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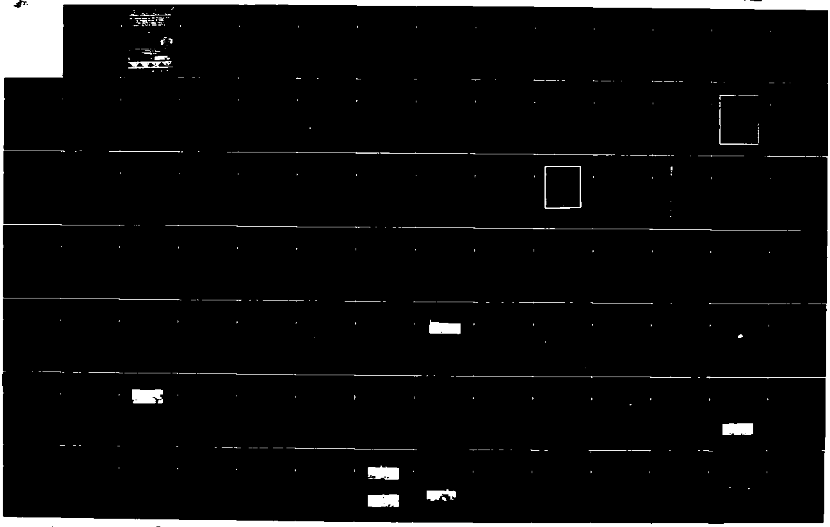

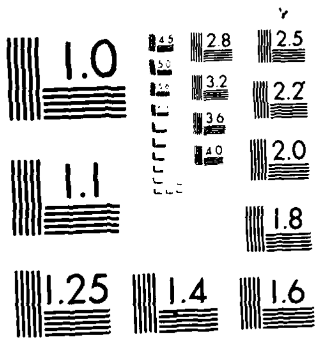

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ARCHAEOLOGICAL INVESTIGATIONS OF THREE SITES WITHIN THE WIPP CORE AREA, EDDY COUNTY, NEW MEXICO

edited by
Kenneth J. Lord
William E. Reynolds

CHAMBERS CONSULTANTS AND PLANNERS, ALBUQUERQUE
PREPARED FOR THE
U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT,
NEW MEXICO

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ABSTRACT

Archaeological investigations of ENM 10222, ENM 10230, and ENM 10418 have produced significant information on one portion of the seasonal round of prehistoric groups which inhabited southeast New Mexico between 1000 B.C. and A.D. 1400. The results of intensive surface collections and subsurface testing suggest that a hunter-gatherer subsistence system was in effect for the entire occupational history of the sites. This system developed out of an indigenous Late Archaic population and continued well into the Neoarchaic. During the Neoarchaic period an overlay of Jornada Mogollon traits entered the area, i.e., ceramics and arrow points. The evidence suggests that these additions did not effect the basic adaptive strategy.

ENM 10222 and ENM 10230 represent plant collection and processing localities and probably were satellite sites to more complex limited base camps. ENM 10418 represents one of these limited base camps. Both functional categories represent one subset in a seasonal round of activities. The three sites investigated represent the summer portion of a seasonal round with acorn and mesquite being the primary subsistence focus.

ARCHAEOLOGICAL INVESTIGATIONS OF THREE SITES WITHIN THE WIPP CORE AREA, EDDY COUNTY, NEW MEXICO

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June 1985

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ACKNOWLEDGEMENTS

Completion of this report has been made possible by the efforts of many concerned individuals. In particular, the entire staff of the WIPP facility greatly aided the project by allowing the use of phones, water, and showers. Captain John Rivenberg, Project Engineer, acted as a liaison between the archaeological crew and the multitude of subcontractors working in the area.

The Albuquerque District Office of the Corps of Engineers also played a valuable role in establishing a good rapport with the various agencies involved in the project. Jasper H. Coombes, P.E., James A. White, Jan V. Biella, and John D. Schelberg all provided valuable input into the formulation and implementation of the various field and analytical phases of the project.

Thomas Zale, formerly Archaeologist for the Carlsbad District of the Bureau of Land Management and subsequently Linda C. Brett, Archaeologist in the same office, were open to our inquiries and provided pertinent suggestions and unpublished manuscripts and site reports which proved to be invaluable.

A number of specialists provided valuable information which was necessary for the contents of this report. These include Larry Smith, geomorphologist; Regge Wiseman, ceramics; and Dr. W. C. Martin and Mollie S. Toll, ethnobotanical identifications.

Mr. Harvey Hicks of Carlsbad deserves special mention. He graciously allowed his extensive collection of materials to be examined and provided valuable information and site locations and attempted to locate people who had collected materials from the three sites. Mr. and Mrs. Rupert Heinsch and Mr. and Mrs. Robert Daugherty of Carlsbad provided the crew the use of phones and general hospitality.

Several people volunteered their help in various phases of the fieldwork. These include Georganne E. Meyer, Pam and George Gavin, and Evelyn J. Caballero.

Georgia Bayliss, Mark Schander, William J. Whatley, and Thomas Killion did the drafting and illustrations, Pati Nagle served as computer consultant, and Teri Van Huss and Diane Loftus typed the manuscript. Ms. Van Huss also served as project coordinator and her skills in administration and finances were greatly appreciated by the field and analytical personnel. Mark Schander also served as administrative assistant and always kept the field crews supplied with equipment, supplies, and other necessary items without which the task of completing the project would have been much more difficult.

Dr. William E. Reynolds served as Principal Investigator and was a constant source of encouragement and input into the structure of the project. CCP personnel not directly involved with the project also supplied valuable input into various stages of the write-up; these include James Rancier, Nancy Akins, and William Whatley.

Lastly, the field crew of the WIPP project who worked under unusual conditions for archaeologists and under a pressure situation should be commended for their efforts.

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Chapter 1

INTRODUCTION

William E. Reynolds

This report is in fulfillment of Delivery Order No. DM0001 under Contract No. DACW47-83-D-0069 awarded to Chambers Consultants and Planners by the Albuquerque District of the U.S. Army Corps of Engineers. The report details archaeological investigations performed at three sites (ENM 10222, ENM 10418, ENM 10230), all associated with the Waste Isolation Pilot Plant Project.

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) research and development facility intended to demonstrate the safe disposal of radioactive waste material produced through national defense activities. It is being constructed as a permanent repository for low-level radioactive waste and as a temporary facility for experimentation with high-level radioactive waste. Storage and experimentation will take place in subsurface chambers excavated in stable salt deposits. Above ground facilities include salt storage areas, buildings for administration and support, paved access roads, water and power lines, and a railroad spur from an existing Atchison, Topeka, and Santa Fe line servicing the Duval Potash Mine. The site of the WIPP facility is in Sections 20, 21, 28, and 29 of Township 22 South, Range 31 East, in Eddy County, New Mexico.

The work was directed by Dr. William E. Reynolds, Principal Investigator, and Dr. Kenneth J. Lord, Field Director. Archaeological investigations commenced October 24, 1983 and were completed on February 17, 1984. The field crew consisted of Crew Chiefs Steven Meyer, Jon Frizell and Lee Heinsch. The Archaeological Technicians included: Charles Locke, Steven Hoagland, John (Chuck) Haight, John Wilson, Colin Garvey, Judith McNeill, George R. (Bob) Phippen, Mark Schander, and Richard Sullivan.

HISTORY OF THE PROJECT

The Scope of Work was developed in compliance with the Archaeological Resources Protection Plan (ARPP) signed by the Department of Interior, Bureau of Land Management; the Department of Energy, WIPP site; the New Mexico State Historic Preservation Officer, and the Advisory Council on Historic Preservation. ARPP identified five mitigative strategies to provide for the mitigation of adverse impacts to the archaeological sites. These strategies included:

1. Cultural Resources Inventories
2. Completion of Previous Investigations
3. Construction Monitoring
4. Site Investigation - Intensive
5. Site Investigation - Sampling

Strategy 5 at ENM 10222 (LA 33165) and ENM 10230 (LA 32623) was designed to obtain more accurate descriptions of the sites while minimizing disturbance to them. This strategy was adopted in order to preserve the sites for the future since project impacts are anticipated to be minimal during the operation of WIPP. In contrast, Strategy 4 at ENM 10418 (LA 18161) involved more intensive studies since substantial portions of the site would be destroyed during the construction of the railroad spur line.

The Scope of Work was issued to CCP on September 30, 1983. Prior to commencement of the field studies, a research design was written by Dr. Reynolds (1983), submitted to the Corps of Engineers and accepted on October 24, 1983.

As a result of initial field studies at ENM 10418, unexpected subsurface deposits were discovered. In each of the test pits excavated at ENM 10418 one or more hearths were encountered along with cultural material. CCP verbally informed the Corps of this matter and submitted a letter report on November 15, 1983. As it appeared that unanticipated substantial subsurface cultural remains were present, the site would be totally destroyed by the railroad, and that in southeastern New Mexico subsurface remains at sites are rare, the Corps issued a Change Order to CCP following the guidelines of Strategy 5 in order to define the subsurface limits of ENM 10418.

Given that the surface of the site did not show any indications of the subsurface remains found by CCP, an extensive magnetometer survey along with additional test pits, a systematic augering program, and backhoe trenches were performed. CCP issued a subcontract to Spectrum Geophysics, which was administered by Mr. Robert Huggins, to perform the magnetometer survey.

The Corps was under extreme time pressure to complete work at ENM 10418 in order to avoid delays in the construction schedule. This meant that the magnetometer survey and the additional field testing at ENM 10418 had to proceed concurrently and quickly. To accomplish this task Mr. Huggins came out to the site and established the survey grids and began the survey. He then returned to Fort Worth and began processing the survey grid data as each grid was completed. These preliminary results were then communicated to Dr. Reynolds and/or directly to Dr. Lord in the field within a 24 to 48 hour time period.

The result of this process was that in a two week time period the magnetometer survey was completed; the results communicated to CCP; and a sample of subsurface anomalies were archaeologically tested. This process resulted in the discovery and excavation of 10 cultural features.

Based on the results of the testing, an extensive mitigation program (Strategy 4) was then implemented at ENM 10418. Fieldwork began on January 2, 1984. This program involved broad scale excavations, additional test pits over the new subsurface anomalies, and a complete scraping of the site by a front end loader at the completion of all hand excavation. In total, 68 features were found at ENM 10418.

The close cooperation and coordination between the Corps of Engineers, Chambers Consultants and Planners, and Spectrum Geophysics allowed a potentially disastrous situation from developing. Instead, a great deal of dirt was examined, excellent data were recovered, and the Corps was able to keep on schedule.

The analysis and writeup was directed by Drs. Lord and Reynolds. Dr. Lord wrote Chapters 4, 7, 8 and 9 and portions of Chapter 2 while Dr. Reynolds wrote Chapters 1, 2 and the spatial analysis in Chapter 8. Mr. Mark Schander wrote Chapter 3. Mr. Jon Frizell performed the ceramic analysis and wrote Chapter 5. Mr. Lee Heinsch performed the tool and flake analysis and wrote that section of Chapter 6; Mr. J. Steven Meyer performed the ground stone analysis and wrote that section of Chapter 6; and Dr. Lord performed the projectile point analysis and wrote that section of Chapter 6. Special testing analyses were performed by the following organization or individuals.

Radiocarbon Dating:	Beta Analytic, Inc. and the University of Texas at Austin
Faunal Analysis:	Dr. Kenneth Lord
Floral Analysis:	Dr. Kenneth Lord
Pollen Analysis:	Ms. Karen Clary of Castetter Laboratory for Ethnobotanical Studies at the University of New Mexico

The report is organized into the following sections: Chapter 2 is the Culture History and Research Perspective; Chapter 3 is the Environment; Chapter 4 is the Methodology, listing field methods and site descriptions; Chapter 5 is Ceramics; Chapter 6 is Lithics and Ground Stone; Chapter 7 is Biological Studies; Chapter 8 is Interpretations and Chapter 9 has Conclusions. There are also Appendices for the final report for the magnetometer survey provided by Mr. Huggins, additional ceramic and lithic information, and fire-cracked rock density maps for site ENM 10230.

Chapter 2

CULTURE HISTORY AND RESEARCH PERSPECTIVE

Kenneth J. Lord and William E. Reynolds

INTRODUCTION

Over 2,000 archaeological sites have been recorded throughout southeastern New Mexico, as it is defined by Camilli and Allen (1979). The vast majority of these sites have been recorded by three agencies: Eastern New Mexico University, New Mexico State University, and the Lea County Archaeological Society. Very few of the sites have been investigated beyond the survey level of effort. The lack of excavated sites has made it difficult to place sites within established cultural chronologies beyond generalized time periods, i.e., Paleoindian, Archaic, and Late Prehistoric occupations.

Comprehensive examination of cultural resources in the southeastern portion of New Mexico is provided in Camilli and Allen's A Cultural Resources Overview for the Bureau of Land Management Roswell District (1979) and Stuart and Gauthier's Prehistoric New Mexico: Background for Survey (1981).

This portion of Chapter 2 will focus on the generalized culture history of southeastern New Mexico with emphasis placed on sites within and surrounding the Nash Draw, New Mexico Quadrangle (see Figure 2.1). This includes the 15' USGS section maps of Carlsbad, Clayton Basin, Hat Mesa, Laguna Gatuna, Malaga, Nash Draw, and Oil City. In addition 7.5' section maps of Bell Lake, Big Sinks, Paduca Breaks East, Paduca Breaks West, Paduca Breaks NW, Phantom Banks, and Pierce Canyon were also included. This encompasses a 2,035 square mile region surrounding the project area.

PALEOINDIAN PERIOD (10,000 B.C. to 5000 B.C.?)

Paleoindian research in southeast New Mexico has had a long and continued emphasis. A number of well documented Paleoindian sites have been examined since the early 1930s. These sites have been extensively reviewed in Camilli and Allen (1979) and a synthesis of this material will be presented below. Major excavated Paleoindian sites in southeastern New Mexico include Blackwater Draw (two localities), Milnesand, Burnet Cave, the Elida Site, and Hermit's Cave. Eleven radiocarbon dates have been derived from three of these sites (Hermit's Cave, Burnet Cave, Blackwater Draw locality 1). These dates range from roughly 10,000 B.C. to 5500 B.C. (Stuart and Gauthier 1981:261).

These sites have been divided into two broad time periods, a middle Paleoindian period and a late Paleoindian period.

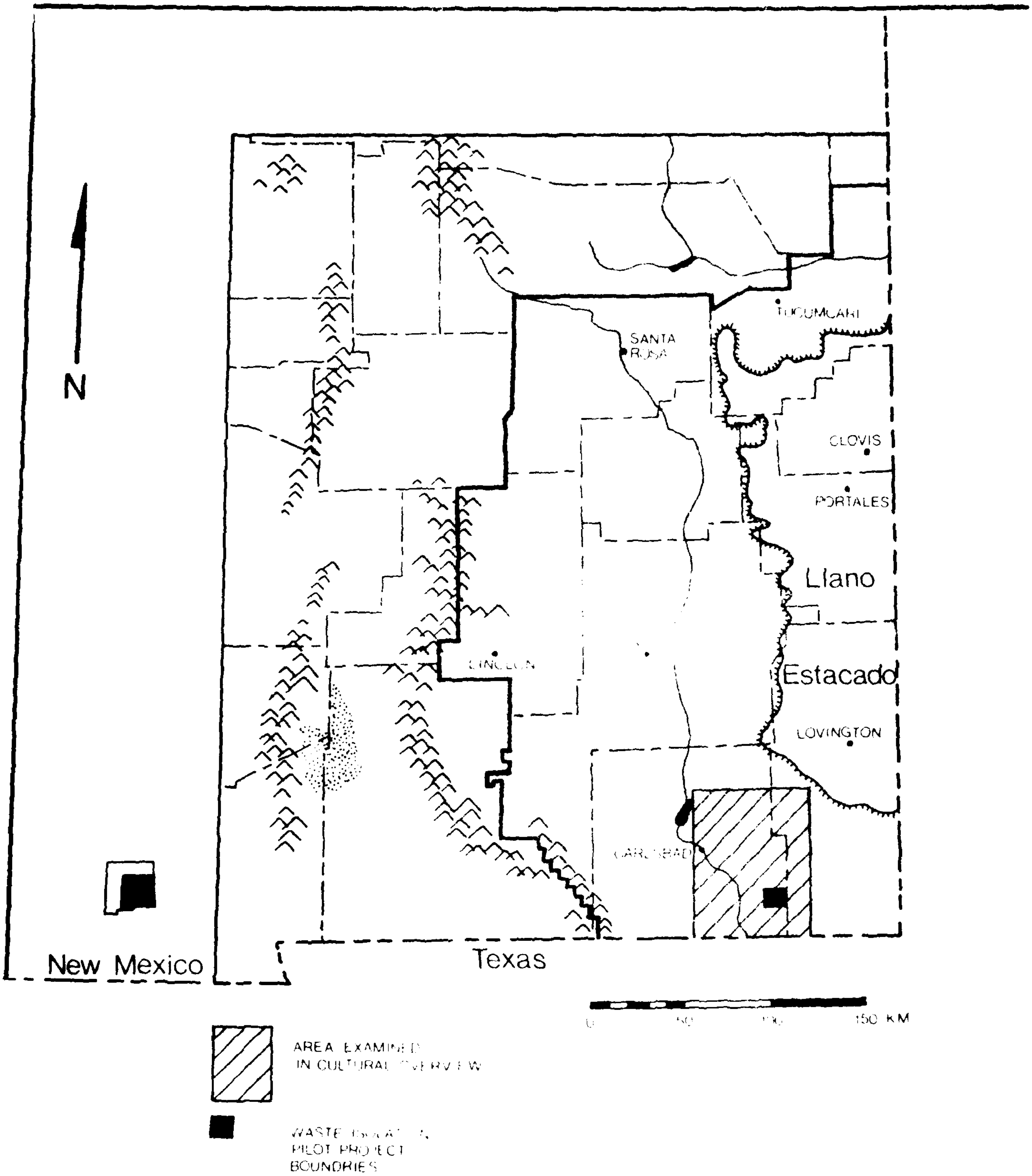


Figure 2.1
Area of Cultural Resource Overview
(after Camilli and Allen 1979)

Middle Paleoindian period sites in the southeastern New Mexico region consist of only Hermit's Cave which has been radiocarbon dated to between 12,900 ± 350 B.P. and 11,850 ± 350 B.P. (Schultz and Martin 1970).

Late period Paleoindian sites have also been found in the region. These include Clovis, Folsom, Midland, and Firstview complexes. Blackwater Draw, located 4 miles south of Clovis and 7 miles north of Portales, New Mexico, contains evidence of a Clovis occupation which has been radiocarbon dated at 11,040 ± 500 B.P., 11,170 ± 360 B.P., and 11,630 ± 400 B.P. (Hester 1972). A Folsom-Midland complex at Blackwater Draw has been radiocarbon dated at 10,250 ± 320 B.P. and 10,490 ± 900 B.P. (Hester 1972). A third complex recognized at Blackwater Draw contains Eden, Scottsbluff, Plainview, San Jon, Agate Basin, Frederick, and Cody projectile points. This complex, known as the Firstview (Judge n.d.), has been radiocarbon dated at 9989 ± 290 B.P. (Hester 1972). All three complexes at Blackwater Draw contain extinct megafauna with bison predominant.

Other excavated sites containing evidence of late Paleoindian remains include Burnet Cave (Howard 1935a), the Elida site (Warnica 1961), the Milnesand site (Sellards 1952), and the San Jon site (Roberts 1942). Bison were again the predominant game species recovered.

Paleoindian Assessment

Based on the results of the excavated Paleoindian sites in southeastern New Mexico and elsewhere in the Southwest (Camilli and Allen 1979; Judge 1973), the following cultural sequence can be postulated. The Paleoindian tradition includes the Clovis, Folsom, and Cody traditions, some of which may overlap temporally. These early traditions are primarily associated with the hunting of extinct Pleistocene herbivores (e.g., mammoth and bison). Stuart and Gauthier (1981) suggest that Paleoindian hunters pressed game species against natural topographic barriers such as the Llano Estacado caprock and the Guadalupe Mountains in southeastern New Mexico.

Because of the lack of Paleoindian survey data, use of this area must be suggested by analogy to other areas. Judge (1973:311), in his Middle Rio Grande study, states that the environmental variables common to all Paleoindian sites were a water source, proximity to a "hunting area" which he defined as a broad open area which could have supported a large game population, and an "overview" defined as a vantage point offering a clear view of the hunting area.

Numerous surface finds of Paleoindian material have been reported in southeastern New Mexico. Within the Roswell BLM District overview (Camilli and Allen 1979), two major studies have collated data from surveyed Paleoindian remains on the Llano Estacado. Broilo (1971) described analyzed Clovis, Folsom, and Midland projectile points from Blackwater Draw and other localities in Roosevelt County. Wendorf and Hester (1975) summarized data from 80 Paleoindian sites recorded in the north-central portion of the Llano Estacado.

Based on data in Camilli and Allen (1979) seven sites in the region surrounding the WIPP core area contain evidence of Paleoindian occupation. Smith (1966) reports Paleoindian points which are not associated with later material at four other localities around Laguna Plata. A Plainview-like point is reported by Hurst (1976) from Maroon Cliffs. A Folsom point from the Duval mine study area and a Sandia point from the vicinity have been reported by Thompson (1980:140). Leslie (1978), in his study of local collections, reported numerous Paleoindian points from throughout the area. Surficial Paleoindian materials have recently been encountered to the northeast and south of ENM 10418 by amateur collectors (personal communication Harvey Hicks 1984).

The potential presence of a limited amount of Paleoindian materials in the WIPP core area cannot be overlooked.

ARCHAIC PERIOD (5000 B.C. to A.D. 1000?)

The Archaic period in the Southwest in general, and southeastern New Mexico specifically, is poorly understood. The Archaic period represented an adaptation to a drier environment that could no longer support the megafauna of the Pleistocene epoch. Archaic adaptations placed emphasis on the gathering of vegetal materials and hunting of smaller game species, e.g., rabbit and deer. This shift in emphasis probably resulted in different site location strategies than those for the Paleoindian period.

The sparsity of Archaic remains in southeastern New Mexico may be the result of several factors: 1) the masking of Archaic sites due to depositional factors or subsequent Late Prehistoric period occupations, 2) removal of diagnostic tool types resulting in nondiagnostic lithic scatters, or 3) a real lack of Archaic use of southeastern New Mexico. It is probable that all three factors are responsible for the paucity of Archaic materials considering the long time span.

Unfortunately, a lack of stratified Archaic period sites presents grave problems in assigning temporal periods to sites with Archaic affiliations. The eastern portions of New Mexico appear to be on the interface of the Southwestern "Desert" cultures represented by the Cochise (Sayles and Antevs 1941) and the Oshara Traditions (Irwin-Williams 1967), and the "Plains" Archaic with close affiliations in Texas (Suhm and Jelks 1962).

The Cochise Tradition of the Archaic is generally confined to the west side of the San Andres Mountains (Beckett 1979). "Oshara-like" materials have been recorded by Jelinek (1967) in the Middle Pecos Valley and by Kemrer and Kearns (1984). Leslie (1978) reports finding both Oshara and Cochise-like materials in the southeastern part of the state.

"Plains" Archaic materials are represented at a number of sites in the region (Leslie 1978, 1979; Warnica 1965). These sites contain point styles resembling Gary, Bulverde, Fairland, Paisano, Frio, and Ellis points as described by Suhm and Jelks (1962). These point types represent broad temporal periods, ranging from 3000 B.C. to A.D. 1000.

In addition, a unique projectile point style called the "Maljamar" point (Corley and Leslie 1963; Smith 1972; Leslie 1978) is found in southeastern New Mexico. The dating is extremely tenuous but it is considered a Late Archaic type.

Cultural affiliations of the Archaic populations of southeastern New Mexico are thus difficult to interpret and may have in fact changed through time. Beckes and Adovasio (1982) attempted to define the cultural affiliations of the Hueco phase (Lehmer 1948) the preceramic precursors of the Jornada Branch of the Mogollon. They analyzed lithic materials and perishables from three more or less distinctive Archaic cultural manifestations. These include the Hueco phase of southern New Mexico, the Chisos focus of the Big Bend district of the Rio Grande (Kelley et al. 1940), and the Pecos River focus (Suhm et al. 1954) of the Lower Pecos region of Texas (Beckes and Adovasio 1982:205). The basic flaked and ground stone tool kit is very similar in all three complexes with virtually the same projectile point types at more or less synchronous periods, although the relative percentages of specific types may vary fror place to place. For example, projectile point types in the Hueco District exhibit a greater variety of small, serrated triangular forms than do the Lower Pecos and Big Bend (Chisos) assemblages. Conversely, large, finely worked dart points of the Langtry and related varieties are most common in the Lower Pecos region, less common in the Big Bend area, and least common in the Hueco District (Beckes and Adovasio 1982:206).

Examination of basketry clearly indicates that the perishable industries of the Hueco District, Big Bend, and Lower Pecos represent essentially the same basic developmental continuum (Adovasio et al. 1981).

Based on these data, Archaic period affiliations in southeastern New Mexico lie to the east (Leslie 1979). Until a large scale survey and excavation project in southeastern New Mexico and adjacent portions of Texas has been undertaken, the true cultural affiliations, temporal periods represented, and subsistence bases present during the Archaic period can only be considered speculation.

Based on data presented in Camilli and Allen (1979) for all the USGS topographic quadrangles adjacent to the WIPP area, 60 Archaic components have been identified. This represents almost 14% of the prehistoric components in the region. In addition, 123 sites have been classified as unknown prehistoric. It is highly likely that a certain percentage of these sites represent Archaic occupations.

Sites with Archaic components, based on radiocarbon dates in the Carlsbad region, include Honest Injun Cave dated to 2930 ± 60 B.P. (Applegarth 1976:54), a date of 1755 ± 65 B.P. from the Laguna Plata site (Haskell 1977), a date of A.D. 584 at Burnet Cave (Burns 1967:40), and two dates from Site 3 at the Duval mine sites: 2530 ± 70 B.P. and 1710 ± 130 B.P. (Thompson 1980:137).

Several sites in the WIPP area contain evidence of Archaic occupation. ENM 10222 contains Archaic-like projectile points (Schermer 1980:30) and ENM 10233 (Hicks 1981a) had a hearth which has been radiocarbon dated to 1530 ± 160 B.P. and 1290 ± 130 B.P. (Schermer 1983).

LATE PREHISTORIC PERIOD (POST A.D. 900)

The Late Prehistoric period has been well documented in southeastern New Mexico by large survey projects. Two hundred and forty-one sites with ceramics have been documented within the 2,035 square mile area intensively examined. Excavated sites, however, have been examined on a much smaller scale. The Lea County Archaeological Society began investigations in 1957 with the Boot Hill Project (Corley and Leslie 1960). This site contained four burials and a variety of artifactual material including ceramics, chipped and ground stone tools, and artifacts of shell and bone. In addition, midden deposits ranging up to four feet in thickness were uncovered. Pithouses may have also been present at the site (Camilli and Allen 1979:82).

Excavations of the Merchant Site (Leslie 1965) were the first to yield evidence of structures east of the Pecos River. These excavations uncovered two pithouses and as many as thirteen surface rooms. Two occupation levels were noted for the pit structures. Ceramic types recovered from the site led Leslie (1965) to propose an occupation date of A.D. 1400 for the site. Ochoa Indented ware made up 96% of the ceramic material recovered. In addition to the structures, 75 bedrock mortars were associated with the site.

Excavations at the Monument Spring Site, southwest of Hobbs, also yielded bedrock mortars. An unfinished pit structure was also noted. Leslie (1968) attributes this site to the Ochoa phase based on ceramic types.

The Laguna Plata site has been excavated by the Lea County Archaeological Society and Eastern New Mexico University (Runyan 1972; Haskell et al. 1977). Runyan describes three shallow pithouses, each characterized by a "non-local" orange-red clay floor, eight to nine inches thick, lying above a natural mottled greenish-white gypsum clay. Runyan believes this clay represents floors of structures. All structures contained post holes indicating some type of superstructure, probably constructed of brush. All three house floors contain a dense midden cover consisting of bone, chipped stone artifacts, and ceramics.

