archaic and Pueblo period limited activity, base camp, or seasonal residential site studies that are proposed for other sites within the project area.

Non-site areas within Alternative 5 need to be considered for this data recovery effort. The potential for buried Archaic or Pueblo period deposits strongly exists north of the I-40 right-of-way west of the current interchange. North of I-40, gently sloped surfaces are covered by colluvial and alluvial deposits of unknown age and depth. Artifacts were unearthed during utility line excavations near the Casa Blanca Casino and parking lot. Therefore, it is expected that buried cultural deposits may exist in adjacent areas. These areas will be examined by monitored backhoe trench excavation. Buried archaeological deposits will be recorded, dated (where possible), and interpreted relative to the research design and data recovery plan. Artifact distributions, features, or other cultural deposits similar to those found at sites within the project area will be addressed according to existing field data recovery methods and the data will be integrated into the analysis and research effort.

Research Design Summary within Regional Context

Archaeological investigations in the Acoma Province have been sporadic and scattered over the last 40 years. In the 1950s and early 1960s, dissertation research and highway and salvage archaeology projects provided, and still do provide, the bulk of excavation data for the area (Danson 1957; Dittert 1959). Scattered inventories have been conducted more recently in compliance with federal and state laws governing cultural resources management and commercial, mineral, land, and transportation development. As outlined previously, only 96 sites with 109 temporal and spatial components are listed in the NMCRIS files for the Cubero Quadrangle. These include 6 Archaic components, 55 Anasazi or Pueblo components, 31 historic components reflecting Pueblo of Acoma and Town of Cubero Grant land use, 1 probable Navajo component, and 16 unaffiliated, non-diagnostic sites. The latter site class is comprised mostly of lithic artifact scatters. The component density can be expressed as 1.5 components per sq km, a grossly underestimated component density for an area that undoubtedly has a rich culture history. When it is compared with the 13 sites comprised of 20 to 25 temporal components found in the 1 sq km of the project area, the magnitude of the difference suggests that the Exit 102 Acomita Interchange project area and its vicinity possessed qualities that attracted occupation, or that the Acomita Interchange project area and vicinity has received more archaeological attention than other nearby areas.

A combination of local and regional physiographic, topographic, geologic, and geomorphological characteristics supported and constrained a wide range of changing and flexible land-use behaviors for up to 10,000 years. The evidence for some temporal components, for example late Paleoindian-Early Archaic, is limited and may actually reflect scavenging and curation behaviors by later people. However, the overall impression of the component distribution and inferred settlement pattern is that the project area was an important place within a regularly inhabited region. Some of the major regional features that may have influenced past settlement patterns are the nearby Rio San José, the brokenland mesas of the Acoma Region, and the mesa and montane volcanic environments of Mount Taylor and areas south of Acoma. Diverse faunal and floral resources would have been available seasonally, annually, and across centuries as ecotones and biotic community distributions shifted in response to changing climatic conditions. Populations adjusted their economic patterns and social relationships in response to these changes as they moved across the regional landscapes. It is against this backdrop of environmental diversity and variability that the material culture patterns may be studied and explained. Therefore, this research design and data recovery plan will address issues of time, technology, economic organization, and change from the archaeological perspective of sites left by populations with recognizably different social and economic organizations that periodically occupied the same space for the same and different reasons.

Survey efforts have documented cultural materials, features, and deposits in the region including and surrounding the project area that range from the late Paleoindian-Early Archaic, Middle Archaic, Late Archaic, Pueblo I and early Pueblo III periods through the late Territorial or early Statehood periods. The research design will direct researchers to compare data and interpretations from the late Paleoindian-Archaic, Pueblo, and Historic period components to better understand the diachronic changes in human social, economic, and land-use patterns and behaviors in the Acoma Province.

The Late Paleoindian-Archaic Period

Late Paleoindian-Archaic period components are represented by projectile points recorded at LA 89019. At LA 89019, a late Paleoindian-Early Archaic point base, an Early Archaic Jay-like, and a Middle Archaic San José-like point were each recorded by a different team of archaeologists. Biface manufacture debris and ground stone implements can also reflect Archaic occupation, but may remain from Pueblo period forager-farmers.

Identified projectile point styles are assigned to the Oshara Tradition classification scheme for chronological control (Irwin-Williams 1973). That the projectile points reflect Oshara (Anasazi ancestry) or Cochise (Mogollon ancestry) culture group boundaries more than the wide distribution of commonly employed projectile point styles by intermountain, basin and range, and plateau pre-Pueblo hunter-gatherer groups is clearly rejected by most Archaic period researchers working in the northern Southwest for the last 25 or 30 years (Matson 1991; J. Moore and Boyer 2002; Hogan 1986; Holmer 1986; Turnbow 1997; Vierra 1994). When viewing the history of research on the Archaic tradition, it is apparent that there are difficulties in rectifying research with an emphasis on cultural-historical constructs with that emphasizing cultural-ecological frameworks based on interpretive models of adaptation (J. Moore and Boyer 2002:53; Vierra 1994:17). Wills (1988:10) characterized the cultural-historical approach by the statement, "Underlying this belief in preceramic cultural boundaries is a series of unstated assumptions about hunter-gatherer organization and about the role of style in egalitarian societies. The fundamental tenet is that material culture varies spatially with social and cultural corporateness." Historically, cultural entities have been assigned spatial limits based on the geographic distribution of diagnostic artifacts or traits. In the case of the Acoma Province, which could be conceived as transitional between Oshara and Cochise culture areas, ascribing occupations to a particular culture group is a tenuous exercise at best. The act of defining culture groups on the basis of material culture and settlement patterns effectively limits the interpretation to only those archaeological sites that fit the models and obscures the variability necessary for understanding human-to-environment/landscape relationships.

J. Moore and Boyer (2002:53) recently recognized the limitations of a cultural-historical framework and have opted for the more flexible and workable cultural-ecological/adaptational approach. They state that, "Southwestern Archaic as an adaptation to local environmental and demographic conditions is marked by a high degree of residential mobility, lack of permanent or semi-permanent residential nodes, and dependence on hunting and gathering for subsistence needs. The use of pottery and specific weapon systems do not enter into the equation. Limited horticulture may have been used to supplement food resources, but domesticates did not represent a subsistence focus" (J. Moore and Boyer 2002:53). By following this perspective, Moore and Boyer argue that archaeologists will expend less energy determining which culture group may have occupied an area and focus more on how and why occupations occurred at different times. The approach combines cultural-ecological and processual orientations and methodologies.

This orientation is especially appropriate for the Exit 102 Acomita Interchange project because it is located in an area that could be argued to be culturally and geographically transitional between two long-accepted culture areas, the Oshara and Cochise or Anasazi and Mogollon. While useful for categorizing sites according to material culture trait lists and chronological assignments, these archaeological culture group assignments are not useful for understanding or explaining how and why occupations occurred and under what environmental conditions. By limiting the effort spent on studying culture groups and interaction through material culture, assemblages recovered from site loci may be more productively examined using processual models developed for investigating and interpreting hunter-gather activities, sites, and systems.

Research Orientation

LA 89019 has Archaic period components as determined by the different types of projectile point present on the sites' surface. Since a large proportion of LA 89019 will be investigated, it has the greatest potential to yield sufficient data to address most of the research issues outlined in the following research orientation and expectations. Because the proposed hunter-gatherer model (below) may be applied to the full temporal range of Archaic phases, it is also expected that this research design will be effectively applied to any unexpected or currently unknown Archaic or Paleoindian period contexts that may be encountered in the course of the data recovery effort. Much of the following research design has been adapted from J. Moore and Boyer (2002, 2003).

A Hunter-Gatherer Model

Both Paleoindian and Archaic period populations derived their subsistence from hunting and gathering. Even with an increasing reliance on farming, ancestral and historic Pueblo populations also depended on hunting for protein and gathering as a seasonal supplement. The hunting and gathering strategies employed would have been dictated by the environment, demography, and social and economic dynamics like trade alliances and marriage practices. Models have been presented for extant ethnographic groups that rely mostly on hunting and gathering and trade for subsistence (Binford 1980). The models have been applied to archaeological sites in an attempt to understand the temporal and spatial variability in artifact patterns and, subsequently, the identified patterns have been applied to temporally nondiagnostic sites, especially in the San Juan Basin (Reher 1977; Vierra 1980, 1985; Elyea and Hogan 1983).

Sites were classified as functional units indicative of different organizational elements of hunter-gatherer settlement and subsistence strategies (Binford 1980; J. Moore 1989; Vierra 1980; Elyea and Hogan 1983). The most commonly defined site types were residential sites, base camps, field camps, and resource extraction locations. The frequency and distribution of different site types were determined by the subsistence strategy which was, in turn, conditioned by the temporal and spatial periodicity of biotic and geologic resources. Binford (1980) proposed two major hunter-gatherer strategies-forager and collector-that have been applied widely throughout the northern Southwest to study and interpret Archaic period sites and examine regional settlement patterns (Hogan 1986; Hudspeth 1997; Lent 1991; J. Moore 2001; Stiger 1986; Vierra 1985, 1994). Expectations for forager or collector site structure and settlement patterns were based on ethnographic studies, which were then extrapolated to distributions of artifacts and features across a landscape.

Briefly summarized, foraging strategies involve the collection of resources that would then be returned to a residential site for processing and consumption. Resource extraction locations were distributed around the residential base camp within a round-trip distance that could, generally, be traveled in a day. This strategy would work best in an environment where most resources were evenly distributed across the landscape, with residential camp locations determined by the most critical resources like water. Residential camps were moved as resources were depleted or the camp became uninhabitable. With this strategy, many base camps would be scattered across the landscape. There would be few or no intermediate sites between the residential site and the resource extraction locations (Binford 1980:5–10).

Collecting strategies describe an economic pattern in which people collect and partly process resources at distant locations, returning them to the base or residential camp for further processing, consumption, and storage. Residential camps would be located at or near critical resources, like water, fuel, and seasonally abundant plant and animal resources. Stays at collector residential camps would be longer than stays at forager camps, with some resource procurement occurring as a multistage process. The residential site might have structures and storage and production facilities. Most resource extraction locations would be distributed within a one-day round trip from the residential site. More distant, but critical resources would be procured from temporary logistic camps that might have production, processing, and consumption facilities, but no long-term food storage facilities or high-investment structures. The temporary logistic camps would be surrounded by resource extraction locations. Long-range resource procurement would be supported by short-term storage facilities or caches of raw materials and processing implements (Binford 1980:10–12).

The Archaic components at LA 89019 can be studied from a hunter-gatherer perspective. The following are relevant research questions and data sources.

Site Dating

> *What are the date ranges for Archaic period components that may be identified at LA 89019? Do different dating sources support one another by allowing for diachronic interpretation of Archaic settlement and subsistence patterns relative to broad trends in environmental data?*

Chronological control is critical to understanding where LA 89019 fits in the occupational sequence of the Middle Rio San José and Acoma Province and for building a site occupation history (diachronic framework) for understanding how LA 89019 functioned within the long-term seasonal mobility patterns of Archaic populations. Accurate dating of Archaic components at LA 89019 will also be necessary to support site structure analyses through the identification and sorting multicomponent contexts. Obviously, the more absolute or chronometric dates that are obtained, the more confidence there will be in diachronic analyses and interpretations. Furthermore, the Archaic period is so poorly understood in this area that any absolute dates will provide a baseline for future studies.

Within dune settings it is probable that temporally unrelated components may be collapsed and mixed, resulting in features from one occupation co-occurring with artifacts from another occupation. The potential for the mixing and conflation of components must be considered. Therefore, as early as possible, a geomorphologist will be employed to assess the integrity of site stratigraphy, identify intact paleosols and mixed strata, and clarify dune formation processes. Geomorphological study will aid in assessing the reliability of associations between artifact and feature distributions and the contexts of chronometric samples.

In order to maximize contextual control over chronometric dating and to effect high resolution cross-dating by multiple methods, features and their surfaces of origin will be the primary focus of sample collection. Radiocarbon assays will be one of the most appropriate dating methods for the Archaic period. When possible, multiple datable samples will be obtained from each feature, surface and/or stratum. Considering assessments of radiocarbon sample precision and accuracy by Smiley (1985) and Dello Russo (1999), we will target carbonized remains of annuals or the outer layers of construction elements, should these types of samples be available. Charcoal from fuel wood will also be collected for analysis, especially from features. However, we realize that dates from these types of samples often represent decades, sometimes centuries, of wood growth prior to fuel use. As a last resort, we will collect bulk soil samples containing powdered charcoal from features and paleosols for dating, only if no better materials are available for sampling.

Samples for dating sediment strata through optically stimulated luminescence (OSL) will also be collected where warranted. This approach often provides bracketing dates for buried components where other classes of datable material are absent, or where the accuracy of other dating approaches requires assessment or corroboration. Sediment samples for OSL have been obtained for Paleoindian and Archaic localities in other regions of the Southwest with marked success (e.g., Feathers et al. 2006).

Archaeomagnetic samples will be collected from suitable burned contexts. Currently, archaeomagnetic measurement results from Archaic sites have limited dating potential since curve development for the Archaic period is in its infancy, but sample collection may help build a curve, especially if reliable radiocarbon dates are obtained from associated contexts. While we do not expect to be able to date features using archaeomagnetic samples, if available they will help expand the current database and may be comparable to the small array of samples already obtained from other Archaic sites (Cox and Blinman 1999). Artifacts with temporally defined stylistic variation may also help provide dates, though it is more likely that dates currently assigned to specific artifact styles will be evaluated and refined in light of radiocarbon dates.

Obsidian hydration can be useful for dating but the error estimates tend to be large (200 to 400 years), which provides poor resolution. The quality of the hydration dates depends on the sample depth, the length of time it was subjected to corrosive processes, the source from which a given sample was procured, the amount of ambient moisture present in the atmosphere at the time a given obsidian artifact was discarded, the amount of soil moisture extant after an artifact was buried, and the care with which samples are selected. Clearly, surface samples or samples that were on the surface for a long time are suspect because of rind deterioration. The deeper the context, the better the chance for a "good" date, although a limit to rind development in encountered when the obsidian is saturated (at about 3.5 percent). Care in sample selection is also important because obsidian in certain situations may be recycled over time and thus have a very long "use-life." Recycling and scavenging of artifacts at residential, base camp, and quarry sites may result in reworked edges or flake scars of very different ages. Each will have its own rind thickness and the average of an Archaic and Pueblo period date is really no date. Obsidian hydration may provide relative dating, if rind thickness corresponds to temporal sequence suggested by stratigraphy, radiocarbon dates, or specific projectile point styles.

Indirect dates or associated dates may be derived from temporally diagnostic lithic artifacts. Projectile points can provide general dates that will only reinforce occupation sequences relative to existing cultural-historical frameworks. However, the combination of radiocarbon dates and projectile points may allow for some adjustment of cultural-historical framework dating, particularly if transitionally early or late date ranges are obtained.

The Archaic Settlement System

> *What part of the Archaic settlement system is represented by the occupations at LA 89019? Does the role played by the site change through time?*

Considering the types of Archaic sites identified in the vicinity of the middle Rio San José and the Acoma Province, a range of possibilities exists for what will be uncovered at LA 89019. Hunter-gatherers occupy and utilize sites in different ways and they employ different occupational strategies to exploit the landscape through which they range. Two basic hunter-gatherer subsistence strategies have been proposed, and each is associated with somewhat different types of sites. Binford (1980) defines two basic hunter-gatherer organizational systems-one in which consumers move to resources (foragers), and a second in which resources are moved to consumers (collectors). Data presented by Irwin-Williams (1973) suggests that Early Archaic hunter-gatherers were foragers, with the transition to a collector-organized system beginning during the Middle Archaic and firmly established by the Late Archaic. Alternately, Vierra (1990:63) feels that Southwestern Archaic hunter-gatherers "may have implemented a foraging strategy from spring to fall, and a collector organized strategy during the winter. That is, groups were mapped onto exploitable resources by being residentially mobile from spring to fall, while during the winter they utilized stored foods, making logistical trips to food caches and for hunting." However, neither this sequence nor a division into foragers and collectors is necessarily clear-cut.

Late Paleoindian and both Early and Middle Archaic occupations appear to be represented at the project area, as indicated by the projectile points present at LA 89019. Therefore, excavation of this site may provide an opportunity to evaluate the change from forager-dominant subsistence strategies and settlement pattern to the onset of collector type strategies and patterns. Excavation may also provide the opportunity to examine changes in settlement organization through time, if components display artifact and feature variability. The structure of an Archaic site, the range of artifacts found there, and the activities reflected by the assemblage can provide information on the type of use pattern represented. While it is probable that sufficient data will be recovered from LA 89019 to evaluate components relative to forager and collector organization, the ability to make diachronic interpretations will depend on the condition and integrity of the artifact and feature associations across the sites.

Forager and collector site types are commonly broken down into two basic categories, though there may be considerable variety within each category. Residential sites (base camps) tend to be the most common type of Archaic site found, representing locales where a band lived for a variable length of time depending on the season and the distribution and abundance of subsistence resources. Resource extractive locales are places where biotic resources and geological materials were gathered or procured, perhaps partly processed or reduced, and then transported to a base camp. Since most activities that extract resources from the environment leave few material remains behind, the actual resource extractive locales may be archaeologically invisible. Exceptions to this include quarries, where debris was generated during the extractive process. Locations where floral or faunal foods were collected and processed for transport may only be marked by a low density scatter of flaked stone artifacts and perhaps a thermal feature. Repeated harvesting or processing over a long period may result in accumulations of artifacts and features, thereby increasing the site visibility, but also blurring the distinction between limited base camp and resource gathering or procurement sites.

This last scenario is acknowledged by Fuller (1989:18), who suggests that field camps are an important intermediate site type that were essentially short-term residential locales used by task-specific groups while collecting resources that will be returned to the base camp for storage. Resources were sometimes cached at field camps for later recovery and movement to the base camp. This type of site may be very difficult or impossible to distinguish from short-term base camps used by foragers.

In general, foragers inhabit base camps for a short period, ranging out from them to exploit resources on an encounter basis. Collectors inhabit base camps for longer periods, exploiting surrounding resources through day trips and sometimes through the use of short-term field camps. Collectors use storage features to cache resources at their base camp in preparation for seasons of limited food availability, a strategy that is not employed by foragers (who simply move on). Thus, small Archaic sites containing few or no thermal features, no evidence of structural remains, and a small array of flaked and/or ground stone artifacts may be indicative of a foraging focus. More extensive sites containing an array of thermal and storage features, small temporary structures, and a comparatively large amount of debris may be indicative of a collector strategy.

Three theoretical forager and collector site types were identified above-residential base camps, field camps, and resource extractive locales. The last of these is presumed to be archaeologically invisible except under certain rare circumstances. A foraging residential base camp should reflect a wide range of maintenance, production, and food-processing activities without a heavy investment in habitation or storage features. Structural remains, if present, should be ephemeral and indicative of short-term use. Collector residential base camps, on the other hand, should not only contain evidence of a wide range of activities, they should also demonstrate a corresponding investment in habitation and storage structures, indicative of a comparatively lengthy occupation. Field camps associated with a collector adaptation should reflect temporary occupancy by a small group engaged in specialized activities. Therefore, a few specialized activities should be represented, storage features should be absent (unless the site was used as a cache), and structures (if present) should be ephemeral.

A potential problem in applying this model involves separating foraging camps occupied for short periods from field camps used by collectors. Both should exhibit evidence of short-term occupation, and the range of activities visible in the artifact assemblage might be quite limited for both. In many cases, these types of sites may be indistinguishable. One way the problem can be dealt with is through analysis of the flaked stone assemblage.

The manufacture of general purpose bifaces reflects a mobile lifestyle, and more commonly occurs at residential base camps than at field camps or resource-extractive locales. Kelly (1988:731) defines three types of bifaces: (1) those used as cores as well as tools; (2) long use-life tools that can be resharpened; and (3) tools with specific shapes and functions. Each type of biface may be curated, but for different reasons and in different ways. Use of bifaces as cores is conditioned by the type and distribution of raw materials. When suitable raw materials are abundant and tools are used in the same location as the raw materials from which they are made, an expedient flake technology can be expected, with little use of bifaces as cores (Kelly 1988:719). When local raw materials are scarce or of poor quality, bifaces can help overcome the difficulties involved in using materials that are obtained at a distance from the location in which they are used (Kelly 1988:719). When raw material scarcity is extreme, mobility is low, or a specific bifacial tool is required for activities performed away from the residential base camp, there may be some use of bifaces as cores as well as extensive rejuvenation of bifacial tools (Kelly 1988:720).

Bifaces with long use-lives may be manufactured under a variety of conditions. "In particular, tools designed for use on long search-and-encounter (as opposed to target specific) logistical forays will be under greater pressure to meet a variety of needs and tasks (e.g., cutting or scraping tools) and thus will need to be bifacial. This requirement can be relaxed for the equipment of target-specific forays" (Kelly 1988:721). Bifaces may also be manufactured as by-products of the shaping process, and this illustrates the importance of the haft to which the tool was attached (Kelly 1988:721). This type of biface might be more frequently maintained or replaced at residential rather than logistical sites (Kelly 1988:721).

Using these concepts, Kelly developed a model to aid in distinguishing between residential and logistical or field camp sites. The model has not been rigorously tested, but it does provide a series of predictions that can be applied to a flaked stone artifact assemblage. When combined with other data sets such as feature type and placement, the number and diversity of activities represented, and the types of resources being exploited, the applicability of the model to a site can be assessed. For example, if residential features are present but flaked stone analysis suggests that the site served as a logistical site or field camp, the model may be incorrect. However, if the residential pattern predicted by both Kelly's model and by site structure attributes are in agreement, the model may be tentatively accepted as valid.

The assemblage diversity and potential for features at LA 89019 suggest that these locales may have served primarily as residential base camps. The potential for a late Paleoindian to Middle Archaic date for the site suggests that both forager and collector subsistence strategies could be identified, particularly if the interpretation by Irwin-Williams (1973) is correct. However, if Vierra's (1990) evaluation of the Archaic subsistence strategies is more accurate, the type of strategy identified will be dependent on the season of occupation. We expect that our studies of LA 89019 will provide baseline data on flexible subsistence strategies and shifting settlement patterns as late Paleoindian and Archaic hunter-gatherers responded to the climate changes that occurred between 7500 and 800 BC (Wills 1988).

If the site or portions of the site represent a foraging focus, we would expect to find evidence for warm-season use. This may include ephemeral shelters lacking internal heating features. There will be no evidence of storage features, and a wide range of activities should be reflected in fairly small artifact assemblages. The types of floral and faunal materials recovered should also reflect warm-season use. If storage features are present and a limited range of activities is represented in the artifact assemblage, we will consider the possibility that a field camp associated with a collecting strategy is represented. As this discussion suggests, a wide range of data will be needed to address this research issue. These data should include details on how structures and features were built, details about artifact type and function, and details about the types of foods that were consumed.