Later investigations of Laguna Plata included excavations of midden deposits by Eastern New Mexico University (Haskell et al. 1977). Bones of jackrabbit and antelope dominated the faunal assemblage, with bison, bighorn sheep, and deer in lower frequencies. Petrographic analyses of tempering materials in the ceramic assemblage suggests that they were not locally manufactured (Burns 1977). The majority of the ceramic material consisted of plain, decorated, and textured Jornada Brown wares. The dates for brown and decorated wares range between A.D. 900 and A.D. 1650 (Camilli and Allen 1979:87). Two radiocarbon dates obtained for the site are A.D. 760 ± 95 and A.D. 915 ± 65 suggesting a narrow span of occupation (Burns 1977). No additional structures were noted.

Excavation work in the Duval Mine area was undertaken in 1979 (Thompson 1980). Six sites were examined using a multiple strategy including surface collections, posthole augering, and test excavations. Ceramics recovered from Sites 3, 4, 7, and 8 indicate occupation during the Late Prehistoric period bracketed between A.D. 700-1400. The lithic assemblages basically conform to these dates; however, some lines of evidence suggest that some of the sites were originally occupied during Archaic times (Thompson 1980:140). Four radiocarbon dates from Site 3 suggest occupation during both the Archaic and Late Prehistoric periods. Dates on wood charcoal are 580 ± 70 B.C., A.D. 240 ± 130, A.D. 810 ± 150, and A.D. 1150 ± 185 (Thompson 1980:137). These dates confirm Archaic and Late Prehistoric period use of Site 3.

Late Prehistoric Period Assessment

Archaeological work within the Late Prehistoric period in southeastern New Mexico has largely been confined to survey recording of sites (Nielsen 1977; MacLennan and Schermer 1979; Laumbach 1979; Beckett 1976; Bond 1979; Hurst 1976). The biggest problem associated with survey documentation revolves around the lack of temporal control on sites. Corley (1965) has proposed a chronological framework based primarily on ceramic associations.

Corley defines the WIPP area as being within the eastern extension of the Jornada Branch of the Mogollon (1965). A three phase sequence of occupation has been defined. The earliest, the Querecho phase, dates between A.D. 950 and 1100 and is characterized by open nonstructural sites associated with a local plain brownware. Associated ceramics include El Paso Brown, Jornada Brown, Jornada Red-on-brown, Three Rivers Red-on-terracotta Boldline, and Chupadero Black-on-white. Based on Camilli and Allen (1979), 38 sites within Nash Draw and surrounding USGS quadrangles contain evidence of Querecho occupation. This represents almost 16% of the ceramic period sites.

The Maljamar phase dates to between A.D. 1100-1300. Sites of this phase contain pithouses and both plain brown and corrugated brownwares. Associated ceramics include El Paso Brown, El Paso Polychrome, Mimbres Black-on-white, Playas Red and Incised, Three Rivers Red-on-terracotta Boldline and Fineline, and Chupadero Black-on-white. Thirty-nine sites (16%) have been attributed to this phase in the region.

The Ochoa Phase is the final period attributable to the Jornada Mogollon. It dates between A.D. 1300 and 1450 and is characterized by sites with surface rooms and Ochoa Indented brownware. In addition to the distinctive Ochoa Indented brownwares, El Paso Polychrome, Three Rivers Red-on-terracotta Fineline, Gila Polychrome, Ramos Polychrome, Pecos Glaze I red and yellow, and Lincoln Black-on-red are found. Only 13 (5.4%) of the ceramic sites in the region date to this phase.

The vast majority of the ceramic sites in the region (62.6%) could not be assigned to the phase designations established by Corley (1965). Reevaluation of these sites is extremely important in order to establish chronological controls for this region. More secure dating methods of the sites, i.e., radiocarbon, will be necessary in order to understand more fully the cultural complexity of the region.

Based on survey and excavation data, the sites dating to the Late Prehistoric period apparently represent temporary camps used for the exploitation of plant and animal resources. Even sites with evidence of structures contain no definite evidence of agricultural pursuits.

Revision of the Jornada Branch of the Mogollon as defined by Lehmer (1948), and Corley's (1965, as updated by Leslie 1979) eastern extension of the Jornada Branch of the Mogollon are based largely on similarities of the ceramic traditions. Beckes and Adovasio (1982) indicate that the precursors of the Jornada Branch of the Mogollon, the Hueco phase, have chipped stone and basketry affiliations to groups in western Texas. The basketry and chipped stone materials of the Jornada Mogollon, however, have ties to the west with the Cochise. "The great disparities between the Jornada Branch Mogollon basketry and the earlier and possibly in part contemporaneous Hueco phase basket wares suggest that no connection of any sort exists between the makers of these materials" (Beckes and Adovasio 1982:208). These changes would have necessitated a total revolution in basketry production with a complete and utter break by the Jornada weavers from 6,000 to 7,000 years of antecedent weaving traditions (Beckes and Adovasio 1982:208). An alternative interpretation of the data would view the Jornada Branch as an immigration.

Lithic materials, primarily projectile points found in Late Prehistoric period sites in southeastern New Mexico, have general shape characteristics similar to those found to the east in Texas (see Leslie 1978; Kauffman 1983). This, coupled with a lack of agricultural pursuits, seems to indicate a settlement-subsistence system which differs from the classic Jornada Mogollon. Collins (1971) in "A Review of Llano Estacado Archaeology and Ethnohistory" states that the Querecho, Maljamar, and Ochoa phases are thought to have become increasingly independent of the most progressive Mogollon development to the west and maintained a greater reliance on hunting. It appears that several explanations account for the presence of Southwestern ceramics on the Llano Estacado: 1) relatively permanent hunting-gathering communities seem to have existed, 2) agricultural Puebloan communities very likely existed in the southeastern region of New Mexico and indigenous people probably received Puebloan ceramics in trade, and 3) it is possible, but unlikely, that hunting groups operating out of the eastern Puebloan communities transported some pottery into the region (Collins 1971:89).

Based on available data, it is difficult to determine if indigenous peoples developing out of essentially Texas Archaic stock were in a trading relationship with more western ceramic producing groups or if Jornada Mogollon groups moved into the region on a seasonal basis to exploit the region for plant and animal resources. Resolving this problem may prove difficult; however, detailed comparisons of lithic technologies from the stratified sites between core area Jornada Mogollon groups and sites of similar time periods in Texas may help to answer this question. These types of studies can then be compared to data from southeastern New Mexico.

PREVIOUS ARCHAEOLOGICAL WORK IN THE WIPP CORE AREA

A number of archaeological surveys and excavations have been undertaken in the WIPP core area (see Figure 2.2). The WIPP core area is defined as the four sections of land which include and surround the WIPP site. The original survey was by J. Nielsen of the Agency for Conservation Archaeology (ACA) for Sandia Laboratories. This survey resulted in the location of 33 sites and 64 isolated artifacts (Nielsen 1977). The next survey by R. MacLennan and S. Schermer of

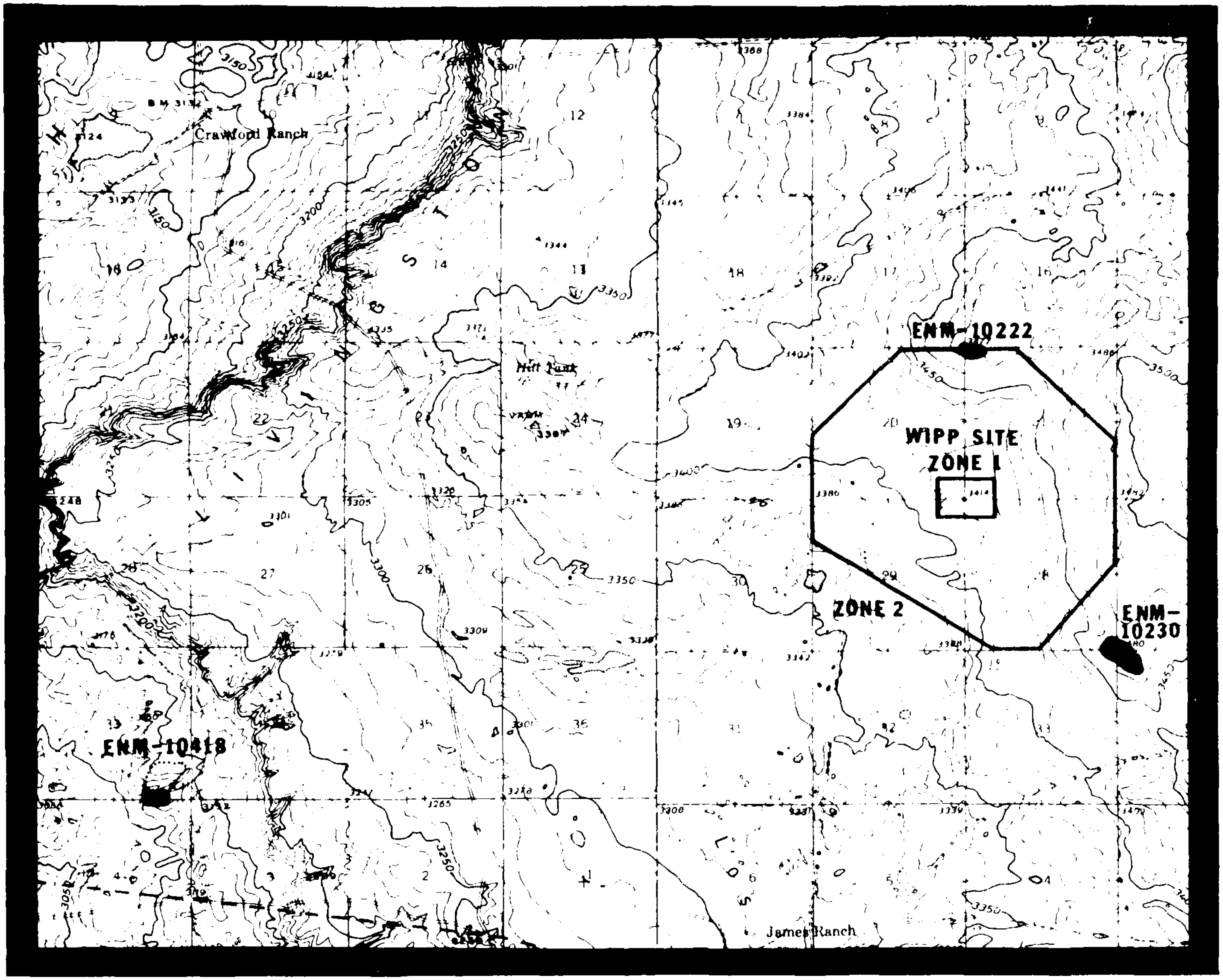


Figure 2.2
General Map of the Project Area

ACA for Bechtel Inc. was for access roads and a railroad right-of-way. The survey encountered two sites and 12 isolated artifacts (MacLennan and Schermer 1979). Schermer performed another survey designed to relocate the sites originally recorded by Nielsen (1977). This survey redescribed 28 of the original 33 sites (Schermer 1980). In 1981 P. Hicks directed the excavation of a total of nine sites in the WIPP core area (Hicks 1981a, 1981b). The last archaeological survey was by B. Bradley of CASA for a proposed water pipeline. This survey recorded one site and four isolated artifacts (Bradley 1982). The survey data are summarized in Table 2.1.

A number of generalizations concerning soils, vegetation, and site features may be gleaned from these survey and excavation data. The majority of the sites are associated with the Berino soil series which are sandy, deep, non-calcareous, yellowish-red to red soils of mixed origin. Nielsen (1977:18) notes that the lower component consists of a red to dark red sandy clay loam and, 1) is associated with the floors of deep blowouts, and 2) cultural material is generally found on this surface.

The major plant association occurring at the sites is made up of Quercus, Prosopis sp., Yucca sp., and annual grasses. The surface morphology is primarily sand, windblown deposits, and sand dunes.

In terms of the human occupation, the majority of the sites have hearths or hearth stains and/or burned caliche/sandstone. The majority also have some pottery and almost all have flakes, manos and/or metates. There were very few cores, hammerstones, or formal tools found during the surveys.

The nine sites excavated in the WIPP core area which are reported in Hicks (1981a and 1981b) are ENM 10201, ENM 10233, ENM 10237, ENM 10241, ENM 10206, ENM 10207, ENM 10209, ENM 10211, and ENM 10212. In both reports Hicks concluded that all the sites represented small gathering and/or plant processing stations. This conclusion was based on the presence of either identifiable ground stone and/or other fragments of sandstone that may have been eroded pieces of similar tools. She also concluded that there was very little evidence for tool manufacture or hunting activities based on the lithic debris present. The majority of the lithics appear to have been produced as a result of resharpening a tool edge. Based on ceramic typologies all of the sites could range in age from A.D. 900 to A.D. 1350. ENM 10233, however, has been radiocarbon dated to A.D. 420 ± 160 and A.D. 660 ± 130 (Schermer 1983).

RESEARCH DESIGN

Introduction

The research results of the excavations at sites ENM 10222, ENM 10230, and ENM 10418 will be dependent on the archaeological material recovered. Our expectations have largely been based on the nature and results of the excavations at similar sites in and near the WIPP core area. The expectations, governing hypotheses, and analytical strategies are detailed below.

Table 2.1
Data for Sites Surveyed in the WIPP Core Area

Site #'s	Soils	Veg	Surface Morph	Hearths	Ceramics	Flakes	Hammer-stones	Core	Mano	Metate	Scraper	Burned Sandstone	Lithic	P Point
201	3B	I		X (1) *	Jornada Brown	X (1)			X (1)	4 frags		X (1		
204	KM	I	Qs						X (15)	X (5)				
206	KM	I	Qsd		Jornada Brown	X	X		X	X				
207	KM	I	Qsd	X					X					
208	3B	I	Qs		Jornada Brown	X (1)								
209	3B	I	Qs		El Paso Brown	X					X	X		
211	KM	I	Qsd			X				X		X		
212	3B	I	Qs						X (1)	X		X		
215	3B	I	Qsa	X	El Paso Brown Jornada Brown	X			X	X	X (1)			
216	3B	I	Qs			X (4)				X		X		
220	3B	I	Qs	X stain)		X				X (1			X	
221	-	-	-	X (2)	El Paso Brown	X						X		
222	3B	I	Qsa	X (1)	El Paso Brown	X			X	X	X	X		? Archaic
223	--	-			El Paso Brown	X (1)						X		
228	3B		Qsa		Chupadero B/W	X			X	X		X		
229	3B	I	Qsa	X (1)	Chupadero B/W	X			X	X		X		
230	3B	I	Qsa	X (?	Jornada Brown El Paso Brown	X			X	X	X			
231	3B	I	Qsa			X								
232	3B	I	Qsd	X (1)	El Paso Brown	X			X					
233	3B	I	Qsd	X					X	X		X		
234	--	-	-		El Paso Brown	X			X	X		X		
235	3B	I	Qs		El Paso Brown Jornada Brown	X			X			X		
236	KM	I	Qs	X (2)		X		X	X	X		X		
237	3B	III	Qs	X (5	El Paso Brown	X			X	X				
238	3B	III	Qs	X ?	El Paso Brown	X			X	X		X		

Table 2.1 (continued)
Data for Sites Surveyed in the WIPP Core Area

Site #'s	Soils	Veg	Surface Morph	Hearths	Ceramics	Flakes	Hammer-stones	Core	Mano	Metate	Scraper	Burned Sandstone	Lithic	P Point
239	KM	I	Qsd	X (?)		X			X	X				
240	BB	I	Qsa		El Paso Brown	X				X	X (1)			
241	BB	I	Qs		El Paso Brown	X (1)			X	X		X		
242	KM	I	Qs	3	El Paso Brown Jornada B/W Chupadero B/W	X			X (2)	X		X	X	
243	BB	I	Qs			X			X (1)	X		X		
244	BB	IV	Qsa	X (1)	Jornada Brown	X (1)			X (2)			X		
245	BB	I	Qsd			X			X (3)	X		X		
246	BB	I	Qs	X (2)		X			X	X	X (1)	X		
418	TF	-	-	X (8)	Jornada Brown			X	X		X			
419	SM	-	-	X (3)		X								
WP-1	--	-	-	X ?	Jornada Brown Chupadero B/W				X					

Key for Table:

* For archaeological phenomena, an 'X' indicates the item is present and the number in ( ) is the count when provided in the survey reports

Soil Associations:
- KM (Kermit-Berino) - fine sands, 0-3% slope, active dunes cover up to 20% of surface
- BB (Berino) - fine sands, gentle slope, hummocky surface
- TF - Tonuco Loamy Fine Sand
- SM - Simona Sandy Loam

Vegetational Zones:
- I - *Quercus* sp., *Prosopis* sp., *Yucca* sp., and annual grasses
- II - *Prosopis* sp., *Quercus* sp., and *Artemisia* sp.
- III - Unidentified composite, *Artemisia* sp., and *Prosopis* sp.
- IV - *Condalia* sp.

Surface Morphology:
- Qs - Sand, windblown deposits, low dunes occasionally
- Qsd - Conspicuous dunes (as seen from aerial photography)
- Qsa - Other high dune areas noted by archaeological crew
- Sst - Sandstone outcrop
- Cal - Caliche outcrop

(see text for full explanation, based on Jones et al. 1973)

Governing Hypotheses

There were three hypotheses regarding prehistoric human utilization of the WIPP area that were considered:

1. The WIPP area was seasonally utilized, where activities were focused on the gathering of vegetal materials (acorns and mesquite beans) with a lesser emphasis on hunting. Temporary structures were set up at base camps. Procurement groups would range into the surrounding areas to hunt and gather as well as to perform initial processing. Foodstuffs were stored at the base camp and subsequently removed to permanent villages, probably located near the Pecos River. Tool production and maintenance was performed at the base camps although tool production for immediate needs might occur elsewhere. This hypothesis varies little from that suggested for the preceding Archaic groups.

2. The WIPP area supported a semi-sedentary population of Mogollon throughout the year. Data from the Merchant site (Leslie 1965) and from the Andrews Lake locality in Texas (Collins 1968) demonstrate the existence of pit structures and surface rooms occupied during the Ochoa phase at playa localities. These populations appear to be almost totally dependent on the hunting of game, especially bison, and the gathering of wild vegetal materials. This situation might have developed earlier in the Mogollon sequence in the WIPP area. Farther to the north, in the panhandles of Texas and Oklahoma, a similar development is called the Antelope Creek focus. Dating between A.D. 1200 and A.D. 1450, these sites are architecturally reminiscent of Southwestern pueblos. Bison were the primary resource, and the Upper Republican complex of the central plains is a suggested cultural origin (Krieger 1947; Watson 1950).

3. The population in the WIPP area was never Mogollon but an indigenous, essentially nomadic hunter/gatherer group that systematically traded for Mogollon ceramics. Puebloan tradewares from the Southwest have been found on Plains Indian sites throughout Texas and Oklahoma (Krieger 1947). An alternative is that a "Plains" group acquired ceramic and architectural technologies from the Mogollon after considerable contact with them. Collins (1968:41) however, considers this an unlikely possibility. An ethnographic example is found in the Jicarilla Apache adoption of adobe pueblos, micaceous pottery, and agriculture that occurred in the 1700s (Gunnerson 1974:10-11).

The Data Base

There were three data bases that were known to exist at the sites based on previous fieldwork: lithic data, spatial data, and ceramic data. Lithic data included material type and attribute recordation, ceramic data included type and attribute recordation, and spatial data were based on surface collections and excavation units.

The presence of features would open other data realms if they were found. Hearths would have the potential for chronometric samples and macrobotanical analysis. However, if any remains were found in the one hearth feature at site ENM 10233 they were not reported. Palynological data also had the potential of existing from hearth features and profiles. Thus far none of the previous excavations had reported the existence of this data base. Last, there was the potential for faunal data but again it was an unknown in terms of its presence and recoverability.

The research design submitted to the Corps first focused on those data bases known to exist and discussed research questions associated with those data. The research design was revised after the completion of the field studies. The following discussions of the lithic, ceramic, and spatial data bases reflect our post field knowledge about the sites.

Lithic Analysis

Lithic analyses used to evaluate the three governing hypotheses revolved around a detailed study of lithic raw material types, manufacturing attributes, and tool morphology.

Lithic raw materials were identified to source areas, if possible, with emphasis placed on the direction of movement of items into the WIPP area. If either Hypothesis 1 or 2 was to be corroborated, a certain percentage of the raw material types would come from west of the Pecos River. Hypothesis 3 would be corroborated if raw materials were locally available or were coming from the east, outside of the eastern extension of the Jornada Branch of the Mogollon culture (Corley 1965).

Lithic manufacturing attributes as delineated by debitage analysis were also an important portion of the overall research design. Kauffman (1983:31-32) indicated that biface manufacturing was much more frequent during the Archaic period. A high percentage of flakes with converging or bidirectional flake scars and flakes with multiple facet platforms, indicative of increased platform preparation, are evidence for biface manufacturing. These two attributes as well as the percentage of cortex, platform angle, distal termination, and size were recorded in order to determine "Archaic-like" versus "Anasazi or Mogollon-like" manufacturing techniques.

Beckett (1979) questioned the Archaic origins of the Jornada Branch of the Mogollon. On the west side of the San Andres Mountains the Archaic seemed to be predominantly that of the Cochise culture while the Archaic on the east side of that mountain range seemed to be more closely related to eastern New Mexico and west Texas (Beckett 1979:224). This dichotomy may have represented different trajectories of Archaic cultural evolution which converged into the Jornada Branch of the Mogollon. An alternative hypothesis is that the Jornada Branch of the Mogollon and its eastern extension, i.e., east of the San Andres Mountains, may represent two separate cultural groups with trading relationships.

Detailed analyses of projectile point form and other tool morphology attributes were undertaken in an attempt to discern regional variation in projectile point forms across the Jornada Branch of the Mogollon. Projectile point types recovered from the fieldwork at ENM 10418 and ENM 10230 were morphologically similar to those found in portions of Texas. Several points from ENM 10230 were similar to the point shown for NMSU 1394 (Kauffman 1983:Figure 7b). These points resembled the Williams type projectile point (Suhm and Jelks 1962:Plate 130a), but they were half the size of this Texas point (Kauffman 1983:28). A number of points found at ENM 10418 closely resembled Alba or Bonham arrow points in the Texas typology (Suhm and Jelks 1962).

The presence of Texas style projectile points in southeastern New Mexico may indicate cultural ties to the east rather than the core area of the Jornada Branch of the Mogollon.

Seven specific research questions concerning the lithic assemblages were formulated:

1. What, if any, lithic reduction activities occurred at the sites?

2. Can lithic use activities be formulated based on the presence of formal tools and/or grinding implements?

3. Do lithic activities correlate with material types, and if so what activities co-occur with material types?

4. If projectile points are present, will they help date the sites?

5. Can lithic raw materials be identified to specific source areas?

6. Can lithic manufacturing attributes as delineated by debitage analyses be related to the three governing hypotheses?

7. Can tool morphology attributes be used to place the sites within a regional context?

Ceramic Analysis

Examination of ceramic types recovered from the three sites focused on identification of types with special emphasis on temper varieties in order to determine if tempering materials shifted through time. This aspect of the analysis was very pertinent within the brownwares since much confusion existed in the area about this large, broadly dated ceramic type. Based on preliminary findings on projectile point types from ENM 10418 and ENM 10230, the two sites did not appear to be similar in age. Additionally ENM 10418 contained at least two different styles of projectile points which may have represented reuse of the site. Chronometric samples were recovered and dates proved to be very useful in determining if tempering styles changed through time.

Other ceramic data pertinent to the hypotheses presented above revolved around the presence of Chupadero Black-on-white sherds at ENM 10418. Kauffman (1983:38) stated that this ceramic type at NMSU 1394 near Loco Hills in Eddy County had one common feature: they had been extremely overfired or misfired.

These misfires probably represented vessels or portions of vessels which were rejected by their manufacturer.

Only a limited number of Chupadero Black-on-white sherds were found on ENM 10418 and none were found on ENM 10222 or ENM 10230. The presence of overfired or misfired sherds were monitored in an attempt to determine if this trait was a valid delineator for suggesting that hunter-gatherer groups in the region obtained decorated wares from Mogollon groups.

The ratio of jars to bowls was also examined to determine if the sites were occupied on a semipermanent or seasonal occupation. The studies of Plog (1980), Hantman (1978), and Pilles (1978) suggested that jars were used as storage and cooking vessels, while bowls were used for food preparation and serving. Jars normally made up 25 to 50% of the vessels on permanent (or long term) habitation sites, and comprised considerably less of the assemblage in temporary, or limited activity sites (Kauffman 1983:39).

Monitoring of these ceramic attributes in conjunction with the lithic analyses, the dating of the sites, and the examination of spatial patterning discussed below provided pertinent information toward the evaluation of the three hypotheses.

Three research questions were developed concerning the ceramic assemblages:

1. Can a relative date be assigned to each site based on the ceramic assemblages?

2. What vessel forms were present and how are they related to subsistence and lithic activities?

3. Can differences in tempering materials be discerned and can these differences be related to temporal periods at the sites?

Spatial Analysis

There are two spatial analytic techniques that were relevant to the WIPP data base. They were nearest neighbor analysis and site structure analysis.

The technique of nearest neighbor analysis (Clark and Evans 1954) is a spatial technique that can be used at both the single and multicomponent sites. The technique serves two purposes: to define artifact contemporaneity and define artifact patterning and association. The technique has been utilized by Reynolds (1974, 1975) to address both of these problems at prehistoric sites.

The second spatial dimension utilized was site structure. This relates to the spatial structure of site features/artifacts during a single occupational episode. Chapman addressed this problem with lithic sites in the Middle Rio Grande (Cochiti Lake) and came to the following conclusions termed "interesting tendencies" (1980:135):

- Maximum concentrations of fire-cracked rock are located adjacent to existing hearths or hearth feature epicenters.

- Maximum concentrations of stone tool manufacturing debris are distributed often within fire-cracked rock piles.

- These concentrations tend to form concentric arcs enclosing empty space near hearths or hearth epicenters.

- Metates and metate fragments are generally found adjacent to hearths.

Site feature/artifact relationships thus formed the second spatial dimension in the definition of single component site characteristics and the identification of multicomponent site complexity.

At a supposed multicomponent site with features, such as ENM 10230 and ENM 10418, the features and artifacts were mapped. Single component site characteristics (if present) based on work from the surrounding area (same time period or different time periods) were compared to ENM 10230 and ENM 10418 to see if any of the single component characteristics are present. If similar spatial patterns are present at the multicomponent sites, the same functional activities may be inferred.

Once the multicomponent sites were analyzed in terms of temporal and functional characteristics, the changes that have occurred through time were noted in terms of activities and site complexity. These data were then integrated with topographic and environmental reconstruction data.

One last relationship discussed was that single component sites may be single component because of environmental and/or topographic behavioral selection processes. Multicomponent sites may have been the result of totally different environmental and/or topographic selection processes. Therefore the analytic dimensions of single component sites (spatial and statistical) may or may not have been relevant to the multicomponent sites. This was a discovery process. However, the same spatial and statistical techniques were utilized for both single and multicomponent sites in conjunction with the respective environmental and topographic data for a valid comparison of single and multicomponent sites characteristics.

A single research question was developed for spatial analyses at the sites:

1. If features are present, they would most likely take the form of hearths which could be used for spatial analyses. Can hearths be used to spatially define specific activity areas for discrete periods of occupation at the sites?

Radiometric Analysis

Radiometric dates on the sites are useful for both inter- and intrasite interpretations. The potential for dating sites chronometrically in conjunction with such relative dating indicators as ceramics and projectile points provides valuable information not only for sites in the WIPP area but also for the southeastern New Mexico region. For this reason a large number of charcoal samples were submitted.

Additional Research Areas

Living Surfaces:

It may be possible, based on the artifact contour maps, to define living surfaces that would still be covered under dune surfaces. This would be a possibility if the sample unit analysis indicates that in a dune between two high artifact density areas, the contour lines are connected. If this were the case, then test trenches would be placed in this area.

Dating Nondiagnostic Lithic Scatters:

If it is possible to separate discrete site occupations at multicomponent sites and some of the occupations could be dated, the lithic characterization of the dated components could be statistically analyzed and compared to other nondated components.

Paleoindian Occupation:

An examination of the Nash Draw 7.5' quadrangle indicated that the area about six miles west of site ENM 10230 may have been a terminal Pleistocene lake. If this was the case, then ENM 10230 satisfies Judge's (1973) requirements for a Paleoindian site, i.e., near water, has a vantage point, and would be near a hunting area. Paleoindian deposits may then exist at site ENM 10230. This possibility would be investigated by extending test trenches/pits beneath the red to dark red sandy clay loam surface (Nielsen 1977:18) and then have these profiles examined by a geologist. It does not appear that this possibility has been investigated in the WIPP core area (Hicks 1981a,b).

The research design was conceived of as open-ended for, aside from lithic, ceramic, and spatial data, the potential data base from pollen, floral, and faunal analyses was unknown. In retrospect these data bases provided little additional information. An unexpected data base which was recovered was the large number of hearths. The presence of a large number of hearths allowed for a refinement of the occupational sequence within the WIPP core area, specifically, and southeastern New Mexico in general.

In general, the governing hypotheses and the specific research questions discussed above have been addressed in this report. These results have provided a significant contribution to the archaeological knowledge of southeastern New Mexico. Additionally, the report has provided a data base which can be used by future researchers, which may help to develop additional research questions and may help to refine the research questions developed for this report.

Chapter 3

ENVIRONMENT

Mark D. Schander

PHYSIOGRAPHY

The project area is located within the eastern portion of the Pecos Valley section of the southern Great Plains physiographic province. This province is a broad belt of highlands gradually sloping eastwards from the Rocky Mountains and Basin and Range Province to the Central Lowlands Province (Powers et al. 1978).

Physiographically, the Pecos Valley section consists of the upper portion of the Canadian River and the valley of the Pecos River. Together they form a long north/south trending trough, from 5 to 30 miles wide. The northern portion is as deep as 1,000 feet.

The Llano Estacado borders the Pecos River Valley to the east. This plain, notably uneroded, is also a member of the Great Plains physiographic province. Lying to the west of the Pecos River Valley section are the Guadalupe and Sacramento Mountains, which are associated with the Sacramento section of the Basin and Range Province. The nearly sheer southeastern margin of the Guadalupe Mountains is named the Capitan escarpment. This feature delineates the boundary between the Basin and Range and the Great Plains Provinces. The relationships between these provinces are illustrated in Figure 3.1. Within the Pecos River valley physiographic section major landforms in the vicinity of the project area include the Pecos River drainage system and the Mescalero Plain with its associated features, e.g., karsts and blowouts.

The site for the WIPP is about 25 miles to the east of the city of Carlsbad in an area of rolling sand covered hills and semi-stabilized dunes. The local name for the area is Los Medaños, Spanish for 'the dunes'. The land rises slightly to the west-northwest to Livingston Ridge. Paralleling this feature to the west is Nash Draw, a solution/subsidence feature caused by the solution of halite and other water soluble minerals by groundwater. This brine is then discharged into the Pecos River at Malaga Bend, which is about 32 km south-southeast of the WIPP site linearly following the depression of Nash Draw. To the north-northwest of Nash Draw lies Quahada Ridge. Rising north of Nash Draw are the Maroon Cliffs. East of the WIPP site rises a broad, low mesa which is named the Divide.

<u>Geology</u>

Stratigraphy:

The geologic make-up of the project area has been extensively studied as a natural consequence of the character of the WIPP project. Any person seeking

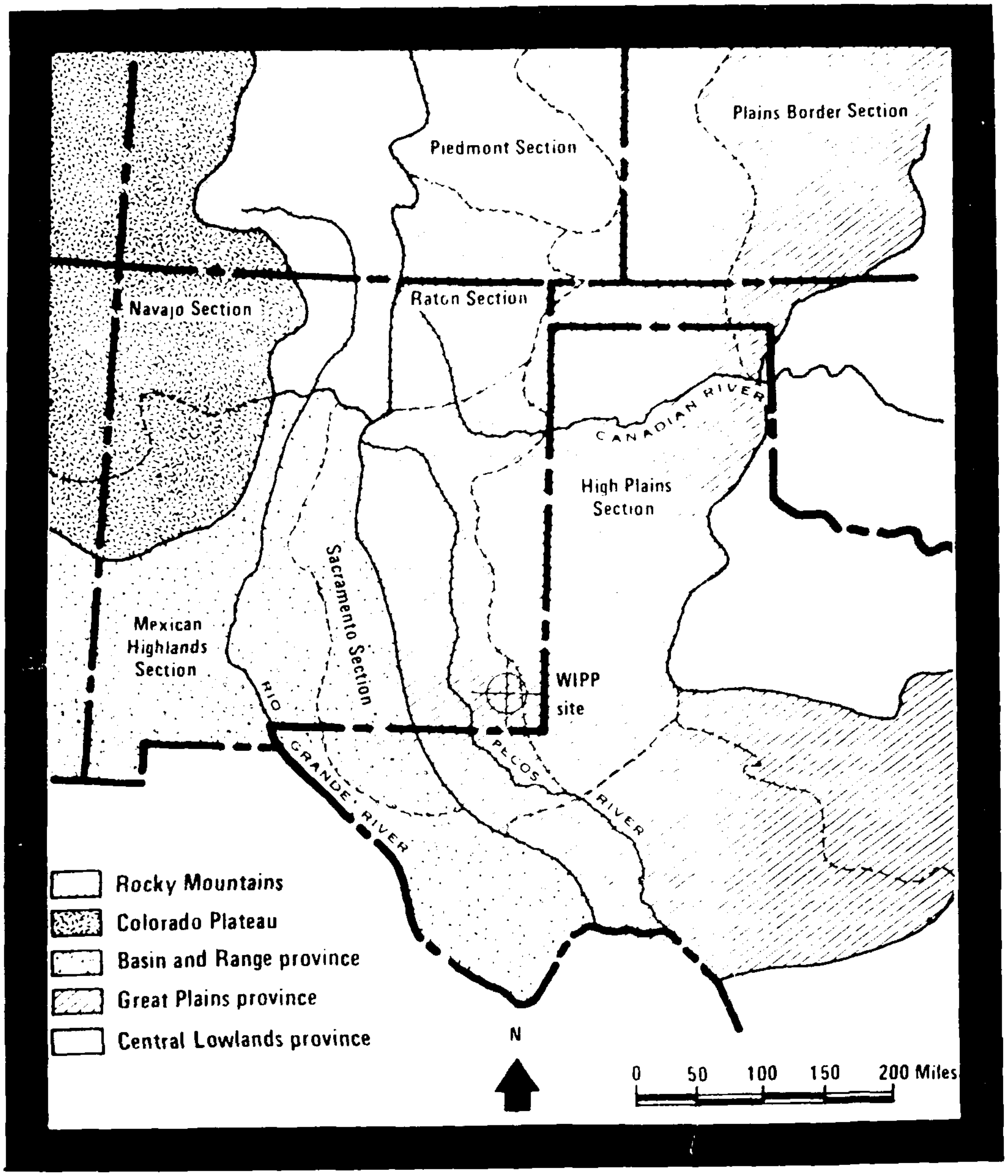


Figure 3.1
Physiographic Provinces and Section
Adapted from Fenneman (1931) and Powers et al. (1978)

in-depth information regarding the geological character of the area should consult the Geological Characterization Report (GCR) by D. W. Powers, S. J. Lambert, S. E. Schaffer, L. R. Hill, and W. D. Weart (editors), which was published in 1978 by Sandia National Laboratories, Albuquerque, New Mexico.

The Delaware Basin contains up to 13,000 feet of Permian strata, making it the most complete sequence of the Permian era yet known in North America. The total thickness of the strata of Permian age beneath the WIPP repository is 12,800 feet. Thus two-thirds of the post-Cambrian sedimentary column dates to the Permian. It should be noted that the strata of the Permian is over twice as thick as all of the earlier Paleozoic formations (about 5,200 feet) combined. Within the Permian evaporites, mainly halite [rock salt] and anhydrite, the depository level of the WIPP will be emplaced. Refer to Figure 3.2 for a stratigraphic column.

The strata representing Permian times both within the Delaware Basin and surrounding areas have long been subject to intensive investigations due to the vast reserves of natural gas and other hydrocarbons. While both surficial and subsurficial stratigraphy is relatively well understood, there remain many differences in nomenclature. Figure 3.3 illustrates correlations with formations from the surrounding areas.

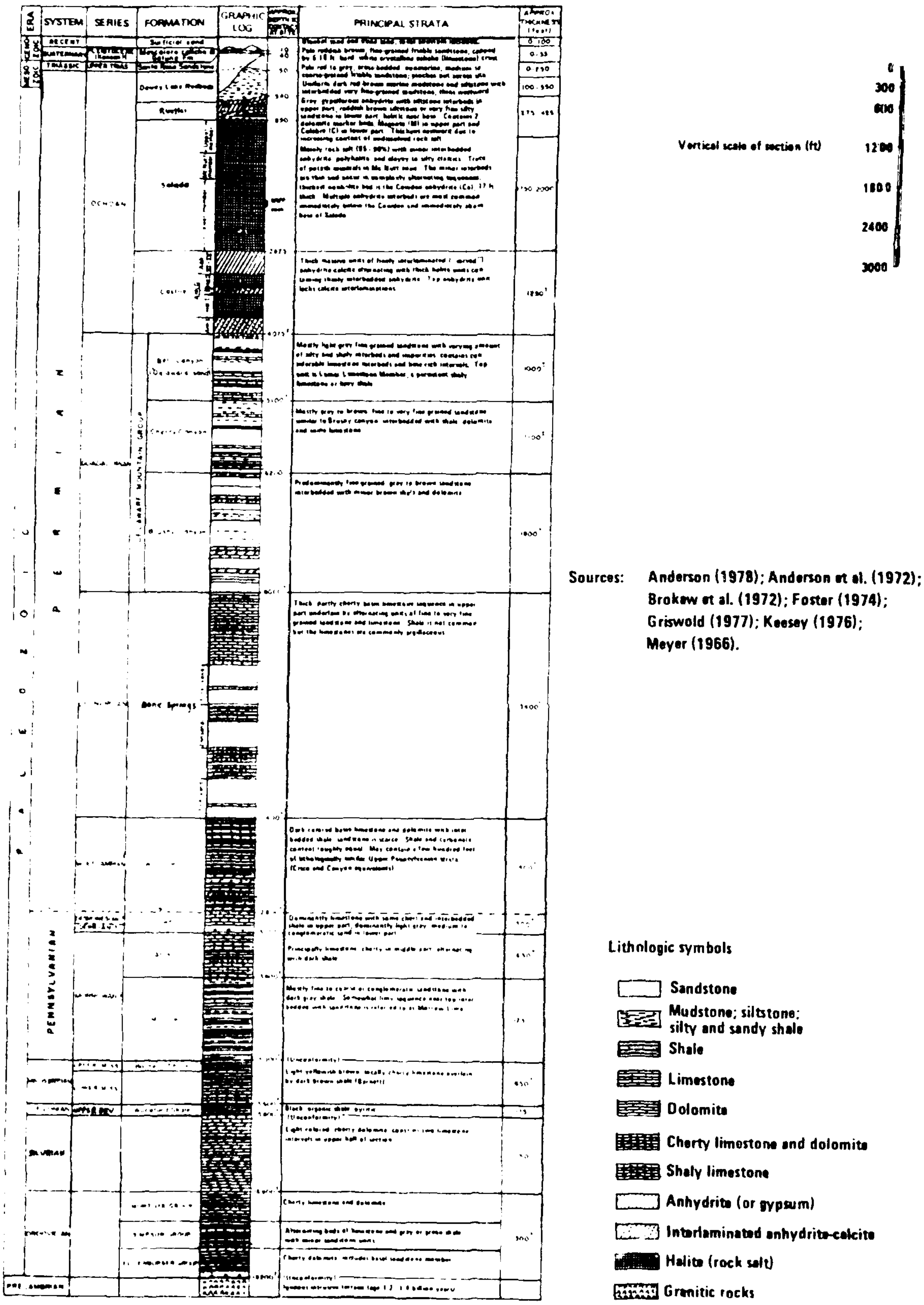
The Ochoan of the Permian of the West Texas provincial series contains the Castile, Salado, Rustler, and Dewey Lake Redbeds formations. Only the Rustler and Dewey Lake Redbeds formations outcrop in the immediate project area and thus only these formations will be discussed.

The final, youngest formation of the Permian Ochoan is the Rustler formation. Within the project area the Rustler consists of thick beds of anhydrite, with some siltstones containing halite near the base. Two beds of dolomite are also contained in the Rustler; the Culebra formation is lowermost, with the Magenta above. The thickness of each is about 25 feet.

Outcropping along the west side of Livingston Ridge, to the east of Nash Draw, the Rustler is overlain by alluvium, sand dunes, and debris. This is caused by the solution and the subsequent collapse of the formation. The Rustler is the last formation in the basin to have been evaporatively deposited from the Permian Sea.

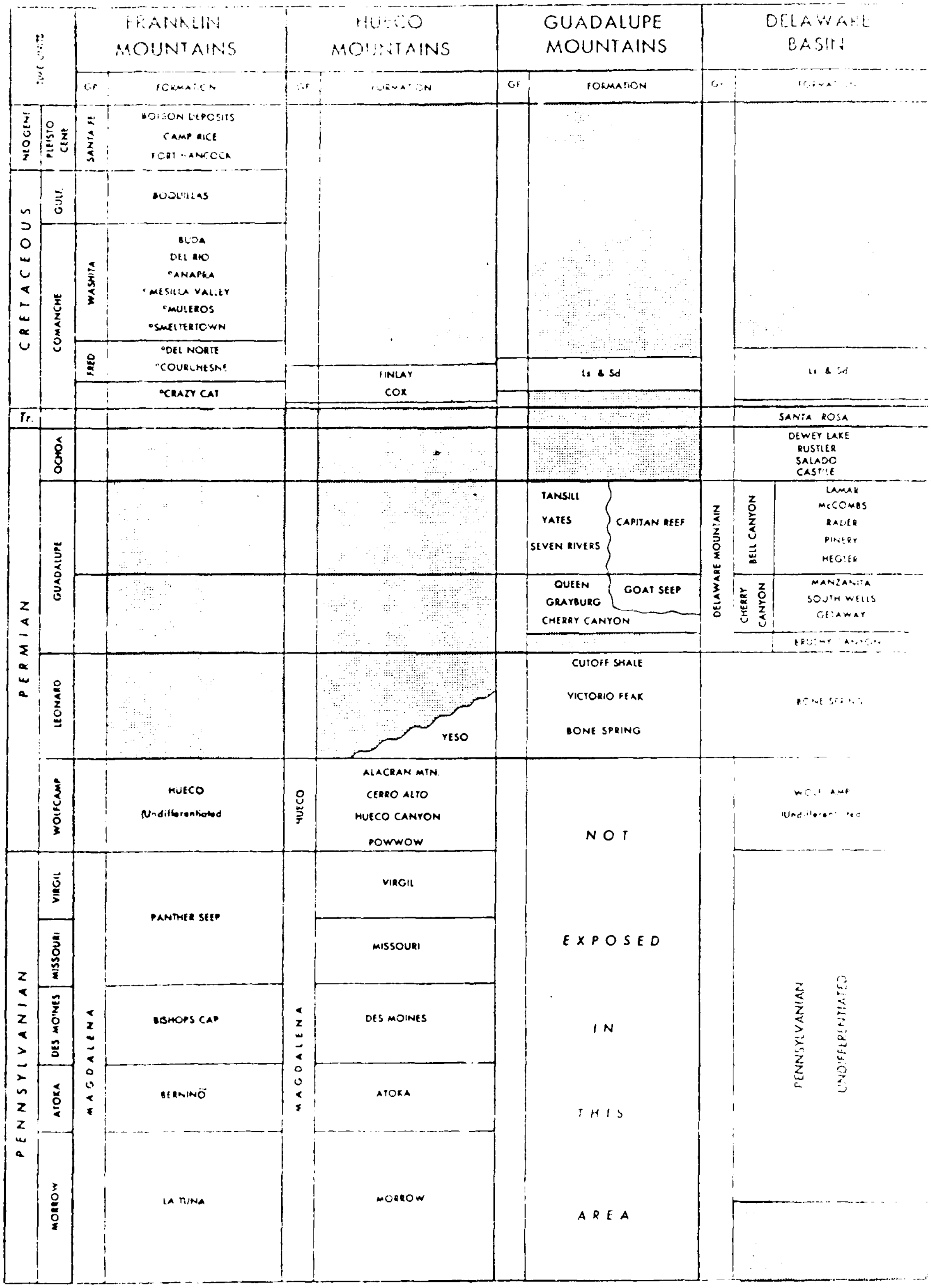
Traversing the Rustler from west to east the thickness of the formation and of halite increases noticeably. This is considered further evidence of dissolution activity (Vine 1963:B-4).

The uppermost formation of the Late Permian Ochoan series is named the Dewey Lake Redbeds. Resting uncomformably upon the Rustler formation evaporites, the Dewey Lake Redbeds are reddish-orange to reddish-brown in color and are siltstones and fine-grained sandstones. The structure of the Dewey Lake Redbeds varies. Some portions of the formation exhibit horizontal lamination or cross lamination, while other portions exhibit no structure at all. The Dewey Lake Redbeds are the youngest formation of the Paleozoic era present in southeastern New Mexico; their thickness ranges from 500 to 560 feet.



Sources: Anderson (1978); Anderson et al. (1972); Brokaw et al. (1972); Foster (1974); Griswold (1977); Keesey (1976); Meyer (1966).

Figure 3.2
Site Geologic Column



*To be published by W. S. Strain

Figure 3.3. Correlation Chart
(from West Texas Geological Society 1969)

TIME UNITS		FRANKLIN MOUNTAINS GP	FRANKLIN MOUNTAINS FORMATION	HUECO MOUNTAINS GP	HUECO MOUNTAINS FORMATION	GUADALUPE MOUNTAINS GP	GUADALUPE MOUNTAINS FORMATION	DELAWARE BASIN GP	DELAWARE BASIN FORMATION
MISSISSIPPIAN	CHESTER		HELMS		UPPER HELMS		NOT EXPOSED IN THIS AREA		
MISSISSIPPIAN	MERAMEC		RANCHERIA		LOWER HELMS				some sh & ls. Undifferentiated (Exact age unknown)
MISSISSIPPIAN	OSAGE		LAS CRUCES						
MISSISSIPPIAN	KINDERHOOK								
DEVONIAN	UPPER		PERCHA SHALE CANUTILLO		PERCHA ? SHALE Chert & Ls				WOODFORD SHALE
DEVONIAN	MIDDLE								
DEVONIAN	LOWER								DEVONIAN Ls & Dol
SILURIAN	MIDDLE		FUSSELMAN		FUSSELMAN				FUSSELMAN
SILURIAN	LOWER								
ORDOVICIAN	UPPER	MONTOYA	CUTTER ALEMAN UPHAM		MONTOYA				MONTOYA
ORDOVICIAN	MID								SIMPSON
ORDOVICIAN	LOWER	EL PASO	+FLORIDA MTS SCENIC DRIVE McKELLIGON CN JOSE +VICTORIO HILLS COOKS *(Note) SIERRITE		EL PASO				ELLENBURGER (EL PASO)
CAMBRIAN			BLISS		BLISS				BLISS
PRECAMBRIAN		RED BLUFF GRANITE	RHYOLITE PORPHYRY LANORIA QUARTZITE MUNDY BRECCIA CASTNER LIMESTONE		GRANITE Undifferentiated				GRANITE (Undifferentiated)

* Not all present in Franklin Mts
+ To be published by D. V. LeMone

Figure 3.3. Correlation Chart (continued)
(from West Texas Geological Society 1969)

Proceeding to the Mesozoic, the Triassic is represented by the Santa Rosa sandstone. In the area of Los Medaños, the Santa Rosa sandstone forms a wedge which lies unconformably on the Dewey Lake Redbed formation. The lithologic unconformity delineates the end of Paleozoic Permian times and corresponds to the interval between Permian and Late Triassic times, an interval which is perhaps longer than the hiatus between Devonian and Mississipian times (Powers et al. 1978).

The texture of the Santa Rosa sandstone is medium to coarse in grain, and its color ranges from gray to a yellow-brown with some reddish-brown mudstone and conglomerate. The constituent particles of the Santa Rosa sandstone are much larger than the particles of the underlying Dewey Lake Redbeds, as well as being less well sorted. Actual fossils and impressions of both herbaceous and reptilian life forms are present in some of the Santa Rosa sandstones.

There are no formations which date to either Jurassic or Cretaceous eras present in the stratigraphic column in the area; however, comparison of the stratigraphic column of Los Medanos with surrounding areas provides evidence of the erosion and removal of the Dockum member. Additional evidence is provided by crevasse deposits and outliers (Powers et al. 1978).

There are no sedimentary formations of Tertiary age within the study area, however an igneous dike with a northeast-southwest trend occurs northwest of the area.

Overlying the early Mesozoic era Santa Rosa sandstone is the Quaternary Pleistocene Gatuna formation. The Gatuna sandstone formation has a fine-grained texture and its color ranges from reddish to brownish. Powers et al. (1978) report that within the Gatuna sandstone pebbles have been found, the origin of which has been determined to be the caprock caliche of the Ogallala formation. This indicates an origin in Pleistocene rather than Pliocene times. In Nash Draw the Gatuna formation is up to 100 feet thick and fills sinkholes which were previously formed in underlying formations by solution/subsidence (subrosion) activities.

Laid upon the Gatuna, yet obscured from sight in most locations by the ubiquitous aeolian surficial sand, is the Mescalero caliche. North of the study area, in Chavez County, New Mexico, the Mescalero caliche forms a broad plain between the Pecos River and the Llano Estacado. This is named the Mescalero Plain. The Mescalero caliche is an accumulation near the earth's surface of clastic materials which are cemented together by calcareous accumulations. The amount of calcareous material present is far in excess of the amount necessary for cementing the clastic grains together; thus the grains are suspended in the calcareous matrix.

The layer formed at the top of the caliche is hard and dense and is one to two feet thick. Wherever this layer is exposed it weathers to resemble a dense, indurate limestone (Vine 1963). According to Vine (1963), in some areas of the Mescalero caliche which are exposed at Nash Draw, there is the appearance of concentric lamination which resembles calcareous algal structures. These features do not have an organic origin, however, and are caused by repeated cycles of dissolution and redeposition of the calcareous matrix. The Mescalero caliche was formed under the semiarid conditions which followed the moist climate of Gatuna times. Bachman (1974) correlates the Mescalero caliche with the Yarmouthian interglacial stage (mid-Pleistocene) which was about 500,000 years B.P.

Deposits of the Holocene include alluvium, aeolian sands, and playa deposits. Of these deposits, it is the aeolian sands which cover almost the entire area. In many areas the sand forms two distinct layers. The lower layer is a compacted aeolian sand, moderately brown in color and slightly clayey. The thickness of this layer is usually one to one and a half feet. This clayey compacted sand is overlain by a light brown to yellowish gray windblown sand.

Soils

The soils of the project area were originally studied and mapped by the Soil Conservation Service (SCS) and the soil survey was published in March of 1971. The General Soil Map, Eddy Area, New Mexico (Chugg et al. 1971) lists three principal soil associations in the project area; the Kermit-Berino association, the Simona-Pajarito association, and the Reeves-Gypsum land-Cottonwood association.

Kermit-Berino Association:

Soils in the Kermit-Berino association are very sandy and occupy undulating plain and low hill topography. These soils developed in reddish, non-calcareous, wind worked sandy deposits. All the soils of this association are highly erodable by water and wind. Wind action has sculpted these soils into hummocks and dunes.

Kermit soils compose 60% of this association. Soils of the Kermit are deep, loose, non-calcareous sands which occur as dunes and occupy higher elevations in the study area.

Thirty percent of this association are Berino soils, which are deep, severely eroded, non-calcareous soils that possess a subsoil of deep, sandy clay loam.

This association also contains areas of Pajarito, Cacique, Wink, and Tonuco soils, as well as Active dune land. All of the soils are highly susceptible to erosion by both wind and water if the vegetative cover is disturbed. Pajarito soils are deep, sandy, calcareous and occur in drainages and depressions. Pajarito soils occur in association with calcareous upland soils. Soils classified as Wink are also sandy and calcareous. They are found over the lacustrine sediments in broad drainages and filled playas. Wink soils are also associated with calcareous upland soils. Cacique soils are shallow to moderately deep, non-calcareous, sandy upland soils. The subsoil is a sandy clay loam underlain by indurated caliche. Similarly, Tonuco soils are non-calcareous upland sands which are shallow and overlay indurated caliche. Active dune land consists of active, shifting dunes of non-calcareous sand often associated with blowouts.

The soils of this association are used for wildlife habitat and grazing. If the soils are not severely eroded and there has been sufficient moisture these soils produce high yields of forage. Vegetation consists of medium to tall grasses, sand sage, mesquite and shinnery oak.

Simona-Pajarito Association:

The Simona-Pajarito soil association consists of calcareous upland soils and landforms. This association occurs in scattered areas in valleys and on breaks, flats, ridges, and slopes.

Forty-five percent of this association consists of Simora soils that are moderately dark colored, sandy, shallow upland soils that overlie indurated caliche. The parent material is derived from the caliche capped Dewey Lake Redbeds on breaks, wash material in valleys, flats, and slopes; and the shallow, sandy, windworked deposits over upland and plains caliche.

Pajarito soils, which comprise 40% of the association, are deep moderately dark colored, sandy soils that developed from material washed from the Dewey Lake Redbeds deposited in drainages and valley slopes.

This association also contains areas of Bippus, Upton, and Largo soils and Rock land, Stony land, and Stony and Rough broken land. These soils comprise 15% of the association. Bippus soils occur in drainages and are subject to flooding. They are deep, moderately dark, and developed in silty alluvium. Upton soils are very shallow and gravelly, overlying indurated caliche. These soils are moderately dark in color, loamy, and occur on gently sloping to sloping breaks. Generally, Largo soils are deep and moderately dark in color, loamy, and also developed from the Dewey Lake Redbeds. Where the Redbeds have been severely dissected there is Rock land. Stony land consists of steep, gullied, or dissected Redbeds occurring with stony land. There is a thin soil layer mixed with stones. Stony and Rough broken land consists of steep slopes and escarpments, and is very dissected. Stones on the lower slopes are mixed with soil material.

Bippus soils occasionally contain small playas, which hold water, generally quite saline, for short periods of time. Soils of this association are used for wildlife and stock grazing. Groundwater is very rare in this association. Vegetation is sparse, consisting of short, mid-height, and tall grasses, with mesquite, creosote, and similar woody plants.