Archaic Site Spatial Organization and Function

> *If discrete temporal or occupation components are identified at LA 89019, what can measures of spatial organization tell us about how these locations were used through time? How do data from spatial organization inform on generalized Archaic site structure and occupation patterns?*

The artifact distributions within the deflated areas of LA 89019 have the potential to reveal factors that influenced selection of particular locales for occupation by Archaic hunter-gatherer groups. They may also elucidate conditions under which repeated occupation may have occurred over a long period. The extensive distribution and multicomponent nature of LA 89019 suggest that the sites were repeatedly occupied by small microbands or commensal units. While larger or macroband size groups may have occupied these locales, there is no immediate indication of larger-scale cooperative resource gathering and processing or hunting preparation. The amount and variety of artifact types is consistent with repeated, but discontinuous, occupation by smaller groups. Investigations of sites located in dune settings in the Grants area to the west (Bryan and Toulouse 1943; Agogino and Hester 1956) and at the Moquino site 15 miles to the east (Beckett 1973) indicate that stratigraphically and spatially discrete components may be intermingled with highly mixed deposits derived from both base camps and from logistical sites. How and why the sites were reoccupied through time may be addressed through the association and distribution of artifacts, features, and structures. The following discussion of occupation behaviors should be useful for distinguishing repeated occupations by the same group from sequential occupations by different or unrelated groups.

Vierra (1985) has examined the process of site reoccupation using ethnographic and archaeological data. In summary, he suggests that several factors appear to affect the decision to reoccupy previously used sites. Among those, perhaps most important is that sites might be reused if the selection of suitable alternate locations is limited. "Certain site functions demand much more specific requirements. The more specific the requirements are, and the more limited the number of locations which meet those requirements, the more frequently these advantageous positions will be reused" (Vierra 1985:64).

In general, logistical sites tend to be reoccupied more often than residential locations, especially when hunting is dependent on the planned intercept of game rather than unplanned or unanticipated encounters (Vierra 1985:64). Locational requirements for residential sites are often more flexible, resulting in less need to reoccupy the same spot (Vierra 1985:65). There are also two very good reasons for not reoccupying old residential locations: hygiene or health concerns and resource depletion (Vierra 1985). Old camps contain unsanitary debris and garbage that can cause infection and sickness as well as parasitic infestation. The zones around them have also been depleted of useable resources, and may require several years to recover sufficiently to allow successful exploitation to occur again. When the same area is reused, new camps tend to be located near, even adjacent to, rather than on top of old camps (Vierra 1985:65).

These patterns can be detected archaeologically. Vierra (1985:183–184) found that multicomponent sites containing Archaic and Pueblo materials in the San Juan Basin did not represent a blending of materials, as might be expected when specific areas were reoccupied. Rather, later occupations were spatially distinct, and are often identified in adjacent areas. Camilli (1989) found evidence of similar site reoccupation patterns on Cedar Mesa in southeast Utah. While smaller sites appear to have represented single-use locales, larger sites contain evidence of overlapping occupations. Eschman (1983) studied site structure at LA 19374 in the San Juan Basin, and concluded that, "The overall extent of these cultural deposits . . . appears to be the result of multiple, overlapping occupations over a considerable time period" (Eschman 1983:379). Thus, when camps were reused, the exact locations were rarely reoccupied. New camps were instead placed in adjacent areas, at times overlapping earlier deposits. This produced sites of large areal extent with artifact densities similar to those of single occupation sites.

In the cases cited above, Archaic strata were mostly deflated and compressed, forming areally extensive but thin deposits. LA 89019 should be similar in structure to those sites, as is suggested by the investigations by Bryan and Toulouse (1943), Agogino and Hester (1956), and Beckett (1973). Variation in the type of remains occurring in each potential occupational zone identified at LA 89019 could indicate that repeated uses of the same general area occurred during different seasons and do not represent the same site function. If different site functions are suggested for locales that reflect the same season of use, a basic forager pattern might be represented in which site use and longevity were dependent on the array of resources available in a particular year.

Locational information and data on artifact type and distribution will be needed to address this research issue. By imposing a system of grid units over the sites we will be able to control for location and artifact distribution, providing data amenable to a variety of analytical methods. Analysis of all recovered artifacts will provide information on the types of activities they represent, which can be combined with the distributional analysis. In addition to these data needs, information on seasonality (discussed later) and dating (discussed earlier) will be critical.

Archaic Subsistence

> *What was the subsistence focus during the Archaic occupations at LA 89019? Did the subsistence activities change as might be expected in response to long-term climate change from late Paleoindian to Late Archaic times?*

Surface artifact classes observed at LA 89019 indicate that a relatively broad spectrum of subsistence activities occurred. Projectile points and evidence of biface manufacture and maintenance suggest hunting and potentially meat processing, packaging, and consumption. Ground stone implements suggest the gathering and processing of at least some of the wide variety of plants and plant products that would have been seasonally available. While it is possible that limited horticulture was practiced during the end of the Middle Archaic period, there is no evidence for early corn from any of the local and regional Archaic site investigations (Agogino and Hester 1956; Beckett 1973; Bryan and Toulouse 1943; Lentz 2004).

We expect to recover data suggesting a generalized hunting-gathering subsistence system involving the consumption of locally available wild plant and animal foods. It is expected that direct evidence of subsistence activities will be obtained from three sources. Faunal remains will hopefully provide information on the types of animals that were exploited for subsistence needs and the possibly the season during which they were procured (see further discussion of seasonality below). Macrofloral materials should be recoverable using flotation analysis, and all contexts that appear able to provide this type of information will be sampled. Finally, pollen analysis may provide a more limited view of the subsistence system, informing researchers about which wild plants were procured, and when, and whether any maize was cultivated. In addition, pollen washes from ground stone artifacts may provide subsistence data that will augment information provided by flotation analysis.

Indirect evidence of subsistence may be obtained from artifacts and features. Artifacts will be analyzed for morphological and technological attributes that may reflect manufacture, function, and use. Feature morphology and content should provide information on the range of processing activities. The different analytical approaches that will be applied to artifacts and features are further discussed in the Analytical Methods section that follows.

Archaic Seasonality and Mobility

> *During what season(s) was LA 89019 occupied and did the seasonality pattern change through time? What mobility patterns are suggested by the lithic raw materials? Do the lithic raw material distributions indicate changing mobility patterns through time?*

Seasonality is an important structuring variable for enabling researchers to better understand occupation type, occupation duration, and site activities. Based on the surface artifact information, we expect that LA 89019 was primarily occupied during late summer and fall when a variety of plant and animal foods were available and when the preparation for over-wintering would have occurred.

If site LA 89019 was occupied during cold seasons, one or more definable structures should be present. Given the large portion of LA 89019 that will be investigated, one or more structures may be encountered. In addition, activity areas or rubbish disposal debris from residential occupation may be encountered in the deflated deposits located within the right-of-way. If structures occur at the site, they will probably be ephemeral and difficult to define because they would have been built as shallow pits without formal floor or walls. One or more thermal features should occur within each structure and there may be evidence of post holes for interior roof supports. In addition, interior storage pits may be present. Alternately, and counter to our expectations, the occurrence of structures that lack internal thermal features and storage pits may be evidence for occupation during the warm season.

Information on the season of occupation may also be obtained through study of macrofloral remains recovered from flotation samples. If a cold-season occupation took place, evidence for the processing of plant foods available in late summer or fall is expected. Plant foods available in the spring or early summer are not expected, unless there is evidence that they were stored in anticipation of future need. In particular, we expect maize macrofossils and/or maize pollen to be recovered if this domesticate was available for use by site occupants.

Some evidence for seasonality may also be available from faunal remains, provided enough identifiable bone is obtained to evaluate this possibility. If a cold-season occupation is reflected, we would expect evidence of 6-month-old artiodactyls, an absence of hibernating species like prairie dogs, and perhaps the presence of bird species that winter in the area. However, Archaic sites rarely yield well-preserved faunal remains, and the bone recovered from this type of site is often burned and in very small unidentifiable fragments. Thus, faunal analysis may augment information available from structural remains and macro-floral fossils but, by itself, fauna is unlikely to provide data that are strongly indicative of seasonality.

LA 89019 most likely represents one component of extensive annual or lifetime territories that were occupied by mobile populations over the last 8,000 years (Binford 1982; Kelly 1992). It is probable that the middle Rio San José was an important stop as hunter-gatherers moved between low and high altitude resource areas, and as indicated above, may have been primarily occupied during late summer to late fall months.

Mapping hunter-gatherer mobility or settlement patterns has been especially productive for the San Juan Basin. For example, Vierra (1990) has suggested populations moved into and out of the San Juan Basin during the warm weather months with fall and winter camps occurring in well-watered higher altitude settings, similar to the middle Rio San José. Accordingly, we might further expect that Archaic populations would have moved between lowland settings of the Middle Rio Grande to the upland settings of the Mount Taylor-Acoma area (see Dello-Russo 1999). While moving between these different areas, local lithic resources may have been used to produce tools or portable cores or large bifaces that were brought to and reduced at LA 89019, resulting in the disposal there of waste products from tool production and use. These behaviors could have resulted in the deposit of a range of low frequency non-local lithic raw materials at the site, reflecting the long-distance aspect of the hunter-gather settlement pattern. Of course, the tracking of non-local raw material type distributions has long been used to infer trade, travel, long-distance exchange, or interaction (Matson 1991; Vierra 1990). For LA 89019, which was intermittently occupied by Archaic groups for 5,000 to 8,000 years, the analysis of lithic raw materials may be particularly fruitful.

Lithic raw material studies will be included in the flaked stone analysis outlined in the Analytical Methods section of this report. During analysis, special attention will be focused on the attribution of exotic raw materials to known and potential source areas. While precise source locations may not be determined given the vagaries of long-term effects of geomorphological and geographical processes on geological materials, we should be able to source some raw materials to geographically discrete regions. X-ray diffraction will be used to source obsidian artifacts from all temporal and spatial components. Comparative lithic collections available at the Office of Archaeological Studies and other institutions will be used to identify the varieties of Zuni, Chinle, Narbona Pass, Brushy Basin, and Morrison Formation cherts, Socorro Mountains silicified rhyolite, and other cryptocrystalline materials that may be recovered.

The Pueblo Period (AD 700–1200)

Pottery identified on the surface of LA 54902, LA 89019, LA 108511, and LA 149868 indicates that these sites may have temporal components dating from AD 700 to 1200. This period spans much of the prehistoric Pueblo occupation of the surrounding region, including the Acoma District, the Middle Rio San José Valley to the east, the San Juan Basin to the north, the eastern Red Mesa Valley to the west, and the Zuni-Mogollon Highlands to the west-southwest. The project area is more or less centered within the geographical region ascribed to the Eastern Anasazi culture area and Anasazi-Mogollon culture area transition. Previous studies in this area have focused heavily on identifying and explaining material culture variability that at different times in the past was thought to have exhibited more similarity to Anasazi or Mogollon or mixed Anasazi/Mogollon or Mogosazi, as is it has been termed by some researchers (Cordell 1979a; Danson 1957; Dittert 1959; Eidenbach 1982; Tainter 1982; Tainter and Gillio 1980). These predominantly cultural-historical studies provide good descriptions and comparisons of material culture trait lists. They document the variability that stems from a long-term seasonally and residentially mobile, agriculturally focused, adaptation that relied heavily on available resources for producing the objects employed in quotidian activities. The use and trade of some items no doubt resulted in the differential distribution of cultural material across a vast and diverse region and these materials may have reflected cultural difference or cultural identities. However, it has also been demonstrated that much of the variability, at least before AD 1000, may simply reflect the distribution and availability of natural resources. These environmentally influenced attributes were manifested in pottery of different paste colors or houses with different forms, although these items were used in essentially the same way across the region (Wilson 2002). Later in the temporal sequence, variability can be partly attributed to long-distance social or economic interactions that resulted in the movement of goods rather than people.

Sites with Pueblo components within and near the project area are evidence of a long-term use pattern that appears to have focused on arable land and available water sources of the mesa canyon bottomlands and the middle Rio San José and its tributaries. The distribution of sites and the activities they represent may be partly conditioned by the distribution of different soil types and depths across the project area. North of Interstate 40, deep alluvial soils cover a large area. These deep and stable soils may have been suitable for farming and, consequently, may also contain buried cultural deposits. South of Interstate 40, the soil is more typically comprised of dune fields with deep alluvial deposits farther south and up the side canyons. The shallower, less stable dune soils could have been farmed as garden patches or they may have been foraging loci that supported seasonal plant species that were different from those available in the deeper alluvial soils. Therefore, the project area may have been suited to two farming strategies and, in addition, may have served as a source of seasonally diverse plant products.

The Exit 102 Acomita Interchange sites reflect only a small part of the regional culture history and the social and economic interactions and changes of the Puebloan past. The portions of sites that fall within Alternative 5 have relatively few surface artifacts or visible features from which data may be recovered for this study. The low frequency of surface materials initially suggests limited Pueblo period occupation within the project area. However, surface artifact and feature distributions may not be the best indicators of the extent and density of subsurface deposits. Shifting dunes and aggraded alluvial deposits most likely mask some of the evidence of past occupation but, nonetheless, the low frequency of surface ceramics from any period suggests that buried deposits will reflect small-scale and short-duration activities consistent with seasonal occupations.

Sites LA 54902 and LA 108511 have few artifacts and no features within the proposed limits of Alternative 5, with larger site areas outside of the proposed construction zones. However, these sites are located north of Interstate 40 in a geomorphic setting where there is potential for deep soils that may contain buried cultural horizons. The surface artifacts in the site areas outside of Alternative 5 include pottery from Pueblo I or White Mound phase and Pueblo II or Cebolleta phase occupations. Data recovery will focus on determining if buried deposits exist in these deep alluvial soils within and adjacent to the LA 54902 and LA 108511 site limits.

Sites LA 89019 and LA 149868 are located on the south side of Interstate 40 in stabilized and deflated dunes interspersed with exposed sandstone bedrock. LA 89019 has a greater area of stabilized dune within the Alternative 5 limit, but with few ceramics present on the surface. Buried, but ephemeral or light-duty architectural remains, and collapsed or deflated features may be present in low numbers. Segregating Archaic and Pueblo period components in the dunes may be difficult. LA 149868 has a well-defined Pueblo II or Cebolleta phase component with a midden or refuse concentration and possible architectural remains that are probably the remains of a fieldhouse. The artifact distribution from the fieldhouse does not extend into Alternative 5. Therefore, the site area may contain scattered artifacts and ephemeral features that may either be contemporaneous with the fieldhouse occupation or may represent the remains of small-scale resource procurement and processing activities.

Research Orientation

The archaeological remains at these sites reflect broad trends in prehistoric Pueblo subsistence practices, settlement, land-use patterns, social identity and social organization. The sites represent an accumulation of material from discontinuous occupation episodes that occurred between AD 700 and 1200. Initial evidence suggests that the sites played multiple roles within seasonal subsistence strategies that changed through time in response to population growth and movement and climatic variability. Based on the survey evidence it is likely that the Pueblo II period or Cebolleta phase will be best represented by the surface and buried artifacts, features, and cultural deposits. The following research design focuses on dating the site Pueblo components and on studying them in terms of seasonal subsistence strategies.

Identifying and Dating Pueblo Period Components

> *Are discrete or identifiable Pueblo period components present at the sites?*

Identifying and dating Pueblo period components are crucial to the implementation of the research design. Surface evidence at the four sites suggests that the project area was intermittently occupied from AD 700 to 1200. However, except for the LA 149868 fieldhouse component, the temporally diagnostic sherds that date the sites occur in low frequency and may reflect ephemeral or brief occupations. One site is mixed with Archaic period materials (LA 89019) and the other three (LA 54902, LA 108511, and LA 149868) have no temporally diagnostic artifacts within Alternative 5. Therefore, the initial data recovery effort will focus on determining if discrete or intact Pueblo period components exist at the sites.

Field assignment of site occupation dates will rely on established ceramic typologies for the Acoma Province and Cibola and Mogollon Highland regions (Carlson 1970; Dittert 1949, 1959; Gladwin 1945; F. Hawley 1936; Ruppé 1953, 1966; M. Marshall 1991). The well-documented white and red ware and less temporally diagnostic brown and gray ware traditions will be employed to assign broad temporal ranges. Unmixed Pueblo period deposits or contexts will be represented by ceramic types from one or two of the temporal phases outlined in the Culture History and Native American Ceramics sections of this report. The recognition that ceramics from two phases may represent a discrete temporal component allows for transitions between cultural phases, such as a transition from Cebolleta to Pilares phase, which may be represented by the co-occurrence of Socorro Black-on-white, Los Lunas Smudged, and Gallup Black-on-white pottery. Also, some pottery types, such as Socorro Black-on-white, were manufactured over a long span of time and had a wide geographic distribution.

The co-occurrence of Archaic projectile points and prehistoric Pueblo pottery may indicate mixed deposits or the collection and reuse, by Puebloan people, of tools exposed in deflated dune areas. Probable Pueblo period deposits or contexts that have one or two Archaic period projectile points, especially if they are from different phases, will be treated as Puebloan. Cases where Puebloan pottery is associated with multiple Archaic projectile points, a predominance of biface manufacture debris, one-hand manos and basin metate fragments are more likely to represent post-occupational mixing. These contexts will be sampled and the recovered artifacts and samples may be used to examine site function and subsistence strategies from a general or non-temporal perspective. LA 89019 should have the greatest potential for mixed deposits because of its dune setting and the presence of deflated and potentially mixed surface deposits.

Chronometric samples will be collected when appropriate contexts or deposits are encountered. The number and range of contexts or features that may yield chronometric samples should be conditioned by the length and intensity of the occupation(s). Limited activity sites consisting of low frequency artifact assemblages and one or two thermal or pit features will have less chronometric potential than seasonal residential sites, which may have a greater number and variety of intramural and extramural thermal features and pits and burned or unburned structural elements or activity spaces. Permanent residential sites would be expected to have sources for chronometric samples similar to seasonal residences, but perhaps in greater abundance. White Mound, Kiatuthlanna, Red Mesa, Cebolleta, and Pilares phase occupations may be represented within the project area by one or more site types or occupation patterns. These different site types may yield contexts or samples for radiocarbon, archaeomagnetic, and dendrochronological dating. Obsidian was observed in the field and may be recovered from subsurface contexts. In the absence of ceramics or other chronometric samples, obsidian hydration may be considered as a means for obtaining relative dates. Collection procedures and justifications are provided in the Chronometrics section of this document.

Farming and Foraging along the Middle Rio San José

> *What is the nature of the occupations at LA 54902, LA 89019, LA 108511, and LA 149868? Do the artifacts and features represent seasonal fieldhouse occupations or repeatedly used gathering base camps? What subsistence strategies are represented and did they change through time? Did these sites function as seasonal residences or limited activity camps?*

The project sites are expected to consist of multiple components of Pueblo period settlement and subsistence systems. Activities and behaviors that are associated with semi-permanent or seasonal residences and foraging, hunting, and travel camps may be represented by the artifact and feature distributions. While the project area has been divided into archaeological sites as administrative units, it is more likely that this area, which provides evidence of persistent, if intermittent occupation, functioned as a more integrated spatial component of local and regional settlement and subsistence systems. Occupation duration and intensity and the tendency to reoccupy the same location were conditioned by the distribution, availability, viability, and abundance of critical resources, and the distance to a primary residence, if seasonal occupation occurred. Site architecture, which is sensitive to these factors, may also have functioned as a landscape or claim marker, as population increased and viable agricultural land grew in importance late in the prehistoric sequence (Kohler 1992; Schlanger 1992). The abundance and variety of tools, containers, and facilities should also increase in proportion to occupation duration and intensity. Therefore, it is expected that when discrete or discernible Pueblo components are encountered, their excavation will provide data that will inform researchers about the relationship between site structure, human behavior and activities, and environmental and social influences.

Previous researchers have developed criteria for the recognition of occupation patterns that were associated with different facets of Pueblo subsistence organization (B. Moore 1980; J. Moore 1989, 2001, 2003; Post 2002). These studies focused on modeling a relationship between site types (seasonal residence, fieldhouse, and limited activity site) and site-related factors, such as duration and intensity of occupation, range of activities, proximity to economically important resources such as agricultural fields, diversity and abundance of biotic resource patches, and the distance from a primary or permanent residence. Criteria were suggested, and are offered below, for unpacking site structure and artifact assemblage variability relative to different types of seasonal occupation. The utility of these criteria on a site-by-site basis will be determined by the amount and kinds of remains found at each site.

Fieldhouses or Seasonal Residences

The following are criteria for, and discussions of, occupation patterning and site structure for fieldhouses or seasonal residences.

1. Structures. Structures consisting of one to three rooms may be present, with one room large enough to permit occupation by one adult. Floor area may be consistent with the average for contemporaneous habitation-village sites within the same settlement system or cultural tradition. Structures may be above ground or subterranean.

Initially, fieldhouses were recognized as one- or two-room masonry structures on or near arable land (Haury 1956; Woodbury 1961). Haury (1956) considered the occurrence of fieldhouses or farmhouses after AD 1000 to be a result of settlement nucleation and population aggregation. Because single-room masonry structures were not common prior to AD 1000, fieldhouses were also presumed to be uncommon. More recently, fieldhouses and their purpose within prehistoric settlement and subsistence systems have been more broadly and probably more accurately defined (Burns 1978; B. Moore 1978; Burns and Klager 1979; Sebastian 1983; Miller 1985).

B. Moore (1978:9) describes fieldhouses as the largest class of architectural prehistoric site spanning Basketmaker III to Pueblo IV times. They are certainly the most frequent site type during Pueblo III and Pueblo IV times. Fieldhouses were used on a daily basis, as seasonal camps, and as way-stations for hunters and wayfarers (B. Moore 1978:10). The factors most often affecting fieldhouse use are its distance from the primary habitation and time of year. Ethnographic data show that field locations may range from direct line of sight to 8 miles distant (B. Moore 1978:10).

Fieldhouses or seasonal residences will have site structure patterns and artifact assemblages that are distinct from those found at limited activity sites. Below, known site structure attributes are briefly summarized by time and then general expectations for occupation patterns in the current project area are provided.

During the White Mound phase, seasonal residences primarily consisted of subterranean dwellings or pit structures in association with a range of storage, processing, and thermal features and light-weight jacal or brush shelters or shades. Late spring to early fall residences were located near arable land and water with distance to most other resources more variable and less critical.

During the Kiatuthlanna and Red Mesa phases, subterranean pit structures may have continued in use, but they have not been documented for the region surrounding the project area. Seasonal residences continued to be formal and substantial surface structures consist of jacal-walled structures with slab foundations. A suite of extramural features similar to those associated with White Mound phase occupations was found to be present when areas outside the structure have been investigated. Residence locations followed the White Mound phase pattern.

During the Cebolleta and Pilares phases, permanent residences consisted of formal above-ground room blocks divided into suites of rooms used as both residences and storage. Walls were masonry with room suites suggesting a household or supra-household level of organization (sensu Wilshusen 1988). Residences may not have been located near arable land used by all site residents. Such a residence is represented by LA 148687, which is located immediately south of the project area. Seasonal fieldhouses, in contrast, appear to have been established near arable land and occupied for different lengths of time depending on geographic (distance to site) and social factors (participation in seasonal rituals or ceremonies). Seasonal fieldhouses may have consisted of above-ground masonry or jacal structures or, alternately, small pit structures may have been employed. Obviously, the latter are often archaeological invisible without excavation. Multiple small pit structures, contemporaneous with the Cebolleta phase, were found at LA 3558 about 30 km to the east in the Middle Rio San José Valley. Small pit structures are more widely known from the Rio Grande Valley near Belen (Wiseman 1995) and Santa Fe (Hannaford 2000). The relative invisibility of small pit structures has often led to the characterization of artifact scatters as limited activity sites in survey data. It is probable that many of the small Cebolleta phase sites had pit structures, which, in turn, reflected a trend toward a more land-extensive settlement pattern.