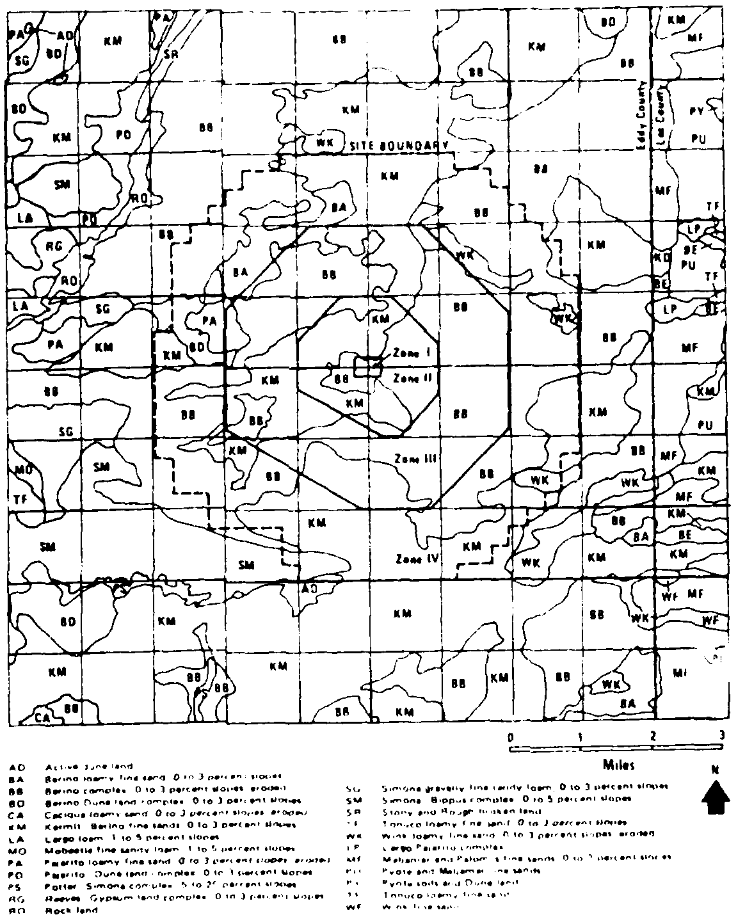
Reeves-Gypsum land-Cottonwood Association:

The soils of this association are gently undulating soils on low hills and plains and gypsum land.

Reeves soil constitute 40% of this soil association. Moderately deep, they are light colored and loamy, occurring in drainages and swales. Gypsum land occupies 30% of this association and occurs at the highest elevations in the project area and on drainage breaks. Little or no soil is associated with Gypsum land. Soils of the Cottonwood are shallow in depth and constitute about 20% of the association. They occur in slight depressions.

Small amounts of Karro, Russler, Reagan, Largo, and Ector soils make up the final 10% of this association. Ector soils developed from the residuum of weathered limestone. The other four soils developed from alluvium. Karro soils occur on high terraces and flats and are light colored, deep, and calcareous. Russler soils are associated with upland areas and range from shallow to deep, are gypsiferous and reddish in color. They undulate gently. In broad drainages Reagan soil is found. These are light colored, deep, calcareous, and loamy. Largo soils are found in drainages, are deep and moderately dark in color. Ector soils occur on limestone knobs scattered throughout the area. They are very shallow and rocky. Soils of this association are mainly used for grazing. Native vegetation consists of short and mid-height grasses, coldenia, tarbush, yucca, and mesquite.

Reference to Figure 3.4, Soils Series Map, will allow the reader to compare distribution of the various soils series which constitute these soils associations.



Source: SCS, 1971.

Figure 3.4
Soil Series Chart

Soils of the Kermit-Berino association constitute 82% of the area soils. Simona-Pajarito soils make up 14% of the area, while the soils of the Reeves-Gypsum land-Cottonwood association constitute 4% of the area.

Weather

Climate is the average condition of the weather in an area over the course of years and is determined by the combination and interplay of a number of variables. The most significant of these variables are the distance of the area from the equator, elevation and distance from the principal sources of moisture (Schander 1983). In the case of the project area, the distance from the equator places it within the temperate zone, characterized by seasonal variability with extremes of hot and cold.

The study area climate is semiarid, with moderate temperatures and distinct seasonal variation. Both precipitation and humidity are low, which combined with the warm temperatures characteristic of the study area results in a high rate of evaporation. Generally, winds are of moderate strength and most commonly from the southeast. A wind rose for the study area is presented as Figure 3.5.

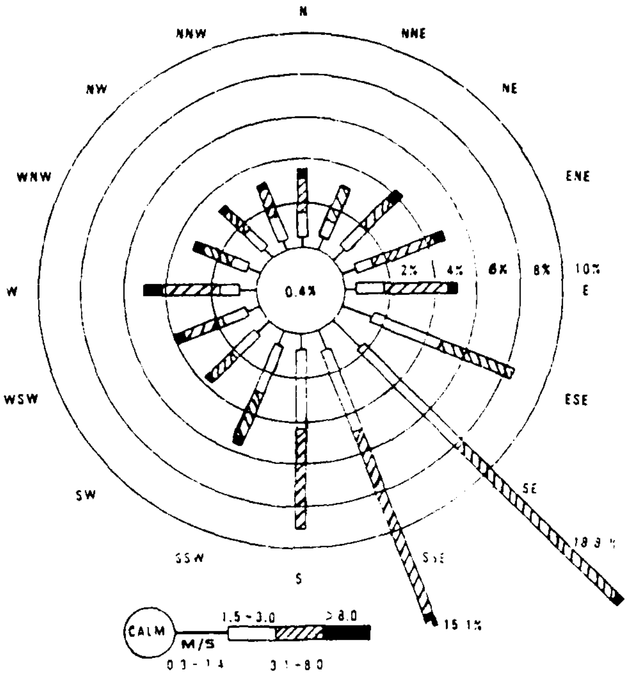


Figure 3.5
Annual Wind Rose for the WIPP Site
(June 1, 1977 to May 31, 1979)

Dominating the winter weather pattern is a high-pressure system generally located in the central western United States in association with a low-pressure system most often located in north-central Mexico. Summer weather is usually a product of a low pressure system that is generally found over Arizona. The climate in the study area is dominated by these large-scale phenomena and the seasonal variations associated with them (DOE 1980).

Temperatures in the area are usually moderate through the year, with noticeable seasonal variability. Mean annual temperatures in southeastern New Mexico is 60° F. While winter morning temperatures are below freezing 75% of the time, the temperature fails to rise above freezing only two or three days a year. Afternoon temperatures commonly rise into the fifties, and seventies are not uncommon during winter months. During the summer the temperature rises above 90° F about 75% of the time (DOE 1980).

Precipitation is light and since most rain originates from summer thunderstorms the rainfall tends to be very unevenly distributed over the landscape. Over half of the precipitation falls during the June through September thunderstorm season. Snow falls in the area during the winter from December through February and usually melts by the afternoon due to warm afternoon temperatures.

Data for temperatures and precipitation are presented in Table 3.1. These data are compiled from NOAA Monthly Summaries for the state of New Mexico. Presented here is four years of data for the weather station nearest the study area, the Duval Potash Mine, located within the study area near ENM 10418.

Table 3.1
Climatic Data Table

1978	Average Maximum	Average Minimum	Average	Total Precipitation	Greatest Day?	Date	Total Snow	Max Depth	Date
Jan	52.4	24.4	38.4	.14	.11	31	T	0	20
Feb	54.4	29.1	41.8	.52	.25	12	.0		
Mar	70.5	37.5	54.0	.23	.15	3	.0		
April	83.9	50.1	67.0	.24	.18	10	.0		
May	86.5	56.7	71.6	.96	.43	2	.0		
June	95.2m	65.7m	80.5m	2.20	.96	3	.0		
July	98.6m	68.0m	83.3m	.43	.30	23	.0		
Aug	93.6m	65.8m	79.7m	1.29	.82	31	.0		
Sept	81.3m	59.1m	70.2m	6.50	3.27	25	.0		
Oct	76.0m	49.0m	62.5m	1.47	.60	24	.0		
Nov	61.2m	41.4m	51.3	2.90	2.11	4	.0		
Dec	54.0	28.3	41.2	.03	.03	30	.0		

Key: m = means missing data, if averages are present then less than 10 days of data are missing;
+ = means that earlier date or dates are included;

All temperatures are in °F, all precipitation is measured in inches

Table 3.1 (continued)
Climatic Data Table

	Average Maximum	Average Minimum	Average	Total Precipitation	Greatest Day?	Date	Total Snow	Max Depth	Date
1979									
Jan	46.4	24.6	35.5	.41	.31	11	.0		
Feb	58.1m	30.0m	44.1m	.40	.28	6	.0		
Mar	66.0m	39.0m	52.5m	.04	.04	17	.0		
April	77.5	48.0	62.8	.30	.30	30	.0		
May	82.4	54.9	68.7	1.73	1.29	17	.0		
June	89.0	61.1	75.1	1.32	.50	3	.0		
July	95.1m	65.9m	80.5m	6.82	2.68	16	.0		
Aug	89.9	63.7	76.8	1.15	.48	14	.0		
Sept	85.8	58.8	72.3	.63	.24	18	.0		
Oct	82.1	48.4	65.3	.0	.0		.0		
Nov	60.3	32.8	46.6	.11	.11	17	.0		
Dec	57.7m	29.5m	43.6m	.50	.44	14	.0		
1980									
Jan	56.3	30.2	43.3	.71	.55	22	6.0		
Feb	59.8	30.6	45.2	.51	.25	1	.0		
Mar	68.6	36.1	52.4	.03	.03	12	.0		
April	75.4m	42.8m	59.1m	.52	.31	12	.0		
May	83.1	55.0	69.1	1.61	.73	4	.0		
June	100.2m	67.7m	84.0m	.03	.03	9	.0		
July	101.2m	70.5m	85.9m	.10	.10	22	.0		
Aug	93.4	65.5	79.5	.86	.24	19+	.0		
Sept	85.6	60.1	72.9	10.13	2.69	26	.0		
Oct	-	-	-	-	-	-	-		
Nov	60.7	34.6	47.7	1.94	1.32	16			
Dec	59.6	31.8	45.7	.01	.01	8	.0		
1981									
Jan	55.3	31.0	43.2	.24	.07	18+	.0		
Feb	63.2	32.0	47.6	.0	.0		.0		
Mar	65.6	40.2	52.9	.41	.18	1	.0		
April	76.8	49.7	63.3	2.94	.90	14	.0		
May	83.9	56.1	70.0	1.73	.58	1	.0		
June	95.2	64.5	79.9	2.25	1.12	30	.0		
July	95.3	69.4	82.4	3.49	2.26	29	.0		
Aug	88.3	65.6	77.0	6.37	4.25	12	.0		
Sept	84.5m	59.3	71.9m	1.97	.123	8	.0		
Oct	75.6	50.7	63.2	1.47	.38	7	.0		
Nov	72.4	40.0	56.2	.06	.06	30	.0		
Dec	62.7	32.8	47.8	.08	.08	13			

Key: m = means missing data, if averages are present then less than 10 days of data are missing;
+ = means that earlier date or dates are included;

All temperatures are in ^{o}F, all precipitation is measured in inches

HYDROLOGY

The study area is within the drainage basin of the Pecos River, a major river which drains most of the eastern half of the State of New Mexico. The headwaters of the Pecos River are formed northeast of the state capital of Santa Fe and head in a southerly direction through eastern New Mexico and portions of west Texas until joining the Rio Grande further to the south. Overall, the length of the main stem of the Pecos is nearly 500 miles, while the drainage basin achieves a maximum width of almost 130 miles. The EIS (DOE 1980) tabulates the total area drained by the Pecos and its tributaries to be 44,535 square miles, although it is noted that 20,500 square miles (46% of the total area) are non-contributing. The major tributaries of the Pecos River are, going upstream: the Delaware River and the Black River, both of which are below the study area; and above the study area, the Rio Peñasco, Eagle Creek, Rio Felix, Rio Hondo, Salt Creek, and the Gallinas River. Nearly 50% of the land area of the USGS' Rio Grande Water Resources Region is drained by the Pecos River.

Surface flow in the Pecos River is usually perennial. However, at a portion of the Pecos below Anton Chico, as well as areas between Fort Sumner and Roswell, the low flows associated with the hot and dry times of the year cause the water to percolate through the bed material. Frequently, the tributary streams of the Pecos are dry. The season of intense thunderstorm activity is from April through September and these storms are estimated (DOE 1980) to contribute 75% of the total precipitation and 60% of the annual flow of the river in the area.

Table 3.2 illustrates the discharge in the basin of the Pecos River at various recording loci near the study area.

Table 3.2
Pecos River Basin Discharge

River	Location	Drainage Area	Length of Record	DISCHARGE Average	Minimum	Maximum
Pecos	Santa Rosa, NM	2,650	63 yrs	138	.3	55,200
Pecos *	Acme, NM	11,380	38 yrs	194	0	45,000
Pecos *	Artesia, NM	15,300	39 yrs	265	0	51,500
Pecos *	Malaga, NM	19,190	39 yrs	196	5	120,000
Pecos *	Orla, TX	21,210	38 yrs	181	0	23,700
Pecos *	Girvin, TX	29,560	36 yrs	96	2.2	120,000
Rio Hondo	Roswell, NM	963	12 yrs	9	0	20,000
Rio Felix	Hagerman, NM	932	36 yrs	16	0	74,000
Rio Penasco	Dayton, NM	1,060	24 yrs	6	0	29,000
Black	Malaga, NM	343	28 yrs	14	.7	74,600
Delaware	Red Bluff, TX	689	38 yrs	14	0	81,400

* = Regulated flow Based on data compiled by USGS (1976) and interpreted by DOE (1980)

The maximum discharge recorded for the Pecos River near Malaga Bend is 120,000 cubic feet per second (cf/s) on 23 August 1966, resulting in a high water mark of 42.1 feet above flood stage. The minimum recorded discharge for the same location is 3.7 cf/s on 20 October 1976.

Previous to the completion of Lake Sumner, for the period 1921-1936, the average discharge for the Pecos near Malaga Bend was 274 cf/s (198,500 acre/-feet per year). For the 46 year period from 1938 through 1982 the average discharge decreased to 173 cf/s (125,300 acre/feet per year) (USGS 1983).

The water in the Pecos River is not of the highest quality because of the high content of dissolved minerals. These minerals originate from both irrigation water return flow and natural sources. The average amount of suspended-sediment discharge near Santa Rosa, N.M. is 1,650 tons per day. Salt Creek and Bitter Creek contribute large amounts of chlorides to the river. Increased quantities of sulfate, calcium and magnesium are noticed in the Pecos below Hagerman. Downstream from Lake McMillan submerged springs contribute further mineral pollution. While submerged springs are particularly difficult to accurately sample, a Total Dissolved Solid (TDS) concentration of 3,350-4,000 ppm is reported by DOE (1980), which also reports the additional contribution of 70 tons per day of chloride to the Pecos at Malaga Bend. Table 3.3 presents the concentrations of dissolved minerals in the Pecos River at three recording sites.

Table 3.3
Mineral Ion Pollution in the Pecos River

USGS Station Near	Volume of Discharge *	pH	Chloride	Sulfate	Sodium	Calcium	Total
Carlsbad	12	7.7	531	1,100	322	334	2,290
Malaga	26	7.7	1,690	1,820	1,030	524	5,060
Pierce Canyon Crossing	28	7.5	6,500	2,280	4,020	551	13,350

* cf/s

Industrial pollution of the water in the vicinity of the study area is a type of pollution which would not, of course, have affected the quality of water in prehistoric times. Currently, however the existence of the potash industry in the area impacts the amount and quality of water in the area. According to the EIS (DOE 1980) the potash industry in the area uses 19,800 acre/feet of ground water annually. Of this quantity 700 acre/feet per year is 'lost' and 19,100 acre/feet per year is discharged in the form of briny effluent. This flow is discharged into surface sediments, resulting in the contamination of shallow aquifers and recharge of the brackish lakes and ponds. Three parts of solid sodium chloride are discharged for each part of potassium chloride recovered. This waste product is stored in large piles and thunderstorms cause an amount of the material to be dissolved and carried away as briny runoff into the hydrologic features of Nash Draw.

Groundwater

The Delaware Basin of southeastern New Mexico and western Texas contains aquifers of such low quality that they are considered to be among the least productive in the entire United States. Not only is the yield of water very low to nonexistent, but the water that can be found is often unpotable.

The Capitan formation, a Permian age limestone reef, surrounds and contains the other hydrologically significant formations of the Delaware Basin. The Delaware Mountain Group, the Rustler formation, the Dewey Lake Redbeds, the Santa Rosa Sandstone, and the Chinle formation, along with the Capitan Reef formation, contain the productive aquifers of the Delaware Basin. The Castile and Salado formations act as aquacludes which are layers of rock bounding an aquifer and are responsible for the containment of the water in the aquifer.

The Capitan formation is the most productive of the aquifers. The water provided by the Capitan supplies the domestic needs of the city of Carlsbad.

Water from the Delaware Mountain Group is briny and not suitable for many uses. The Castile and Salado formations are not considered aquifers, but do contain pockets of brine, often under pressure due to dissolved gases.

The Rustler formation contains a great deal of water, although again the high mineral content of the water renders it unsuitable for domestic usage. The water flowing beneath and aiding the dissolution/subsidence of Nash Draw is associated with the Rustler. The Redbeds of the Dewey Lake formation contain only small amounts of water, confined to lenses of sandstone. The Santa Rosa sandstone, although not expansive in the vicinty of the site, contains some water. The EIS (DOE 1980) indicates that the Santa Rosa may contribute to recharging the aquifers along the Pecos River.

VEGETATION

Vegetation in the study area is composed principally of shrubs and grasses which are heterogeneously distributed over the landscape. Among the causes for vegetative diversity are elevation, aspect, soil type, depth of soil, and the presence and depth to caliche.

The Environmental Impact Statement (DOE 1980) distinguishes between five topographic-edaphic zones of vegetation. These are the Mesa zone, the Central Dune zone, the Creosote Flats zone, the Livingston Ridge zone, and the Tobosa Flats zone.

Mesa Zone

The Mesa zone, also referred to as the Mesquite Grassland zone, is found on the Divide, a low mesa at the eastern side of the study area, and is a typical desert grassland. The dominant shrub in this zone is honey mesquite (*Prosopis glandulosa*) and snakeweed (*Gutierrezia sarothrae*) is the dominant subshrub. The most important, as well as the most abundant, grasses occupying the Mesa zone are burrograss (Scleropogon brevifolius), black grama (Bouteloua eriopoda), bush muhly (Muhlenbergia porteri), and fluff grass (Tridens pulchellus).

Prickly pear (Opuntia phaeacantha) is present, but not common. Yucca campestris is common in this zone, while Y. torreyi is present but uncommon.

This vegetation zone occurs on soils of the Kermit-Berino soils association. Because of the relatively high density of grasses originally contained in this zone, grazing has negatively impacted the plant distribution, resulting in an increasing abundance of mesquite.

The invasion of southern New Mexican vegetative communities by mesquite has been the object of study and speculation for some time. The EIS traces this debate from 1917, when an investigator classified the vegetative change as a grazing disclimax. Other origins for the change from a tall-to-mid grass dominated zone to a shrub dominated zone that have been postulated include the exclusion of fire and changes in the climate. The authors of the EIS conclude that grazing is the likeliest hypothesis, since the introduction of cattle to the area is co-incidental to the appearance and spread of mesquite through southern New Mexico.

Central Dune Zone

The Central Dune zone is subdivided into three subzones, each related to a different dune manifestation. These are stabilized dunes, oak-mesquite hummocks, and active dunes.

The greatest percentage of the Central Dune zone consists of the stabilized dune subzone. The shrubs which dominate this subzone are shinnery (havard) oak (Quercus havardii), honey mesquite, sand sagebrush (Artemisia filifolia), snakeweed, and dune yucca (Yucca campestris). These shrubs are distributed heterogeneously throughout the subzone. At some loci all of these shrubs are present, while at others one or more species may be present in low densities, or entirely absent. Localized variations in soil depth and type is reported as the major cause of variability (DOE 1980). The stabilized dune subzone is a patchwork of closely related, but different plant associations. Found at the majority of study loci in the subzone, and most common to the Central Dune zone as a whole, is purple three-awn (Aristida purpurea), a perennial grass. Other species which occur with some frequency are red three-awn (Aristida longiseta), sand dropseed (Sporobolus cryptandrus), giant dropseed (S. gigantieus), black grama, hairy grama (Bouteloua hirsuta), and fall witch-grass (Leptoloma cognata).

On sandy areas, sandbur (Cenchrus incertus) grows abundantly, though locally. Various members of the genus Muhlenbergia occur on compact soils of the subzone, although not abundantly. The most common annual grass species is false buffalograss (Munroa squarrosa). It grows very dense in the spring and early summer seasons of moist years.

The second subzone of the Central Dune zone is the Oak-Mesquite Hummock subzone. This subzone is visually distinctive due to the presence of hummocks of sand which have been stabilized by vegetation, usually mesquite and shinnery oak. These hummocks resemble small islands separated by expanses of barren sand. This sand is very susceptible to erosion by wind, which blows the sand from the barren areas away, forming blowouts and leaving the vegetatively stabilized areas as isolated, slightly elevated hummocks. The vegetation associated with the stabilized dune subzone does not differ greatly from the vegetation associated with this subzone; it is the radically different appearance of this subzone that causes it to be classified separately.

The third and final subzone of the Central Dune zone is the Active Dunes zone. While relatively barren in appearance, sparse vegetation grows in this subzone. Western soapberry (Sapindus drummondi), a small tree, occurs in small stands. Dune reverchonia (Reverchonia arenaria), an annual, is also present in small amounts. The perennials which are present include snowball sand verbena (Abronia fragrans) and several species of the genus Proboscida (unicornplant). Reverchonia is the only one of the plants of this subzone that does not occur in other subzones of the Central Dune zone.

The Central Dune zone soils are members of the Kermit-Berino soils association.

Creosote Flats Zone

To the west and southeast of the Central Dune area is the Creosote Flats vegetation zone. This vegetation zone occurs on shallow to very shallow soils overlying caliche, which is occasionally exposed. These soils are from the shallower series of soils in the Kermit-Berino association. As might be expected, creosote bush (Larrea tridentata) is the dominant species of shrub, while both shinnery oak and sand sagebrush are noticeably absent. The dominant subshrub in this zone is snakeweed.

Many species of the perennial Muhlenbergia are found in this zone, as are black grama and purple three-awn. Clumps of mesquite occasionally occur in depressions.

Livingston Ridge Zone

The area forming Livingston Ridge, between the WIPP site and Nash Draw, is the location of the fourth vegetation zone. Here mescat acacia (Acacia constricta) is the dominant shrub, with shinnery oak and snakeweed as dominant shrub and subshrub also. Doveweed (Croton dioicus) and lanceleaf ratany (Krameria lanceolata) are perennial herbs quite common to the zone and bush muhly the most common perennial grass.

Tobosa Flats Zone

To the west of Livingston Ridge is Nash Draw, with its broad flat valley floor. As may be inferred from the name tobosa grass (Hilaria mutica) is the plant most densely occupying the valley floor. Acacia, common on the ridge top to the east disappears. Creosote bush reappears, as does the common perennial lanceleaf ratany. Snakeweed is absent, while the occasional thin stand of Spanish dagger (Yucca torreyi) is notable.

Common to most of the study area are several annuals; of these desert bluets (Hedyotis humifusa), foetid marigold (Pectis angustifolia), and bindweed (Heliotropium convolvulacem) are the most commonly encountered.

FAUNA

The grasslands and shrublands of the study area support a faunal assemblage which is typical of such an environment. While the semiarid environment supports expected populations of mammals, birds and reptiles, amphibians were also noted, although they are not an important part of the faunal assemblage.

Mammals

As would be expected, several species of bats have been recorded in the study area. The brazilian free-tailed bat (Tadaria braziliensis), the inhabitant of Carlsbad Caverns, has been recorded, although the most commonly collected species is the cave myotis (Myotis velifer).

Desert cottontails (Sylvilagus audubonii) and the blacktailed jackrabbit (Lepus californicus) are common throughout the area.

Rodent species representative of both native and introduced species occur. Among the native desert dwelling rodents are pocket mice, grasshopper mice, and kangaroo rats. The Norway rat and the house mouse (Mus musculus) represent introduced species of Rodentia.

Carnivores are drawn to the area by the availability of these creatures. Among these meat eaters are the swift fox (Vulpes velox), the gray fox (Urocyon cinerecargenteus), and the ubiquitous coyote (Canis latrans).

Mule deer (Odocoileus hemionus) and pronghorn antelope (Antilocapra americana) are game species noted in the area.

Avifauna

Many species of birds have been recorded in the WIPP study area and surrounding areas, such as the Laguna Grande de Sal and the Pecos River at the point it intersects New Mexico Highway 31.

The total number of avifaunal species counted is 122 of which six species are classified as game. These are mourning doves (Zenaida macroura), scaled quails (Callipepla squamata), bobwhites (Colinus virginianus), mallards (Anas play-rhynchos), and both green and blue winged teals (Anas crecca and A. discors, respectively). The New Mexico Department of Fish and Game is quoted in the EIS (DOE 1980) as stating that only the mourning dove and scaled quail are present [illegible] suitable for nesting. The three species of ducks were noted at stock tanks in the area. Regarding these migratory species it should be noted that the study area is part of the region named the Central Flyway, a federally administered unit for waterfowl. The region is not considered to be an important waterfowl breeding area, although the presence of bodies of water such as the Laguna Grande de Sal and the Pecos River provided habitats for waterfowl which could have been harvested by the aboriginal inhabitants of the area.

Raptors inhabiting the area include Harris' hawks (Parabuteo unicinctus), Swainson's hawks (Buteo swainson), marsh hawks (Circus cyaneus), and American kestrels (Falco sparverius). While the density of these raptors never exceeds one per 100 hectares, they are nonetheless consistently sighted in the area.

The mockingbird (Mimus polyglottos), the pyrrhuloxia (Cardinalis sinuata), the loggerhead shrike (Lanius ludovicianus), the black-throated sparrow (Amphispiza bilineata), the vesper sparrow (Pooecetes gramineus), the lark bunting (Calamospiza melanocorys), Cassin's sparrow (Aimophilia cassinii), and the white-crowned sparrow (Zonotrichia leucophrys), in addition to the aforementioned scaled quail and mourning dove, constitute the avifaunal species occupying the area in the greatest densities.

Reptiles and Amphibians

Reptiles are often found in the study area, 23 different species have been recorded. Of the 23 reptiles recorded, 11 are species of lizards, 10 are snakes, and the remaining two are turtles.

The most commonly observed lizard species are the side-blotched lizard (Uta stansburiana) and the western whiptail (Cnemidophorus tigris), both of which are found in most of the plant habitats of the area. The Texas horned lizard (Phrynosoma cornutum) commonly confines itself to the mesquite grassland and oak-mesquite plant associations. All of the lizard species recorded are primarily insectivorous and diurnal.

With small mammals and lizards so common to the areas it is not surprising that snakes are also common inhabitants of the area. The western rattlesnake (Crotalus viridis), the western hognose snake (Heterodon nasicus) and the coachwhip (Masticophis flagellum) are the most common. Less common, but still relatively abundant are the night snake (Hypsiglena torquata), the long-nosed snake (Rhinocheilus lecontei), and the massasagua (Sistrurus catenatus).

Two species of turtle have been recorded, a terrestrial species and an aquatic species. The aquatic species, the yellow mud turtle (Kinosternon flavescens), is commonly found in the stock tanks and ponds which ranchers have built in the area. The western box turtle (Terrapene ornata) is the terrestrial species and inhabits most of the study area with the exception of the creosote bush plant association.

Amphibians, as might be predicted from the aridity of the area, do not play a very important role in the fauna of the area. The amphibians which have been recorded are adapted to the arid environment to some degree. Water is of course still required for reproductive activity and development, but adults can survive some periods of drought.

PALEOENVIRONMENT FOR SOUTHEASTERN NEW MEXICO

Paleoenvironmental reconstructions in southeastern New Mexico have been attempted for a number of years using both pollen and plant macrofossil analyses (Hafsten 1961; Oldfield and Schoenwetter 1975; Van Devender 1977, 1980; Van Devender and Everitt 1977; Van Devender and Riskind 1979). These studies generally date from the Late Pleistocene to Recent periods. These studies will be reviewed in an attempt to reconstruct the vegetation surrounding the WIPP project. No direct evidence for the WIPP area exists; however, surrounding areas have been well sampled.

Palynological evidence for plant species in the region is generally confined to the Pleistocene-Holocene boundary with emphasis placed on areas containing evidence of Paleoindian archaeological remains. Localities for pollen sampling have generally been confined to lake sediments. The majority of these data come from the northeast of the WIPP area within the Llano Estacado. The periods of interest for this study extend from approximately 2500 B.P. to the present. Based on archaeological remains from the WIPP area the Sand Canyon Post-pluvial which began at 7000 B.P. and ended between 4000 to 5000 B.P. is most important (Oldfield and Schoenwetter 1975).