2. Site location. Land potentially suitable for agriculture should be near the site. Such land should be in a direct line of sight of the structure. Based on soil characterizations and on-site visits, the area north of Interstate 40 within the project limits includes potentially arable land. Additional arable land is available immediately to the south of the project area. Field locations may be verified by pollen analysis and/or the presence of water control or irrigation features.

3. Patterns of Use. Three limited-use patterns are proposed.

Daily use would have occurred during crucial parts of the agricultural cycle, such as planting, early sprouting, pre-harvest, and harvest. Daily-use fieldhouses were primarily near the residence but out of direct view. Sporadic visits to the fields for maintenance and inspection would also have been similar to daily visits. Sporadic visits would have involved limited activities and therefore such sites would have limited visibility in the archaeological record (B. Moore 1980:85; Sebastian 1983:404). Brush structures and lean-tos would have been the most common architectural feature. Food consumption and preparation would have been represented by bowl vessel fragments or one or two storage vessels for water. Breakage of these vessels would probably be a rare event because of low traffic and infrequent use. Hearths, if present, would be expected to be extra-mural.

A daily-use pattern, with overnight stays restricted to pre-harvest and harvest conditions, should have produced only the sparsest remains. Tools and containers used in food procurement, preparation, and consumption may have been present, with processing tools rare or in low frequencies. Hearths, if present, should have been placed outside the structure and used for food preparation rather than heat. Repeated use over a long period of time may have resulted in greater artifact frequencies and resulted, archaeologically, in some degree of difficulty in segregating the evidence of daily use from the evidence of biseasonal use.

Seasonally used fieldhouses would have been located near fields that were too distant for daily travel. Use would have occurred during planting, pre-harvest, harvest, and when the crops were threatened by bird or animal foraging. Full-time surveillance of the fields could have been necessary. A household with a substantial structure could have been established (B. Moore 1978:12), which would have minimized the inconvenience created by distant field locations. This behavior pattern would have resulted in more highly visible archaeological remains, possibly including weakly stratified midden deposits. Early surveys and research projects in the Southwest were often less concerned with artifact scatters not associated with architecture. As a result, the remains of less substantial fieldhouses were not identified by Haury (1956).

The evidence of biseasonal use with continual occupancy during the growing season will be difficult to distinguish from the evidence of year-round occupation. An artifact assemblage reflecting nearly a full range of food preparation, tool production, and maintenance activities should be present. Characteristics of full-time residency, which are not expected to be present, would include interior hearths for heating and cooking; ritual features, such as kivas; weakly stratified or unstratified midden deposits; and other features from which evidence of non-seasonal occupation may be derived.

Occasional use by travelers or wayfarers might not be distinguishable from other uses. Use of existing hearths, tools, and containers is likely, and introduced objects may not be distinguishable from existing items.

Repeated occupation of a fieldhouse would result in mixed deposits. Annual or periodic reuse of these more substantial fieldhouses would result in an artifact assemblage that is very similar to that of a residential site. Sebastian (1983:411) classifies full-time or substantial fieldhouses as a substantial structure with an interior hearth and a concentration of trash reflecting a full range of domestic activities. The actual length of occupation, the number of occupants, and the number of times they or their descendants return may be extremely variable. Substantial fieldhouses are also known as farmsteads (Wilcox 1978; Haury 1956).

In addition to their use as habitations, masonry fieldhouses may have served as storage units (Wilcox 1978:28). Such fieldhouses would have allowed the farmer to transport the harvested crop on demand rather than immediately after harvest. This would have been desirable if the distance between the fieldhouse and winter residence was great. Another reason for a more seasonally intensive use of fieldhouses could be the need to build and maintain water and erosion control devices (Wilcox 1978; J. Moore 1985).

Fieldhouses may have functioned as rest stations or base camps for hunting and gathering forays and trade trips. While these activities might have increased artifact frequencies, they might not presently be separable in the archaeological record. Binford (1980) observed a great amount of variability and overlap in site use by mobile hunters and gatherers. B. Moore (1978:14) and Sebastian (1983:404) suggest that residents of seasonal or full-time fieldhouses would also have relied on hunting and gathering for food. The processing and cooking of gathered foods and stored grains at a habitation would have resulted in an artifact assemblage that virtually masks the remains of past hunting and gathering activities.

Besides acting as shelters and part-time homes, it is possible that masonry or well-maintained jacal structures may have served as boundary markers or symbols of ownership (Kohler 1992). A maintained structure would be visible proof of field ownership. This might have been important as population in the Acoma Province increased and primary farmland became more valuable. Primary farmland would have been close to the settlement, well watered, and productive. Greater competition for fields could have made the marking of ownership necessary, especially after the Red Mesa phase.

This brief overview of fieldhouse attributes and functions demonstrates that there was much variability in form and function. Two main attributes-the nature of their artifact assemblages and their archaeological visibility-are conditioned by the distance from a primary habitation, reason(s) for occupation, duration of occupation, number of occupations, number of occupants, and types of activities performed. These variables are by no means mutually exclusive and each depends, to some extent, on the others.

Gathering sites. Gathering sites, when used only for that purpose, may have had characteristics that were different from those of fieldhouses. These characteristics are derived mostly from attributes assigned by archaeologists to Archaic period sites and from studies that included so-called gathering sites (Sebastian 1983; Reher 1977; Moore and Winter 1980). Gathering sites may be present for temporal components suggested by the site data.

1. Structure. Structural evidence may be absent or, if it is present, should be insubstantial. Examples of insubstantial structures are lean-tos or wickiups. Evidence of these structures may include shallow, saucer-shaped depressions or postholes. Structures would be used primarily for shelter against wind and rain and for very temporary seasonal use.

2. Site location. Gathering sites should have been located in environmental transition zones where plant diversity was high, allowing for exploitation of a wide range of plant species. Alternatively, site locations may have been near areas where one seasonal plant could have been harvested in abundance. Sites may or may not have been located near potentially arable land.

3. Pattern of use. The use of gathering sites should have been seasonal and short term. Overnight stays are implied, and the length of stay probably corresponded to the amount of time it took to collect a sufficient supply of a given resource. Depending on the distance from the habitation and the nature of the resource, the length of stay may have included processing time. Features may have included interior and exterior hearths, and fire-cracked rock discard piles or scatters. Artifact assemblages would have reflected a focus on processing tools such as grinding implements, scrapers, and hammer stones. The types of seeds or nuts gathered for processing would have dictated the types of ground stone utilized. Diversity in ground stone may be expected if transitional zones were exploited. A more restricted tool kit should have occurred with single or limited resource procurement. Small numbers of vessels for consumption and processing and short-term storage vessels are expected. Reworked vessel fragments used as scoops or plates may also be present.

Survey recording of LA 54902, LA 89019, LA 108511, and LA 149868 suggests that they could have been fieldhouses or foraging locations. The excavation and recording of architectural and feature remains should provide site structural information that can be related to the intensity and duration of the occupation, as well as to the range of site activities. By analyzing the surrounding area for agricultural potential it should be possible to assess the spatial relationship of the sites to potential fields or gathering resource areas. Recovery of floral and faunal remains from features and trash deposits should provide information about the range of activities performed at the sites. Depending on specimen preservation, indexes of seasonality using plant remains may be developed. Recovery and analysis of artifacts will also provide information about the activities performed, and artifact distributions may lead to inferences about the intensity of occupations and the potential for repeated occupations. Field and analytical methods, frameworks, and ancillary research directions are provided in the following section.

Historic Period Components

LA 89019 and LA 149868 are multicomponent sites with prehistoric and historic features and artifacts. The historic-era features probably date from the late Territorial period (AD 1879 to 1912) and most likely reflect aspects of a pastoral subsistence pattern. Grazing was the primary subsistence activity in the local rural landscape throughout the historic period beginning with sheep and changing to cattle around the turn of the century (Polk 2000:12–13; Tainter and Gillio 1980:142–143). Hispanics were centered in the Town of Cubero Grant with domestic residences at the town of Cubero several miles northwest of the project area. Pueblo Indians were centered at the Pueblo of Acoma and smaller villages, such as Acomita. Both Pueblo Indians and Hispanics practiced a grazing economy within the checkerboard pattern of land ownership that characterizes the project area.

LA 89019 contains a single rectangular sandstone structure foundation measuring about 6.8 m by 6.5 m. A hole-in-top can fragment and a single fragment of purple glass were the only historic artifacts noted in the area. The site occupation date range is based on the artifact manufacture dates. The low-frequency artifact assemblage and lack of midden argues for a seasonal rather than full-time domestic occupation. The site is located on a private grantee parcel (Baca) within the Town of Cubero Grant. Alternative 5 will affect 60 percent of LA 89019 including the entire foundation of the structure.

LA 149868 contains three historic features including a similar rectangular sandstone structure foundation measuring 4.9 m by 3.0 m, a concentration of unmodified pieces of sandstone measuring about 4.5 m in diameter, and a reservoir measuring about 6.0 m in diameter. Historic artifacts were limited to two pieces of unidentified metal, an unidentified can top, and a small spot-solder (milk) can. The site was given a date of ca. 1900 based on these few artifacts. The small reservoir suggests a concern for grazing activities, but the small number of artifacts again argues for a seasonal rather than a full-time domestic occupation. The site has general Town of Cubero Grant land status. Alternative 5 roads will affect the north and south edges of LA 149868, but the historic-era features will not be impacted. At the most, a few scattered historic-era artifacts may be in the site area affected by Alternative 5.

LA 89019 and LA 149868 are only about 60 m apart suggesting that the historic era features on the two sites may actually be related or contemporaneous. The low frequency of surface artifacts argues for a seasonal pastoral subsistence pattern within the shifting socio-political boundaries of Acoma Pueblo and the Town of Cubero Grant. Acoma land parcels are just to the south and east of the Town of Cubero Grant parcels containing the sites. Some nine historic pueblo residential and ranching components have been recorded showing rather extensive Pueblo local land usage. The site area is still currently utilized for grazing.

Research Questions and Data Needs

It is unrealistic to pose complex questions about the rather ephemeral features and low-frequency artifact assemblages present at the sites. Therefore, two basic domains will be investigated to better understand the place of the sites in the regional settlement pattern: temporal context and site function.

Temporal Context

> *What is the temporal context of the historic era features?*

The sites, together, are currently dated to around AD 1900 based on five artifacts. Dating of the sites is the first step in understanding regional patterns of social and subsistence organization, and the relationship of the site to larger social aggregations. Minimally, the recovery and analysis of the artifact assemblages will supply temporal information. A search of documents in the state archives centered around the Cubero Town Land Grant may provide an additional source of temporal information. Lastly, interviews with members of the Town of Cubero Grant association and Acoma tribal members with help from the Acoma Historic Preservation Office may provide oral testimony unrecorded in public documents.

Site Function

> *What was the function of each site? Are the sites actually related to an aspect of a seasonal grazing economy? Were the sites associated with sheep or cattle grazing? Is the feature at LA 89019 the remains of a habitation or storage structure or some kind of animal pen or corral? Is it possible to delineate whether the site occupants were of Hispanic or Pueblo cultural affiliation?*

Again, the recovery and analysis of the artifact assemblages will supply baseline information on the range of activities, duration of occupation, and possibly cultural affiliation, which will begin to shed light on settlement and subsistence. The presence or absence of manure may inform on the function of the LA 89019 feature. However, Cattle et al. (1977) concluded that the best mitigation of sites attributed to Laguna herding was through ethnological rather than archaeological fieldwork. Archaeology will complement an understanding of site function, but an examination of documents and oral interviews will most likely provide information critical to the understanding of site function. As with the question of temporal affiliation, a search of documents in the state archives centered around the Town of Cubero Grant may provide an additional source of documentary information. Similarly, interviews with members of the Town of Cubero Grant association and Acoma tribal members with help from the Acoma Historic Preservation Office may provide oral testimony unrecorded in public documents relevant to site function.

GENERAL FIELD METHODS

This section provides a general overview of the techniques that will be used during data recovery investigations. Because each site has unique characteristics, specific work plans for each site are provided in the next section. The methods, which are tailored to data recovery at the four sites are, in part, adapted from Boyer et al. (2003:67–72)

Horizontal Provenience

The first step in excavation will be to establish a Cartesian grid system across the site. The main site datum, usually designated as the intersection of the 100 N and 100 E or the 500 N and 500 E lines in the grid, will be used to reference all horizontal and vertical measurements. A plan of the site will be prepared, illustrating the locations of excavation areas, structures, and features.

Surface collection and excavation units will be linked to the grid system. These units will be identified by the grid lines that intersect at their southwest corners. The basic excavation units will be 1-by-1-m grid units, but naturally defined horizontal and vertical units are considered optimal. Therefore, areas with probable features visible from the surface will first be cleared using grid control until a unit such as a structure, or other feature type is defined, at which time they will become independent excavation units. Very large features (such as structures) will be subdivided, usually into halves or quadrants, to increase the precision of horizontal provenience control. Point proveniencing or point plotting within these horizontal subdivisions will be tied to the Cartesian coordinate system.

Vertical Provenience

Just as the horizontal grid system will be linked to the main datum, so will all vertical measurements. All such measurements will be made in meters with 10.00 m as an arbitrary elevation for the site main datum. All elevations will be recorded relative to the site main datum. Since it is often difficult to provide vertical control for an entire site with one datum, additional sub-datum locations will be established as needed. Horizontal and vertical control of these points will be maintained relative to the main datum.

Before it is possible to delimit the extent and nature of soil or sediment strata, it is usually necessary to examine them in cross section. This requires the excavation of exploratory units, which will consist of 1-by-1-m grid units excavated in arbitrary 10-cm vertical levels and/or of auger transects with auger holes spaced at 2 m intervals. When natural divisions—soil or sediment strata—have been defined, they will be used to delimit the boundaries of a level. Outside exploratory grid units, strata will be used as the main units of vertical excavation. In general, stratigraphic control for any feature will be established through controlled excavation of part of the feature to provide a profile. The profile will then guide removal of the remaining fill in natural stratigraphic units, if necessary. Fill immediately above defined use surfaces (formal floors or other activity surfaces) will be removed as single units of 10 cm or less, leaving floor artifacts in place for plotting. Floor artifacts and samples will be numbered sequentially (point proveniences or pp numbers), located horizontally and vertically, and indicated on feature maps. Sub-floor tests will be placed in any excavated architectural feature to ascertain whether cultural deposits continue below; all excavations will be taken to sterile soil.

Mechanical Excavation

Exploratory backhoe trenches are planned for the data recovery plan, particularly in the area north of the interstate highway where deeper soils are expected and surface development may mask buried cultural deposits. Backhoes will be equipped with buckets between 32 to 36 inches (81 to 91 cm) in width, and trenches will be excavated to a minimum width of 35 inches (90 cm) and to a maximum depth of 4 ft (1.2 m).

An archaeologist will monitor the excavation of each backhoe trench (BHT). Functionally or temporally diagnostic artifacts will be opportunistically collected from trench back dirt as they are observed. After excavation, loose and smeared soil will be cleaned off the trench walls with hand tools, and all trenches will be closely examined for exposed cultural deposits or features. The stratigraphic character and cultural content of each backhoe trench will be documented on a standardized excavation form. Artifacts found in situ in trench walls may be point-provenienced. Horizontal provenience of trenches will be maintained at each site by assigning each trench a unique number and tying each end of each trench to the Cartesian coordinate grid. Profiles of trench walls will be drawn only when cultural features or strata are present, or to collect geomorphic data.

Mechanical scraping may be employed if Phase I hand augering and excavation fail to encounter cultural deposits. Scraping will also be used to remove non-cultural overburden from above cultural deposits, or to explore for horizontally extensive cultural deposits or features. Mechanical scraping may be accomplished with a wide, smooth-edged bucket or scraping blade. Soil will be removed in 5- to 10-cm-thick layers to minimize disturbance or displacement of features, deposits, or artifact concentrations that may be exposed. An archaeologist will monitor and direct all scraping activities with the goal of identifying and exposing use surfaces, features, or stratigraphic breaks as the scraping proceeds.

Recovery of Cultural Materials

Most artifacts will be recovered in three ways: visual inspection of levels as they are excavated, screening though variable-sized mesh, or through collection in bulk samples that can be processed in the laboratory rather than the field. Regardless of how cultural materials are collected, they will all be inventoried and recorded in the same way. Collected materials will be assigned a field specimen (FS) number which will be listed in a catalog and recorded on all related excavation forms and bags of artifacts. FS numbers will be tied to provenience, so that all materials collected from the same horizontal and vertical provenience units will receive the same FS number. From the point of excavation through the analysis and curation phases, the FS number will be the primary tool to maintain the relationship between recovered materials and associated spatial information.

Most artifacts will be recovered by systematically screening soil and sediment removed from excavation units. All soil and sediment from exploratory grids and features will be passed through screens. Two sizes of screen, 1/4-inch and 1/8-inch mesh, will be used. While many artifacts are usually large enough to be recovered by 1/4-inch mesh, some, such as smaller biface flakes, are too small to be retrieved by that size screen. These artifacts can provide important clues about the activities that occurred at a site. However, there is a trade-off in gaining this additional information. As the size of mesh decreases, the amount of time required to screen soil and sediment to recover artifacts increases. Sampling is a way to balance these concerns; thus, smaller mesh will only be used under certain circumstances. Rather than establishing specific guidelines for sampling by 1/8-inch mesh screens, it is considered better to leave this to the discretion of the site supervisor. However, at a minimum, all soil and sediment in certain types of features (such as hearths and ash pits) will be screened through 1/8-inch mesh (if not collected), as will all soil and sediment at floor or living surface contacts. Other potential applications of this recovery method include culturally deposited strata and activity areas.

Other cultural materials, such as macrobotanical samples, will be recovered from bulk soil or sediment samples. In general, samples for flotation analysis will be collected from culturally deposited strata and features. The sediments that comprise cultural features will only be sampled in their entirety because types of information unrelated to subsistence might be available from the structure of deposits in features or the placement of certain types or classes of artifacts in the feature at the time of abandonment. Where adequate material is available within a provenience, samples should contain at least 2 liters of soil. Macrobotanical materials like corn cobs, piñon shells, wood samples for identification, charcoal, etc., will be collected as individual samples whenever found. All botanical samples will be catalogued separately and noted on pertinent excavation forms.

Field collection of pollen will be determined by feature or stratigraphic context. First priority samples will be taken from lower structure and feature strata and floors. Preferred collection points should not exhibit evidence of post-occupation disturbance or mixing. Second priority samples will come from upper feature fill or proveniences that exhibit limited evidence of disturbance. A control sample will be collected from each off-site location to allow the pollen analyst to account for sample contamination with modern pollen. Samples will be taken from unburned contexts and stratigraphic contexts in possible field or agricultural locations.

Up to ½ cup of soil will be collected from all features or internal feature strata for pollen or other macrobotanical analyses. These samples will be collected in coin envelopes and labeled with provenience information. Samples will be sealed in the field. They may be opened in the laboratory to determine if they have dried sufficiently for repackaging according to analyst instructions.

Specific Field Methods: Structures, Features, and Extramural Areas

Most excavation will be accomplished using hand tools. Methods of excavation will vary depending upon whether a structure, a feature, or an extramural area is being examined.

Structures

Individual numeric designations will be assigned to structures on a site, as well as to the rooms they contain. Excavation within rooms or single-room structures will begin by digging an exploratory trench, in 1-by-1-m grid units, from one wall to the center of, or completely across, a room. Soil and sediment in each unit will be screened through 1/4-inch mesh. Due to safety concerns, exploratory trenches will not exceed 1.3 m in depth. Below 1.3 m, adjacent unit(s) or quadrant(s) may be removed to guard against collapse. Exploratory trenches will be excavated by grid units to provide controlled samples and cross sections of the deposits. In some cases, this procedure will be repeated, perpendicular to the initial trench, to provide additional information on the filling processes. The exploratory cross section(s) or profile(s) will be mapped and the nature of the fill defined. Remaining fill will be excavated by quadrant. Quadrant boundaries will be determined by the locations of grid lines or exploratory trench(es) and, thus, may not always be the same size.

At least one quadrant, whether cultural or non-cultural in nature, will be excavated by the defined strata. This method will provide a sample of materials associated with these strata, allowing for a more comprehensive understanding of the fill sequence. Recognizing that quadrants are rarely equal in size, the quadrant(s) selected for sampling will usually be the largest, in order to maximize the number of artifacts recovered from each stratum. However, a smaller quadrant may be chosen if defined strata are better represented. Factors determining quadrant selection include the presence of representative strata, the potential for obtaining a representative sample of associated materials, and the discretion of the site supervisor. For example, if a structure is filled with cultural deposits that address specific research questions, more than one quadrant may be sampled. Remaining fill will be removed without screening, though artifacts will be collected when observed. All roof fall, intact trash deposits, floor fill, and floor deposits will be screened.

Following complete excavation of a structure, architectural details will be recorded on a series of forms. Building elements encountered during excavation will be included. In particular, any roof elements found during excavation will be mapped and described. Samples of roof material, if encountered, will be collected for species identification. Descriptions of individual rooms will include information on wall dimensions, construction materials and techniques, and associated features. In addition, scaled plan and profile maps of each structure will be drawn, detailing the locations of rooms and internal features, artifacts found in direct contact with floors, and any other details considered important. A series of 35-mm black-and-white photographs will be completed for each structure showing its overall form, individual rooms, construction details, and the relationship of features with other architectural elements. In addition, digital photographs may be taken during excavation when warranted and 35-mm color slides may be taken at the discretion of the site supervisor.

Features

Features will constitute individual horizontal provenience units. Features will be assigned sequential numbers as they are encountered at a site. Feature numbers will be recorded on a feature log. Feature information will be recorded on a feature form describing, in detail, its shape, content, use history, construction detail, and inferred function. All features will be photographed, using 35-mm black-and-white film, documenting the excavation process. Other photographs, including 35-mm color slides and digital images, showing construction or excavation details may be taken at the discretion of the excavator.

After defining the horizontal extent of a feature, such as a hearth or ash pit, it will be bisected. To efficiently define internal stratigraphy, one half of the feature will be excavated in a single level and fill collected. A scaled profile of internal strata will be drawn. The second half will be removed by internal strata. Flotation and pollen samples will be recovered from each associated stratum and remaining fill (depending on volume) will be screened through 1/8-inch mesh or collected. After all the fill has been removed, a second cross section, perpendicular to the soil profile, will be drawn illustrating the feature's vertical form. In addition, a scale plan of the feature showing the grid location, size, and location of profile lines will be drawn.

Excavation of Extramural, Feature-Related, or Midden Areas

Areas outside structures or around features like hearths were often used as work areas. Thus, certain zones may be examined to determine whether work areas can be defined. Excavation in these zones will proceed by grid unit. Most soil and sediment encountered during these investigations will be screened through 1/4 or 1/8-inch mesh depending on the circumstances. Plans of each extramural area investigated will be drawn, detailing the excavation limits and location of any features.

Midden deposits can be extensive and deep. If midden deposits are encountered, depending on the depth below surface, overburden will be removed by hand or mechanical equipment to expose the feature limits. Once the extent of the midden is known, a trench consisting of contiguous 1-by-1-m units will be excavated across two axes. If internal features are present, excavation units will be expanded to define them. Features will then be excavated as outlined above. Following excavation of the two cross trenches, the midden excavation may halt depending on the field archaeologists' judgment as to whether sufficient data has been recovered to address the research questions. Additional excavation units may be placed in the midden area to recover additional information, if warranted.

Special Situations

Sensitive Materials

This category pertains to the discovery of culturally sensitive materials or objects of religious importance. At this time, the only special situations we can prepare for are human burials, but no burials are expected given the apparent non-residential nature of the sites. If human remains are encountered at the sites, OAS will abide by all stipulations contained in 4.10.11 NMAC and any special stipulations imposed by the CPRC, the state archaeologist, and the SHPO. Specific procedures are determined by land ownership status and associated statutory and regulatory requirements.

As appropriate, consultations will be initiated upon the initial recognition of fragmentary or articulated human remains. Human remains will be excavated using standard archaeological techniques, including the definition of the burial pit, the use of hand tools to expose skeletal materials, the mapping and photographing of the positions of the skeleton and grave goods, and the collection of appropriate non-osteological samples.

While human remains or other sensitive materials are being excavated, no person will be allowed to handle or photograph them except as part of data recovery and repatriation efforts. Photographs of sensitive materials related to data recovery efforts will not be released to the media or general public.

Unexpected Discoveries

There is always a risk of finding unexpected deposits or features during an archaeological excavation. This is especially true for the project outlined in this plan since it is based solely on survey observations. Procedures that will be followed in the event of an unexpected discovery will vary with the nature and extent of the find. Small features, structures, or cultural deposits that were not anticipated will be excavated according to the procedures outlined above. On the other hand, finds that have the potential to significantly alter the scope and intent of this plan, such as spatially extensive buried components, will require consultation with the NMDOT, the State Historic Preservation Division, the Bureau of Indian Affairs, and the Pueblo of Acoma. Our knowledge of LA 54902, LA 89019, LA 108511, and LA 149868 is limited to surface materials, some of which may have been unearthed by recent construction activities. Consequently, data recovery excavations at the sites will proceed in phases oriented toward:

1. Assessing the nature, depth, and extent of deposits at each site, and
2. Recovering data from the components represented at each site.

Because the scope of the data recovery effort has been determined by the selected design alternative, data recovery strategies for each site will be organized according to the parameters set by the implementation of Alternative 5. Any modifications of the design alternative will most likely be within the overall scope of the research orientation, and strategies will be amended as necessary to accommodate the modifications.

DATA RECOVERY STRATEGY FOR ALTERNATIVE 5 SITES

LA 54902

LA 54902 covers a 606-sq-m area, of which 202 sq m is within Alternative 5. Artifact frequency within the project area is low. Potential for soil depth is high because of the gentle slope and probable long-term geomorphological stability. A Cebolleta phase component is indicated by the pottery types.

Phase 1: Site preparation and preliminary investigations.

1. Establish site grid and main datums.
2. Systematic surface artifact location within project limits.
3. Preliminary site mapping including feature or artifact concentration locations.
4. 100 percent artifact collection employing an electronic total station or optical transit for point-proveniencing in low density areas and 1-by-1-m collection units in higher density areas.
5. Placement of four to eight 1-by-1-m excavation units in artifact concentrations. A series of auger transects (two to eight) will be placed appropriately, with auger holes spaced at 2-m intervals. If no concentrations are identified, then excavation units will be spaced at systematic intervals across the site.
6. If subsurface cultural materials, features, or deposits are encountered, excavations will be expanded and follow the Phase 2 strategy.
7. If no artifacts are encountered, then three 14-m-long backhoe trenches will be excavated at 5-m intervals across the site area constituting a 20 percent sample.
8. If no subsurface cultural materials, features, or deposits are encountered, the backhoe trench stratigraphy will be profiled and pollen samples collected from each major stratum. Pollen samples will be collected at 2–3-m intervals from trenches cut 10–15 cm below the surface to examine for pollen indictive of an agricultural field.
9. If artifacts, features, or cultural deposits are exposed, excavation will follow the Phase 2 strategy.
10. Final site recording and mapping, if no subsurface artifacts, features, or cultural deposits are encountered.

Phase 2: Excavation of features and deposits and recovery of artifacts and samples.

11. Phase 1 hand or mechanical excavation will be expanded to define and fully excavate the features or define the extent and depth of artifact distributions or cultural deposits (i.e., midden). Excavation around features will be expanded to expose associated surfaces, features, or deposits.
12. Features, structures, and deposits will be excavated using hand techniques and documented following procedures outlined in Data Recovery Field Methods.
13. Site map will be annotated to show excavation areas and features or cultural deposit extent.
14. Once hand excavation and documenting of artifacts, features, or cultural features has been completed, backhoe excavation of two or three trenches across the excavation area will be used to determine if other features or intact cultural deposits are present at similar or deeper stratigraphic levels. If no additional features or intact cultural deposits are encountered, work will be halted.
15. If additional features or cultural deposits are encountered; the Phase 2 procedures will be repeated. Mechanical equipment may be used to remove non-cultural material-bearing overburden to advance the hand-excavation effort.
16. Final site mapping conducted.

LA 89019

LA 89019 covers a 12,230-sq-m area, of which 8,030 sq m is within Alternative 5. Temporally diagnostic artifacts indicate the presence of late Paleoindian-Early Archaic, Early and Middle Archaic, Pueblo I and Pueblo II, and historic period components. Prehistoric surface artifacts are most visible and abundant in deflated or blow-out areas that cover the north half of the site area. The south half is covered by dune deposits of varying stability with fewer prehistoric artifacts visible. The historic component is in the southwest portion of the site area to be investigated with few associated artifacts.

Phase 1: Site preparation and preliminary investigations.

1. Establish site grid and main datums.
2. Systematic surface artifact location within project limits.
3. Preliminary site map locating features, temporally diagnostic artifacts, and artifact concentration locations.
4. 100 percent artifact collection employing an electronic total station for point-proveniencing in low density areas and 1-by-1-m collection units in higher density areas.
5. Excavate a 1 percent sample of subject area using 1-by-1-m units with half of the units distributed systematically across the investigation area to provide preliminary information on stratigraphy, artifact distribution, and cultural deposit extent and integrity. A geomorphologist will examine strata exposed in a sample of the hand-excavation units. The geomorphological assessment will be used to guide Phase 2 excavations and mechanical scraping.
6. If subsurface cultural materials, features or deposits are encountered, excavations will be expanded and follow the Phase 2 strategy.
7. If scattered, low frequency artifact distributions and no features are encountered, then five areas 5-by-20 m in dimension will be mechanically scraped to non-cultural material-bearing levels. The 500-sq-m mechanically scraped area will constitute 10 percent of the more stable dune area within Alternative 5.
8. If no subsurface cultural materials, features, or deposits are encountered, then the investigation will be halted.
9. If artifacts, features, or cultural deposits are exposed, excavation will follow the Phase 2 strategy.
10. Final site recording and mapping will be completed, if no subsurface artifacts, features, or cultural deposits are encountered.

Phase 2: Excavation of features and deposits and recovery of artifacts and samples

11. Phase 1 hand or mechanical excavation will be expanded to define and fully excavate the features or define the extent and depth of artifact distributions or cultural deposits (i.e., midden). Excavation around features will be expanded to expose associated features or deposits.
12. Features, structures, and deposits will be excavated using hand techniques and documented following procedures outlined in Data Recovery Field Methods.
13. Site map will be annotated to show excavation areas and features or cultural deposit extent.
14. Once hand excavation and documentation of artifacts, features, or cultural features has been completed, mechanical scraping of up to 500 sq m will be completed within the most stable dune areas or peripheral to excavations areas that had horizontally or vertically extensive occupation components. If no additional features or intact cultural deposits are encountered, work will be halted.
15. If additional features or cultural deposits are encountered, the Phase 2 procedures will be repeated. Mechanical equipment may be used to remove non-cultural material-bearing overburden to advance the hand-excavation effort.
16. Final site mapping conducted.

LA 108511

LA 108511 covers a 7,170-sq-m area, of which 40 sq m or less than 1 percent is within Alternative 5 as indicated by surface artifacts. Artifact frequency within the project area, which passes through the southernmost site limit, is low. The potential for soil depth is high because of the gentle slope and probable long-term geomorphological stability. White Mound and Cebolleta phase components are indicated by the pottery types. Further, subsurface deposits have been unearthed by recent construction and utility installation activities.

Phase 1: Site preparation and preliminary investigations.

1. Establish site grid and main datum.
2. Systematic surface artifact location within project limits.
3. Preliminary site mapping including feature or artifact concentration locations.
4. 100 percent artifact collection employing an electronic total station or optical transit for point-proveniencing in low density areas and 1-by-1-m collection units in higher density areas.
5. Placement of two 1-by-1-m excavation units, or one or two auger transects, with auger holes placed at 2-m intervals, to determine the depth of the cultural deposit within the project area.
6. If subsurface cultural materials, features, or deposits are encountered, excavations will be expanded and follow the Phase 2 strategy.
7. If no artifacts are encountered, then one backhoe trench will be excavated across the site area. Also, one 50-m-long backhoe trench will be excavated within the planned access road limit adjacent to LA 108511. This trench will be part of a series of backhoe trenches that will be excavated to ensure that buried cultural deposits are not within non-site areas.
8. If no subsurface cultural materials, features or deposits are encountered, the backhoe trench stratigraphy will be profiled and pollen samples collected from each major stratum. Pollen samples will be collected at 2–3-m intervals from trenches at 10–15 cm below the surface to examine for pollen indicative of an agricultural field.
9. If artifacts, features, or cultural deposits are exposed, then excavation will follow the Phase 2 strategy.
10. Final site recording and mapping, if no subsurface artifacts, features, or cultural deposits are encountered.

Phase 2: Excavation of features and deposits and recovery of artifacts and samples

11. Phase 1 hand or mechanical excavation will be expanded to define and fully excavate the features or define the extent and depth of artifact distributions or cultural deposits (i.e., midden). Excavation around features will be expanded to expose associated features or deposits.
12. Features, structures, and deposits will be excavated using hand techniques and documented following procedures outlined in Data Recovery Field Methods.
13. Site map will be annotated to show excavation areas and features or cultural deposit extent.
14. Once hand excavation and documentation of artifacts, features, or cultural features has been completed, one or more backhoe trenches across the site will be excavated across the excavation area to determine if other features or intact cultural deposits are present at similar or deeper stratigraphic levels. If no additional features or intact cultural deposits are encountered, work will be halted.
15. If additional features or cultural deposits are encountered, the Phase 2 procedures will be repeated. Mechanical equipment may be used to remove non-cultural material-bearing overburden to advance the hand-excavation effort.
16. Final site mapping conducted.

LA 149868

LA 149868 covers a 3,656-sq-m area, of which 284 sq m are within Alternative 5. Artifact frequency within the project area is low. Alternative 5 incorporates the northernmost site area, which is predominantly a deep stabilized dune deposit. Most of the cultural material and features occur in the southern three-quarters of the site area. Surface artifacts within Alternative 5 may represent limited site activity or distribution through post-occupation disturbances or processes.

Phase 1: Site preparation and preliminary investigations.

1. Establish site grid and main datums.
2. Systematic surface artifact location within project limits.
3. Preliminary site mapping including feature or artifact concentration locations.
4. 100 percent artifact collection employing an electronic total station or optical transit for point-proveniencing in low density areas and 1-by-1-m collection units in higher density areas.
5. Placement of four to eight 1-by-1-m excavation units in artifact concentrations. If no concentrations are identified, then excavation units will be spaced at systematic intervals across the site. Additional placement of one or two auger transects with auger holes will be placed at 2-m intervals.
6. If subsurface cultural materials, features, or deposits are encountered, excavations will be expanded and follow the Phase 2 strategy.
7. If no artifacts are encountered, then two 2-by-20-m areas will be mechanically scraped to the bottom of potential cultural-material bearing deposits, as defined by the geomorphological examination of site stratigraphy at LA 89019.
8. If no subsurface cultural materials, features, or deposits are encountered, the investigation will be halted.
9. If artifacts, features, or cultural deposits are exposed, then excavation will follow the Phase 2 strategy.
10. Final site recording and mapping, if no subsurface artifacts, features, or cultural deposits are encountered.

Phase 2: Excavation of features and deposits and recovery of artifacts and samples

11. Phase 1 hand or mechanical excavation will be expanded to define and fully excavate the features or define the extent and depth of artifact distributions or cultural deposits (i.e., midden). Excavation around features will be expanded to expose associated features or deposits.
12. Features, structures, and deposits will be excavated using hand techniques and documented following procedures outlined in Data Recovery Field Methods.
13. Site map will be annotated to show excavation areas and features or cultural deposit extent.
14. Once hand excavation and documenting of artifacts, features, or cultural features has been completed, work will be halted.
15. Final site mapping conducted.

Non-Site Areas

LA 54902 and LA 108511 are in an area with the potential for deep, stable alluvial or colluvial deposits. These potentially stratified deposits may contain or overlie cultural materials, features, and deposits that are not represented or are poorly indicated by the surface materials. Therefore, to minimize the potential for unexpected discoveries during Alternative 5 construction, a series of backhoe trenches is proposed for the open or non-site spaces north of Interstate 40 and west of the existing Exit 102 Acomita Interchange. A work plan is provided for the backhoe trench placement and excavation. If subsurface cultural deposits are found, the nearest site limit will be expanded to incorporate the new finds.

To the west and northwest of LA 54902 is a 30,000-sq-m area of stable colluvial deposits. Up to eight backhoe trenches ranging in length from 25 to 75 m long and spaced at 60 m intervals will be excavated to a minimum of 1.3 m deep, where possible. The backhoe trenches constitute a 1 percent spatial sample of the area. We expect that a 1 percent sample should be sufficient to determine if extensive buried cultural deposits or features are present. If cultural deposits or features are encountered, the Phase 2 excavation protocol will be implemented. If no evidence of cultural deposits or features is encountered, then the backhoe trench stratigraphic profile will be documented and pollen samples will be collected from the major strata visible in each trench. Pollen samples will be collected at 2–3-m intervals from trenches at 10–15 cm below the surface to examine for pollen indicative of an agricultural field.

An access road is planned for the area to the south and west of LA 108511. The road corridor passes through the south site limit. As previously mentioned, one 50-m-long backhoe trench will be excavated parallel to the current site limit. Three other 50-m-long backhoe trenches will be spaced at 50-m intervals along the length of the proposed road corridor. We expect that these trenches will expose any extensive cultural materials or features that may be encased by potentially deep alluvial deposits. If cultural deposits or features are encountered, Phase 2 excavation strategies will be implemented. If no evidence of cultural deposits or features is encountered, then the backhoe trench stratigraphic profile will be documented and pollen samples will be collected from the major strata visible in each trench, as per the pollen collection protocol described above.

Chronometrics
by James L. Moore

Accurate dates are needed in every archaeological study to place sites in the proper chronological context, both locally and regionally. Inaccuracies are built into many chronometric techniques, or perhaps more properly phrased, some methods may not actually reflect the age of the cultural event they are being used to date. In order to assign accurate occupational dates to a site, it is usually desirable to obtain as many types of chronometric data as possible. That way they can be used to cross-check one another and to permit the researcher to identify and eliminate faulty dates. Several categories of chronometric data are potentially available from the sites, including dateable artifacts, radiocarbon samples, archaeomagnetic samples, OSL dates, and tree-ring samples. Each category can provide useful and important temporal information, but there are also problems associated with each. Various types of samples will be collected under different circumstances, as detailed below.

Relative Dating of Artifacts

Several categories of artifacts have the potential to provide relative dates, including pottery, flaked stone, and Euroamerican artifacts. It is likely that only pottery will provide the dating resolution needed to address research issues posed for Puebloan remains. Ceramic types that have been dated by tree-ring correlations can be especially useful, and an attempt will also be made to seriate the local ceramic sequence. If any of the components yield independent and high-precision chronometric results, this should help fine-tune both the prehistoric and historic ceramic sequence, and may improve the accuracy of dates assigned by pottery associations.

Some flaked stone artifacts also have the potential to provide relative dates. Projectile points, in particular, are often used for this type of dating (see, for instance, Thoms 1977; Turnbow 1997). Unfortunately, dates for specific projectile point styles are usually not well anchored and, in most cases, they can only be assigned to time spans measured in centuries or millennia rather than years or decades. Some styles were used for long periods of time, often overlapping a wide range of ceramic types and styles. In addition, projectile points were frequently collected from earlier sites and reused, thus "contaminating" later sites with earlier styles.

Euroamerican artifacts are another source of dating information. Manufacturing techniques, brand names, and other technological attributes can be very sensitive temporal indicators. Various earthenwares often have very long temporal spans, but a few types have fairly limited production spans and can provide useful temporal data.

Obsidian Hydration

Certain other flaked stone materials are somewhat more useful for dating sites. The physical properties of obsidian allow it to be dated, but the results are often questionable and open to interpretation. This type of analysis is based on the tendency of obsidian to absorb moisture at a relatively constant rate, depending on certain factors. The first of these factors is source. Obsidians from different flows vary in composition and absorb moisture at different rates. This problem can be overcome by certain tests (such as x-ray fluorescence) that provide information on the elemental makeup of obsidians, allowing them to be assigned to sources with known hydration rates (if a match exists). Temperature and soil moisture also affect the rate at which obsidian absorbs moisture. By placing sensors on or next to sites to monitor variations in soil moisture and temperature over time, enough information can be gathered to take these effects into consideration. Since it appears that obsidian found on the surface or at shallow depths hydrates at a different rate than does obsidian found in deeply buried contexts (where soil temperature and moisture content are more constant), the analysis of samples from less than a meter deep is considered to be less than desirable. If deep cultural deposits are encountered, it is unlikely that obsidian will be the only temporally sensitive material present.

However, even when obsidians are sourced and calibrated to their respective environmental variables, this dating method is fraught with potential problems. Foremost among them is the determination of what event is being dated. Obsidian is perhaps the best material available in the Southwest for the production of flaked stone tools, and it does not occur naturally in the immediate project area. Obsidian, therefore, had to be imported (the nearest sources are associated with Mount Taylor or lag gravel deposits from the Rio San José), and it therefore represented a desirable resource if found on abandoned sites. The collection and recycling of high quality raw materials in antiquity, especially obsidian, can result in much of the obsidian on sites having been salvaged from earlier sites in the area and reused. Thus, depending on what portion of an artifact is sampled, hydration dating analysis could date either the original period of use or a secondary or tertiary period of use.

Given the problems that are associated with obsidian hydration analysis, this method is best used for corroboration when other types of chronometric data are available. It should be used cautiously when it is the only dating technique available. This material will be used to provide chronometric information judiciously or in extreme cases.

Radiocarbon Dating

Radiocarbon analysis has been used to date archaeological sites since the 1950s. While this process was initially thought to provide accurate absolute dates, several problems have cropped up over the years that now must be taken into account. The three most pervasive problems have to do with the ways in which wood grows and is preserved. Both animals and plants absorb a radioactive isotope of carbon (^{14}C) while they are alive. Immediately following death, ^{14}C begins decaying into ^{13}C at a known rate. Ideally, by simply measuring the proportion of each carbon isotope it should be possible to determine how long ago that entity stopped absorbing radioactive carbon. Since plant parts are often available on sites, this technique is usually applied to those types of materials. However, more recent research has tossed a few bugs into the system. For example, some plants use carbon in different ways. This variation can be taken into account by determining the type of plant being dated.

More serious problems are encountered when wood or wood charcoal is submitted for dating (Smiley 1985; Dello-Russo 1999). Only the outer parts of trees continue to grow through the life of the plant, hence only the outer rings and bark actively absorb new carbon. Samples of wood submitted for dating may contain numerous rings, each representing growth in a different year, and each "aging" in terms of isotope ratios with each passing year. Thus, rather than measuring a single event (when the tree died or was cut down), the radiocarbon assay of a series of growth rings averages isotope ratios from the entire span of growth represented in the sample. This "cross-section effect" often tends to overestimate the age of the material. Smiley (1985:385) notes that a large error in age estimation can occur in arid or high-altitude situations, where tree-ring density may be high and dead wood can preserve for long periods of time ("old-wood problem"). Disparities as large as 1,000+ years were found in dates from Black Mesa, and there was an 80 percent chance that dates were overestimated by over 200 years and a 20 percent chance that the error was over 500 years (Smiley 1985:385–386).

The disparity in dates can be even greater when fuel wood rather than construction wood is used for dating (Smiley 1985:372). This is because when residents sought out wood for fuel, they chose dry wood that could have been lying on the surface for several hundred years before it was burned. So when dating the wood from that burning event, the event being measured is the death of the plant, not when it was used for fuel. Furthermore, when wood combusts from the outside in, the burning eliminates the younger carbon of the outer rings and preserves the older carbon of the inner rings for dating. This then compounds the dating issue further.

One other problem with the use of this method is caused by solar activity. Sunspots cause fluctuations in atmospheric ^{14}C levels, and hence in the amount of radioactive carbon absorbed by living entities. This introduces error into the calculations, which is currently corrected by using a calibration based on decadal fluctuations in atmospheric ^{14}C as measured from tree-ring sequences (Suess 1986). While this problem may no longer be as significant as the others mentioned, it indicates that we are still learning about how this isotope is absorbed, how it decays, and how many environmental, behavioral, and sampling factors complicate the dating method.

Even considering these problems, radiocarbon analysis can provide relatively sensitive dates when properly applied. For example, annuals or twigs from perennials represent short periods of growth and can often be confidently used for radiocarbon dating. Construction wood can also be sampled in a way that measures the approximate cutting date rather than a series of growth years. This can be accomplished by submitting only bark and outer rings instead of sending in charcoal that contains inner rings. This is often difficult and time consuming, but this cautious practice provides dates that are much more reliable.

Accordingly, we will only submit radiocarbon samples in certain circumstances. Samples of fuel woods will not be submitted unless there are no other temporally sensitive materials available. Construction wood may be a better material for radiocarbon dating, but only when it comes from small elements like latillas and lintels. Large elements, like vigas and posts, may be sampled, but it must be remembered that they were often salvaged from older structures and reused. Thus, they may be dating the occupation of another structure and not the one being investigated. Construction wood would be sampled as outlined above. Only bark (if available) and outer rings will be segregated for submittal. In general, these materials are more accurately dated by dendrochronology. However, deteriorated wood often does not survive the process of removal in good enough shape or with enough rings to make that type of analysis possible, and not all types of wood can be used for tree-ring dating (e.g., cottonwood). The principal source of radiocarbon samples will be plant parts that can be identified botanically, that can be demonstrated to include one or only a few years of carbon accumulation, and that can be linked to the cultural event that is the target of the dating effort.

Finally, bone is another category of artifact that can potentially provide temporal information. Like wood, bone contains a radioactive isotope of carbon that is amenable to accurate dating. However, floral specimens are better suited for this type of analysis, and it is unlikely that we will find any bone that would be amenable to radiocarbon dating.