The Sand Canyon post-pluvial contains low pine, high Chenopodicae and varied herb representation, including persistent Ephedra records, suggesting a prairie environment, essentially treeless with all of the elements of the present-day pollen rain, and vegetation present (Oldfield and Schoenwetter 1975:168-169). This time period probably encompasses the Altithermal period. The Altithermal period in southeastern New Mexico and West Texas probably represents a time when increased summer rainfall occurred in the monsoonal rainfall areas (Van Devender 1980). This would have been to the detriment of winter rains which had an effect on plant species present. Conditions in the region would have been essentially modern in character i.e., a desert grassland.

Post-Altithermal episodes for the Llano Estacado indicate a brief pine maximum which may record a very brief environmental fluctuation which gives no indication of having materially altered what must have been a prairie environment throughout the period (Oldfield and Schoenwetter 1975:169). The higher frequencies of Artemisia found in samples probably reflects slightly cooler or moister conditions than those that prevailed around the time of the Altithermal (Oldfield and Schoenwetter 1975:169).

A generalized trend of Postglacial pollen from the Llano Estacado (Hafsten 1961; Oldfield and Schoenwetter 1975) reveal a trend toward increased aridity and the establishment of large dry grassland areas lacking trees except along major drainages and in areas of higher elevation. Hafsten's (1961) pollen records from several playa lakes on the Llano Estacado show an apparent mesic interval occurring around 2,500 years ago. This brief interval was characterized by higher percentages of both grass and pine pollen but it was short-

[illegible] ended the warming and drying trend in west Texas contin[illegible] until the present (Bryant and Shafer 1977:18).

Plant macrofossil remains from southeastern New Mexico also indicate environ mental changes. Examination of well preserved plant remains from fossil packrat middens from Rocky Arroyo and Last Chance Canyon, Eddy County record a juniper-oak community in the early Holocene (10,500 - 10,000 B.P.) (Van Devender 1980). Rocky Arroyo and Last Chance Canyon are located less than 100 km west of the WIPP project area on the east flanks of the Guadalupe Mountains at elevations between 1100 and 1200 meters. The WIPP area is between 900 and 1000 meters.

The general vegetational gradient in the area is from mesquite scrub along the Pecos floodplain, to a succulent Chihuahuan desert-scrub or desert-grassland on the rocky slopes flanking the Guadalupes to oak woodland or pinyon-juniper woodland higher in the mountains (Van Devender 1980). Radiocarbon dates for the packrat middens from Rocky Arroyo are 10,560 ± 100 B.P., 3840 ± 80 B.P., 1550 ± 60 B.P., 850 ± 90 B.P., and 90 ± 60 B.P. The earliest radiocarbon date for WIPP materials is 3090 ± 190 B.P. (Tx 5040).

The fossil packrat middens record two different plant communities in Rocky Arroyo and Last Chance Canyon: juniper-oak woodland in the early Holocene and a desert-scrub/desert-grassland in the late Holocene (Van Devender 1980:367). A more mesic pinyon-juniper woodland was in the area prior to 11,000 years ago in the late Wisconsinan.

The early Holocene woodlands in the area from 10,500 to 10,100 years ago were still more mesic than the present communities. Many succulents were absent or rare while the woodland components were more important. The gentle divides between canyons could have supported grassland at any time in the Holocene (Van Devender 1980:368).

Pinyon retreated to higher elevations and was not available to Folsom inhabitants of early Holocene woodlands and grasslands at middle elevations. About 8,000 years ago a more xeric environment developed with a climate that was probably warmer and wetter in summer and drier in winter. The middle Holocene summer monsoon period would have favored grasslands. The climate of the last 4,000 years probably was close to the requirements of both desert-scrub and desert-grassland (Van Devender 1980:368). A prolonged drought or certain types of disturbance such as modern grazing would shift the balance in favor of shrubs. Good summer rains and recurrent fires would favor grass. Shifts from grassland to shrub communities similar to that in historic times may have happened naturally in earlier climatic fluctuations (Van Devender 1980:368).

A map of New Mexico with the proposed natural vegetation of the area has been produced by Gross and Dick-Peddie (1979). Using territorial survey records as a data base they reconstructed the vegetation patterns in New Mexico during the latter part of the nineteenth century. The southeastern portions of the state were apparently grassland savanna areas with a relatively even but fairly heavy distribution of shrubs such as mesquite, saltbush, and shinnnery oak (Gross and Dick-Peddie 1979:118, Figure 1b).

Small islands of grassland were present in extreme southeastern Eddy County. Grassland areas were those with open grass although some of these areas may have had localized stands of trees or shrubs in canyons and along escarpments (Gross and Dick-Peddie 1979:118).

The greatest departures on the map from current vegetation maps are in the grassland-woodland savanna-desert types. In many areas, grasslands have been replaced by woodland savanna at the upper boundaries and desert at the lower boundaries. Some of the grassland savanna boundaries are essentially unchanged such as the shinnery oak areas in the southeastern portion of the state (Gross and Dick-Peddie 1979:121).

The environmental conditions of southeastern New Mexico, therefore, have probably remained essentially unchanged for the last 4,000 years. Undoubtedly, an increase in shrub species such as creosotebush and a decrease in both the numbers and diversity of grass species occurred since the beginning of the twentieth century due to grazing pressures, but in general the modern vegetation of the region has remained essentially stable.

Chapter 4

FIELD METHODOLOGY AND SITE DESCRIPTIONS

Kenneth J. Lord

GENERAL METHODOLOGIES

Field methodologies carried out at all three sites included mapping, surface collection, and the excavation of test pits.

Mapping

The crew placed a pinflag with each artifact, artifact cluster, and feature visible on the surface in order to define the site perimeters. After this task was completed a permanent site datum was established near the center of the site. The site was then mapped with a plane table/alidade or surveyors transit with respect to that datum. The map included locations of natural features such as the micro-relief of coppice sand dunes, cultural features including aboriginal hearths and ash stains, diagnostic artifacts and tools, concentrations of artifacts, surface collection units, tested areas, and modern land surface modification such as nearby fences and roads. An X-Y axis was also established across the sites to facilitate provenience information. This baseline was placed using a transit.

Surface Collection

All surface artifacts were collected via a point provenience system. Surface materials were provenienced to a 1 by 1 m square with the southwest corner of the unit being the numerical designator. All surface artifacts were bagged by grid unit and recorded on Artifact Record forms which include information on site number, provenience, field specimen number, type of item, material, and functional information.

Only ENM 10230 was not collected at the 100% effort level.

Test Pits

A number of test pits were placed at each site. The test pits were excavated to a depth of at least 50 cm or sterile soil, whichever resulted in a deeper excavation. All excavation was performed using hand tools. If natural stratigraphy was present, excavations were conducted by natural levels subdivided into levels less than or equal to 10 cm. Otherwise, arbitrary levels not greater than 10 cm were used. During the excavation of activity areas and areas where pressure retouch and thinning flakes were observed, all material was dry-screened through 1/8" hardware cloth. If no activity areas or thinning flakes were observed 1/4" hardware cloth was used. Stratigraphic profiles were recorded for each excavation unit. These profiles were recorded by scale diagram, black and white photographs and color transparencies. All soil horizons and strata have written descriptions using scientific terms with color descriptions in Munsell terminology.

Features were recorded in three dimensions with profiles of the cross sections recorded by scale diagrams and photography. Flotation samples were collected from all stratigraphic levels and features. Pollen samples were collected from the site in locations that could be related to natural and/or arbitrary 10 cm levels and features. Charcoal was collected for radiocarbon samples.

All materials recovered from the site were bagged by 1 by 1 m provenience units in either natural stratigraphic or arbitrary 10 cm units. All materials were recorded on artifact record sheets.

Upon completion of field investigations, all excavation units were backfilled in such a manner as to not damage unexcavated portions of the site.

ENM 10222

Site Description

ENM 10222 is a moderate sized site located in Township 22 South, Range 31 East, at the juncture of Sections 16, 17, 20 and 21. The site is oblong and follows an east-west trending ridge. The site extends from a dune covered ridgetop, downsloping to the south through a series of low dunes. The dunes range in height from 0.5 to 1.5 m. The site area is composed of the Mescalero sands, a Quarternary complex of pure fine-grained sands (Jones et al. 1973:6). These deposits cover the site to a depth of 1 to 2 m. Below this Berino complex soils probably exist, followed by a deep red clay which lies just above the Mescalero Caliche (see Figures 4.1 and 4.2). Bedrock in the area is probably composed of the Dewey Lake Redbeds. The dunes in the site area are still active with some stabilized dunes present. Numerous blowout depressions are present and new blowouts may still be forming.

The on-site vegetation consists of mesquite, shinnery oak, dune yucca, snakeweed, sand sage, and small amounts of unidentified forbs and grasses. A high percentage of the site supports no vegetation and vegetation is generally confined to semi-stabilized dunes (see Plate 4.1).

Fauna noted at the site during fieldwork include lizards, desert cottontails, Ord's kangaroo rats, quail, and golden eagle.

Water sources for the site probably consisted of seasonal playas. These are located approximately 2 to 3 km southwest of the site. More reliable water sources may have existed prehistorically in Nash Draw 7 to 10 km to the west.

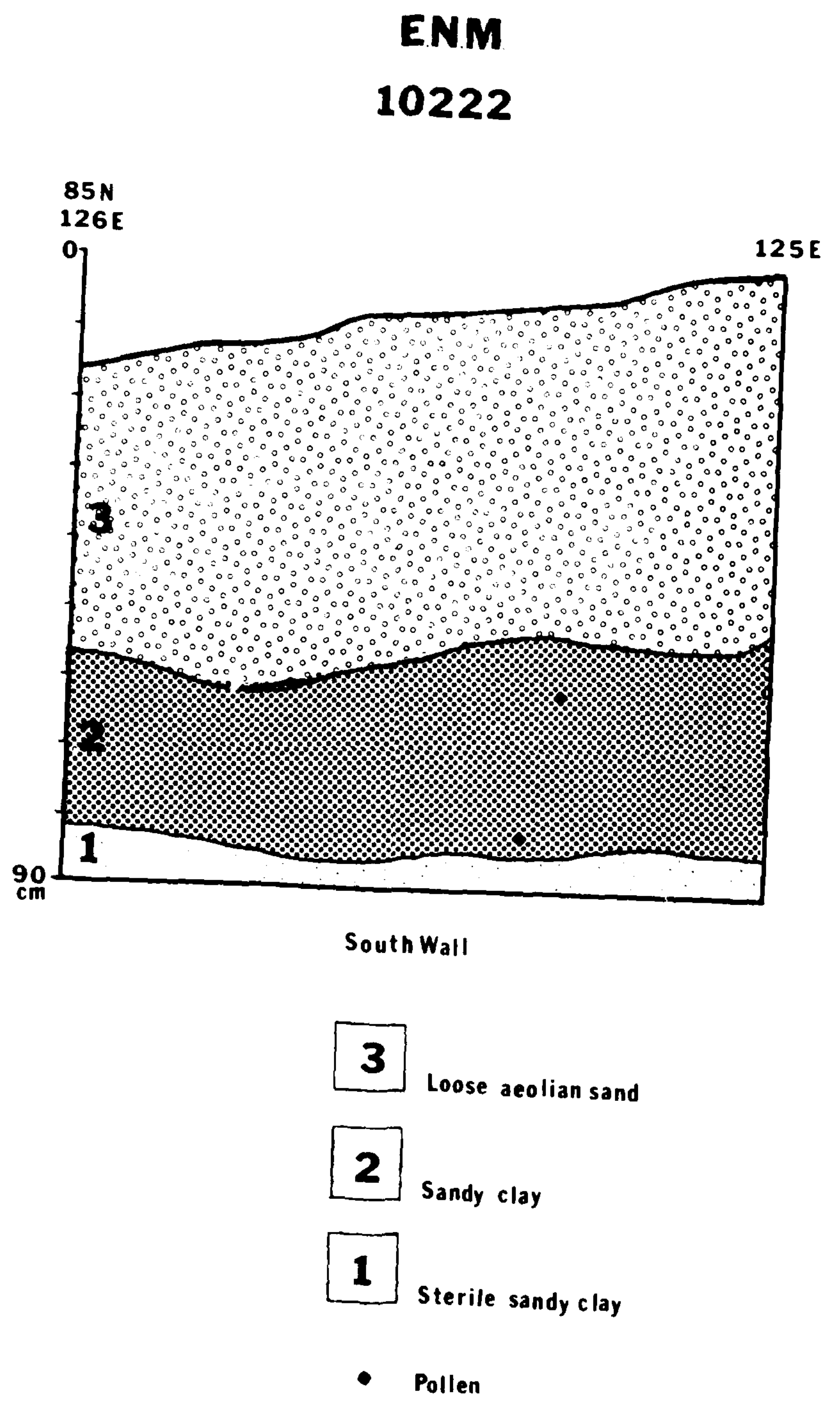
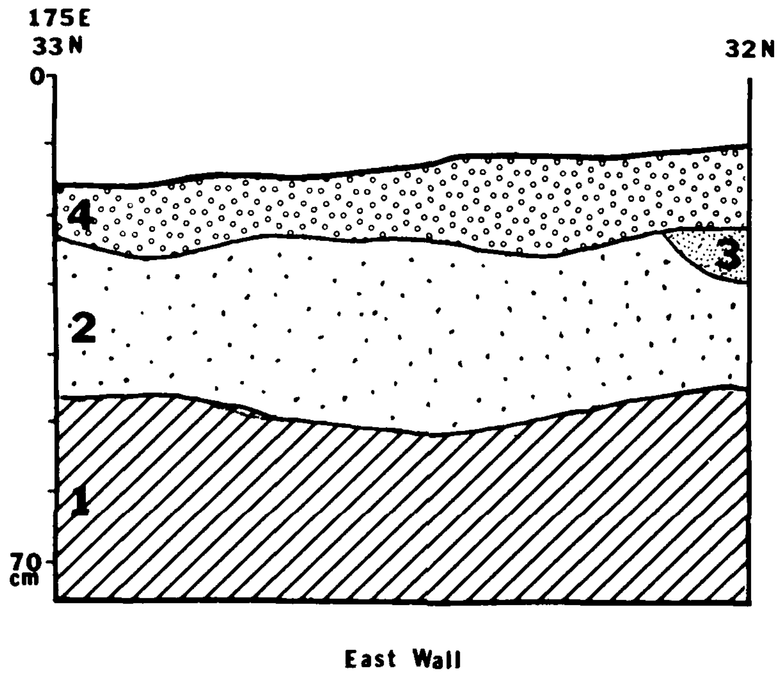


Figure 4.1
ENM 10222 Profile of 85N/126E

ENM
10222



4	Loose aeolian sand
3	Stain
2	Sandy clay
1	Bedrock

Figure 4.2
ENM 10222 Profile of 33N/175E

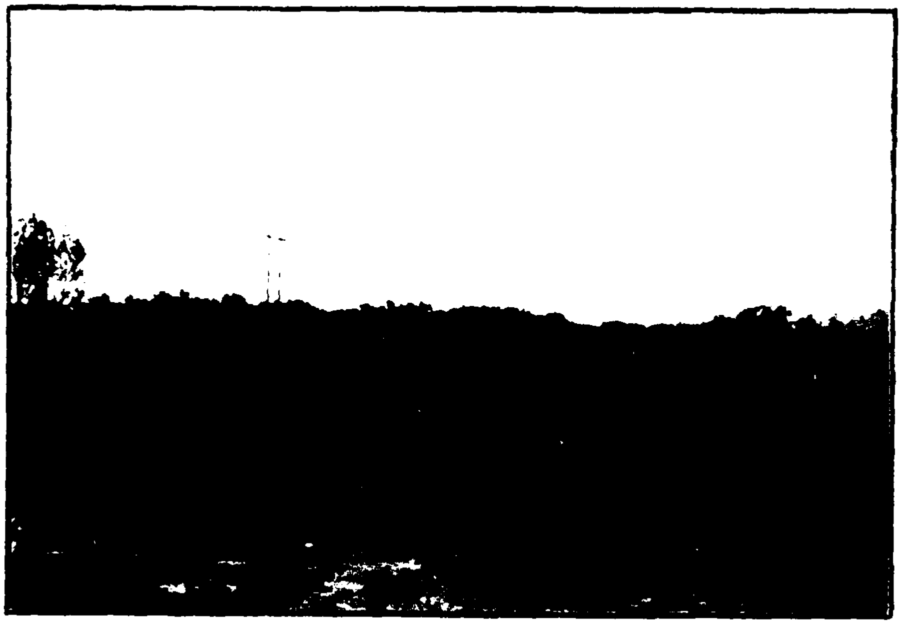


Plate 4.1
General View of ENM 10222

ENM 10222 spans an area measuring 150 m east-west by 80 m north-south. It consists primarily of a moderate scatter of lithics, ground stone and fire-cracked caliche. The majority of these materials are confined to the blowout depressions, particularly along a fenceline road which extends along the northern portion of the site.

No ceramics were found during the 1983 field season; however, Schermer (1980:30) mentions the presence of El Paso Brownware sherds. This discrepancy may be due to the shifting nature of the sand at the site.

Methodology

The field methodology employed at ENM 10222 encompassed several stages. The first stage involved a pedestrian survey across the site placing pin flags by all artifacts. This was accomplished by five people in early November, 1983. This stage defined the areal extent of the site.

The second stage involved establishing a grid system for the site. An arbitrary grid point was established 2 m south of the bench mark delineating the juncture of Sections 16, 17, 20, and 21. This point was labeled 100 N/100E. The grid was aligned on true north and wooden stakes were placed every 5 m south from the 100N/100E grid point for 90 m. The east-west stakes ran from the 90N/100E point 100 m east and 60 m west, again at 5 m intervals. All of these stakes were set in place using a transit and 30 m tape.

After the baseline was established, a contour map of the site was made using a transit and stadia rod (Figure 4.3). The elevations of dune crests and the center o' the blowout depressions were also calculated.

The third stage of work at ENM 10222 involved a complete surface collection of all cultural materials at the site. All artifacts were provenienced to 1 by 1 m grid squares using the southwest corner for provenience (Figure 4.3). A total of 88 1 by 1 m grids contained cultural materials with 166 artifacts recovered. The vast majority of these artifacts were flakes with three pieces of ground stone, a hammerstone, one retouched flake, and three projectile points (one complete) recovered. These materials were bagged by 1 by 1 m provenience units and were recorded on artifact record sheets.

The final stage of fieldwork entailed test excavations at the site to determine if subsurface deposits exist. Fourteen 1 by 1 m units were excavated at the site (Figure 4.3). These units were selected based on artifact densities, the presence of fire-cracked rock concentrations and extended into the margins of dunes in order to determine if cultural materials were present below the dunes. Excavation unit proveniences were established using the baseline with the southwest corner of the grid used for both horizontal and vertical control. Elevations for the southwest corner of the grid units were determined in relation to an arbitrary 100.00 m at the 100N/100E grid stake. A transit and stadia rod were used to determine the surface elevations; subsequent elevations were determined using a line level. The excavation units were dug in arbitrary 10 cm levels until the C horizon was reached since no recognizable cultural strata were recognized. Shovel scraping in 1 to 2 cm levels was used until sensitive areas, i.e., features, were encountered. Trowels were used in these sensitive areas. All fill was passed through 1/8" mesh hardware cloth or 1/4" mesh hardware cloth with the upper fill (blowsand) screened using the smaller mesh. All cultural materials were provenienced by the grid square and by 10 cm level. All excavation units were profiled (see Figures 4.1 and 4.2) and a selected number of units had pollen samples taken. A summary by excavation unit is shown in Table 4.1. The average depth of excavation was 52 cm, with 7.27 cubic meters of fill removed.

Two cultural features were encountered within the excavation units (Table 4.2). Feature 1 is a shallow charcoal filled pit, while Feature 2 is a basin shaped pit containing charcoal and burned caliche. Profiles of both features are shown in Figure 4.5 (Figure 4.4 is the key to the feature illustrations).

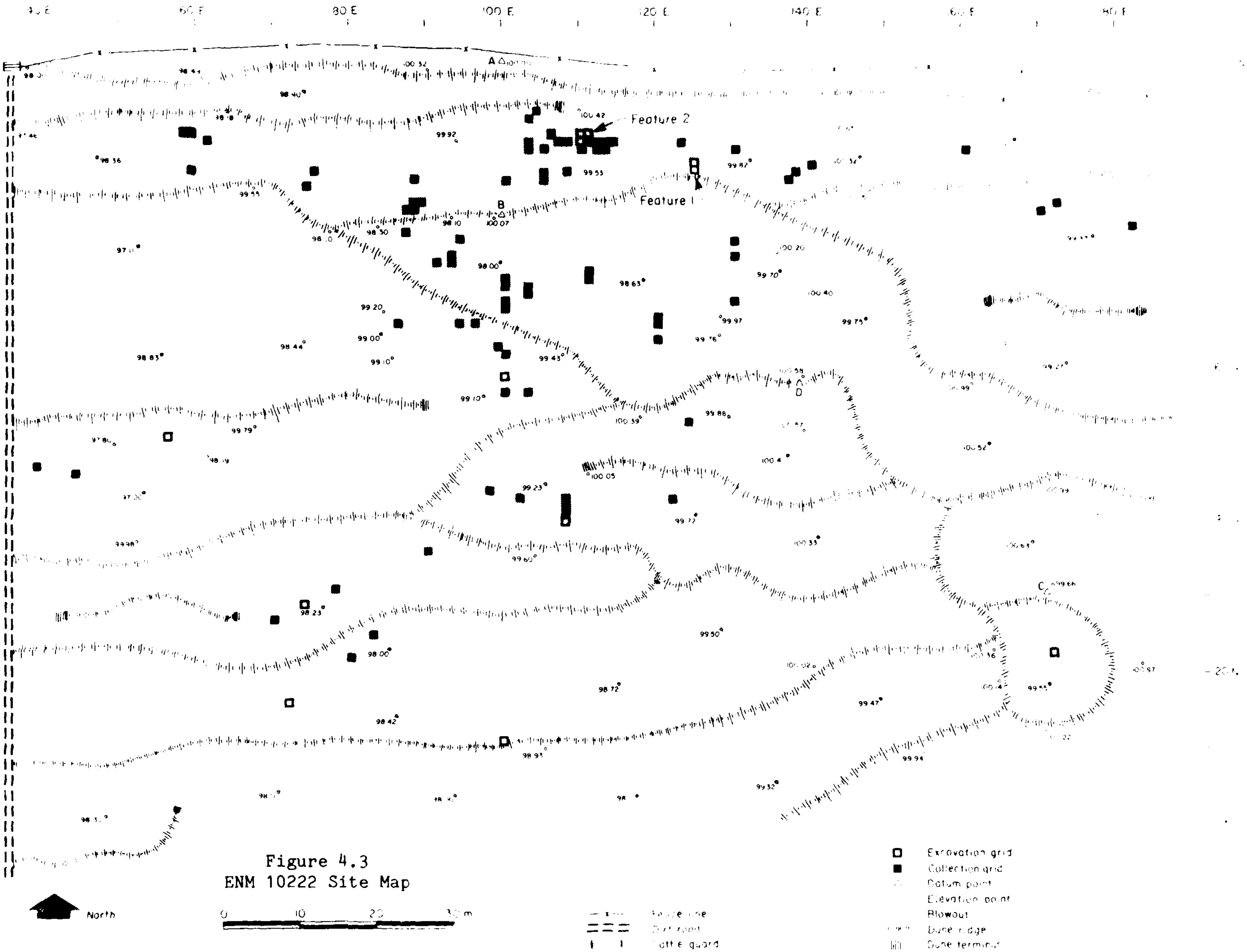


Figure 4.3
ENM 10222 Site Map

Table 4.1
ENM 10222 Excavation Unit Summary

Grid Number	Feature Number	Surface Area (sq m)	Average Depth (cm)	Cubic Meter	Lithic	Proj. Point	Ground Stone	Ceramic	Bone	Shell	Pollen	Flotation	Radiocarbon
10N/100E	x	1	50	.50	1	x	x	x	x	x	x	x	x
14N/100E	x	1	56	.56	x	x	x	x	x	x	x	x	x
22N/175E	x	1	60	.60	1	x	1	x	x	x	1	x	x
32N/75E	x	1	40	.40	2	x	x	x	x	x	x	x	x
39N/108E	x	1	56	.56	2	x	x	x	x	x	1	x	x
40N/5E	x	1	40	.40	x	x	x	x	x	x	x	x	x
50N/56E	x	1	65	.65	x	x	x	x	x	x	x	x	x
58N/100E	x	1	60	.60	1	x	x	x	x	x	1	x	x
85N/125E	x	1	30	.30	9	x	x	x	x	x	1	x	x
86N/125E	1	1	90	.90	9	x	1	x	x	x	4	x	1
87N/111E	x	1	02	.02	14	x	x	x	x	x	x	x	x
88N/111E	2	1	48	.48	14	x	1	x	x	x	x	x	x
89N/111E	2	1	60	.60	7	x	x	x	x	x	2	2	1
89N/112E	x	1	10	.10	6	x	x	x	x	x	1	x	x

x = absence

Table 4.2
ENM 10222 Feature Summary

Feature 1

Provenience:	86N/125E
Elevation:	98.58
Description and Assessment:	Feature 1, a possible root mould, consists of a 10 by 6 cm circular shallow pit filled with charcoal stained sand, C-14 and pollen samples were recovered. C-14 date Tx-5039 of 1230 ± 590 B.P. A very small sample. No pollen samples were processed from this feature.

Feature 2

Provenience:	89N/111E
Elevation:	99.40
Description and Assessment:	Feature 2 consists of a 60 by 50 cm circular basin shape hearth, filled with charcoal and fire burned CaCO3. Pollen, C-14, and flotation were recovered. C-14 date Tx-5040 of 3090 ± 190 B.P. Pollen and flotation samples were analyzed and are discussed in Chapter 7.