Archaeomagnetic Dating

Archaeomagnetic dating analyzes the remnant magnetization in materials that were fired prehistorically. Those materials must contain particles with magnetic properties (ferromagnetic minerals) such as iron compounds like magnetite. Ferromagnetic minerals retain a remnant, or permanent, magnetization, which remains even after the magnetic field that caused it is removed (Sternberg 1990:13–14). The heating of ferromagnetic materials above a certain point (which varies by the type of compound) causes the remnant magnetization to be erased and reestablished (Sternberg 1990:15). Samples of that material can be analyzed to determine the direction of magnetic north at the time of firing. Since magnetic north changes location over time and the pattern of its movement has been plotted for about the last 1,500 years in the Southwest, comparison of this pattern with the archaeomagnetic plot can provide a reasonably accurate date. However, it should be remembered that only the last event in which the material was heated to the point where re-magnetization could occur is being dated. Thus, a feature could have been in use over a span of decades, but this method provides a date only for the last time that the feature was fired to the proper heat.

Archaeomagnetic analysis can potentially contribute good temporal data for sites, providing the properly fired materials are encountered. When a structure burns it occasionally attains the necessary heat for remagnetization to occur and, thus, these events can be dated. However, as noted above, one must keep in mind the event that is actually being dated. An archaeomagnetic date from a pit house hearth cannot be used to place the construction of that structure in a temporal perspective because that is not the event being dated. Thus, archaeomagnetic samples can provide dates for the last use of certain features at a site, but cannot be used to determine when they were built.

Archaeomagnetic samples will be taken whenever possible. In most cases only hearths will be amenable to this type of analysis. However, if other burned soils are found in situ, samples of them may also be taken if they appear related to events that occurred during the time of occupation.

Tree-Ring Dating

This method was developed in the early twentieth century, and is based on the tendency of growth rings in certain types of trees to reflect the amount of moisture available during a growing season. In general, tree-rings are wide in years with abundant rainfall and narrow when precipitation levels are low. These tendencies have been plotted back in time from the present, in some cases extending over several thousand years. An absolute date can be obtained by matching sequences of tree-rings from archaeological samples to master plots. This is the most accurate dating technique available because it can determine the exact year in which a tree died (or was cut down). However, as with other dating techniques, it is necessary to determine what event is being dated.

Because the reuse of wooden roof beams was common in the prehistoric and historic Southwest, it is not always possible to determine whether a date derived from a viga is related to the construction of the structure within which it was found, or to a previous use. Clusters of similar dates in roofing materials are usually, but not always, a good indication of the approximate date of construction. Isolated dates may provide some information, but are often of questionable validity.

Another problem associated with tree-ring dating concerns the condition of the sample being analyzed. In order to represent the year in which a tree stopped growing (or was cut down), the outer surface of the tree is needed. Evidence that the outer surface is present can include the bark covering of the tree, beetle galleries that occur under the bark (either causing tree death or coincident with tree cutting), or outer rings that are continuous around the circumference of the sample. In addition, enough rings must be present to allow an accurate match with the master sequence. It is often possible to provide a date when only inner rings are present, but this will not be a cutting date.

Even considering the potential problems associated with this technique, it represents the best method available for dating sites in the Southwest. Samples of construction materials that appear to contain enough rings for analysis will be collected. Latilla and lintel fragments would be the best specimens for collection, since it is less likely that they were salvaged from earlier dwellings and reused. Since building materials were often salvaged from structures at the time of abandonment or soon after that event, it is probable that few tree-ring samples will be available from these sites.

Optically Stimulated Luminescence (OSL)

As noted above, with other chronometric methods such as the radiocarbon approach, the dating of archaeological sites can be problematic in areas of poor preservation or in situations where charcoal is unavailable and other materials must be dated (e.g., bone). To address some of these concerns, luminescence dating has been applied successfully to archaeological sites, including those in eolian sediments of the Great Plains (Clarke and Rendell 2003; Forman et al. 2001; Stokes and Gaylord 1993) and in southeastern New Mexico (Hall 2002). According to Feathers et al. (2006:1651–1652),

> Luminescence analysis of sediments dates the last exposure to sufficient daylight, a burial event that provides a direct date of sediment deposition. It is applicable to ubiquitous materials, mainly quartz and feldspars, which are abundant in sandy geological settings. Analytical complications can arise from post-depositional disturbance and from partial resetting (or bleaching) of sediment grains at the time of deposition. Therefore, much recent effort has focused on single-grain dating through the examination of age distributional data among grains, allowing disturbance or partial bleaching to be detected.

And, as noted by Hall (2002:8), "OSL has three advantages over radiocarbon: (a) it can provide ages for sandy sediments that lack organic matter, (b) the range of OSL age potential goes much farther back in time than possible for radiocarbon, and (c) OSL can provide accurate ages on sandy sediments less than 200 years old which is more difficult for radiocarbon because of recent fluctuations in the ^{14}C content of the atmosphere."

Samples are collected by driving light-tight cylinders into exposed profiles or from a soil-coring rig. Radioactivity is measured in the laboratory by alpha counting, flame photometry and beta counting, and in the field by in situ gamma spectrometry and $CaSO_4$:Dy dosimeters (Feathers et al. 2006:1654). Additional standard technical details about OSL dating can be obtained in Aitken (1985).

Documentary Sources and Local Informants

Documents can be particularly productive sources of temporal information and can yield data on site occupants, such as when they arrived in the area, when they left, how they lived, and their relative social position. Documents in the state archives in Santa Fe pertaining to the Town of Cubero Grant may be a productive source of information on those project area sites with historic period components.

In addition to a documentary search, an ethnohistorian will conduct interviews with members of the Town of Cubero Grant association and Acoma Pueblo concerning the Historic period components. This approach can be particularly useful when descendants of site occupants can be located and interviewed. Information obtained in this manner is often an important adjunct to documentary sources because informants may know details that do not appear in public records.

Flaked Stone Artifacts
by James L. Moore

The primary contributions of flaked stone analyses derive from data on material selection, reduction technology, and tool use. These topics provide information about ties to other regions, mobility patterns, and site function. While material selection studies cannot reveal how materials were obtained, they can usually provide some indication of where they were procured. One of the most important concerns for economic and social organization is mobility, or how far and how often people moved around the landscape. Hunter-gatherers tend to move their camps often, occupying many residential sites during the course of a year. In contrast, farmers tend to occupy a single residential site for one or more years at a time, though they may also use logistical camps to collect resources that occur at some distance from the main village. Analysis of flaked stone assemblages should allow us to examine mobility patterns exhibited by the occupants of archaeological sites so as to define degrees of residential and logistical mobility. By studying the reduction strategies employed during each occupation, it should be possible to compare how different cultural groups approached the problem of producing useable flaked stone tools from raw materials. These comparisons can contribute to discussions of ethnic group affiliation. The types of tools in an assemblage can also be used to help assign a function, and to aid in assessing the range of activities that occurred at a site. Flaked stone tools provide temporal data in some cases, but unfortunately they are usually less time-sensitive than other artifact classes, like pottery and wood.

All flaked stone artifacts will be examined using a standardized analysis format (OAS 1994a). This analytical format includes a series of mandatory attributes that describe material, artifact type and condition, cortex, striking platforms, and dimensions. In addition, several optional attributes have been developed that are useful for examining specific questions. This analysis will include both mandatory and optional attributes.

Each flaked stone artifact will be examined using a binocular microscope to aid in defining morphology and material type, examine platforms, and determine whether it was used as a tool. The level of magnification will vary between 20x and 100x, with higher magnification used for wear-pattern analysis and identification of platform modifications. Utilized and modified edge angles will be measured with a goniometer; other dimensions will be measured with a sliding caliper. Analytical results will be entered into a computerized database to permit more efficient manipulation of the data, and to allow rapid comparison with other databases on file at the OAS.

Attributes that will be recorded for all flakes, angular debris, cores, and tools include material type, material quality, artifact morphology and function, amount of surface covered by cortex, portion, edge damage, dimensions and evidence of thermal alteration. Other attributes are aimed specifically at examining the reduction process, and can only be obtained from flakes. They include platform type, evidence of platform lipping, presence or absence of opposing dorsal scars, and distal termination type.

Flaked stone artifacts could have been used for a wide range of tasks in both prehistoric and historic contexts. The variety of formally designed tools and used edges in an assemblage provides information on the range of activities performed at a site, and an assessment of these data can help determine how a site and its structures and features functioned in the settlement and subsistence system. The distribution of various classes of flaked stone artifacts across a site often provides clues concerning how different areas were used and can augment data provided by other analyses.

By tracking the occurrence of local and non-local raw material use, we should be able to define some of the ties this population had to other regions. Such ties can include indirect acquisition of lithic raw materials through exchange or direct procurement by logistical expedition. The condition of materials when they were brought to sites (early reduction stages) can provide information that will allow us to determine which of these processes is most likely, but such interpretations will be strongest if they are augmented with data from other classes of artifacts.

An assessment of strategies used to reduce lithic materials at a site often provides evidence of residential mobility or stability. Two basic reduction strategies have been identified in the Southwest. Efficient (also termed curated) strategies entail the manufacture of bifaces that served as both unspecialized tools and cores, while expedient strategies were based on the removal of flakes from cores for use as informal tools (Kelly 1985, 1988). Technology was usually related to lifestyle. Efficient strategies tended to be associated with a high degree of residential mobility, while expedient strategies were typically related to sedentism. The reason for this type of variation is fairly simple:

> Groups on the move tended to reduce the risk of being unprepared for a task by transporting tools with them; such tools were transportable, multi-functional, and readily modifiable. Sedentary groups did not necessarily need to consolidate tools into a multi-functional, lightweight configuration. (Andrefsky 1998:38)

Of course there are exceptions to this general statement. Highly mobile groups living in areas that contained abundant and widely distributed raw materials or suitable substitutes for stone tools would not need to worry about efficiency in lithic reduction (Parry and Kelly 1987). Where lithic materials suitable for flaking occurred only in the form of small nodules, efficient reduction may have been impossible and another strategy would have been used (Andrefsky 1998; Camilli 1988; J. Moore 1996). Neither of these exceptions applies to the study area.

Southwestern biface reduction strategies were similar to the blade technologies of Mesoamerica and Europe in that they focused on efficient reduction with little waste. While the initial production of large bifaces was labor intensive and resulted in much waste, the finished tools were easily and efficiently reduced. Efficient strategies allowed flint knappers to produce the maximum length of useable edge per biface. By maximizing the return from cores, they were able to reduce the volume of raw material required for the production of informal tools. This helped lower the amount of weight transported between camps. Neither material waste nor transport cost were important considerations in expedient strategies; flakes were simply struck from cores when needed. Thus, analysis of the reduction strategy used at a site allows us to estimate whether site occupants were residentially mobile or sedentary.

Ground Stone Artifacts
by James L. Moore

The primary, but not exclusive, contribution of ground stone analysis data will be as a support of functional inferences. Ground stone artifacts usually are not abundant, but they provide unique data on subsistence. Such information can be derived either indirectly or directly. Tool size, form, and other general design characteristics are commonly used to infer function. However, many assumptions are made when such attributes are used to assign function to an artifact. An additional perspective on how ground stone tools functioned is to collect data that are directly related to use. The most commonly used methods of doing this include the analysis of wear patterns on surfaces and the recovery of residues (especially pollen).

Most ground stone artifacts in Southwestern assemblages are related to grinding foodstuffs or other raw materials. The design of passive and active grinding implements is assumed to be conditioned by the type of material being ground, the importance of grinding within food preparation tasks, the intensity of episodes of grinding, and the mobility of the subsistence adaptation. Residentially mobile Archaic hunter-gatherers tended to use one-hand manos, basin or slab metates, and mortars. These are fairly generalized tools that can be used to grind a variety of generally fine-grained wild and domestic plant foods. However, these forms were not designed to rapidly and efficiently process large quantities of food. Ground stone tools used by Southwestern farmers were more specialized toward the processing of corn and usually included trough or through-trough metates and two-hand manos. Such tools allow large quantities of foods like corn to be processed more rapidly and efficiently (Lancaster 1983). Mano surface areas may also provide quantitative information concerning the degree of reliance on cultigens (Hard 1986). Coupled with other evidence, data on grinding surface area may support comparisons of the degree of agricultural dependence of different components. Although there is a general trend toward more efficient grinding tool design through time, the trend is not unilinear, and the introduction of small-seeded cultigens (such as wheat and barley) in historic period mission settlements appears to have been accompanied by an increased use of one-hand manos (Eric Blinman, pers. comm. 2003), and later by communal mills powered by water or domestic animals.

Formally designed grinding tools are assumed to be related to the processing of seeds, especially corn. In the latter case this has been confirmed in many cases by both contextual evidence and residue studies (pollen and starch). However, grinding surfaces are multipurpose and can be used for both other food and nonfood materials. Items such as cholla pollen, clay, and pigments have been found on grinding surfaces as well as corn. Residue samples will be collected from grinding surfaces from secure contexts and from items with macroscopic evidence of residue presence.

The ground stone artifact category is defined by manufacturing technique as well as by the grinding function, and there are many diverse artifact types that can fall within this class. Axes can occur as either ground stone or flaked stone implements, and items such as polishing stones and ornaments can also fall within this class. Although theoretical bases for interpretations are poorly developed for most of these other types of artifacts, morphological and functional classifications are useful for component and feature interpretations. Residue analysis may also be carried out in some cases to either confirm or explore possible interpretations.

Ground stone artifact assemblages, especially grinding stones, can also contribute to questions of occupation duration and abandonment. Grinding implements can break and routinely wear out through use and resurfacing. Discarded ground stone or ground stone that is reused in architecture can provide an indication of site longevity and reuse. Similarly, formally designed tools are often heavy and represent a significant investment of time and energy in manufacture. The decision to remove or to cache or abandon ground stone can contribute to interpretations of residential mobility, residential stability (relocation distances), and the social context of structure abandonment (Schlanger 1991).

Ground stone artifacts will be analyzed using a standardized methodology (OAS 1994b) which was designed to provide data on material selection, manufacturing technology, and use. Artifacts will be examined macroscopically, and results will be entered into a computerized database for analysis and interpretation. Several attributes will be recorded for each ground stone artifact, while others will only be recorded for certain tool types. Attributes that will be recorded for all ground stone artifacts include material type, material texture and quality, function, portion, preform morphology, production input, plan view outline, ground surface texture and rejuvenation, shaping, number of uses, wear patterns, evidence of heating, presence of residues, and dimensions. Specialized attributes that will be recorded in this assemblage include information on mano cross-section form and ground surface cross section.

By examining function(s), it is possible to define the range of activities in which ground stone tools were used. Because these tools are usually large and durable, they may undergo a number of different uses during their lifetime, even after being broken. Several attributes are designed to provide information on the life history of ground stone tools, including dimensions, evidence of heating, portion, ground surface rejuvenation, wear patterns, alterations, and the presence of adhesions. These measures can help identify post-manufacturing changes in artifact shape and function and can describe the value of an assemblage by identifying the amount of wear or use. Such attributes as material type, material texture and quality, production input, preform morphology, plan view outline form, and texture provide information on raw material choice and the cost of producing various tools. Mano and ground surface cross section are specialized measures aimed at describing aspects of form for manos and metates, since as these tools wear they undergo regular changes in morphology that can be used as relative measures of use life.

Pollen washes will be conducted in the laboratory, necessitating certain precautions. A thin cover of dirt will be left on tools found on floors until they are ready for photographing. Loose dirt will be removed prior to photographing, and the artifacts will be placed in plastic bags as soon as is feasible after that procedure is completed. Laboratory processing will proceed as follows: the entire surface of tools will be brushed before samples are collected. Using distilled water and a tooth brush, grinding surfaces will be scrubbed to collect embedded materials. The size of the area sampled will be measured and noted. Wash water will be collected and packaged for storage until samples are selected for analysis.

Native American Ceramics
by C. Dean Wilson, James L. Moore, and Eric Blinman

Data recorded for pottery from individual components, structures, and features include ceramic type and descriptive attribute categories. Information regarding distributions of various type and attribute categories contributes to the overall research goals by providing insights relating to the production, area of origin, decoration, and use of the associated pottery. One of the most important uses of ceramic data is the determination of the time of occupation represented at various sites and contexts, through the comparison of distributions of a particular assemblage with those from dated proveniences in the region. Examinations of distributions of ceramic types and attributes from dated proveniences may provide information regarding trends in ethnic affiliation, patterns of pottery production and exchange, and the use and function of pottery in various activities.

Ceramic Attributes

Attribute categories used in these investigations will be similar to those employed in recent OAS studies. These categories include temper type, paint type, surface manipulation, post-firing modification, and vessel form. Other types of data that will be recorded for smaller samples of sherds will involve more detailed characterizations of pastes through refiring and petrography. Design style and vessel construction methods have the potential to contribute to both refined dating inferences and to ethnicity discussions. If whole or substantially reconstructible vessels are recovered, vessel attributes (such as volume and use wear) will be recorded in addition to the sherd attributes described above.

Basic ceramic classification encodes a large amount of information. Ceramic types refer to groupings identified based on various combinations of paste and surface characteristics with known temporal, spatial, and functional significance. Sherds are initially assigned to specific traditions based on probable region of origin as indicated by paste and temper. They are then placed in a ware group on the basis of general surface manipulation and form. Finally they are assigned to temporally distinctive types previously defined within various tradition and ware groups.

Ceramic Traditions and Types

Most of the pottery from the Acoma area resembles types defined for the Cibola Gray Ware, Cibola White Ware, or White Mountain Redware traditions, although low frequencies of Mogollon Brown Ware types may also be present in some assemblages (Dittert 1959; Ruppé 1953, 1966; M. Marshall 1991). Ceramics are assigned to Cibola types based on the presence of sand and sherd temper, and mineral paint, and in some cases by stylistic traits (Gladwin 1945; Hawley 1936).

Pottery exhibiting characteristics of Cibola types dominate assemblages occurring over a very wide geographic area covering most of the Southern Colorado Plateau including the Cebolleta Province or Acoma District. This district has been characterized as a distinct expression of the Cibola region (Dittert 1949, 1959). Some investigators differentiate ceramic types thought to be unique to this district, while others do not. This has resulted in some inconsistency in the ceramic typology used for this area. Our strategy of analysis will involve mainly using ceramic type categories utilized for the entire Cibola tradition, as well as a few type categories defined for the Cebolleta variants, if deemed appropriate. Such distinctions are often based on subtle differences in paste, slip, and decorative tradition.

Cibola tradition gray ware types are usually defined by the presence of white to gray pastes, and the absence of polish or painted decorations. The great majority of gray wares from sites in the Acoma District dating to all temporal periods exhibit combinations of light gray to white pastes and sand or sherd temper indicative of Cibola Gray Wares. These gray wares will be assigned to specific types based on exterior surface treatments such as plain, neck-banded, and corrugated.

Cibola White Ware types are decorated with black mineral paint and exhibit light gray to white pastes. Types produced early within the tradition (pre-AD 1000) are tempered with sand but were tempered with crushed sherd during later periods. Cibola White Ware types are defined by a progression of design styles, which in temporal order include La Plata Black-on-white, White Mound Black-on white, Kiatuthlanna Black-on-white, Red Mesa Black-on-white, Escavada Black-on-white, Gallup Black-on-white, Reserve Black-on-white, Cebolleta Black-on-white, Tularosa Black-on-white, and Klagetoh Black-on-white.

White Mountain Redware types represent a specialized technology that developed in areas of the Southern Colorado Plateau (Carlson 1970). Such pottery was produced within a fairly limited area in west-central New Mexico and east-central Arizona but was widely traded throughout much of the southwest. White Mountain Redware is characterized by a white or gray to orange paste, crushed sherd temper and a deep red slip. Surfaces are well polished, and painted decorations are usually executed in a black mineral or organic paint, although polychrome effects are sometime achieved through the additional use of white clay paint. Examples of White Mountain Redware types that may be identified include Puerco Black-on-red and Polychrome, Wingate Black-on-red and Polychrome, St. Johns Black-on-red and Polychrome, Springerville Polychrome, and Heshotautla Glaze-on-red.

It is likely that all the previously discussed traditions could have been locally produced in the Acoma area. The most common intrusive pottery is represented by Mogollon Brown Ware types dominating sites in the southwestern part of New Mexico. Mogollon Brown Wares are made from self-tempered clays derived from redeposited volcanic sources common in the Mogollon Highlands (Wilson 1994). These clays are high in iron content and contain igneous and sandstone inclusions. Mogollon Brown Wares were assigned to previously defined types based on differences in textured decoration, coil patterns, and smudging (Haury 1936). Other intrusive ceramic types or traditions that may be represented include Socorro Black-on-white and San Juan and Mimbres White Ware types.

Ceramic Dating

The relatively wide variety of pottery types noted during the initial survey of the project area and its immediate environs indicates a very long temporal sequence, covering the Pueblo I through Pueblo III periods. Some investigations have attempted to define a series of temporally distinct phases for the Acoma region (Dittert 1949, 1959; Ruppé 1953, 1966; Marshall 1991). Based on pottery types noted during the initial survey, phases that could be represented at sites in the Alternative 5 APE include the Early Cebolleta phase (AD 950 to 1050); Late Cebolleta (AD 1050 to 1100); Early Wingate phase (AD 1050 to 1125), Pilares or Late Wingate phase (AD 1125 to 1200), Early Kowina or Tularosa Phase (AD 1200 to 1275), and Late Kowina phase (AD 1275 to 1325). The assignment of pottery to these various phases will provide an opportunity to examine various synchronic and diachronic issues and trends.

Trends in the Production and Exchange of Ceramic Vessels

Temper and paste characterizations, along with any direct evidence of production (raw materials, tools, unfired pottery, or firing failures) provide an opportunity to examine issues associated with trends in the production and exchange of vessels. Binocular microscope observations of temper and paste will be the basis for most source evaluations. Petrography will be used to confirm and refine resource and characterizations. Depending on sample characteristics, more precise paste characterizations may be warranted to distinguish regional production trends. These patterns in turn will support inferences of social interactions within and between communities, both in terms of formal models of production and consumption and in terms of social networks and alliances. These issues are relevant to the reconstruction of prehistoric cultural patterns. Embedded within production and exchange interpretations are issues of the ethnicity of pottery production. While some studies have attempted to distinguish similar pottery forms produced by different ethnic groups through rim shape, surface manipulation, or temper size, there is considerable overlap in such attributes. Ultimately, detailed examination of pottery resources and manufacturing techniques will be required to argue for any ethnic affiliation of pottery recovered from the site collections.

Trends in production and exchange networks may be most obvious in changes in the total frequency of pottery assigned to various traditions. Shifting patterns in production, exchange, and cultural association of utility ware vessels will be reflected by changes in the total frequency of Cibola Gray Ware to Mogollon Brown Ware types. For example, an increase in the frequency of Mogollon Brown Wares would, in some cases, reflect increasing ties and interactions with "Mogollon" groups to the south. In other cases, such an increase could reflect a shift in the source of raw materials for ceramic manufacture. For decorated ware vessels, changes in frequency of Cibola White Ware, and White Mountain Redware, as well as Socorro Black-on-white, and San Juan White Wares reflect geographic distribution of social and economic ties.

Trends in the Use and Function of Ceramic Vessels

Functional qualities of vessel assemblages can be inferred from sherd distributions in ware as well as form categories that reflect the shape and portion of a vessel. Vessel form identification is generally based on rim shape and the presence and location of polish and painted decorations. It is often easy to identify the basic form (bowl vs. jar) of body sherds from prehistoric vessels for many Southwestern regions by the presence and location of polishing.

Rim sherds will also contribute functional information through measurement of rim diameter. Rim diameter correlates with vessel size in many forms, and simultaneous measurement of rim arc (in degrees) can help quantify vessel assemblages. The former measure can contribute to interpretations of the nature of economic activities for each component, as well as the size of social groups involved in food preparation and consumption. The latter measure is the most efficient means of quantifying vessel contributions to components, and it can support interpretations of occupation duration as well as the intensity of different functions that result in vessel breakage.

Detailed analysis of any whole vessel that might be recovered will provide more specific information about the use of pottery containers. Attributes that will be examined include shape, overall size, thickness, and wear and sooting patterns. Attempts will also be made to compare and relate patterns noted in sherd and vessel-based distributions. While sherds often reflect the context of pottery discard, the occurrence of complete vessels may provide information concerning actual loci of use.

Botanical Remains
by Mollie S. Toll, Pamela McBride, and James L. Moore

Macrobotanical materials recovered from sites provide direct evidence of subsistence practices. Most of these floral materials will be recovered from flotation samples, but preserved vegetal material (such as charcoal, seeds, or even textile fragments) also can be recovered directly during excavation. Charred seeds can tell us what plants were included in the diet, both domestic and wild. Charcoal from hearths and trash deposits can be used to examine fuel wood gathering activities. Floral materials contained in architectural materials can be used to augment other types of botanical data, and samples from historic corrals can provide information on the diet of livestock. These types of data not only tell us what plant foods site occupants were gathering, growing, or trading for, they also provide important information on what the local environment might have looked like.

Pollen analysis should be considered complementary rather than parallel to macrobotanical data from flotation samples. Pollen is preserved in very different contexts than carbonized seeds, is usually dominated by environmental rather than cultural sources, and has different contributions to make to the body of biological data that informs on subsistence and environmental parameters. While flotation samples are commonly recovered from primary and secondary deposits related to thermal features, pollen does not survive burning nor does it survive deposition in alkaline, water-holding features. Pollen's particular contribution lies in characterizing plant utilization activities that do not involve burning, such as milling bins, ground stone artifacts, storage features, coprolites, and living surfaces. On well-preserved interior floors, systematic intensive sampling (such as alternate grid units) of pollen and flotation can work well together to produce relatively detailed mapping of activity areas of household space. Recovery from burials can provide ritual information. The potential contributions of pollen analysis are more restricted from strata such as trash fill, roof fall, and middens.

Prior to submitting pollen samples for analysis, they will be evaluated by the project director according to their potential to contribute information on research issues. The project director will rely on context evaluations provided by the excavators. Pollen analysis may be used to address issues of seasonality, environmental change, subsistence mix, post-depositional mixing, and social practices (as might be associated with human interments). The pollen analyst will need to determine the quality of the sample in terms of preservation, intermingling of modern, post-depositional, and subject pollen (pollen related to feature use). Sample sufficiency for addressing the range of related research questions will also be assessed and evaluated. For the current project, attempts will be made to assess what wild and/or domestic plants had been utilized by different site occupants and to discern food processing activity areas if possible.

The potential contribution of botanical analyses is necessarily limited by the sampling universe of provenience types and preservation conditions that is encountered within the sites. Interpretable samples require confidently defined temporal and behavioral contexts. Prime among differentiated, potentially informative contexts are intact interior floor surfaces protected by fill and roof fall. Sampling multiple locations on interior floors contributes data for mapping cultural activities involving plant materials. This patterning informs on the organization of economic and cultural behavior on a household level. Analogous exterior surfaces, such as extramural work areas with associated cooking and storage features, are of equal interpretive interest but tend to have very poor preservation of perishable remains, and consequently do not merit intensive sampling. Primary deposits within features, architectural deposits, and refuse strata provide specific sampling opportunities.

Botanical studies of archaeological deposits will include flotation analysis of soil samples, species identification and (where appropriate) morphometric measurement of macrobotanical specimens, and species identification of wood specimens from flotation and macrobotanical samples and ^{14}C samples prior to submission. Flotation is a widely used technique for separation of floral materials from the soil matrix. It takes advantage of the simple principle that organic materials (and particularly those that are nonviable or carbonized) tend to be less dense than water, and will float or hang in suspension in a water solution. Each soil sample is immersed in a bucket of water. After a short interval that allows heavier sand particles to settle out, the solution is poured through a screen lined with "chiffon" fabric (approximately 0.35 mm mesh). The floating and suspended materials are dried indoors on screen trays, then separated by particle size using nested geological screens (4.0, 2.0, 1.0, and 0.5 mesh), before sorting under a binocular microscope at 7 to 45x.

This basic method has been in use since 1936, but did not become widely used for recovery of subsistence data until the 1970s. Seed attributes such as charring, color, and aspects of damage or deterioration are recorded to help in determining cultural affiliation vs. post-occupational contamination. Relative abundance of insect parts, bones, rodent and insect feces, and roots help to isolate sources of biological disturbance in the ethnobotanical record.

All macrobotanical remains collected during excavation will be examined individually, identified, repackaged, and cataloged. Condition (carbonization, deflation, swelling, erosion, damage) will be noted as clues to cultural alteration, or modification of original size dimensions. When less than half of an item is present, it will be counted as a fragment; more intact specimens will be measured as well as counted. Corn remains will be treated in greater detail. Width and thickness of kernels, cob length and mid-cob diameter, number of kernel rows, and several cupule dimensions will be measured following Toll and Huckell (1996). In addition, the following attributes will be noted: overall cob shape, configuration of rows, presence of irregular or undeveloped rows, and post-discard effects.

Euroamerican Artifacts
by Charles Hannaford

LA 89019 and LA 149868 have late Territorial period components that seemingly reflect pastoral subsistence patterns within the shifting socio-political boundaries of Acoma Pueblo and the Town of Cubero Grant. Historic period artifacts were very sparse around the structural remains at LA 89019 and the primary historic component at LA 149868 should be avoided by the proposed construction projects. The historic component at LA 149868 may represent extramural activity areas associated with the structural remains at LA 89019, which is only about 60 m away. However, historic artifacts recovered from LA 149868 will probably be confined to stray items from the north and south site edges and away from the primary activity centers. Abundant historic artifact assemblages are not expected from either site, but recovered artifacts should contribute information as to how the sites functioned in the settlement-subsistence system.

Euroamerican artifacts will be examined using a standardized analysis format developed by the Office of Archaeological Studies (OAS 1994c). The main emphasis of this analysis is the identification of artifact function. One of the major benefits of this type of analysis is that "various functional categories reflect a wide range of human activities, allowing insight into the behavioral context in which the artifacts were used, maintained, and discarded" (Hannaford and Oakes

1983:70). This is especially relevant in understanding the function and use intensity of the structure at LA 149868. The function of each artifact is described by a hierarchical series of attributes that classifies it by functional category, type, and specific function. These three attributes are all closely related and provide a chain of variables that will specify the exact function of an artifact, if known.

Eleven functional categories are used, including economy/production, food, indulgences, domestic, furnishings, construction/maintenance, personal effects, entertainment/leisure, communication, and unknown. Other variables are recorded to amplify the hierarchy of functional variables and provide a more detailed description of each artifact. Included in this array of attributes are those that provide information on material type, dating, manufacturer, and what part(s) are represented. Chronological information is available from a variety of attributes, as are data on manufacture, and physical descriptions.

The Euroamerican assemblage should provide information on critical areas including chronology, activities performed at the sites, site function, trade contacts, and social standing.

Faunal Remains
by Nancy J. Akins

Faunal remains have the potential to contribute information on the kinds of animals present in the local and regional environment, strategies used to take these animals, relative dietary contribution, and food preparation techniques. The assemblages from non-residential occupations (e.g., fieldhouses) can contribute to our understanding of the seasonal logistics of the subsistence economy, including an assessment of the garden hunting model.

A growing body of data indicates that the initial strategy of Southwestern farmers was one of garden hunting. The garden hunting model, as proposed by Linares (1976:331), suggests that the abundance of some taxa found in archaeological assemblages is the direct result of farmers hunting in gardens and cultivated fields. Disturbing the primary vegetation for agricultural plots not only attracts and increases the biomass of some animals, but hunting in fields eliminates seasonality and scheduling conflicts while protecting fields from crop predators. As horticultural activity increases, so do the habitats that support higher densities of small mammals and their availability for human procurement. When communities become larger, more residentially stable and more committed to horticulture, large animals increase in importance as hunters turn to scheduling hunting activities. Reliance on maize, which is low in two essential amino acids and niacin, increases the need for high-quality animal protein, at least seasonally (Speth and Scott 1989:71, 74).

Sedentary groups generally exploit a wider variety of animals than do mobile ones. They also depend more on smaller animals, and use more traps, ambushes, and long-distance hunts (Kent 1989:3). When hunting close to home, a wider range of animals is taken, including less-preferred smaller animals. To maximize their return, the farther a group travels to hunt, the narrower the range of species and the larger the size of the animal sought. Once the locally available large game animals have been depleted, hunters must travel greater distances to acquire these resources, relocate their settlements closer to more productive areas, or reduce their commitment to horticulture (Speth and Scott 1989:75, 78).

In areas where the garden hunting model fits well, artiodactyl indices (a measure of relative proportions of lagomorphs and artiodactyls) start low and increase over time, presumably with respect to agricultural commitment. For Chaco Canyon, the indices begin at 0.13 in early Basketmaker III assemblages and increase to 0.39 in Pueblo III assemblages (Akins 1999:11). For the Dolores Project sites from southwestern Colorado, the index starts much higher at 0.58 for the AD 600 to 720 period, falls dramatically to 0.20 between AD 720 and 800, and eventually rises to 0.42 (Neusius

1986:214–253). Sites excavated in San Juan Basin and Rio Puerco drainage for the Transwestern Pipeline Project have indices that fall between 0.00 and 0.03 for all periods (Brown and Brown 1993:354–366). On the West Mesa of Albuquerque, Basketmaker sites have low indices (0.04) increasing to 0.08 and 0.32 at the Coors Road site (Akins 1986a, 1986b; Sullivan and Akins 1994:141). Unlike these sequences that fit well with a garden hunting model, Late Developmental period (AD 900–1100) sites between Santa Fe and Pojoaque Pueblo, where groups appear to have been more mobile and less committed to agriculture, have indices that differ significantly from all but the earliest Dolores assemblages. In four sites with sample sizes between 1,273 and 3,507 specimens, the artiodactyl indices are much higher, between 0.71 and 0.73 for LA 388, LA 391, and LA 3119 and somewhat lower for LA 835 (0.55). Thus, with adequate samples, these simple indices can reveal a great deal about mobility and subsistence within a given region.

Preexisting data on animal subsistence in the Acomita area are scant. Either the sites investigated produced little or no bone or the reports are from eras when the standard for reporting fauna was to simply list the species recognized without any indication of even relative quantities. Excavations at two nearby PII–PIII pueblos (LA 2639 and LA 2640) with 10 and 15 rooms produced unknown quantities of fauna. Species lists for the two include deer, fox, jackrabbit, and cottontail from LA 2639 and deer, turkey, jackrabbit, cottontail, gopher, and hawk from LA 2640 (Olson and Wasley 1956:305, 317-318). Relatively recent excavations have been conducted along Interstate 40 at State Road 6 west of the project area. Small faunal assemblages were recovered from two sites focused on agriculture with permanent or seasonal occupations between AD 750 and 900 (Post 2002:187–188). The assemblage of 57 bones from three features and general fill at LA 70163 had more cottontail rabbit (n=18) than any other species. Other taxa include a variety of mice, jackrabbit, artiodactyl, and bird. A larger sample (n=291) from nine features and general fill was recovered from LA 3558. However, much of the sample (n=191) was from a single dog burial and a partial toad (n=41). Otherwise, rare identified taxa include a single prairie dog, cottontail bones, and 16 bones from jackrabbit (Mick-O'Hara 2002:263–266).

To the east, archaeological testing at the Elena Gallegos land exchange Atrisco sites generally produced small samples of fauna. Sample sizes are not always given and data are generally presented as MNIs (minimum number of individuals). From earliest to latest, a Late Archaic to Pueblo I site (1A) with a sample of 150 pieces of burned bone had squirrel, jackrabbit, and cottontail identified; an Early Basketmaker III site (31C) had jackrabbit, cottontail, and wood rat; a Pueblo I-II site (15C) with a sample of about 500 bones was mainly cottontail and jackrabbit with some wood rat and artiodactyl; a Pueblo II artifact scatter and hearth (38C) had artiodactyl and jackrabbit-sized bones; a Pueblo IV lithic and ceramic scatter (12B) had jackrabbit, cottontail, wood rat, rodent, and domestic sheep; and a lithic scatter with no ceramics (36C) had burned bones of cottontail and jackrabbit (Bertram 1995a:11–76, 1995b:94–195).

While the data are scant, there is a hint that the Basketmaker and Pueblo assemblages from the general area are consistent with the garden hunting model outlined above. Only a small number of taxa have been reported and nearly all indicate exploitation of the immediate environment. The abundance and consistent presence of cottontail rabbits, which are the hallmark of the Southwestern garden hunting strategy, and the near absence of artiodactyl remains, may suggest a primarily agricultural subsistence strategy for prehistoric groups inhabiting this general area. Because subsistence data are so rare, any information recovered from the excavation of the Acomita Interchange sites will add considerably to our knowledge of the past. If suitable samples of bone are recovered it may be possible to suggest how the area was used and how this may have changed over time.

Specimens recovered by project will be

identified using the Office of Archaeological Studies comparative collection supplemented by those at the Museum of Southwest Biology, at the University of New Mexico. Recording will follow an established OAS computer coded format that identifies the animal and body part represented, how and if the animal and part was processed for consumption or other use, and how taphonomic and environmental conditions have affected the specimen. Variables for the analyses include a suite of provenience descriptions, taxon, element, completeness, a series of taphonomic observations, burning, butchering, and modification. Quantification conventions record elements and groups of conjoined elements in order to minimize the inflation of counts that can result from fragmentation and partial carcasses.

Human Remains
by Nancy J. Akins

Land status determines which laws and regulations govern the treatment of human remains recovered from archaeological sites. Some of the project sites are located on Pueblo of Acoma land, invoking the *Native American Graves Protection and Repatriation Act* (25 U.S.C. 3002, 1990). This act states that human remains and associated funerary objects, sacred objects, or objects of cultural patrimony belong to the lineal descendants or, if the lineal descendants cannot be ascertained, to the tribe on whose land the objects were discovered. Acoma Pueblo and other groups that could be lineal descendants must be consulted before any items are excavated or removed. The criteria for determining lineal descent (43CFR10.14) are fairly rigorous. Lineal descendants are individuals who can trace their ancestry directly without interruption by means of the traditional kinship system of the appropriate tribe. Consultations will be completed with Acoma Pueblo as the land owner and any other groups who may reasonably claim to be the lineal descendants concerning any human remains, funerary objects, sacred objects, or objects of cultural patrimony that might be encountered on Tribal land. All aspects of discovery, recovery, analysis, and final disposition will be agreed on before excavation begins.

On state and private land, state law (NMSA § 18-6-11.2, 1989 and HPD Rule 4 NMAC 10.11) requires a permit for excavation of unmarked burials. As defined in the regulation, an "unmarked burial ground" is "a location where there exists a burial or burials of any human beings that are not visibly marked on the surface of the ground in any manner traditionally or customarily used for marking burials and includes any funerary object, material object or artifact associated with the burial or burials" (4 NMAC 10.11.7G). Since virtually every archaeological and historic site has the potential to be an unmarked human burial ground under this definition, the type of permit required must be determined by whether or not the site is known to contain or is reasonably expected to contain human remains. If the site is known to contain burials, an individual permit is needed to exhume any human remains. Because human remains are not reasonably expected at any of the project sites located on state or private land within the project area, any that are encountered will be treated as discovery situations and excavated under the annual burial permit issued to the Office of Archaeological Studies. Following the permit provisions, if human remains are discovered the intent to use the annual permit, including a legal description of the location of the burial, the written authorization to remove the burial from the landowner, a description of the procedures to be implemented to identify and notify living relatives of the burials, certification that the law enforcement agency having jurisdiction in the area has been notified, a list of personnel supervising and conducting excavations of the human burial, and the NMCRIS LA Project/Activity Number for the permitted excavation will be submitted in writing to the State Historic Preservation Division (HPD) before excavation of the burial begins. The local law enforcement agency with jurisdiction over the area will be notified to contact the state medical investigator who will determine if the burial is of medico-legal significance. Within 45 days of completing the permitted excavation, recommendations for the disposition of human remains and funerary objects will be made to the HPD. These recommendations will take into consideration the comments of living persons who may be related to the burial and the wishes of the landowner. The plan will provide a proposed location for reburial or approved curatorial facilities and an inventory of funerary objects, other artifacts found in association, or collected in the course of excavation. The HPD, after consulting with the State Indian Affairs Department (IAD), will determine the appropriate disposition of the human remains and associated funerary objects. If a final report cannot be completed within a year of the completion of fieldwork, an interim report will be submitted along with an estimated completion date for a final report.

In addition to the provisions of the State Burial Law, the draft Department of Cultural Affairs Policy Regarding Tribal Consultation requires that OAS make a good faith effort to consult with Native American governments when actions could affect Native American human remains. Under this policy, in a discovery situation, OAS will augment the HPD and IAD consultations with informational letters to pueblos, tribes, or nations who have made a claim or have a history of interest in the geographic area where the human bone was discovered. If any of these groups expresses an interest in making a claim to the remains, OAS will assist them in initiating contact with the HPD/IAD.

None of the project sites is of the size and duration of occupation where we expect to encounter human remains as either isolated pieces or intact burials. If any are found, it is unlikely that the number will be large, and the primary objective will be to provide life history information that can be integrated into broader research perspectives on topics such as subsistence, diet, and demography (e.g., Martin 1994). Even in small samples, the basic analysis of human remains has the potential to contribute significant information on life during prehistory. Human bones and teeth record conditions during life as well as at death (Goodman 1993:282). Several indicators of physiological stress are used to address general health. These include adult stature, which may be related to nutrition, and sub-adult size, which can indicate the timing of stress events. Defects in dental enamel (hypoplasias or pitting) are associated with specific physiological disruptions and can be relatively accurately assigned an age of onset. Dental asymmetry begins *in utero* and reflects developmental stress, while dental crowding can be nutritional or genetic. Dental caries reflect refined carbohydrates in the diet and can lead to infection and tooth loss. Dental abscessing can become systemic and life-threatening. Osteoarthritis and osteophytosis can indicate biomechanical stress. Osteoporosis, related to calcium loss and malnutrition, can be acute to severe during pregnancy and lactation, and can also affect the elderly. Porotic hyperostosis is related to iron deficiency anemia and leaves permanent markers. Periosteal reactions result from chronic systemic infections (Martin 1994:94–95). Although limited by the quality of preservation of bone and the integrity of the interment, all of these observations can be made without invasive or destructive analyses.

In addition, mortuary treatment places the individual into a social context adding valuable information concerning social, demographic, and economic conditions (Brown 1995:7; Larsen 1995:247). Recent mortuary analyses have approached a variety of topics, ranging from individual, gender, ethnic, political, and social identity, to interpersonal conflict, resource control, labor and organization, ritual and meaning, social inequality, trade, population dynamics, and residential patterning (Larsen 1995:260).

Few human burials have been recovered from the vicinity of the project area. The four Basketmaker III-Pueblo I burials found in the Interstate 40 State Road 6 sites were all adults found in a possible pit structure (LA 70163) or extramural pits (LA 3558) (Mick-O'Hara 2002:142–146; Post 2002:48). All had extensive dental wear, tooth loss, and caries (Mick-

O'Hara 2002:199–211) suggesting that maize comprised a large part of the diet. Rates of dental caries generally increase along with the horticultural component of the diet (Stodder 1989:181). Yet, femoral indices (a mean of 1.04 for the three females and 1.23 for the male) suggest that at least the male (and the female from LA 70163 at 1.2) may have maintained a degree of mobility. Femur shaft shape is an indication of strength and of mobility. Smaller, more circular indices (mid-shaft anterioposterior diameter divided by the mid-shaft mediolateral diameter) are associated with decreased mobility while higher ratios are characteristic of hunter-gatherers (Bridges 1996:118).

One of the primary issues to be addressed by this project concerns the nature of the prehistoric occupation. Were these sites the product of small groups of settled agriculturalists who moved frequently, fairly mobile groups who were seasonally sedentary, or camps or fieldhouses built by residents of more settled agricultural communities using the area on a seasonal basis? If human remains are recovered, the information collected could aid in answering these kinds of questions. This will be done by examining the evidence for mobility or the degree of sedentism and agricultural commitment of the groups who lived at the project area sites. Mortuary practices, simple metric measurements, demographic structure, indications of general heath and nutrition, and dental wear and caries frequencies all can give us some indication of the diet and mobility. Other methods, that require destruction of small pieces of bone, can provide fairly accurate indications of the diet of prehistoric populations. Strontium/calcium ratios characterize the amount of meat consumed by individuals, as does a broad spectrum of trace elements found in bone. Stable carbon isotope ratios in bone and tooth apatite are used to measure the dietary importance of maize (Buikstra and Ubelaker 1994:168-169). Basic data will be compared to other populations, particularly those from the Southwest, to assess the relative success of these individuals and this particular adaptation.

Burial excavation procedures will follow professional archaeological standards. This generally includes the identification of a burial pit and careful removal of fill within the pit. When possible, half the fill will be removed to provide a profile of the fill in relation to the pit and the burial. The pit, pit fill, burial goods, and burial will be examined and recorded in detail on an OAS burial form with special attention paid to any disturbance that may have taken place. Plans and profiles and photographs will further document the burial and associated objects. Flotation and pollen samples will be taken from all burials. Disarticulated or scattered remains will be located horizontally and vertically, drawn, and photographed. Any associated materials and the potential cause of disturbance or evidence of deliberate placement will be recorded in detail.

Analysis methods will follow the procedures and conventions set out in *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). This comprehensive protocol collects the maximum amount of information by recording a standard set of attributes using the same criteria. A series of 29 forms and diagrams of skeletons and anatomical parts allows for illustrating the extent and location of observations. Another form codes commingled or incomplete remains. The process for recording includes:

1. A coding procedure for each element that makes up a skeleton is provided. Diagrams of skeletons and anatomical parts allow for the location of any observations concerning these parts. Another form codes commingled or incomplete remains.

2. Adult sex is determined by examining aspects of the pelvis and cranium. Age changes are documented on the pubic symphysis using two sets of standards, on the auricular surface of the ilium, and through cranial suture closure. For immature remains, the age-at-death is determined by scoring epiphyseal union, union

of primary ossification centers, and measurements of elements.

3. Recording of dental information includes an inventory, pathologies, and cultural modifications. Each tooth is coded and visually indicated for presence and whether it is in place, unobservable, or damaged, congenitally absent, or lost premortem or postmortem. Tooth development is assessed, occlusal surface wear is scored, caries are located and described, abscesses are located, and dental hypoplasias and opacities are described and located with respect to the cementoenamel junction. Any premortem modifications are described and located. The secondary dentition is measured and dental morphology scored for a number of traits.