ENM 10230

Site Description

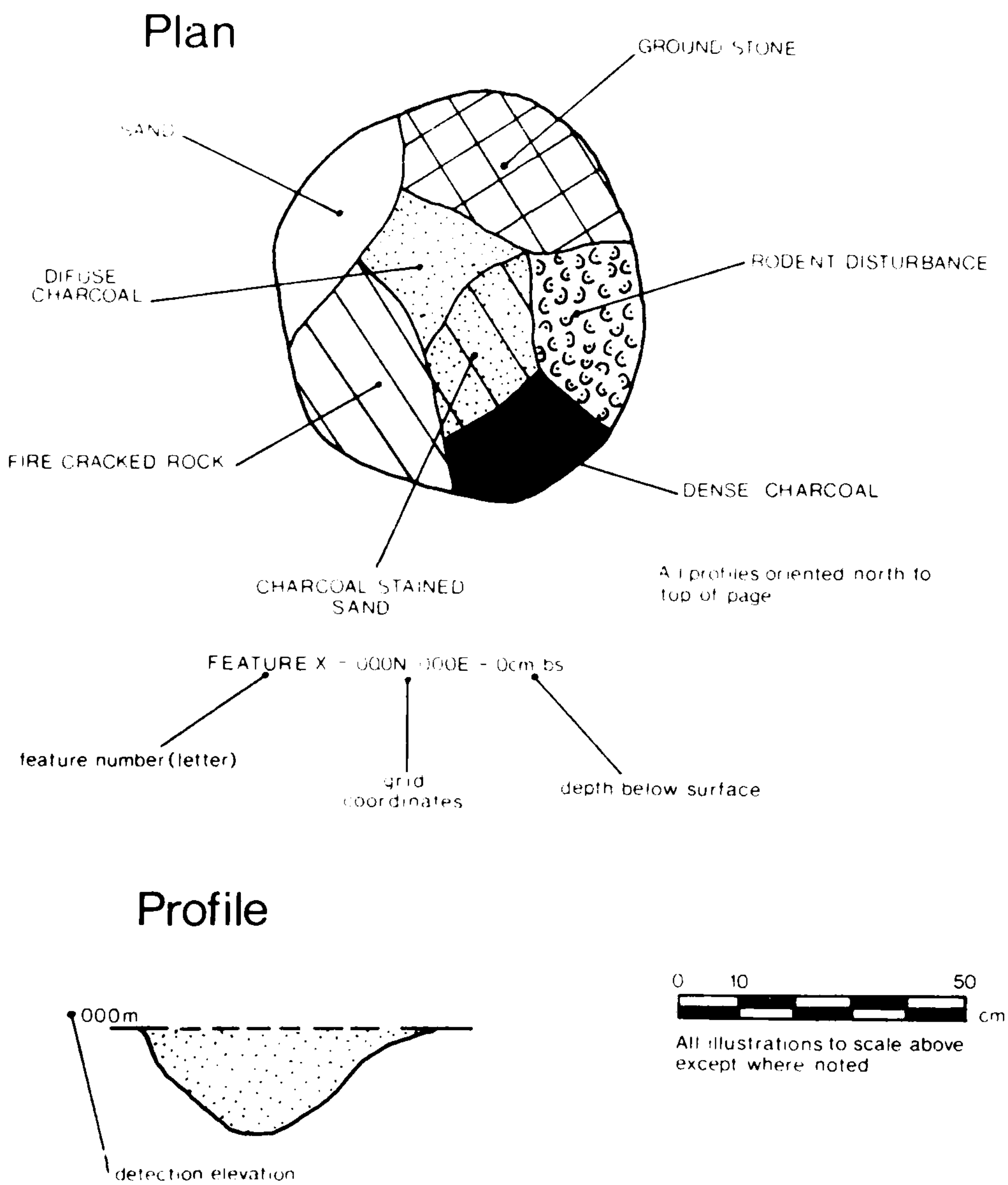
ENM 10230 is a large site located in Township 22 South and Range 31 East at the juncture of Sections 27, 28, 38 and 34. The site is roughly oval in shape and follows a low southeast trending portion of a larger ridge. The ridge itself is composed of Dewey Lake Redbeds capped by the Mescalero caliche (Department of Energy 1980:7-34). This is in turn capped by a Kermit-Berino series of soils. The Berino complex is a deep noncalcareous yellow-red to red sandy soil that developed in wind-worked materials of mixed origins (Department of Energy 1980:7-77). The ridgetop and the area immediately surrounding the site are occupied by large southeast trending dunes which range in height from 1 to 4 m. These dunes are still very active within the site and movement of sand across the site was noted during fieldwork. Based on the excavation profiles (Figures 4.6 and 4.7) archaeological materials are confined to these dunal deposits. A large portion of the site therefore remains essentially intact.

The on-site vegetation consists of mesquite, shinnery oak, dune yucca, snakeweed, sand sage, and small amounts of unidentified forbs and grasses. A large portion of the site supports no vegetation (see Plate 4.2). The majority of the vegetation is confined to semi-stabilized dunes. Fauna noted during fieldwork include lizards, desert cottontail, Ord's kangaroo rat and coyote. Only lizards and desert cottontails were actually sighted. Harris hawks were also sighted.

Water sources for the site probably consisted of seasonal playas. Several small playas are located less than 2 km southeast of the site.

Figure 4.4

KEY TO FEATURE ILLUSTRATIONS



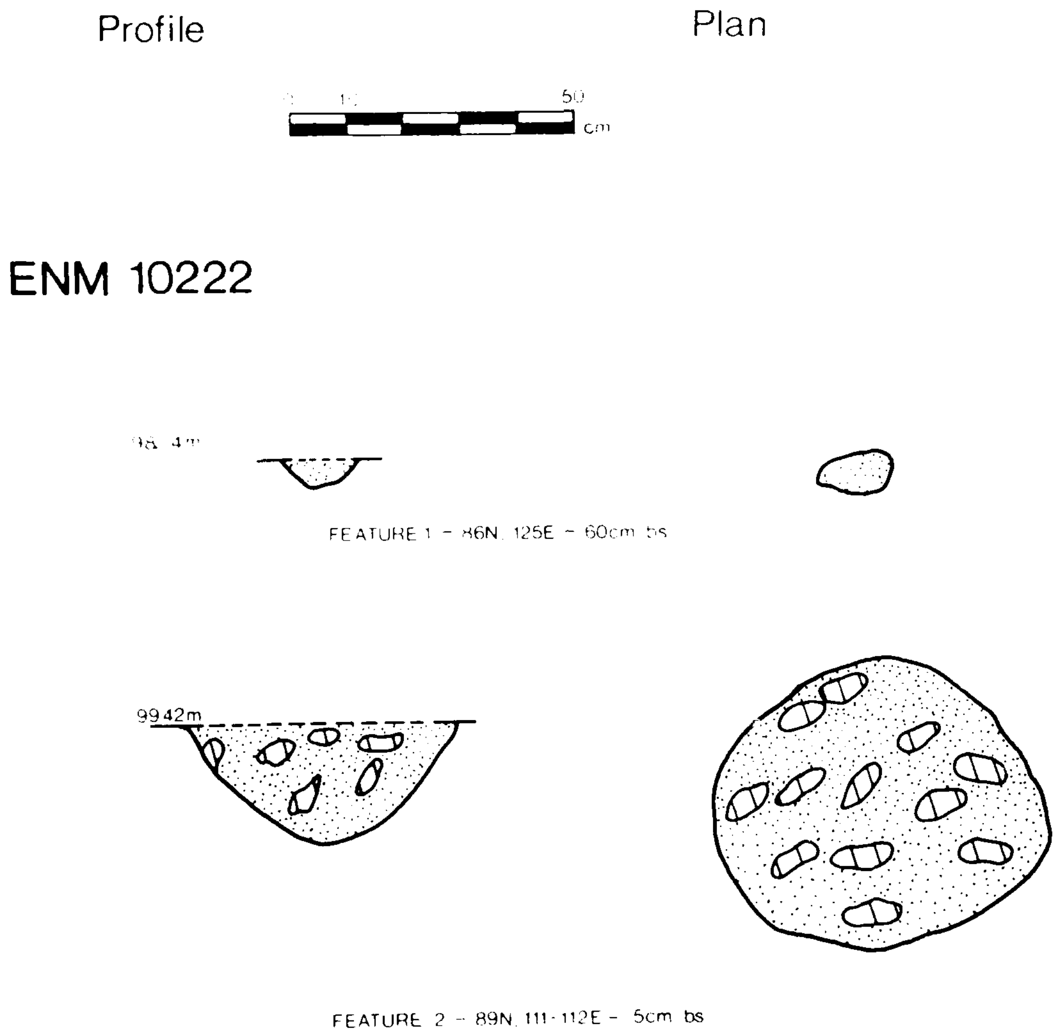
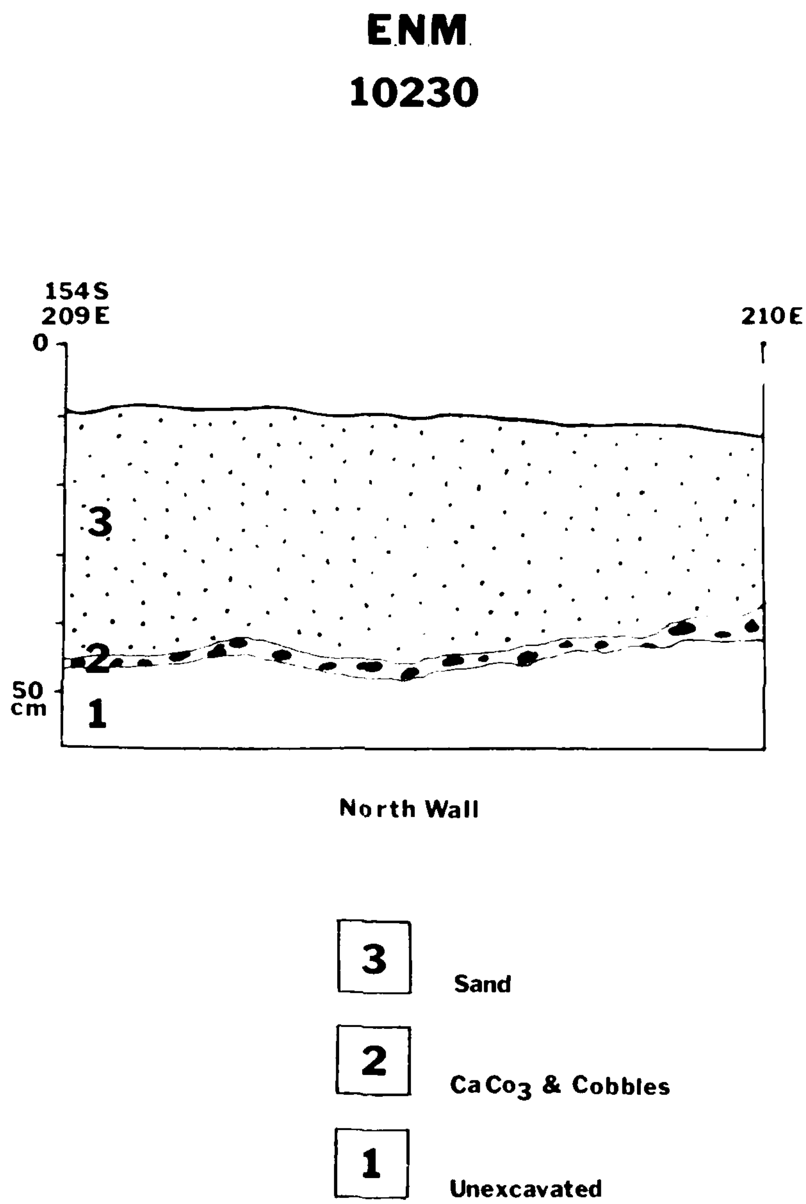


Figure 4.5
ENM Feature Plan and Profile Views



Feature 4.6
ENM 10230 Profile of 154S/209E

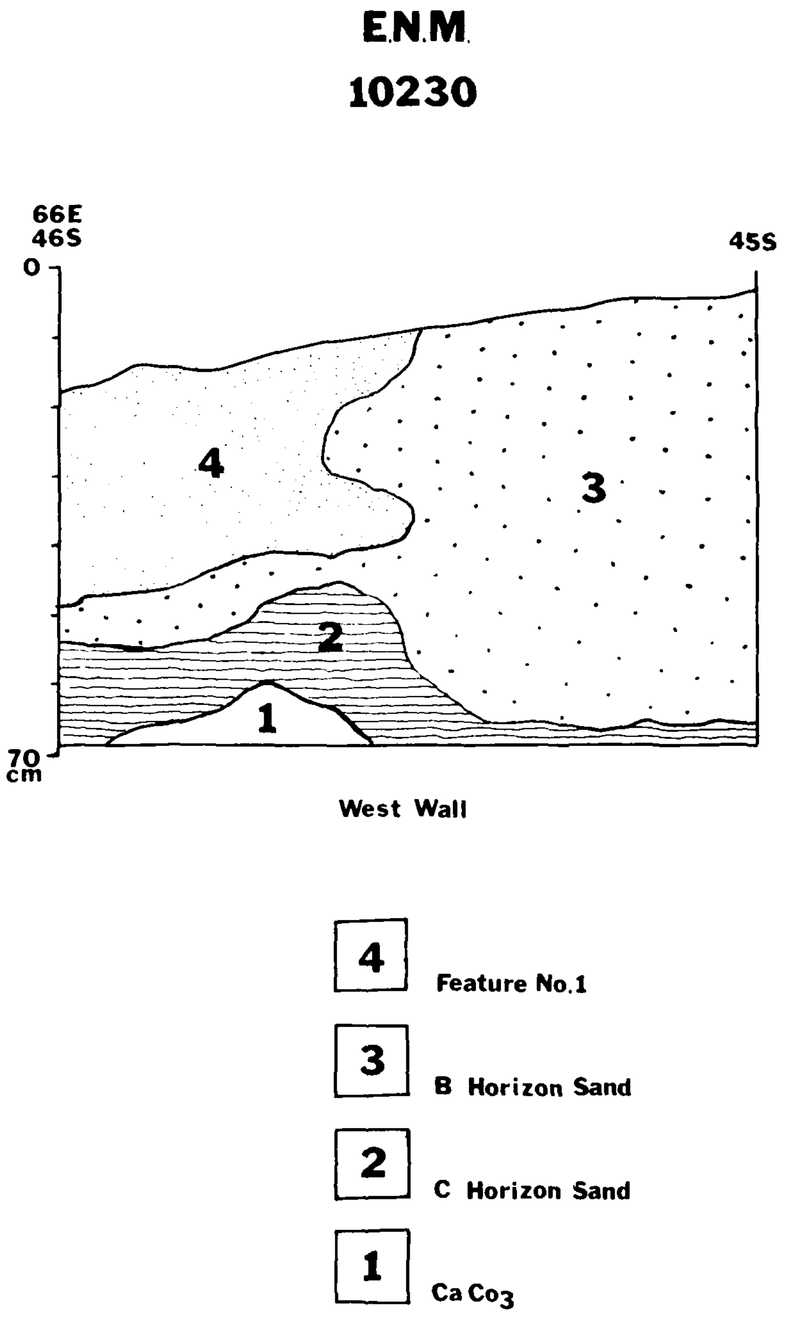


Figure 4.7
ENM 10230 Profile of 46S/66E

Plate 4.2
General View of ENM 10230

ENM 10230 covers an area measuring 395 m (NW-SE) by 205 m (SW-NE) and consists primarily of a dense sherd, lithic, and ground stone scatter usually confined to blowout depressions. In addition there are large concentrations of fire-cracked rocks and charcoal stained sands, indicating the presence of hearths. Lithic materials include primary and secondary decortication flakes, interior and biface manufacture flakes, utilized flakes, bifaces, projectile points, and numerous ground stone fragments. Ceramics found during the 1983 fieldwork are confined to brownware, red-on-brown, and corrugated brown sherds. The survey done by Eastern New Mexico University had a ceramic inventory which included Jornada Brown, Carlsbad Brown, Chupadero Black-on-white, and an unidentified red-on-brown ware (Schermer 1980:60).

Although Schermer (1980:60) indicated that at least one roomblock was present at the site, current investigations of the proposed roomblock suggest that this feature is the result of a natural outcropping of the Santa Rosa sandstone. No other structures were discovered during the present field studies. Recent impacts to the site include establishment of a seismic monitoring station and a well pad and well head for monitoring groundwater fluctuations.

Methodology

The size and complexity of ENM 10230 warranted a multi-stage sampling strategy. The first stage involved a pedestrian survey across the site placing pinflags at artifact concentrations. This was accomplished by five people in early

November 1983. This stage helped to define broad areal limits of the site. The second stage consisted of establishing a grid system for the site. A zero baseline point was established on the northwestern limits of the site. The grid was established on south and east axes. These axes are 2° west of magnetic north (9° east of true north). The grid was shot in using a transit and 30 m tapes with stakes place every 25 m. The grid was stair-stepped to the south and east (Figures 4.8 and 4.9 - in map pocket) in order to adequately cover the site. This stage was accomplished by three people. Additional baselines off of the main grid system were subsequently shot-in to make proveniencing easier for the following stages of work.

A topographic map of the site was produced by means of aerial photography. United Aerial Mapping of San Antonio, Texas made a low level fly-over of the site on November 30, 1983. Four measured points were established at the proposed extent of the site. These points in turn were used to produce a scaled topographic map of the site (Figures 4.8 and 4.9 - in map pocket). A scale of 1" to 600' with a contour interval of 1 m was used.

The third stage of work at ENM 10230 consisted of a random sample of the site. The site area encompasses approximately 50,000 sq m. Visual inspection of the site suggested that 60% of the site (30,000 sq m) had the potential for producing surficial cultural materials. The remaining portions of the site are covered with both active and stabilized dunes. Approximately 10% of the site was to be sampled according to the scope of work.

A random transect method was used in order to establish more accurate site boundaries and to provide a statistically valid idea of the density of cultural materials (see Figure 4.9). The sampling methodology consisted of 1 m wide transects which were either 30 or 60 m long. The transects were aligned on both north-south and east-west axes. The transect coordinates were selected by the supervisory archaeologist in a non-biased fashion. The established baseline was used to determine starting points. Tapes were stretched out their full 30 m length and Brunton compasses were used to align the tapes with the grid system. The sampling strategy called for the collection of every third 1 by 1 m square, resulting in 10 collection units (10 sq m) for every 30 m long transect. Two collection methods were employed: 1 by 1 m wooden squares constructed of 1" by 2" wood; and dog-leash units which encompassed 1 sq m. The 1 by 1 m units provenience designations came from southwest corners. The dog leash provenience units were from the center of a chaining pin along the transect line. All lithics, ceramics, ground stone, bone, and shell were collected and bagged with the proper provenience designations. Fire-cracked rocks within the collection squares were counted and noted on artifact inventory sheets.

Due to the topographical nature of the site, i.e., active and stabilized dunes, a record was kept of collection units which were considered uncollectable.

Based on counts shown in Table 4.3, 36.2% of the site could not be expected to produce visible cultural remains. Thus only 32,000 sq m of the 50,000 sq m of the site could be expected to contain visible archaeological remains at the time of the fieldwork. These figures, however, can change due to the shifting nature of the sand dunes.

Table 4.3 indicates that 3.8% of the site was examined using the random transect method. Only 8.1% of the visible portions of the site contain cultural materials. Five days with four or five two man crews sampling the site using the random transect method resulted in only 155 1 by 1 m squares out of 1919 squares sampled containing cultural material (Figure 4.9). The decision was made to abandon the random sampling methodology in favor of a biased strategy in order to obtain culturally diagnostic materials.

Table 4.3
ENM 10230 Results of the Random Sampling Strategy

	Transects Aligned on a North-South Axis	Transects Aligned on an East-West Axis	Total Random Sample for the Site
Total Length of Transects	1950 m	3840 m	5790 m
Number of Squares Sampled	650	1269	1919
Number of Squares with No Artifacts	382	687	1069
Number of Squares Uncollectable	263	431	694
Number of Squares with Artifacts	4	88	92
Number of Squares with Fire-Cracked Rock	0	63	63
Number of Squares with Cultural Material	4	151	155

A biased collection strategy was employed in order to obtain more detailed information about the site by intensifying work in areas with large concentrations of cultural materials, i.e., blowouts. Blowout depressions were widely scattered across the site and 15 were selected for biased collection. These blowout depressions provided large amounts of cultural materials and could provide valuable information on individual occupational episodes at the site. Examination of ceramic types, lithic raw materials, lithic reduction strategies, and tool types may prove to be useful for isolating individual occupation loci at the site.

The methodology used for the biased sample was similar to that used in the random sampling strategy. Tapes were stretched out from the baselines on both north-south and east-west axes to determine provenience. Every other 1 m square within selected blowouts was collected, using 1 by 1 m squares. Alternate squares were collected in order to avoid complete destruction of the site integrity. All cultural materials within the squares were collected with the exception of fire-cracked rock. The burned rock was counted and recorded on artifact record forms. In all, 1018 one meter squares were examined during the biased collection phase of the project, with 749 squares containing cultural materials (73.6%). Table 4.4 lists the biased sample units by blowout (see Figure 4.9). The biased sample accounts for 3.2% of the visible portions of the site.

Table 4.4
ENM 10230 Results of the Biased Sampling Strategy

	Total Number of 1 meter squares examined	Total Number of Squares With Cultural Materials	
Blowout 1	45	33	73.3%
Blowout 2	44	40	90.9%
Blowout 3	37	12	32.4%
Blowout 4	60	59	98.3%
Blowout 5	69	55	79.7%
Blowout 6	38	37	97.4%
Blowout 7	38	30	78.9%
Blowout 8	22	18	81.8%
Blowout 9	57	33	57.9%
Blowout 10	81	74	91.3%
Blowout 11	281	172	61.2%
Blowout 12	50	48	96.0%
Blowout 13	49	42	85.7%
Blowout 14	75	51	68.0%
Blowout 15	72	45	62.5%
TOTAL	1018	740	73.6%

The final stage of fieldwork at ENM 10230 involved the excavation of 13 1 by 1 m units. These units were selected on the basis of their potential for yielding subsurface cultural remains. Areas of the site having the potential to contain cultural features were selected, either based on charcoal staining of the soil and/or areas containing discrete areas of fire-cracked rock. In addition, several areas were selected at the base of dunes in order to determine if cultural materials existed within or below the dunes.

Excavation unit proveniences were established using the same methods as those used for the surface collections (see Figure 4.9). The southwest corner of the unit was used for both horizontal and vertical controls. Elevations of the southwest corner were determined from an arbitrary datum using a transit and stadia rod for the surface elevations and line levels for subsequent elevations. The excavations units were dug in arbitrary 10 cm levels since no visible stratigraphy was recognized. Shovel scraping in 1 to 2 cm levels was used until sensitive areas were encountered; then trowels were used. All cultural materials were screened through 1/8" mesh hardware cloth and were provenienced by the 1 m square and by 10 cm level. All excavation units were profiled and a selected number of units had pollen samples taken (see Table 4.5). The average depth of excavation was 72.5 cm, with 8.28 cubic meters of fill removed. Six features were encountered in the excavation units. They consist primarily of charcoal-filled pits. Some pits also contained fire-cracked rock.

Table 4.5
LSM 10230 Excavation Unit Summary

Grid Number	Feature Number	Surface Area (sq m.)	Average Depth (cm)	Cubic Meter	Lithic	Proj. Point	Ground Stone	Ceramic	Bone	Shell	Pollen	Flotation	Radiocarbon
45S/66E	2 & 4	1	33	.88	6	x	x	2	x	1	x	1	2
46S/66E	1	1	50	.50	6	x	x	x	x	x	2	3	3
69S/167E	5	1	52	.52	1	x	1	x	x	x	1	2	x
70S/167E	5	1	56	.55	2	x	2	x	x	x	1	x	1
81S/174E	x	1	90	.71	10	x	x	x	x	x	x	x	1
82S/174E	x	1	130	.92	12	x	x	x	x	x	x	x	x
95S/174E	x	1	125	.34	4	x	x	x	x	x	1	x	2
96S/174E	x	1	90	.81	[illegible]	x	x	x	x	x	x	x	x
156S/236E	x	1	61	.62	3	x	x	x	x	x	x	x	x
155S/209E	x	1	40	.36	[illegible]	x	1	x	x	x	x	x	1
155S/287E	3	1	43	.43	6	x	x	x	x	x	1	x	x
156S/287E	3	1	48	.46	3	x	1	x	x	x	x	x	x
173S/244E	6	1	60	.59	1	x	x	x	x	x	1	2	1

x = absence

A summary of the features is listed in Table 4.6 and profile views are displayed in Figures 4.10, 4.11, and 4.12.

Table 4.6
ENM 10230 Feature Summary

Feature 1

Provenience:	46S/66E
Elevation:	95.49 - 95.22 m
Description and Assessment:	Charcoal filled pit measuring 27 by 27 by 27 cm. The feature contains dense ash and large chunks of charcoal ranging in size up to 1.7 cm. It is a deep pit with steeply sloping sides. The pit appears to have been dug into the B horizon soil. A chert flake was recovered from the fill of the feature and numerous flakes were recovered from the same level surrounding the feature. C-14, pollen and flotation samples were removed. C-14 dates were Tx-5031 of 1370 ± 60 B.P. and TX-5030 of 1280 ± 60 B.P. These samples were separated by 5 cm of charcoal fill. Pollen and flotation samples were processed and are discussed in Chapter 7.

Feature 2

Provenience:	45-46S/66E
Elevation:	95.69 - 95.54 m
Description and Assessment:	Charcoal filled pit measuring 40 by 57 by 15 cm. The feature consists of dark charcoal stained sand and small chunks of charcoal. It is a basin shaped feature dug into the B horizon soil. No artifacts or fire-cracked rock were found in association. Artifacts, however, were found in the same level surrounding the feature. C-14 and flotation samples were removed. The C-14 sample was too small to date. Results of the flotation samples are discussed in Chapter 7.

Feature 3

Provenience:	155-156S/287E
Elevation:	25 - 40 cm below modern surface
Description and Assessment:	Fire-cracked rock concentration measuring 65 by 55 by 12 cm. The feature consists of a semicircle of 22 pieces of fire-cracked sandstone and 1 piece of burned caliche. One of the sandstone pieces was a ground stone fragment. Artifacts were found in the same levels adjacent to the feature. No charcoal was found in association. A pollen sample was taken. This feature may represent a deflated hearth which was subsequently reburied or a dump of materials from a hearth. The pollen sample results are discussed in Chapter 7.

Table 4.6 (continued)
ENM 10230 Feature Summary

<u>Feature 4</u>
Provenience: 45S/66E
Elevation: 95.87 - 95.67 m
Description and Assessment: Charcoal filled pit measuring 50 by 55 by 20 cm. The feature consists of a basin shaped pit filled with dense ash and chunks of charcoal. No artifacts or fire-cracked rocks were found in direct association, however, cultural materials were found adjacent to the feature. C-14 and flotation samples were collected but were not submitted.

<u>Feature 5</u>
Provenience: 70S/167E
Elevation: 97.76 - 97.66 m
Description and Assessment: Fire-cracked rock concentration measuring 55 by 70 by 10 cm. The feature consists of a shallow deflated basin shaped depression containing approximately 20 pieces of fire-cracked sandstone and caliche fragments. A dark charcoal stain was evident in the central portion of the feature just below the rock layer. Two ground stone fragments were found within the feature. C-14, pollen and flotation samples were extracted from the feature. C-14 date TX-5033 of 1690 ± 150 B.P. The results of the flotation analysis are discussed in Chapter 7.

<u>Feature 6</u>
Provenience: 173S/244E
Elevation: 99.45 - 99.17 m
Description and Assessment: Charcoal filled pit measuring 49 by 30 by 28 cm. The feature consists of a fairly deep basin shaped depression filled with dense charcoal fill. No artifacts or fire-cracked rock were found is association. A flake was found in the same level adjacent to the feature. C-14, pollen and flotation samples were removed. C-14 date TX-5037 of 640 ± 40 B.P. The results of the pollen and flotation analyses are discussed in Chapter 7.