4. Measurements are recorded for the cranium (n=35), clavicle, scapula, humerus, radius, ulna, sacrum, innominate, femur, tibia, fibula, and calcaneus (n=46). Nonmetric traits are recorded for the cranium (n=21), atlas vertebra, seventh cervical vertebra, and humerus.

5. Postmortem changes or taphonomy are recorded when appropriate. These include color, surface changes, rodent and carnivore damage, and cultural modification.

6. The paleopathology section groups observations into nine categories: abnormalities of shape, abnormalities of size, bone loss, abnormal bone formation, fractures and dislocations, porotic hyperostosis/cribra orbitalia, vertebral pathology, arthritis, and miscellaneous conditions. The element, location, and other pertinent information are recorded under each category.

7. Cultural modifications such as trepanation and artificial cranial deformation are recorded in another set of forms.

Curation

After all necessary analyses are complete, the disposition of cultural materials from the Acomita Interchange project will proceed according to land management status or ownership. Acoma Pueblo, the Cubero Land Grant and the Baca family (private land) will decide whether to retain cultural materials from their respective lands. If they choose not to retain these materials, they can then donate them to the Museum of Indian Arts and Culture (MIAC), Museum of New Mexico, Santa Fe. Only materials from State of New Mexico lands, along with all original field documents and photographs, will definitely be curated at the MIAC.

REFERENCES CITED

Abert, James W.
1962 *Abert's New Mexico Report: 1846–1947.* Horn and Wallace, Albuquerque.

Adams, Eleanor B., and Fray Angelico Chavez (translators and annotators)
1956 *The Missions of New Mexico, 1776: A Description by Fray Francisco Atanasio Dominguez with Other Contemporary Documents.* University of New Mexico Press, Albuquerque.

Agogino, George A., and James J. Hester
1956 A Re-evaluation of the San José Non-Ceramic Cultures. *El Palacio* 63(1):6–21.

Aitken, M. J.
1985 *Thermoluminescence Dating.* Academic Press, London.

Akins, Nancy J.
1986a NM:I:10:4:16 Faunal Remains. Report on file with author.
1986b The NM:I:10:4:8 Faunal Remains. Report on file with author.
1999 Chacoan Anasazi Animal Use. Paper prepared for the Chaco Economy and Ecology Synthesis Group workshop, Tucson.

Andrefsky, William, Jr.
1998 *Lithics: Macroscopic Approaches to Analysis.* Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge United Kingdom

Arany, Lynne E.
1982 Spanish Colonial to Early Territorial Period: AD 1696–1879. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Pueblo of Acoma,* vol. I, edited by John B. Broster and Bruce G. Harrill, pp. 49–55. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Bailey, Vernon
1913 *Life Zones and Crop Zones of New Mexico.* North American Fauna No. 35. U.S. Department of Agriculture, Bureau of Biological Survey, Washington, D.C.

Baker, Larry L., and Stephen R. Durand
2003 *Prehistory of the Middle Rio Puerco Valley, Sandoval County, New Mexico.* Archaeological Society of New Mexico Special Publication No. 3. University Printing Services, Eastern New Mexico University, Portales.

Barclay, Donald A., James H. Maguire, and Peter Wild (editors)
1994 *Into the Wilderness Dream: Exploration Narratives of the American West, 1500–1805.* University of Utah Press, Salt Lake City.

Beal, John D.
1976 *An Archaeological Survey of the Malpais Recreation Area.* School of American Research, Santa Fe New Mexico.

Beckett, Patrick H.
1973 Cochise Culture Sites in South Central and North Central New Mexico. Unpublished M.A. thesis, Eastern New Mexico University, Portales.

Bertram, Jack B.
1995a The Atrisco Sites. In *Archeology of the Albuquerque Sector of the Elena Gallegos Project,* edited by Joséph A. Tainter, pp. 11–81. USDA Forest Service, Heritage Resources Management, Southwestern Region Report No. 14.
1995b Atrisco Sector Faunal Remains. In *Archeology of the Albuquerque Sector of the Elena Gallegos Project,* edited by Joséph A. Tainter, pp. 193–199. USDA Forest Service, Heritage Resources Management, Southwestern Region Report No. 14.

Binford, Lewis R.
1980 Willow Smoke and Dogs Tails: Hunter-

Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4–20.
1982 The Archaeology of Place. *Journal of Anthropological Archaeology* 1:513.

Bolton, Herbert E.
1916 *Spanish Exploration in the Southwest, 1542–1706.* Charles Scribner's Sons, New York.
1921 *The Spanish Borderlands: A Chronicle of Old Florida and the Southwest.* Yale University Press, New Haven.

Bowden, J. J.
1969 Private Land Claims in the Southwest. Unpublished Master's thesis, Southern Methodist University, Dallas.

Boyer, Jeffrey L., Steven A. Lakatos, and James L. Moore
2003 *A Plan for Data Recovery Investigations at LA 84927, LA 89021, and LA 138960, U.S. 84/285 Santa Fe To Pojoaque Corridor, Santa Fe County, New Mexico.* Archaeology Notes. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Bridges, Patricia S.
1996 Skeletal Biology and Behavior in Ancient Humans. *Evolutionary Anthropology* 4:112–120.

Broster, John B.
1982 Projectile Point Analysis. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Pueblo of Acoma,* vol. I, edited by John B. Broster and Bruce G. Harrill, pp. 67–87. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Broster, John B., and Bruce G. Harrill (editors)
1982 *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Pueblo of Acoma.* Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Brown, David E., and Charles H. Lowe
1994 *Biotic Communities of the Southwest* (map). Reprinted. University of Utah Press, Salt Lake City. Originally published 1980, Rocky Mountain Forest and Range Experiment Station, USDA, Forest Service, Tempe.

Brown, James
1995 On Mortuary Analysis—with Special Reference to the Saxe-Binford Research Program. In *Regional Approaches to Mortuary Analysis,* edited by Lane Anderson Beck, pp. 3–26. Plenum Press, New York.

Brown, Marie E., and Kenneth L. Brown
1993 Subsistence and Other Cultural Behaviors as Reflected by the Vertebrate Faunal Remains. In *Across the Colorado Plateau: Anthropological Studies for the Transwestern Pipeline Expansion Project, Subsistence and Environment,* vol. 10, edited by Joséph C. Winter, pp. 327–381. Office of Contract Archeology and Maxwell Museum of Anthropology, Albuquerque.
2005 *A Class I and Class III Cultural Resource Survey of 6 Hectares (246 Acres) between I-40 Mile Posts 101.34 and 102.83 for the Exit 102 Improvement Project, Cibola County, New Mexico.* Marron and Associates Cultural Resource Report Number 0062, Albuquerque.

Bryan, Kirk, and Joseph H. Toulouse
1943 The San José Non-Ceramic Culture and its Relation to a Pueblo Culture in New Mexico. *American Antiquity* 8:269–280.

Buikstra, Jane E., and Douglas H. Ubelaker (editors)
1994 *Standards for Data Collection from Human Skeletal Remains.* Arkansas Archeological Survey Research Series No. 44, Fayetteville.

Burlington Northern Santa Fe (BNSF)
2004 Company Profile. http://www.bnsf.com/media/html/company_profile.html

Burns, Bruce
1978 Tentative Ceramic Chronology for the Middle Rio Puerco Valley and Chronometric Analysis. In *Archaeological Investigations in the Area of the Middle Rio Puerco River Valley, New Mexico, May 1-December 1, 1978.* Progress report to the

Bureau of Land Management.

Burns, Bruce, and Karol Klager
1979 A Summary and Interpretation of the Ceramics. In *Archaeological Excavations at Three Sites and Four Locations within the Jackpile Mine Lease near Paguate, New Mexico,* submitted by Mark E. Harlan to Anaconda Company. Office of Contract Archeology, University of New Mexico, Albuquerque.

Camilli, Eileen L.
1988 Lithic Raw Material Selection and Use in the Desert Basins of South-Central New Mexico. *The Kiva* 53:147–163.
1989 The Occupational History of Sites and the Interpretation of Prehistoric Technological Systems: An Example from Cedar Mesa, Utah. In *Time, Energy, and Stone Tools,* edited by R. Torrance, pp. 17–26. Cambridge University Press.

Carlson, Roy L.
1970 *White Mountain Redware and Pottery Tradition of East-Central New Mexico.* Anthropological Papers of the University of Arizona, No. 19. University of Arizona Press, Tucson.

Cattle, Dorothy J., C. H. Carroll, and D. E. Stuart
1977 An Ethnographic and Ethnohistorical Investigation of Eight Historic Laguna Archaeological Sites within the Anaconda Company's P-15/P-17 and Dames and Moore Acreages: The Jackpile Mine, Paguate, New Mexico. Ms. on file, Office of Contract Archeology, University of New Mexico, Albuquerque.

Chronic, Halka
1987 *Roadside Geology of New Mexico.* Mountain Press, Missoula.

Clarke, M. L., and H. M. Rendell
2003 Late Holocene Dune Accretion and Episodes of Persistent Drought in the Great Plains of Northeastern Colorado. *Quaternary Science Review* 22:1051–1058.

Condie, Carol J.
1993 Inspection of an Area Adjacent to an Access Road on Acoma Pueblo for Mountain States Construction. Quivira Research Center/Associates. Albuquerque. NMCRIS 41514.

Cordell, Linda S.
1979a *A Cultural Resources Overview of the Middle Rio Grande Valley, New Mexico.* USDA Forest Service, Albuquerque and USDI Bureau of Land Management, Santa Fe. U.S. Government Printing Office, Washington, D.C.
1979b Prehistory: Eastern Anasazi. In *Handbook of North American Indians,* vol.9, *Southwest,* edited by Alfonso Ortiz, Jr., pp. 131–151. Smithsonian Institution, Washington, D.C.
1997 *Archaeology of the Southwest.* 2nd edition. Academic Press, San Diego.

Cox, Jeffrey R., and Eric Blinman
1999 Results of Archaeomagnetic Sample Analysis. In *Pipeline Archaeology 1990-1993: The El Paso Natural Gas North System Expansion Project, New Mexico and Arizona,* vol. 12, *Supporting Studies: Nonceramic Artifacts, Subsistence and Environmental Studies, and Chronometric Studies,* compiled by Timothy M. Kearns and Janet L. McVickar, Chapter 19. Western Cultural Resource Management, Inc., Farmington, New Mexico.

Danson, Edward B.
1957 *An Archaeological Survey of West-Central New Mexico and East-Central Arizona.* Papers of the Peabody Museum of Archaeology and Ethnology, vol. 44(1). Cambridge, Massachusetts.

Dart, Al
1982 Archeological Background. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Pueblo of Acoma,* vol. I, edited by John B. Broster and Bruce G. Harrill, pp. 33–44. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Dello-Russo, Robert
1999 Climatic Stress in the Middle Rio Grande Valley of New Mexico: An Evaluation of Changes in Foraging Behaviors during

the Late Archaic/Basketmaker II Period. Ph.D. dissertation. University of New Mexico, Albuquerque.
2006 *Recent Work on Late Paleoindian Sites at the Sargent Wildlife Management Area, Chama, New Mexico: Overview and Prospects for the Future.* New Mexico Department of Game and Fish, Santa Fe.

Dick-Peddie, William A.
1993a *New Mexico Vegetation Map*. University of New Mexico Press, Albuquerque.
1993b *New Mexico Vegetation: Past, Present, and Future.* University of New Mexico Press, Albuquerque.

Dittert, Alfred E., Jr
1949 The Prehistoric Population and Architecture of the Cebolleta Mesa Region, Central Western New Mexico. M.A. Thesis, University of New Mexico, Albuquerque.
1959 Culture Change in the Cebolleta Mesa Region, Central Western New Mexico. Unpublished Ph.D. dissertation. Department of Anthropology, University of Arizona, Tucson.

Dittert, Alfred E., Jr., and Reynold J. Ruppé, Jr.
1951 The Archaeology of Cebolleta Mesa: A Preliminary Report. *El Palacio* 58(4):116–129.

Eidenbach, Peter L.
1982 *Inventory Survey of the Lower Hidden Mountain Floodpool, Lower Rio Puerco Drainage, Central New Mexico.* Human Systems Research, Inc., Tularosa, New Mexico.

Elyea, Janette M., and Patrick Hogan
1983 Regional Interaction: The Archaic Adaptation. In *Economy and Interaction along the Lower Chaco River,* edited by Patrick Hogan and Joséph C. Winter, pp. 393–402. Office of Contract Archeology and Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Elyea, Janette, Patrick Hogan, and C. Dean Wilson
1994 *The Armijo Canyon Archeological Survey.* Office of Contract Archeology, University of New Mexico, Albuquerque.

Eschman, Peter N.
1983 Archaic Site Typology and Chronology. In *Economy and Interaction Along the Lower Chaco River,* edited by P. Hogan and J. Winter, pp. 375–384. Office of Contract Archeology and Maxwell Museum of Anthropology, University of New Mexico,. Albuquerque.

Feathers, James K., Vance T. Holliday, and David J. Meltzer
2006 Optically Stimulated Luminescence Dating of Southern High Plains Archaeological Sites. *Journal of Archaeological Science* 33:1651–1665.

Findley, James S., Arthur H. Harris, Don E. Wilson, and Clyde Jones
1975 *Mammals of New Mexico.* University of New Mexico Press, Albuquerque.

Forman, S. L., R. Oglesby, and R. S. Webb
2001 Temporal and Spatial Patterns of Holocene Dune Activity on the Great Plains of North America: Megadroughts and Climate Links. *Global and Planetary Change* 29:1–29.

Frison, George C.
1978 *Prehistoric Hunters of the High Plains.* Academic Press, New York.
1991 *Prehistoric Hunters of the High Plains.* 2nd edition. Academic Press, New York.

Fugate, Francis L., and Roberta B. Fugate
1989 *Roadside History of New Mexico.* Mountain Press Publishing Company, Missoula, Montana.

Fuller, Steven L.
1989 *Research Design and Data Recovery Plan for the Animas-La Plata Project*. Four Corners Archaeological Project Report No. 15. Complete Archaeological Service Associates. Cortez, Colorado.

Garcia-Mason, Velma
1979 Acoma Pueblo. In *Handbook of North American Indians,* vol.9, *Southwest,* edited by Alfonso Ortiz, Jr., pp. 450–466. Smithsonian Institution, Washington, D.C.

Giese, Dale F.
1995 *Forts of New Mexico.* Privately published.

Silver City, New Mexico.

Gladwin, Harold A.,
1945 *The Chaco Branch, Excavations at White Mound and the Red Mesa Valley.* Medallion Paper No. 32, Gila Pueblo; Globe, Arizona

Goetze, Christine E., and Barbara J. Mills
1993 Ceramic Chronometry. In *Across the Colorado Plateau: Anthropological Studies for the Transwestern Pipeline Expansion Project,* vol. 26, by Barbara J. Mills, Christine E. Goetze, and Maria Nieves Zedeño, pp. 87–150. Office of Contract Archeology and the Maxwell Museum, University of New Mexico, Albuquerque.

Goodman, Alan H.
1993 On the Interpretation of Health from Skeletal Remains. *Current Anthropology* 34.

Gunnerson, James H.
1987 *Archaeology of the High Plains.* Cultural Resource Series No. 19. Colorado State Office, Bureau of Land Management, Denver.

Hall, Stephen A.
2002 *Field Guide to the Geoarchaeology of the Mescalero Sands, Southeastern New Mexico.* Prepared for State of New Mexico Historic Preservation Division and New Mexico Bureau of Land Management. Red Rock Geological Enterprises, Santa Fe.

Hannaford, Charles A.
2000 *Excavation at LA 115266: A Coalition Period Fieldhouse Site.* Archaeology Notes 263. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Hannaford, Charles A., and Yvonne R. Oakes
1983 Historic Artifacts. In *The Ontiberos Site: A Hispanic Homestead near Roswell, New Mexico.* Laboratory of Anthropology Notes 311. Museum of New Mexico, Santa Fe.

Hard, Robert J.
1986 Ecological Relationships Affecting the Rise of Farming Economies: A Test from the American Southwest. Unpublished Ph.D. dissertation, University of New Mexico, Albuquerque.

Haury, Emil W.
1936 *Some Southwestern Pottery Types: Series IV.* Medallion Papers 4. Gila Pueblo, Globe, Arizona.
1956 Speculations on Prehistoric Settlement Patterns in the Southwest. In *Prehistoric Settlement Patterns in the New World,* edited by Gordon R. Willey, pp. 3–17. Viking Fund Publications in Anthropology 23.

Hawley, Florence M.
1936 *Field Manual of Prehistoric Southwestern Pottery Types.* University of New Mexico Bulletin, Anthropology Series, Vol 1. No. 4.

Hawley, John W.
1986 Physiographic Provinces I. In *New Mexico in Maps,* edited by Jerry L. Williams, pp. 23–25. 2nd edition. University of New Mexico Press, Albuquerque.

Hogan, Patrick V.
1986 *Overview, Research Design, and Data Recovery Program for Cultural Resources within the Bolack Exchange Lands.* Office of Contract Archeology, University of New Mexico Proposal No. 185-247a. Albuquerque.

Holmer, Richard N.
1986 Common Projectile Points of the Intermountain West. In *Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings,* edited by C. Condie and D. Fowler, pp. 89–115. University of Utah Anthropological Papers No. 110. Salt Lake City.

Huber, Edgar K
2006 Early Maize at the Old Corn Site (LA137258). In *Archaeological Data Recovery in the New Mexico Transportation Corridor and First Five-Year Permit Area, Fence Lake Coal Mine Project, Catron County, New Mexico,* edited by E. K. Huber and C. R. Van West, vol. 4: *Synthetic Studies and Summary.* Technical

Series 84, Statistical Research, Inc., Tucson.

Huckell, Bruce B.
1995 Of Marshes and Maize: Preceramic Agricultural Settlements in the Cienega Valley, Southeastern Arizona. Anthropological Papers 59. University of Arizona, Tucson.

Hudspeth, William B.
1997 Chapter 23.0 Archaic Subsistence and Settlement in the Ole Project Area. In *OLE,* vol. 3: *Analysis,* edited by John C. Acklen, pp. 143–197. TRC Mariah Associates, Inc., Albuquerque, New Mexico. Published by Public Service Company of New Mexico.

Hurst, Winston B.
2003 Chapter 5. Typological Analysis of Ceramics from the Middle Rio Puerco of the East. In *Prehistory of the Middle Rio Puerco Valley, Sandoval County, New Mexico,* edited by Larry L. Baker and Stephen R. Durand, pp. 55–118. Archaeological Society of New Mexico Special Publication No. 3. University Printing Services, Eastern New Mexico University, Portales.

Indian Health Service
2002 Pueblo of Acoma, Baca Well and Pipeline Construction Project: Preliminary Engineering Report in draft. U.S. Public Health Service, Indian Health Service, Albuquerque.

Irwin-Williams, Cynthia
1973 *The Oshara Tradition: Origins of Anasazi Culture.* Contributions in Anthropology 5(1). Eastern New Mexico University, Portales.

Irwin-Williams, Cynthia, and Larry Baker
1991 Anasazi Puebloan Adaptation in Response to Climate Stress: Prehistory of the Middle Rio Puerco Valley. Ms. on file Bureau of Land Management, Albuquerque Area Office, Albuquerque, New Mexico.

Irwin-Williams, Cynthia, and C. Vance Haynes, Jr.
1970 Climatic Change and Early Population Dynamics in the Southwestern United States. *Quaternary Research* 1(1):59–71.

Jodry, Margaret A.
1999 Paleoindian Stage. In *Colorado Prehistory: A Context for the Rio Grande Basin,* by M.A. Martorano, T. Hoefer III, M.A. Jodry, V. Spero, M.L. Taylor, pp. 45–114. Submitted by Foothill Engineering Consultants, Inc. to Colorado Council of Professional Archaeologists, Denver.

Judge, W. James
1973 *Paleo-Indian Occupation of the Central Rio Grande Valley in New Mexico.* University of New Mexico Press, Albuquerque.
1982 The PaleoIndian and Basketmaker Periods: An Overview and Some Research Problems. In *The San Juan Tomorrow: Planning for the Conservation of Cultural Resources in the San Juan Basin,* edited by Fred Plog and Walter Wait, pp. 5–57. National Park Service, Southwest Region, Santa Fe.

Julyan, Robert
1996 *The Place Names of New Mexico.* University of New Mexico Press, Albuquerque.

Kelley, Klara B.
1982 *Navajo Ethnohistory: Anasazi and Navajo Land Use in the McKinley Mine Area near Gallup, New Mexico,* vol. 2. Office of Contract Archeology, University of New Mexico, Albuquerque.

Kelly, Robert L.
1985 Hunter-Gatherer Mobility and Sedentism: A Great Basin Study. Unpublished Ph.D. dissertation, Department of Anthropology, University of Michigan, Ann Arbor.
1988 The Three Sides of a Biface. *American Antiquity* 53(4):717–734.
1992 Mobility/Sedentism: Concepts, Archaeological Measures, and Effects. *Annual Review of Anthropology* 21:43–66.

Kent, Susan
1989 Cross-Cultural Perceptions of Farmers as Hunters and the Value of Meat. In *Farmers as Hunters: The Implications of Sedentism,* edited by Susan Kent, pp. 1–17. Cambridge University Press, Cambridge.

Kenward, Amalia
2003 *Cultural Resources Survey for Eight Proposed Microwave Communications Towers between Albuquerque and Gallup, Cibola and McKinley Counties, New Mexico.* TRC Mariah Associates, Inc., Albuquerque. NMCRIS 85306.

Kohler, Timothy A.
1992 Field Houses, Villages, and the Tragedy of the Commons in the Early Northern Anasazi Southwest. *American Antiquity* 57(4):617–635.

Kubler, George
1990 *The Religious Architecture of New Mexico in the Colonial Period and Since the American Occupation.* 5th edition. University of New Mexico Press, Albuquerque.

Lancaster, James W.
1983 An Analysis of Manos and Metates from the Mimbres Valley, New Mexico. Unpublished M.A. thesis, University of New Mexico, Albuquerque.

Lang, Richard W.
1982 Transformations in White Ware Pottery of the Northern Rio Grande. In *Southwestern Ceramics: A Comparative Review,* edited by A. H. Schroeder. Arizona Archaeologist 15.

Larsen, Clark Spencer
1995 *Bioarchaeology: Interpreting Behavior from the Human Skeleton.* Cambridge University Press, Cambridge.

Lent, Stephen C.
1991 *The Excavation of a Late Archaic Pit Structure near Otowi, San Ildefonso Pueblo, New Mexico.* Archaeology Notes 52, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Lentz, Stephen C.
2004 *A Good Place to Hunt: Data Recovery and Site Stabilizations at the La Vega Site (LA 9075), Cibola County, New Mexico.* Archaeology Notes 304, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Linares, Olga F.
1976 "Garden Hunting" in the American Tropics. *Human Ecology* 4(4):331–349.

Lintz, Christopher, Amy C. Earls, W. Nicholas Trierweiler, and Jan V. Biella
1988 *An Assessment of Cultural Resource Studies Conducted at Kirtland Air Force Base, Bernalillo County, New Mexico.* Mariah Associates, Inc., Albuquerque.