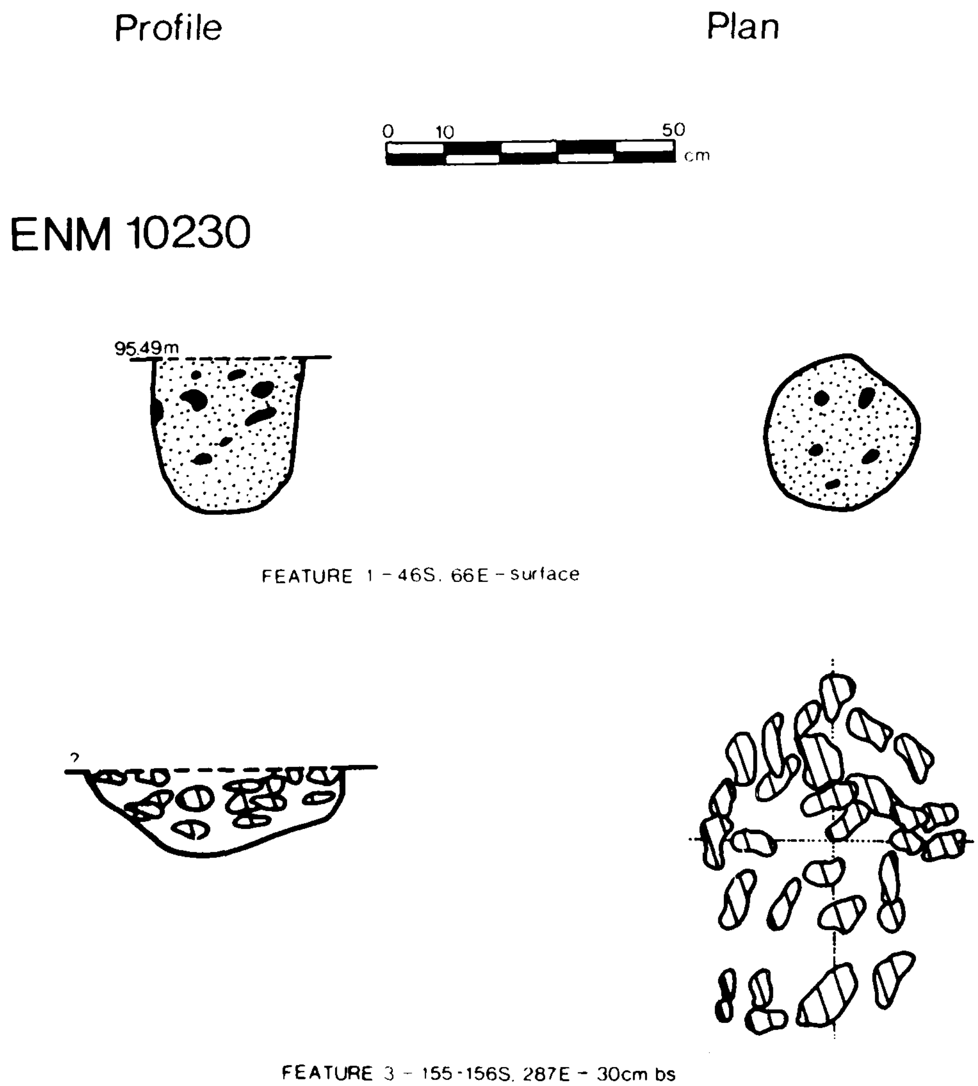


Figure 4.10
ENM 10230 Feature Profiles and Plan Views

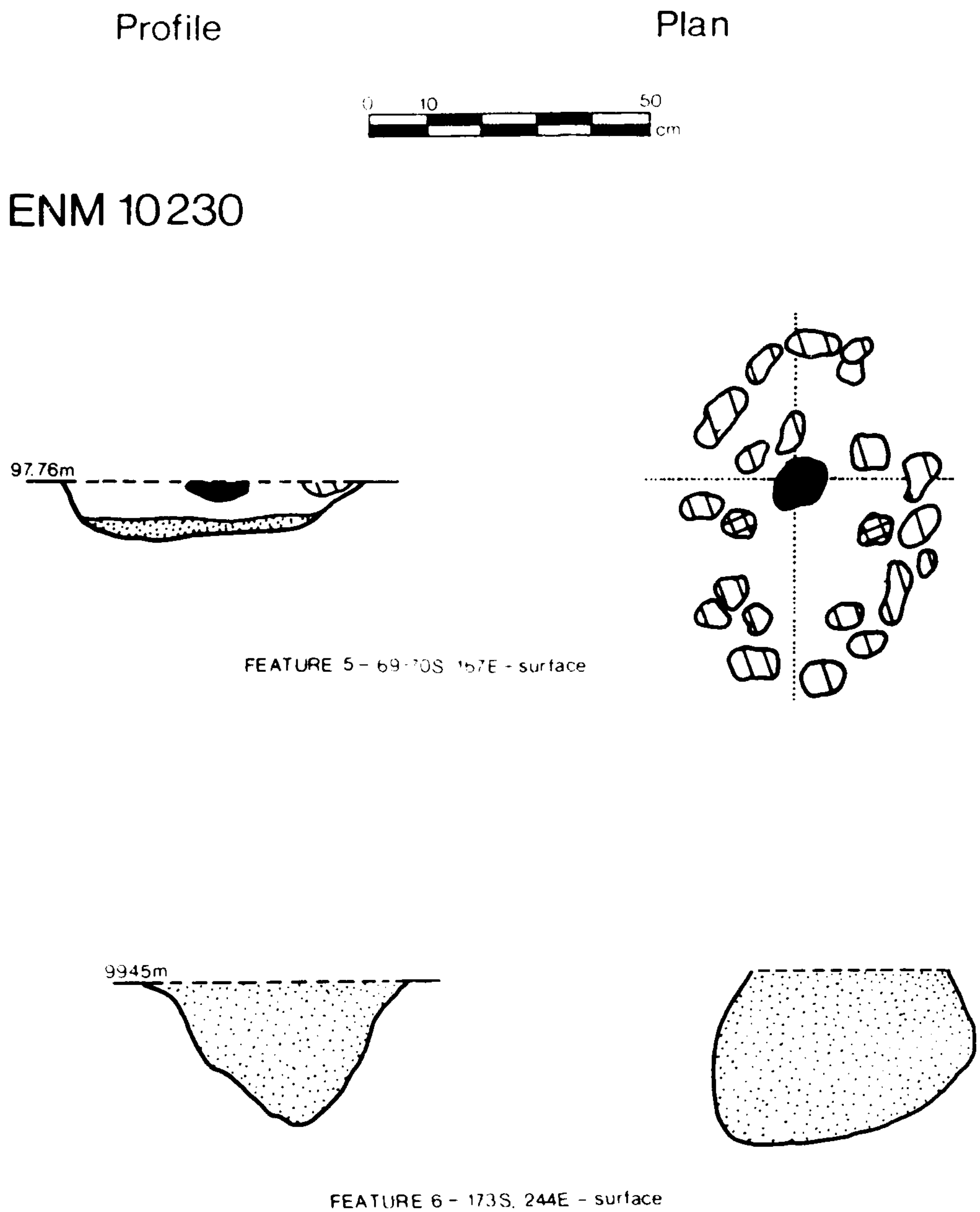


Figure 4.11
ENM 10230 Feature Profile and Plan Views

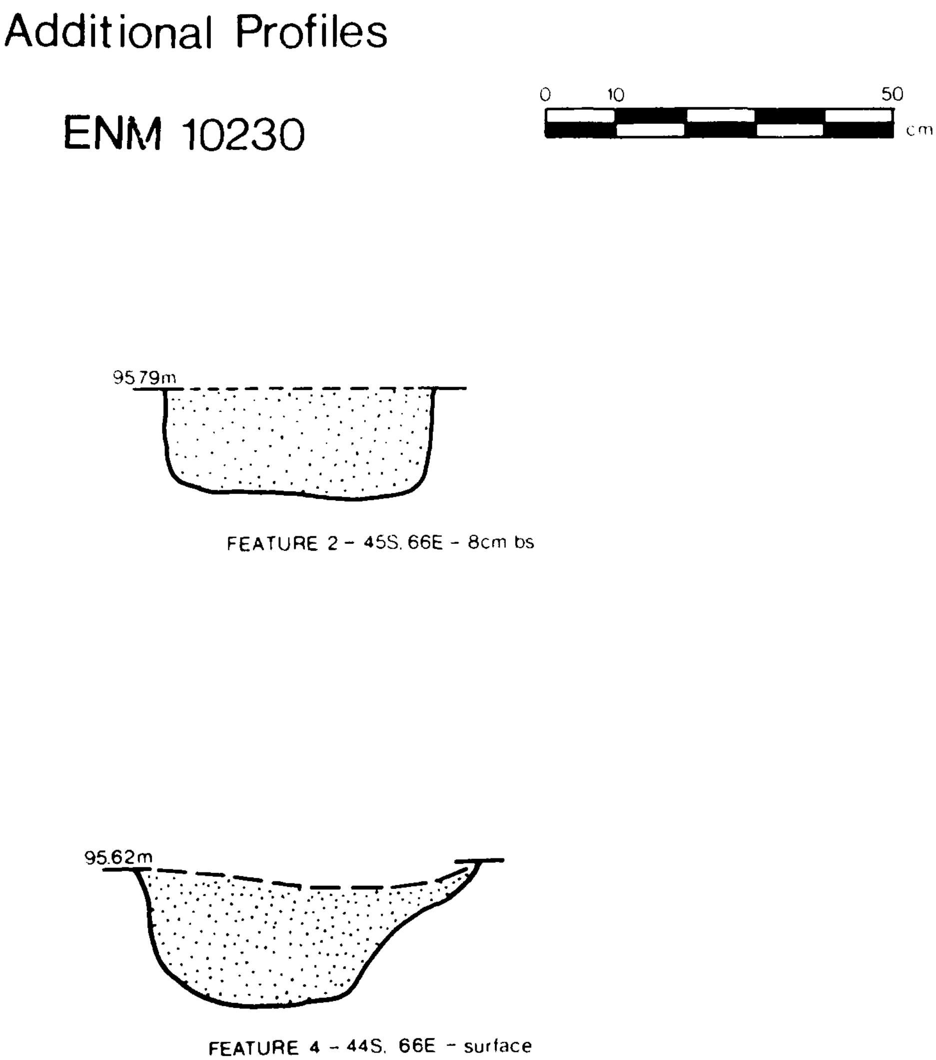


Figure 4.12
ENM 10230 Feature Profiles

ENM 10418

Site Description

ENM 10418 is a large site located in Townships 22 and 23 South and Range 30 East in the southeast and northeast quarters of Sections 33 and 4. The site is roughly oval in shape and is bisected by an unnamed arroyo which runs into Nash Draw. Soils in the site area are Tonuco Loamy Fine Sand (Chugg et al. 1971) with small hummocks of stabilized sand. Mescalero caliche underlies these soils (see Figures 4.13 and 4.14). The bedrock is the Rustler Formation which near Nash Draw is often disrupted close to the surface by the solution of salt and gypsum to form a jumbled mass of gypsum with some dolomite, sandstone and clays (Department of Energy 1980:7-34). Archaeological materials were generally confind to the Tonuco loamy fine sand with the deposition of the sand dunes post-dating the occupational history of the site.

The site vegetation consists of creosote bush, mesquite, dune yucca, four-wing saltbush, prickly pear cactus, snakeweed and perennial muhly. The area has been overgrazed and in general plant cover is sparse (see Plate 4.3). Fauna noted during the fieldwork include lizards, desert cottontail, wood rat and coyote. Both Harris and Swainson hawks were noted in the site area. Mule deer were sighted several kilometers east of the site.

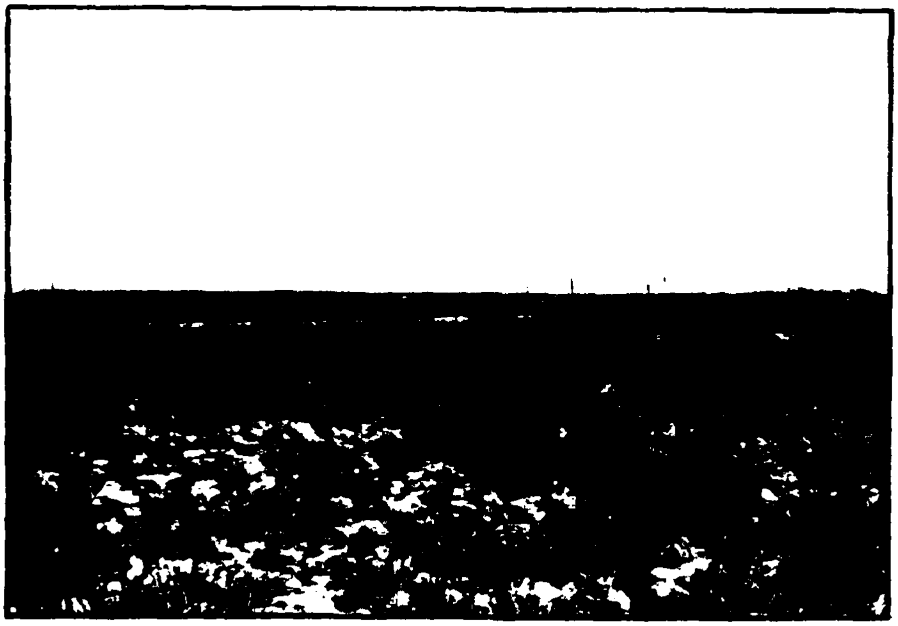


Plate 4.3
ENM 10418 General Site Setting,
Looking Southwest Toward Salt Lake

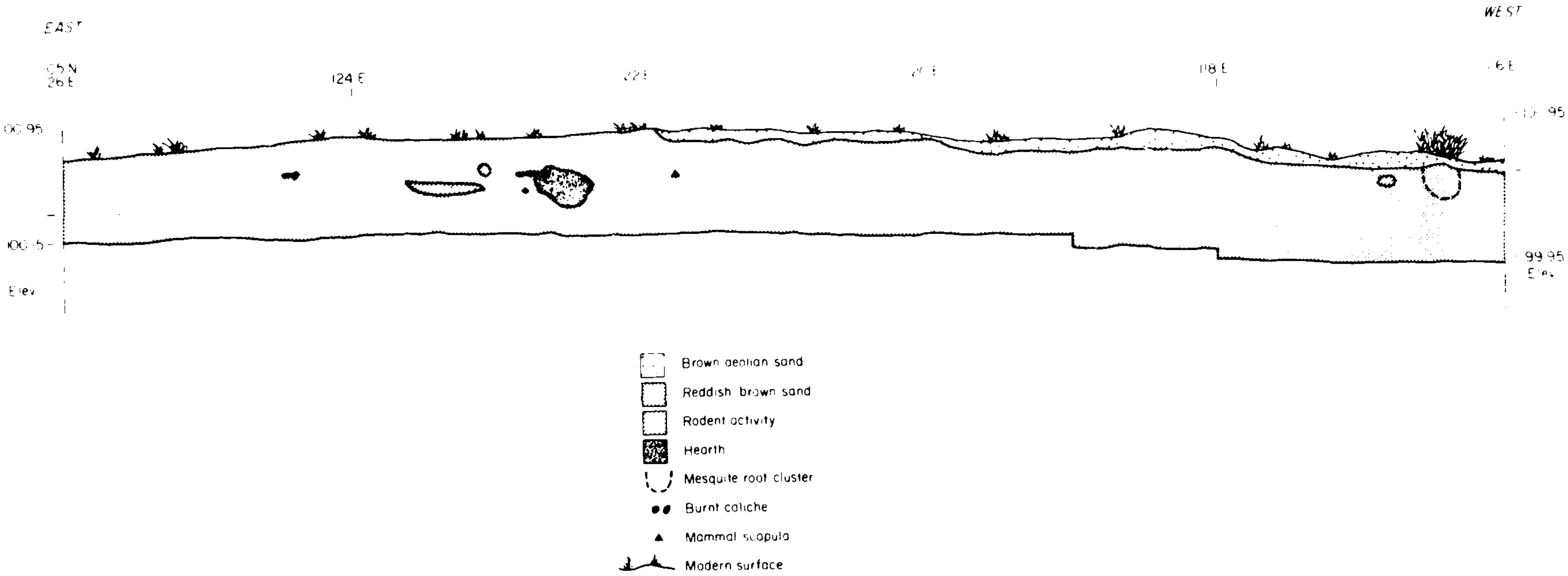


Figure 4.13
ENM 10418 Soil Profile

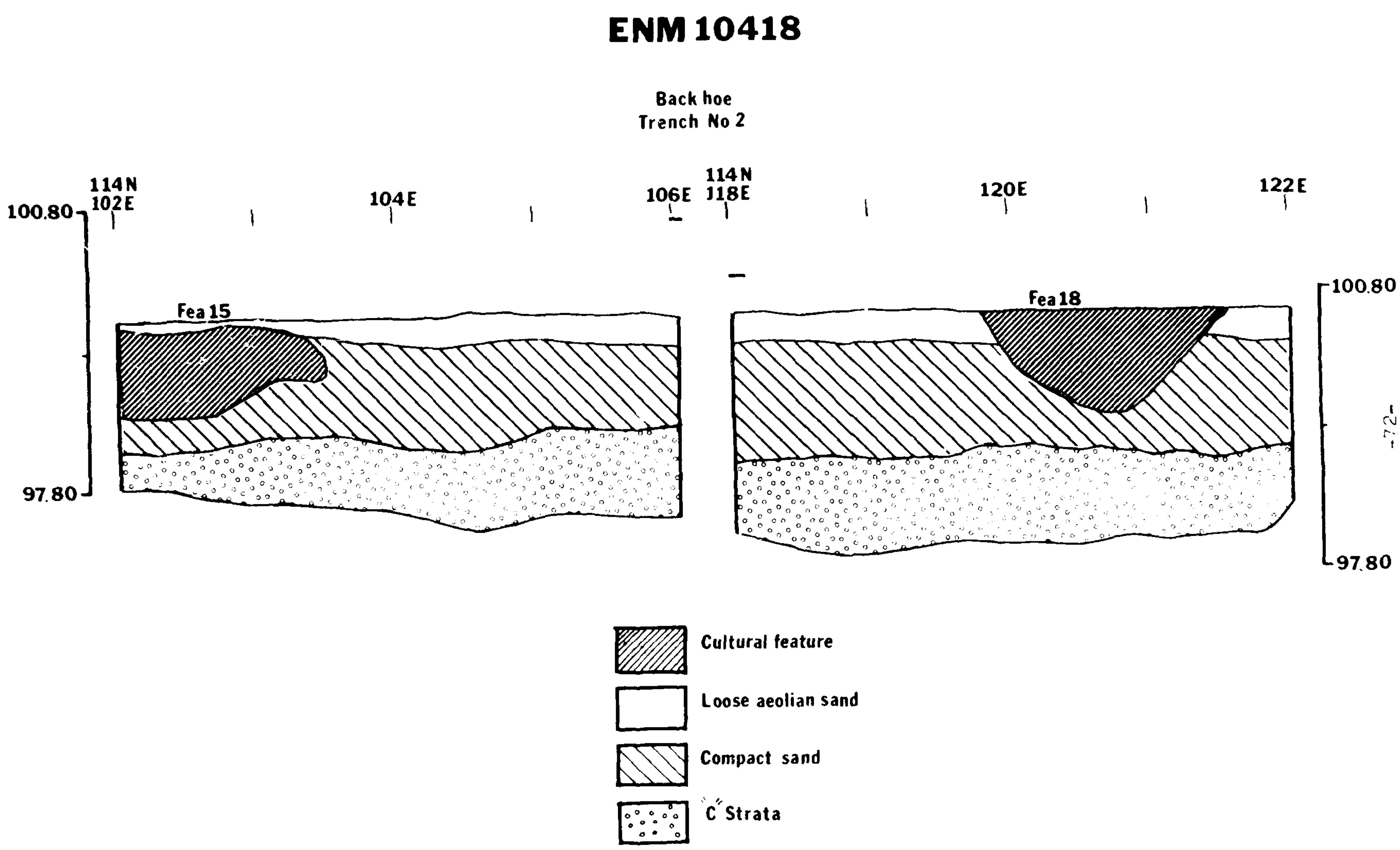


Figure 4.14
ENM 10418 Profile of Backhoe Trench No. 2

Water sources during prehistoric times included the arroyo within the site area and active playa lakes located 2 to 3 km west of the site.

ENM 10418 covers a total area measuring approximately 400 m north-south by 400 m east-west, and consists of a moderate scatter of sherds, lithics, ground stone and shell. Only a portion of the site was investigated. This portion is bounded by a road on the west leading to the Duval Mine Nash Draw property, a railroad spur leading to the mine on the north and the section line fence on the south. This area of the site measures 100 m north-south by 250 m east-west. Cultural items within this portion of the site include lithics, projectile points, ceramics, ground stone and large concentrations of fire-cracked caliche. Several areas of the site also had charcoal stained soil on the surface representing partially deflated hearths. Ceramics at the site include brownwares (both plain and corrugated), Chupadero Black-on-white, and unidentified graywares. No evidence of formal structures was noted.

Impacts to the site include the construction of the road and railroad spur leading to the Duval mine, which occurred in the 1940s. Impacts also include the section line fence across the southern portion of the site and unauthorized collection of archaeological materials by unknown persons.

Future impacts consist primarily of a railroad spur cutting across the site on a northeast-southwest axis which will eventually service the WIPP plant.

Methodology

Work at ENM 10418 consisted of a number of phases. The first phase involved a pedestrian survey of the site locating and pinflagging artifacts in order to determine the site parameters. The site was found to be larger than had been previously reported.

The second phase of work consisted of establishing a grid system on the site and production of a contour map (see Figure 4.15). A transit and stadia rod were used to produce a contour map of the site. The transit, stadia rod and 30 m tape were used to set in a grid system across the site. The grid system was aligned on magnetic north with a centrally located datum established. This point was designated 100N/100E and was given an arbitrary elevation of 100.00 m. Wooden grid stakes were shot in every 4 m on both the east-west and north-south axes across the site. All surface materials were then collected and provenienced using the grid system in 1 by 1 m units (see Figure 4.15).

Following the surface collections, a subsurface mitigation phase was initiated. This phase of work at ENM 10418 focused on exploring areas with potential features. Ten 1 by 1 m units were excavated to sterile deposits (see Table 4.7). Several features were encountered in this excavation phase (see Table 4.8).

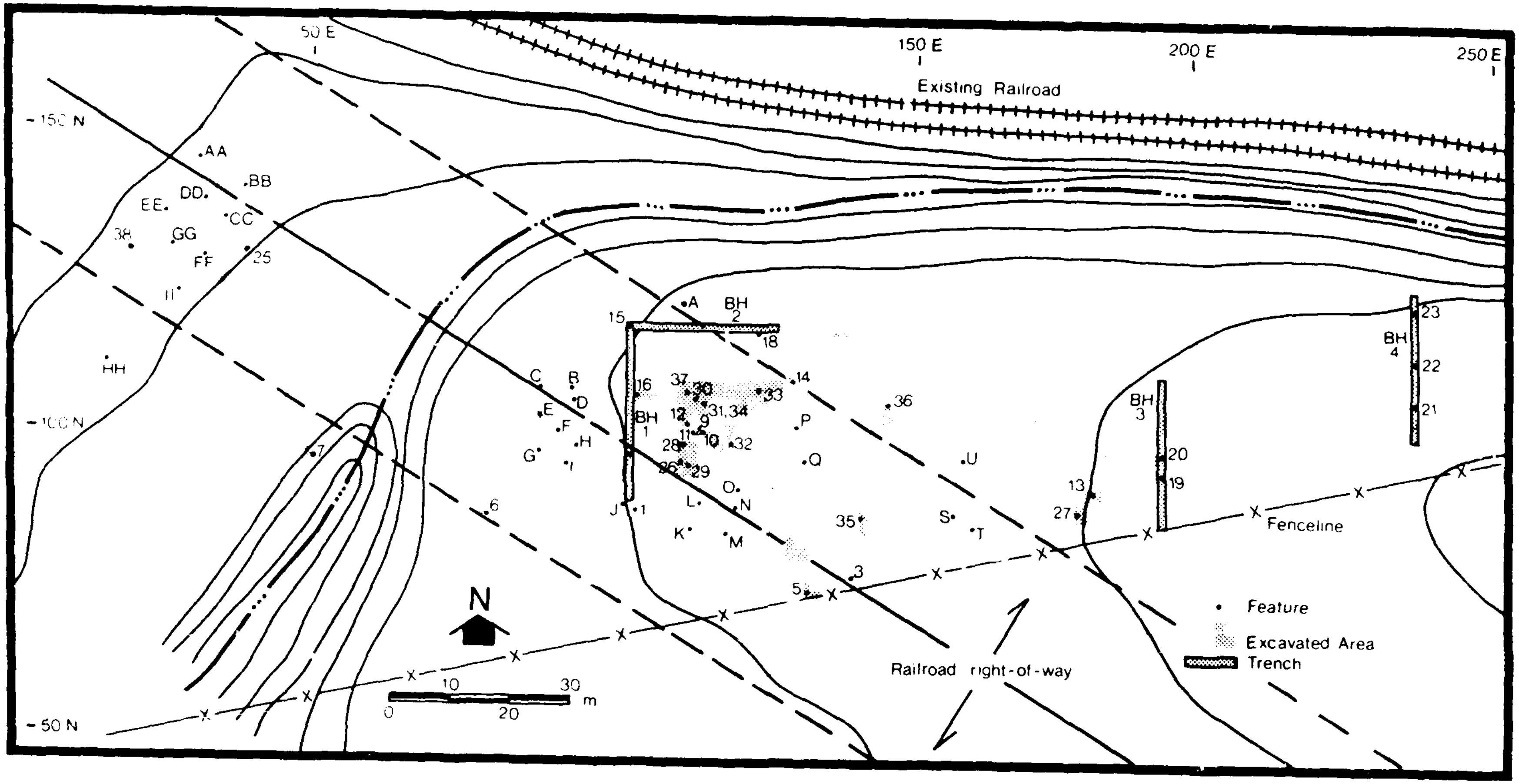


Figure 4.15
ENM 10418 Site Map

Table 4.7
ENM 10418 Excavation Unit Summary

Grid Number	Feature Number	Surface Area (sq m)	Average Depth (cm)	Cubic Meter	Lithic	Proj. Point	Ground Stone	Ceramic	Bone	Shell	Pollen	Flotation	Radiocarbon
						PHASE I							
73N/131E	5	4	50	2.00	0	x	x	x	x	x	x	x	x
85N/79E	6	1	23	.23	0	x	x	x	x	x	2	1	x
100N/112E	11	1	70	.70	0	x	x	x	x	x	x	x	x
100N/113E	9	1	50	.50	2	x	1	x	x	x	1	1	1
100N/114E	10	1	50	.50	4	x	x	x	x	5	x	1	1
114N/117E	x	2	45	.90	0	x	x	x	x	12	x	x	x
						PHASE II							
52N/156E	x	1	60	.60	0	x	x	x	x	x	x	x	x
90N/178E	13	3	27	.82	6	x	x	x	x	x	4	x	3
91N/89E	x	1	70	.70	0	x	x	x	x	x	x	x	x
97N/181E	x	1	70	.70	1	x	x	x	1	2	x	x	x
100N/119E	x	3	80	2.40	2	x	1	x	3	x	5	x	1
108N/129E	14	2	80	1.60	2	x	x	x	x	x	2	2	2
110N/243E	x	2	89	1.78	5	1 (3-C)	x	x	x	2	x	x	x
129N/39E	25	1	50	.50	1	x	1	x	x	x	2	3	2
132N/23E	x	1	50	.50	0	x	x	x	x	x	7	3	x
183N/113E	x	1	70	.70	0	x	x	x	x	x	x	x	x
						PHASE III							
79N/128E	x	4	20	.80	2	x	x	x	x	1	x	x	x
79N/130E	x	4	24	.96	2	1 (9)	x	x	x	1	x	x	x
81N/128E	x	4	16	.64	0	x	x	x	x	x	x	x	x
81N/130E	x	2	14	.28	0	x	x	x	x	x	x	x	x
82N/140E	x	4	50	2.00	3	x	x	x	x	1	x	x	x
83N/91E	x	2	30	.60	0	x	x	x	x	x	x	x	x
83N/92E	x	4	33	1.32	0	x	x	x	x	x	x	x	x
84N/140E	35	4	60	2.40	10	1 (?)	x	x	x	x	x	2	1
86N/140E	35	4	60	2.40	15	x	x	x	x	x	2	[illegible]	1
86N/176E	27	4	36	1.44	5	x	x	1	x	1	1	2	1
87N/156E	x	4	30	1.20	0	x	x	x	x	1	x	x	x
88N/176E	27	4	36	1.44	7	x	x	1	x	24	x	x	x
90N/179E	x	4	47	1.88	5	x	x	x	x	2	x	x	x
92N/128E	x	4	25	1.00	1	x	x	x	x	3	x	x	x
93N/110E	29	4	20	.80	2	x	x	x	x	x	x	x	x
93N/112E	x	4	30	1.20	5	x	x	x	x	x	x	x	x
95N/48E	x	3	132	3.96	1	x	x	1	x	x	x	3	3
95N/110E	26	4	30	1.20	15	x	1	1	x	x	x	1	1
95N/112E	x	4	50	2.00	5	x	1	x	x	1	x	x	x
96N/187E	x	4	50	2.00	1	x	x	x	x	x	x	x	x
97N/110E	28	4	35	1.40	0	x	x	x	x	1	x	1	1
97N/112E	x	4	40	1.60	7	x	x	x	x	1	x	x	x
97N/116E	x	2	30	.60	3	x	x	x	x	2	x	x	1
97N/118E	x	2	30	.60	3	x	x	2	1	x	x	x	x
98N/118E	32	4	30	1.20	3	x	1	4	x	[illegible]	2	2	3
100N/86E	x	4	36	1.44	17	x	x	x	x	x	x	x	x
100N/144E	x	4	[illegible]	.88	[illegible]	x	x	x	x	[illegible]	x	x	x
101N/110E	[illegible]	4	30	1.20	0	x	x	1	x	[illegible]	[illegible]	1	[illegible]