Mabry, John, David A. Phillips, Jr., and M. Zyniecki
1996 *Cultural Resource Survey of the Plains Electric West Mesa to Bluewater 115 KV Transmission Line, Bernalillo and Cibola Counties, New Mexico.* Archaeological Report 96-161. SWCA, Inc., Albuquerque.

Maker, H. J., H. E. Dregne, V. G. Link, and J. U. Anderson
1978 *Soils of New Mexico.* Research Report 285. Reprint. Agricultural Experiment Station, New Mexico State University, Las Cruces.

Marron and Associates, Inc.
n.d. Acomita Interchange. NMCRIS 94806.

Marshall, Michael P.
1991 Ceramic Analysis. In T*he Prehistoric Cebolla Canyon Community: An Archaeological Class III Inventory of 320 Acres of BLM Land at the Mouth of Cebolla Canyon,* by Frank E. Wozniak and Michael P. Marshall, pp. 6-1–6-42. Office of Contract Archeology, University of New Mexico, Albuquerque.
1995 *A Cultural Resource Survey for the Acomita Development Site on Acoma Tribal Trust Land, Cibola County, New Mexico.* Research Report No. 130. Cibola Research Consultants, Corrales. NMCRIS 48418.
1997 *A Cultural Resource Survey of the Proposed Acoma Pueblo Bibo Ranch Purchase, Cibola County, New Mexico.* Research Report No. 181. Cibola Research Consultants, Corrales. NMCRIS 56663.
n.d. *Acomita Wastewater.* Research Report No. 161, Cibola Research Consultants, Corrales. NMCRIS 53230.

Marshall, Sandra L
1990 *A Cultural Resource Survey along SR 124*

East of Grants District Six Maintenance Project. New Mexico State Highway and Transportation Department, Santa Fe. NMCRIS 31903.

1992 *A Cultural Resource Survey along I-40 at Acomita.* NMSHTD Project No. IR-040-2(54)100. NMSHTD Report No. 92-41. Environmental Section, New Mexico State Highway and Transportation Department, Santa Fe. NMCRIS 39824.

Martin, Debra L.

1994 Patterns of Health and Disease: Stress Profiles for the Prehistoric Southwest. In *Themes in Southwest Prehistory,* edited by George J. Gumerman, pp. 87–108. School of American Research Press, Santa Fe.

Matson, R.G.

1991 *Origins of Agriculture in the Southwest.* University of Arizona Press.

McKenna, Peter J.

1994 *Cultural Resource Survey: Realigning the Northern Leg of the Acomita Road (SP30), Acoma Pueblo Lands, New Mexico.* US Bureau of Indian Affairs, Albuquerque Area Office. NMCRIS 45335.

2001 *Proposed Community Housing Project on Mesa Hill, Acoma Pueblo Lands, New Mexico.* Report AC01-021. Bureau of Indian Affairs Southwest Region, Albuquerque. NMCRIS 72380.

2004 *Cultural Resource Survey: Proposed Dump Rehabilitations for Acoma Pueblo, New Mexico.* Report AC04-184. Bureau of Indian Affairs Southwest Region, Albuquerque. NMCRIS 89778.

Mera, Harry P.

1935 *Ceramic Clues to the Prhistory of North-Central New Mexico.* New Mexico Archaeological Survey, Laboratory of Anthropology Technical Series Bulletin 8. Santa Fe.

Michalik, Laura

1998 *Management Recommendations for Previously Recorded Sites Located along the Proposed US West Fiber Optic Cable Right-of-way on Acomita Road (BIA Route SP 30), Cibola County, New Mexico.* Archaeological Services by Laura Michalik, Las Cruces. NMCRIS 62831.

Mick-O'Hara, Linda

2002 Appendix 7. The Analysis of Faunal Remains from the I-40 Project. In *Archaeological Investigation of Two Multicomponent Sites along Interstate 40 Near the State Road 6 Exit, Cibola County, New Mexico,* by Stephen S. Post, pp. 263-269. Archaeology Notes 253. Museum of New Mexico, Office of Archaeological Studies, Santa Fe.

Miller, John

1985 Settlement and Subsistence in the UII Area. In *Human Adaptations in a Marginal Environment: The UII Mitigation Project,* edited by J. L. Moore and J. C. Winter, submitted to Utah International, Inc., by Joseph C. Winter. Office of Contract Archeology, University of New Mexico, Albuquerque.

Minge, Ward Alan

1991 *Ácoma: Pueblo in the Sky.* Revised edition. University of New Mexico Press, Albuquerque.

Moore, Bruce

1978 Are Pueblo Field Houses a Function of Urbanization? In *Limited Activity and Occupation Sites: A Collection of Conference Papers,* edited by A. E. Ward, pp. 9–16. Contributions to Anthropological Studies No. 1. Center for Anthropological Studies, Albuquerque, New Mexico.

1980 *Pueblo Isolated Small Structure Sites.* Ph.D. dissertation, Southern Illinois University. University Microfilms (no. 8017423). Ann Arbor, Michigan.

Moore, James L.

1985 *An Archaeological Clearance Survey near La Mesita Negra on Laguna Pueblo Land, Bernalillo County, New Mexico.* Quivira Research Center Publications 75. Albuquerque.

1986 *An Archeological Survey of 16.67 Acres near Cubero on Acoma Pueblo Land, Cibola County, New Mexico.* Publications 87. Quivira Research Center, Albuquerque. NMCRIS 12794.

1989 *Data Recovery Plan for Three Sites along State Road 502, Santa Fe County, New Mexico.* Laboratory of Anthropology

Note No. 495. Museum of New Mexico, Santa Fe.
1996 Analysis of the Santa Teresa Flaked Stone Artifact Assemblages. In *Archaeological Investigations in the Southern Mesilla Bolson: Data Recovery at the Santa Teresa Port-of-Entry Facility.* Archaeology Notes 188. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.
2001 *Prehistoric and Historic Occupation of Los Alamos and Guaje Canyons: Data Recovery at Three Sites near the Pueblo of San Ildefonso.* Archaeology Notes 244. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.
2003 Examining the Classic Period Components. In *A Plan for Data Recovery Investigationis at LA 84927, LA 89021, and LA 138960, U.S. 84/285 Santa Fe To Pojoaque Corridor, Santa Fe County, New Mexico,* by Jeffrey L. Boyer, Steven A. Lakatos, and James L. Moore, pp. 56–65. Archaeology Notes 323. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, James L., and Jeffrey L. Boyer
2002 Examining the Archaic Component at LA 111333. In *The Tesuque Y Site: Archaeological Testing Results and a Plan for Data Recovery at LA 111333, U.S. 84/285 Santa Fe to Pojoaque Corridor, Santa Fe County, New Mexico,* by James L. Moore, Jeffrey L. Boyer, and H. Wolcott Toll, pp. 53–70. Archaeology Notes 316. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.
2003 Examining the Archaic Components. In *A Plan for Data Recovery Investigations at LA 84927, LA 89021, and LA 138960, U.S. 84/285 Santa Fe To Pojoaque Corridor, Santa Fe County, New Mexico,* by Jeffrey L. Boyer, Steven A. Lakatos, and James L. Moore, pp. 25–44. Archaeology Notes 323. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, James L., and Joseph C. Winter
1980 *Human Adaptations in a Marginal Environment: The UII Mitigation Project.* Submitted to Utah International, Inc., by Joseph C. Winter, Office of Contract Archeology, University of New Mexico, Albuquerque.

Myrick, David F.
1990 *New Mexico's Railroads: A Historical Survey.* Revised edition. University of New Mexico Press, Albuquerque.

Neusius, Sarah W.
1986 The Dolores Archaeological Program Faunal Data Base: Resource Availability and Resource Mix. In *Dolores Archaeological Program: Final Synthetic Report,* compiled by David A. Breternitz, Christine K. Robinson, and G. Timothy Gross, pp. 199–303. Bureau of Reclamation, Engineering and Research Center, Denver.

Nials, Fred L., Chris Kincaid, and John R. Stein
1983 Summary and Conclusions. In *Chaco Roads Project, Phase I: A Reappraisal of Prehistoric Roads in the San Juan Basin, 1983,* edited by Chris Kincaid, pp. 11-1–11-4. Bureau of Land Management, Albuquerque.

OAS (Office of Archaeological Studies)
1994a *Standardized Lithic Artifact Analysis: Attributes and Variable Code Lists.* Archaeology Notes 24b. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.
1994b *Standardized Ground Stone Artifact Analysis: A Draft Manual for the Office of Archaeological Studies.* Archaeology Notes 24a. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.
1994c *Historic Artifact Analysis: Standardized Variable and Attribute Codes.* Archaeology Notes 24d. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Olson, Alan P., and William W. Wasley
1956 An Archaeological Transverse Survey in West-Central New Mexico. In *Pipeline Archaeology; Reports of Salvage Operations in the Southwest on El Paso Natural Gas Company Projects,* edited by Fred Wendorf, Nancy Fox, and Orian L. Lewis, pp. 256–390. Laboratory of Anthropology and Museum of Northern Arizona. Santa Fe and Flagstaff.

Parham, Tommie Lee
1993 *Soil Survey of Cibola Area, New Mexico, Parts of Cibola, McKinley, and Valencia Counties.* USDA, Soil Conservation Service, Washington, D.C.

Parry, William J., and Robert L. Kelly
1987 Expedient Core Technology and Sedentism. In *The Organization of Core Technology,* edited by J. Johnson and C. Morrow, pp. 285–304. Westview Press, Boulder.

Pierce, Christopher D.
1999 Explaining Corrugated Pottery in the American Southwest: An Evolutionary Approach. Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington, Seattle.

Pitblado, Bonnie L.
2003 *Late Paleoindian Occupation of the Southern Rocky Mountains – Early Holocene Projectile Points and Land Use in the High Country.* University Press of Colorado, Boulder.

Polk, Harding, II
2000 *Cultural Resource Survey of I-40 Exits 102 and 104 at Acomita-Sky City and Seama-Cubero-Budville, Cibola County, New Mexico.* Archaeological Report No. 00-243. SWCA, Albuquerque. NMCRIS 70890.

Post, Stephen S.
2002 *Archaeological Investigation of Two Multi-component Sites along Interstate 40 Near the State Road 6 Exit, Cibola County, New Mexico.* Archaeology Notes 253. Office of Archaeological Studies, Museum of New Mexico. Santa Fe.
n.d. Ceramic Development along the Middle Rio San José, New Mexico. Ms. on file, Office of Archaeological Studies, Santa Fe.

Pratt, Boyd C., and Dan Scurlock
1990 *The Northwest New Mexico Regional Overview, vol.1: Historic Overview.* New Mexico Historic Preservation Division, Santa Fe.

Prince, Patricia A.
1982 Lithic Analysis. In *A Cultural Resource Management Plan for Timber Sale and Forest Development Areas on the Pueblo of Acoma,* vol. I, edited by John B. Broster and Bruce G. Harrill, pp. 88–109. Forestry Archeological Program, Bureau of Indian Affairs, Albuquerque Area Office, Albuquerque.

Pueblo of Acoma Historic Preservation Office
2005 Exit 102 Interchange Project: Reconstruction Impacts on all Known Cultural Resources within the Area. Letter report from the Pueblo of Acoma Historic Preservation Office, Pueblo of Acoma, New Mexico.

Reed Lori S., C. Dean Wilson, and K. A. Hays-Gilpin
2000 From Brown to Gray: The Origins of Ceramic Technology in the Northern Southwest. In *Foundations of Anasazi Culture: The Basketmaker-Pueblo Transition,* edited by Paul F. Reed, pp. 203–229. University of Utah Press, Salt Lake City.

Reher, Charles A. (editor)
1977 *Settlement and Subsistence along the Lower Chaco River: The CGP Survey.* Office of Contract Archeology, University of New Mexico, Albuquerque.

Robinson, Sherry
1994 *El Malpais, Mt. Taylor, and the Zuni Mountains: A Hiking Guide and History.* University of New Mexico Press, Albuquerque.

Roney, John R.
1992 Prehistoric Roads and Regional Integration in the Chacoan System. In *Anasazi Regional Organization and the Chaco System,* edited by David E. Doyel, pp. 123–131. Maxwell Museum of Anthropology Anthropological Papers No. 5. Maxwell Museum of Anthropology, Albuquerque.

Ruppé, Reynold J., Jr.
1953 *The Acoma Culture Province: An Archaeological Concept.* Ph.D. dissertation, Harvard University, Cambridge.
1966 The Archaeological Survey: A Defense. *American Antiquity* 31(3):313–333.

Schlanger, Sarah H.
1991 On Manos, Metates, and the History of Site Occupations. *American Antiquity* 56:460–474.
1992 Persistence Places in a Pueblo Landscape. In *Space, Time, and Archaeological Landscapes,* edited by Jacqueline Rossignol and LuAnn Wandsnider. Plenum Press, New York and London.

Schmader, Matthew F.
1994 Early Puebloan Site Structure and Technological Organization in the Middle Rio Grande Valley, New Mexico. Unpublished Ph.D. dissertation. Department of Anthropology, University of New Mexico, Albuquerque.

Schroeder, Albert H.
1963 Navajo and Apache Relationships West of the Rio Grande. *El Palacio* 70(3):5–23.

Schutt, Jeanne A., Carolyn L. Daniel, and Richard C. Chapman
1997 Cultural Overview, Previous Research, and Research Orientation. In *Cycles of Closure: A Cultural Resources Inventory of Fort Wingate Depot Activity, New Mexico,* edited by Jeanne A. Schutt and Richard C. Chapman, pp. 13–36. Report No. 185-551. Office of Contract Archeology, University of New Mexico, Albuquerque.

Sebastian, Lynne
1983 Anasazi Site Typology and Chronology. In *Economy and Interaction along the Lower Chaco River: The Navajo Mine Archeological Program, Mining Area III San Juan County, New Mexico,* edited by P. Hogan and J. C. Winter. Office of Contract Archeology, University of New Mexico, Albuquerque.

Shackley, M. Steven
1999 Grants Ridge and Horace Mesa Mount Taylor Volcanic Field, Northwestern New Mexico. http://obsidian.pahma.berkeley.edu/ grants.htm

Smiley, Francis E., IV
1985 *The Chronometrics of Early Agricultural Sites in Northeastern Arizona: Approaches to the Interpretation of Radiocarbon Dates.* Ph.D. dissertation, University of Michigan. University Microfilms International (8520986), Ann Arbor.

Speth, John D., and Susan L. Scott
1989 Sedentism and Prehistoric Animal Procurement among Desert Horticulturalists of the North American Southwest. In *Farmers as Hunters: The Implications of Sedentism,* edited by Susan Kent, pp. 80–95. Cambridge University Press, Cambridge.

Sternberg, Robert S.
1990 The Geophysical Basis of Archaeomagnetic Dating. In *Archaeomagnetic Dating,* edited by J. Eighmy and R. Sternberg, pp. 5–28. The University of Arizona Press, Tucson.

Stiger, Mark
1986 *Technological Organization and Spatial Structure in the Archaeological Record.* Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Stokes, S. and D. R. Gaylord
1993 Optical Dating of Holocene Dune Sands in the Ferris Dune Field, Wyoming. *Quaternary Research* 39:274–281.

Stodder, Ann Lucy Wiener
1989 Bioarcheological Research in the Basin and Range Region. In *Human Adaptations and Cultural Change in the Greater Southwest,* by Alan H. Simmons, Ann Lucy Wiener Stodder, Douglas D. Dykeman, and Patricia A. Hicks. Arkansas Archeological Survey Research Series No. 32, Fayetteville.

Stuart, David A., and Rory P. Gauthier
1984 *Prehistoric New Mexico: Background for Survey.* 2nd edition. New Mexico Archeological Council, Albuquerque.

Suess, Hans E.
1986 Secular Variations of Cosmogenic C^{14} on Earth: Their Discovery and Interpretation. *Radiocarbon* 28:259–265.

Sullivan, Richard B., and Nancy J. Akins
1994 *Archaeological Investigations at LA 15260;*

The Coors Road Site, Bernalillo County, New Mexico. Archaeology Notes 147. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Tainter, Joseph A.
1982 Symbolism, Interaction, and Cultural Boundaries: The Anasazi-Mogollon Transition Zone in West-Central New Mexico. In *Mogollon Archaeology: Proceedings of the 1980 Mogollon Conference,* edited by Patrick H. Beckett and Kira Silverbird, pp. 3–9. Portales, New Mexico.

Tainter, Joseph A., and David "A" Gillio
1980 *Cultural Resources Overview, Mt. Taylor Area, New Mexico.* USDA Forest Service, Southwestern Region, Albuquerque and Bureau of Land Management, New Mexico State Office, Santa Fe.

Thoms, Alston V.
1977 A Preliminary Projectile Point Typology for the Southern Portion of the Northern Rio Grande Region. Unpublished Master's thesis, Texas Tech University, Lubbock

Toll, Mollie S., and Linda Huckell
1996 Guidelines for Standardizing Collection of Zea mays Morphometric Data: Or How to Get the Most Out of Your Maize. Paper prepared for the 5th Southwest Paleoecology Workshop, Flagstaff, Arizona.

Turnbow, Christopher A.
1997 Projectile Points as Chronological Indicators. In *OLE,* vol. 2: *Artifacts,* edited by John C. Acklen, pp. 161–230. Public Service Company of New Mexico, Albuquerque.

Vierra, Bradley J.
1980 A Preliminary Ethnographic Model of Southwestern Archaic Settlement Systems. In *Human Adaptations in a Marginal Environment: The UII Mitigation Project,* edited by J. L. Moore and J. C. Winter, pp. 351–357. Office of Contract Archeology, University of New Mexico.
1985 Hunter-Gatherer Settlement Systems: To Reoccupy or Not To Reoccupy, That is the Question. Unpublished M.A. Thesis, University of New Mexico, Albuquerque.
1990 Archaic Hunter-Gatherer Archaeology in Northwestern New Mexico. In *Perspectives on Southwestern Prehistory,* edited by P. Minnis and C. Redman, pp. 57–67. Westview Press. Boulder, Colorado.
1993 Across the Colorado Plateau: *Anthropological Studies for the Transwestern Pipeline Expansion Project,* vol. 27(1–,2), *Lithic Resource Variation across the Colorado Plateau,* Book 2: *Architectural Studies, Lithic Analyses, and Ancillary Studies,* by Bradley J. Vierra, Tim W. Burchett, Kenneth L. Brown, Marie E. Brown, Paul T. Kay, and Carl J. Phagan, pp. 157–167. Joseph C. Winter, Principal Investigator. Office of Contract Archeology and Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.
1994 Archaic Hunter-Gatherer Archaeology in the American Southwest. In *Archaic Hunter-Gatherer Archaeology in the American Southwest,* edited by B. Vierra, pp. 5–61. Eastern New Mexico University, Contributions in Anthropology 13(1), Portales.

Vivian, R. Gwinn
1990 *The Chacoan Prehistory of the San Juan Basin.* Academic Press, San Diego.

Warren, A. Helene
1982 Prehistoric Mineral Resources of the Lower Rio Puerco. In *Inventory Survey of the Lower Hidden Mountain Floodpool, Lower Rio Puerco Drainage, Central New Mexico,* by P. L. Eidenbach, pp. 67–69. Human Systems Research, Inc., Tularosa, New Mexico.

Wase, Cheryl L., David A. Phillips, Jr., Robin Stipe-Davis, and David H. Greenwald (editors)
2000 *Class III Cultural Resource Survey of the Proposed Enchanted Skies Park and Observatory near Grants, Cibola County, New Mexico,* vol. 1. Cultural Resources Report 97-155. SWCA, Inc., Albuquerque.

Wendorf, Fred, N. Fox, and O. L. Lewis (editors)
1956 *Pipeline Archaeology: Reports of Salvage*

Operations in the Southwest on El Paso Natural Gas Company Projects 1950–1953. New Mexico Office of Cultural Affairs, Museum of New Mexico Laboratory of Anthropology, Santa Fe. NMCRIS 36.

Wheat, Joe Ben
1972 *The Olsen-Chubbuck Site: A Paleo-Indian Bison Kill*. Memoir 26. Society for American Archaeology, Washington, D.C.

Wilcox, David R.
1978 The Theoretical Significance of Field Houses. In *Limited Activity and Occupation Sites: A Collection of Conference Papers,* edited by A. E. Ward, pp. 25–34. Contributions to Anthropological Studies No. 1. Center for Anthropological Studies, Albuquerque, New Mexico.

Wills, W. H.
1988 *Early Prehistoric Agriculture in the American Southwest.* School of American Research Press, Santa Fe.

Wilshusen, Richard H.
1988 Architectural Trends in Prehistoric Anasazi Sites During A. D. 600 to 1200. In *Archaeological Program: Supporting Studies: Additive and Reductive Technologies,* compiled by E. Blinman, C. J. Phagan, and R. H. Wilshusen, pp. 599–634. USDI, Bureau of Reclamation, Engineering and Research Center, Denver, Colorado.

Wilson, C. Dean
1994 Implications of Ceramic Resource Surveys in the Northern Mogollon Country. In *Mogollon VII: The Collected Papers of the 1992 Mogollon Conference* Held in Las Cruces, New Mexico. COAS Publishing and Research, Las Cruces.
2002 A Reappraisal of the Nature and Significance of Spatial Distributions of Pottery from Sites in the Northern Southwest. In *Anasazi Archaeology at the Millennium; Proceedings of the Sixth Occasional Anasazi Symposium,* edited by P. R. Reed, 129–136. Center for Desert Archaeology, Tucson, Arizona.

Wilson, C. Dean, and Eric Blinman
1994 Early Anasazi Ceramics and the Basketmaker Transition. In *Anasazi Symposium 1991*, compiled by A. Hutchinson and J.E. Smith, pp. 199–214. Mesa Verde Museum Association, Mesa Verde.
1995 Changing Specialization of White Ware Manufacture in the Northern San Juan Region. In *Ceramic Production in the American Southwest,* edited by Barbara J. Mills and Patricia L. Crown, pp. 63–87. University of Arizona Press, Tucson.

Windes, Thomas C.
1981 *A View of Cibola White Ware from Chaco Canyon.* Division of Cultural Research, National Park Service, Albuquerque.

Winkler, James, and Emma Lou Davis
1961 *Wetherill Mesa Project Archaeological Survey in Socorro and McKinley Counties, New Mexico.* University of California-Los Angeles. NMCRIS 37.

Winship, George Parker (translator and editor)
1933 *The Journey of Francisco Vasquez de Coronado, 1540–1542.* Grabhorn Press, San Francisco.

Wiseman, Regge N.
1995 *The Belen Bridge Site and the Late Elmendorf Phase of Central New Mexico.* Archaeology Notes 137. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Woodbury, Richard B.
1961 *Prehistoric Agriculture at Point of Pines, Arizona.* Memoirs of the Society of American Archaeology 17. Salt Lake City.

Wormington, H. Marie
1957 *Ancient Man in North America.* 4th edition. Popular Series No. 4. Denver Museum of Natural History, Denver.

Wozniak, Frank
1981 *The Antonio Sedillo Grant: An Archaeological Survey of Laguna Pueblo on the Lower Part of the Middle Rio Puerco of the East*. Office of Contract Archeology, University of New Mexico, Albuquerque.