x = absence

Table 4.7 (continued)
ENM 10418 Excavation Unit Summary

Grid Number	Feature Number	Surface Area (sq m)	Average Depth (cm)	Cubic Meter	Lithic	Proj. Point	Ground Stone	Ceramic	Bone	Shell	Pollen	Flotation	Radiocarbon
PHASE III (continued)													
102N/86E	x	4	41	1.64	11	x	x	1	x	x	x	x	x
102N/144E	x	4	36	1.44	0	1 (8-D)	x	x	x	x	x	x	x
103N/110E	x	4	23	.92	0	x	x	3	x	x	x	x	x
103N/112E	x	4	63	2.52	7	x	x	12	x	x	x	x	1
103N/114E	x	4	50	2.00	10	x	1	15	1	2	2	1	x
103N/120E	x	4	53	2.12	11	x	1	3	18	4	x	x	x
103N/122E	x	4	38	1.52	6	x	x	1	1	14	x	x	1
103N/170E	40	4	60	2.40	1	x	2	x	x	x	x	1	x
104N/144E	36	4	44	1.76	6	x	x	x	x	1	2	2	2
105N/103E	16	2	20	.40	0	x	x	x	x	x	1	1	1
105N/104E	x	4	22	.88	0	x	x	x	x	x	x	x	x
105N/106E	x	2	30	.60	0	x	x	x	x	x	x	x	x
105N/110E	x	4	50	2.00	0	x	x	x	x	x	x	1	x
105N/112E	30-37	4	73	2.92	8	2 (3)	[illegible]	[illegible]	x	x	2	1	3
105N/114E	31-34	4	80	3.20	4	1 (3-C)	x	4	x	1	2	2	2
105N/116E	x	4	60	2.40	4	x	x	6	x	4	x	x	x
105N/118E	x	4	58	2.32	5	x	1	1	2	1	1	x	x
105N/120E	x	4	55	2.20	1	x	x	x	[illegible]	4	x	x	x
105N/122E	x	4	67	2.68	18	x	x	x	[illegible]	22	x	x	2
105N/124E	x	4	60	2.40	9	x	x	x	x	25	x	x	x
105N/166E	x	4	34	1.36	2	x	x	x	x	x	x	x	x
105N/168E	x	4	30	1.20	2	x	x	x	x	x	x	x	x
106N/156E	x	4	21	.84	3	x	x	x	x	4	x	x	x
106N/226E	x	12	20	2.40	15	x	x	x	x	x	x	x	1
107N/112E	37	4	66	2.64	1	x	1	1	x	x	2	x	x
107N/114E	x	3	52	1.56	0	x	x	9	x	x	x	1	3
107N/115E	x	2	42	.84	0	x	x	x	x	x	x	x	x
107N/116E	x	4	33	1.32	[illegible]	1 (8-D)	1	3	x	1	x	x	x
107N/118E	x	4	68	2.72	2	x	x	[illegible]	x	2	x	x	x
107N/120E	x	4	56	2.24	4	x	x	x	x	3	x	x	x
107N/122E	33	4	70	2.80	[illegible]	x	2	x	[illegible]	10	x	x	x
107N/174E	x	4	50	2.00	6	x	x	x	x	2	x	x	1
107N/126E	x	4	35	1.40	5	x	x	x	x	14	x	x	x
108N/156E	x	4	33	1.32	1	x	x	x	x	x	x	x	x
108N/247E	x	4	34	1.36	4	x	x	x	x	x	x	x	x
114N/178E	x	4	28	1.12	1	x	x	x	x	x	x	x	x
115N/122E	18	4	60	2.40	0	x	x	x	x	x	1	1	x
116N/136E	x	4	50	2.00	0	1 (8-D)	x	x	x	1	x	x	x
116N/138E	x	4	32	1.28	2	x	x	x	x	x	x	x	x
118N/6E	x	4	10	.40	0	x	x	x	x	x	x	x	x
118N/41E	x	4	45	1.80	0	x	x	x	x	x	x	x	x
118N/43E	x	4	50	2.00	0	x	x	2	x	x	x	x	x
118N/82E	x	4	41	1.64	0	x	x	x	1	x	x	x	x
118E/138E	x	4	31	1.24	7	x	x	x	x	x	x	x	x
121N/114E	x	4	25	1.00	0	x	x	x	x	x	x	x	x
124N/34E	x	4	20	.80	3	x	x	x	x	x	x	x	x
126N/26E	x	4	29	1.16	5	x	x	1	x	x	x	x	x
128E/18E	38	4	18	.72	0	x	x	x	x	x	x	x	x
128N/20E	38	4	21	.84	0	x	x	x	x	x	x	x	1
128N/37E	x	4	20	.80	0	x	x	x	x	x	x	x	x
135N/105E	x	4	40	1.20	3	x	x	x	x	x	x	x	x
148N/31E	x	4	20	[illegible]	2	x	x	3	x	x	x	x	x

x = absence

Augering of the site was initiated to determine if additional subsurface features were present. The auger was hand operated and consisted of a 2" hollow bit that could bore to a depth of 1 m. Twenty-seven auger test holes were placed across the site in areas which due to surficial appearances had the potential to yield subsurface features. Eleven of the auger tests (40%) yielded evidence of subsurface features. Charcoal flecks, charcoal chunks, and fire-cracked rock pieces were found, ranging in depth from 0 to 60 cm below the surface.

Following the initial work at the site it was determined that additional excavations would be needed to define the nature and extent of subsurface deposits.

A magnetic survey of the site was undertaken to streamline the selection of units for excavation. Magnetic surveying is a method whereby subsurface cultural features may be located and identified prior to archaeological mitigation. Features such as house pits, fire hearths and concentrations of refuse, shell or rock can produce detectable signatures in the earth's magnetic field (referred to as anomalies). Based on the results of a magnetic survey, areas of cultural activity may be recognized, and archaeological investigations can then concentrate on areas with the most pertinent cultural information (see Appendix 1 for a detailed summary of the magnetic survey).

Provision was made for the collection of ten 20 by 20 m blocks of magnetometer data samples at a .5 sq m interval (Plate 4.4).

In conjunction with the magnetic survey, additional augering tests were performed. This augering program was done in a systematic fashion within the magnetometer grid units. Auger test holes were placed every 5 m. In all, 228 auger holes were systematically placed across the site. Forty-two (18.4%) of the auger holes yielded evidence of subsurface charcoal or fire-cracked rock.

Following the evaluation of the magnetic survey and augering data, additional 1 by 1 m subsurface excavations were initiated at the site. These excavation units were located in areas of magnetic anomalies, in areas containing positive augering results, and in areas thought to be at the limits of the subsurface deposits. Sixteen 1 by 1 m units were excavated to sterile fill across the site.

In addition to hand dug units at the site, four machine excavated test trenches were placed across the site. The purpose of the test trenches was to determine the character of the depositional history of the site. The test trenches were 25 m long, approximately 1 m wide and were excavated to the caliche deposits. Eight features were encountered within the test trenches. Samples were taken from all features encountered. The test trenches were profiled; pollen columns were taken; then the trenches were backfilled.

This phase of work at the site verified the presence of large amounts of intact subsurface deposits across the site. The results of these phases of work indicated that additional excavations at the site would be needed to mitigate the effects of the railroad bed construction on the site.

Plate 4.4
ENM 10418 Magnetometer Survey

The final phases of work at the site focused on areas within the railroad right-of-way. For the final phase of excavation, 2 by 2 m units were excavated in order to obtain more detailed information on activity areas. During this phase 229 sq m of the site were excavated (Figure 4.15). Fourteen additional features, two cultural surfaces and artifacts were encountered during this final excavation phase.

The final activity conducted at ENM 10418 consisted of blading the railroad right-of-way in order to obtain additional information on the number, types and distributional patterns of features at the site. The blading was carried out using a front-end loader with an eight foot wide bucket (Plate 4.5). Materials were scraped in approximately 5 to 10 cm levels to a depth of approximately 50 cm. The area was monitored during blading and all cultural features were pinflagged. These features were cross sectioned, drawn in plan and profile, and radiocarbon, pollen and flotation samples were removed. The features were also plotted on the base map (Figure 4.15) and are distinguished from other features by letter designations. After all of these features were investigated the site was covered up and the fieldwork was terminated.

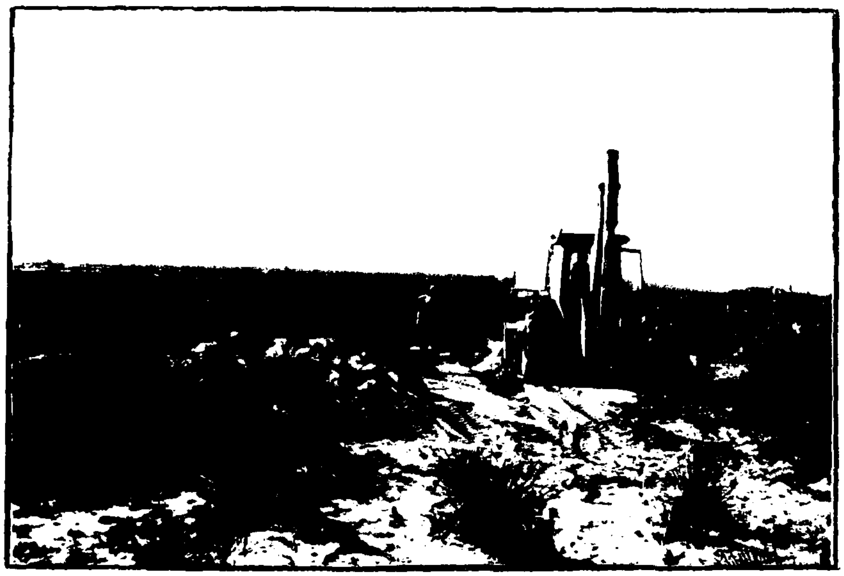


Plate 4.5
ENM 10418 Blading of the Site Railroad Right-of-Way

In summary, three major phases of fieldwork were carried out at ENM 10418. Phase I consisted of delineation of the site boundaries, mapping and gridding of the site, and the excavation of 10 1 by 1 m units to an average depth of 48 cm, with 4.83 cubic meters of fill removed. Preliminary auger testing was also carried out.

Phase II consisted of the magnetometer survey, auger testing and the excavation of 16 1 by 1 m units to an average depth of 64 cm, with 10.30 cubic meters of fill removed. In addition, four 25 m long test trenches were excavated with a backhoe.

Phase III consisted of the excavation of 299 sq m to an average depth of 40 cm, with 124.72 cubic meters of fill removed and the blading of the right-of-way for additional features.

All hand excavation at the site represents approximately 3.5% of the surface area of the right-of-way. Coupled with the blading of the right-of-way, all subsurface cultural features have been exposed and sampled.

A summary of the features is listed in Table 4.8 and profile views are displayed in Figures 4.16 through 4.31.

Table 4.8
ENM 10418 Feature Descriptions

<u>Feature 1</u>

Provenience:	87N/109E 88N/109E 88N/108E
Elevation:	surface - 99.81 m
Description and Assessment:	Dispersed surface scatter of burned caliche measuring 1.5 m north-south by 2 m east-west. Probably cultural; possibly remnants of disturbed hearth. No surface artifacts in association. Feature was not tested.

<u>Feature 2</u>

Provenience:	100N/110E 100N/111E 100N/112E 100N/113E 100N/114E 101N/110E 101N/111E 101N/112E 101N/113E 101N/114E
Elevation:	surface - 100.56 m
Description and Assessment:	Dispersed surface scatter of burned caliche rock measuring 4.5 m north-south by 2 m east-west. No surface artifacts found in association. Feature was tested and three subsurface charcoal filled pits were encountered (see Features 9, 10 and 11).

<u>Feature 3</u>

Provenience:	80N/140E 80N/141E 81N/141E 80N/142E 81N/142E 80N/143E 81N/143E
Elevation:	surface - 100.86 m
Description and Assessment:	Dispersed surface scatter of burned caliche measuring 2 m north-south by 4 m east-west. Probably cultural; possibly remnants of disturbed hearth. No surface artifacts in association. Feature was not tested.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 4

Provenience:	109N/115E 109N/116E 110N/115E 110N/116E 111N/116E 111N/117E 112N/117E 113N/117E 113N/118E 114N/117E 114N/118E
Elevation:	surface (108N/115E) - 100.61 m
Description and Assessment:	Dispersed surface scatter of burned caliche measuring 5.6 m north-south by 3 m east-west. Three 1 by 1 m test pits were placed within scatter (108N/115E, 114N/117E and 115N/117F). Although test pits produced abundant artifactual remains, no subsurface features were identified.

Feature 5

Provenience:	72N/131E 92N/132E 73N/131E 73N/132E 74N/131E 74N/132E 75N/131E 75N/132E
Elevation:	surface (73N/131E) - 100.32 m
Description and Assessment:	Dispersed surface scatter of burned caliche measuring 4 m north-south by 2 m east-west. Probably cultural; possibly remnants of disturbed hearth. No surface artifacts in association. Four grids (73N/131E, 73N/132E, 74N/131E, and 74N/132E) were surface stripped, and one (74N/131E) was excavated to 50 cm. No subsurface artifactual material was recovered and no subsurface features were identified.

Feature 6

Provenience:	85N/79E
Elevation:	98.73 - 98.53 m
Description and Assessment:	Dispersed scatter of burned caliche with an associated gray ash-like stain measuring 40 cm north-south by 40 cm east-west. Feature was excavated to 20 cm with flotation and pollen samples taken. No artifactual material was found in association.

Feature 7

Provenience:	95N/48E
Elevation:	97.33 - 95.87 m
Description and Assessment:	Three lenses of charcoal/ash stain found eroding into a north-south trending arroyo. Excavation of a 2 by 2 m test trench (95N/47E) placed west of the arroyo bank yielded information indicating charcoal/ash strata were redeposited and not in situ cultural deposits. A C-14 sample was collected but was too small to accurately date.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 8

Provenience: 131-137N/36-42E

Elevation: 99.96 m (center of feature, surface)

Description and Assessment: Dispersed scatter of burned caliche measuring 6 m north-south by 8 m east-west. No surface artifacts were found in association. A 1 by 1 m test unit was placed within scatter (135N/40E) with no subsurface features encountered. Feature 25 was encountered 10 m south in 1 by 1 m grid 128/30E. Two additional features were encountered just beyond the defined limit of Feature 8. Features BB and CC were identified during the blading of the site. Feature BB is located in grid 139N/38E, 2 m north of the boundary of Feature 8. Feature CC is located in grid 133N/38E 3 m west of the defined boundary of Feature 8.

Feature 9

Provenience: 100N/112E 100N/113E

Elevation: 100.57 - 100.27 m

Description and Assessment: Charcoal filled pit measuring 60 cm in diameter and 30 cm deep. Feature was encountered within the defined boundary of Feature 2, a surface scatter of burned caliche rock. A mano was recovered from the fill and flotation and C-14 samples were taken. C-14 date Tx-5010 of 1590 ± 50 B.P. The results of the pollen and flotation analyses are discussed in Chapter 7.

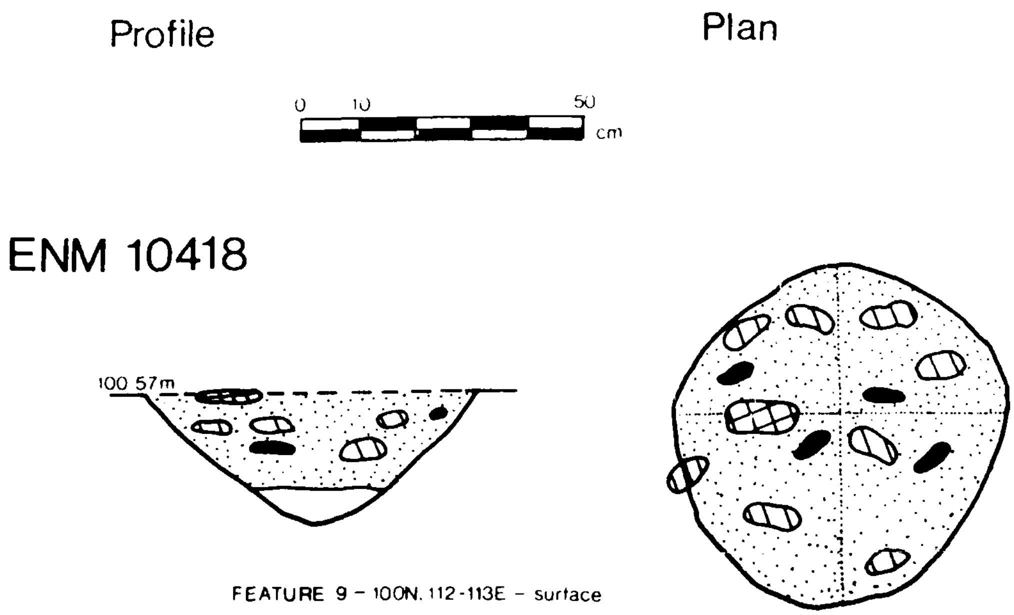


Figure 4.16

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 10
Provenience: 100N/113E 100N/114E
Elevation: 100.54 - 100.31 m
Description and Assessment: Charcoal filled pit measuring 42 cm in diameter and 23 cm deep. No artifactual material in direct association. C-14 and flotation samples taken. C-14 date Tx-5011 of 2120 ± 270 B.P. The flotation analysis is discussed in Chapter 7.

Feature 11
Provenience: 100N/110E 100N/111E
Elevation: 100.54 - 100.22 m
Description and Assessment: Charcoal filled pit measuring 47 cm in diameter and 32 cm deep. No artifactual material was found in direct association. No pollen, flotation or C-14 samples were taken.

Feature 12
Provenience: 101N/111E
Elevation: 100.54 - 100.29 m
Description and Assessment: Charcoal filled pit measuring 60 cm in diameter and 25 cm deep. Fill contained charcoal ash and numerous burned caliche rocks. Flotation, pollen and C-14 samples were taken. No artifactual material found in direct association. C-14 date Tx-5012 of 220 ± 60 B.P. The pollen results are discussed in Chapter 7.

Feature 13
Provenience: 90N/178E
Elevation: 100.54 - 100.47 m
Description and Assessment: Charcoal filled pit measuring 10 cm in diameter and 7 cm deep. No artifactual material in direct association. Possible cultural posthole. Pollen and C-14 samples taken. The pollen and C-14 samples were not submitted for processing.

Feature 14
Provenience: 108N/129E
Elevation: 100.53 - 100.28 m
Description and Assessment: Charcoal filled pit measuring 50 cm in diameter and 35 cm deep. Fill contained numerous burned caliche rocks and one lithic flake. Flotation, pollen and C-14 samples taken. C-14 date Tx-5013 of 680 ± 100 B.P. The flotation sample results are discussed in Chapter 7.

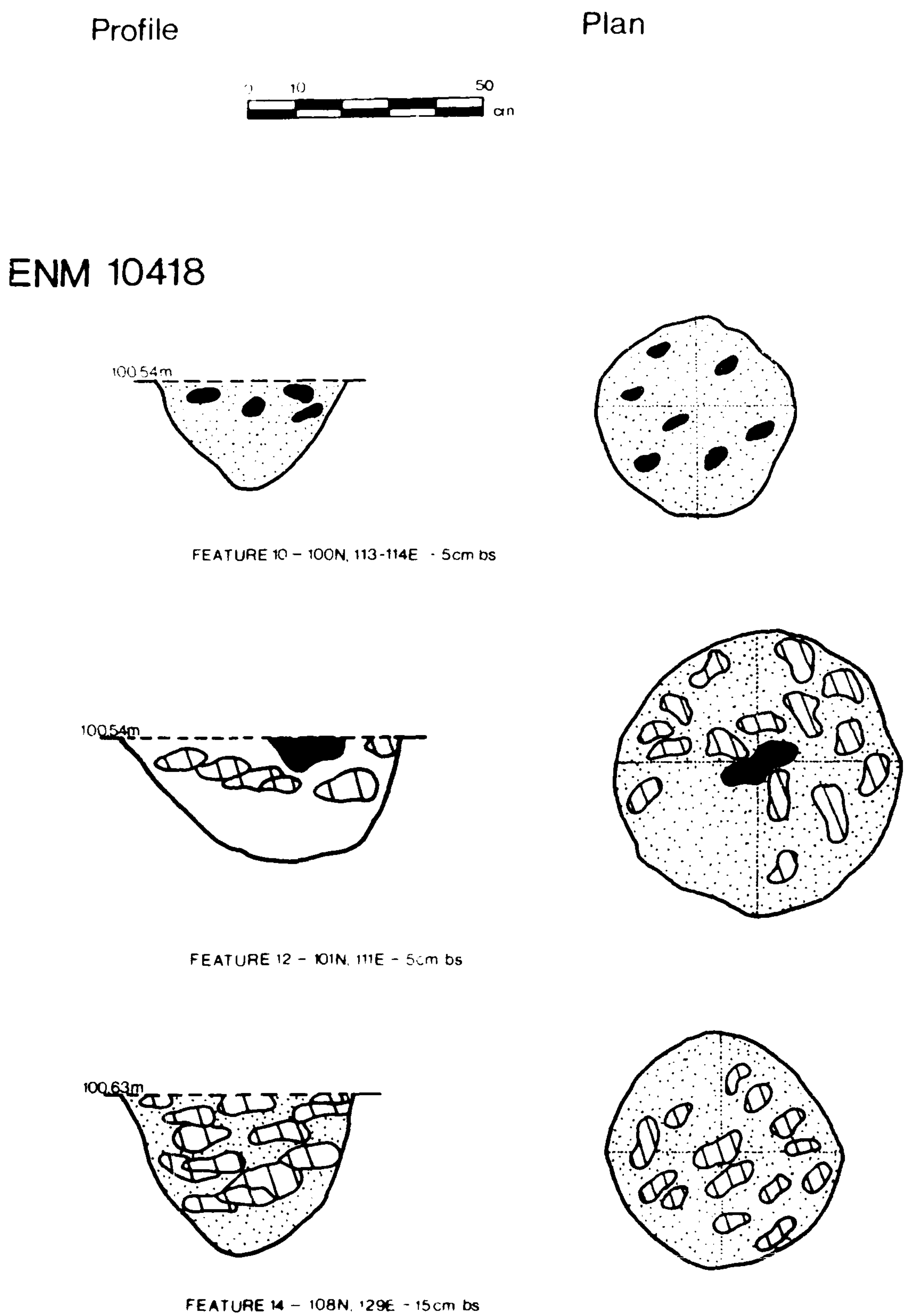

Profile
Plan
0 10 50
cm
ENM 10418
100.54m
FEATURE 10 – 100N, 113-114E - 5cm bs
100.54m
FEATURE 12 – 101N, 111E – 5cm bs
100.63m
FEATURE 14 – 108N, 129E – 15cm bs

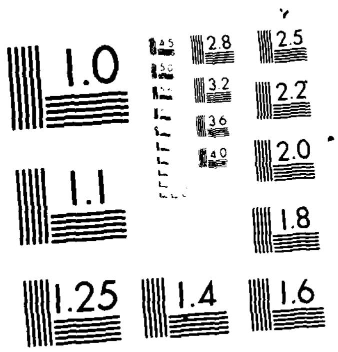
Figure 4.17

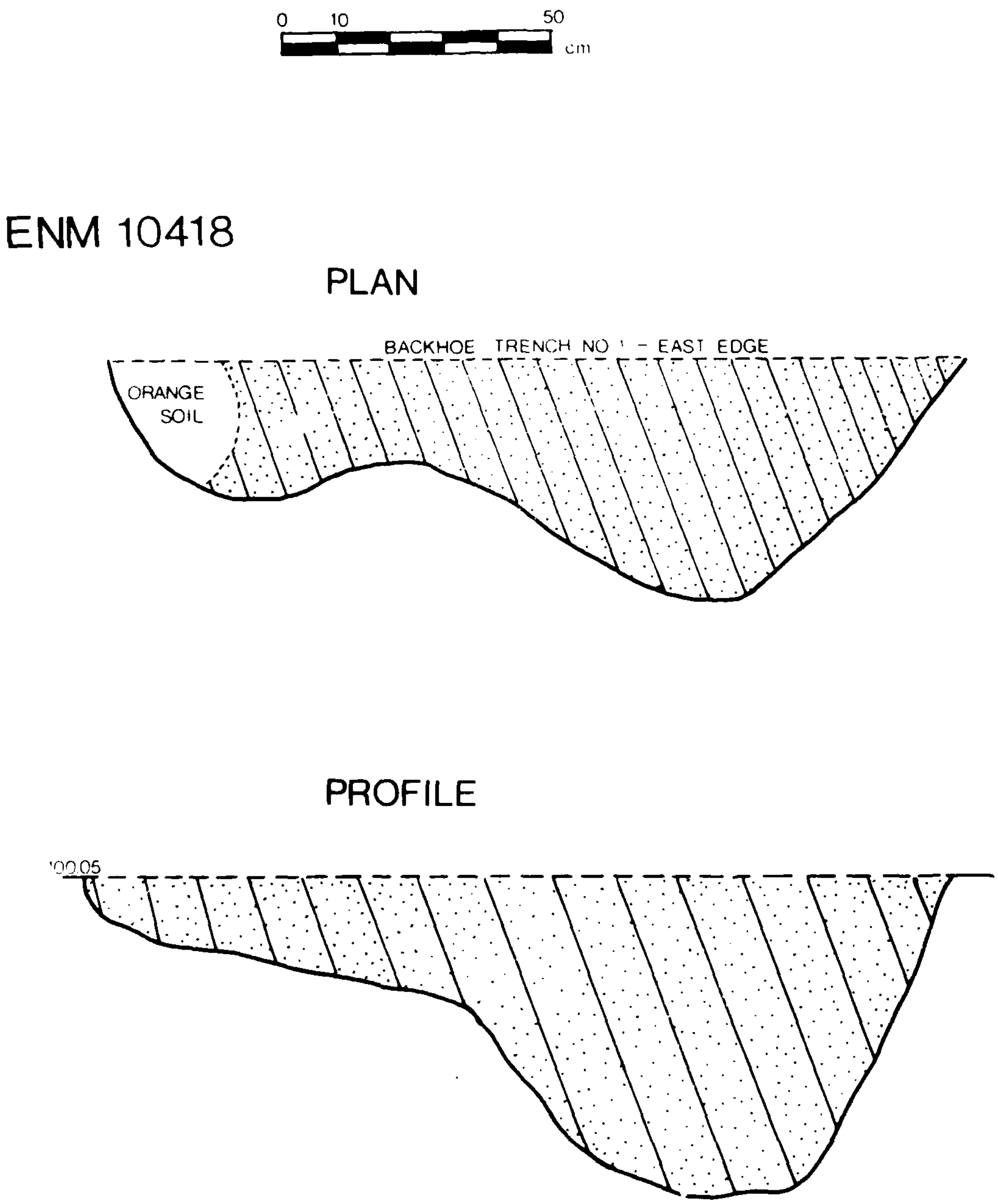
Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 15	
Provenience:	102N/114E
Elevation:	100.05 - 99.40 m
Description and Assessment:	Charcoal filled pit 50 cm in diameter and 65 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material found in association. No samples were submitted for further processing.
Feature 16	
Provenience:	104N/102E 105N/102E 106N/102E
Elevation:	100.05 - 99.45 m
Description and Assessment:	Charcoal filled pit measuring 160 cm in diameter and 60 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material was found in association. Flotation and pollen samples taken. The results of the flotation analyses are discussed in Chapter 7. The pollen sample was not submitted for processing.
Feature 17	
Provenience:	94N/102E
Elevation:	99.68 - 99.18 m
Description and Assessment:	Charcoal filled pit measuring 80 cm in diameter and 50 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material in association. Flotation and pollen samples were taken, but were not submitted for processing.
Feature 18	
Provenience:	114N/119E 114N/120E 114N/121E
Elevation:	100.60 - 99.90 m
Description and Assessment:	Charcoal filled pit measuring 180 cm in diameter and 70 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material was found in association. Flotation, pollen and C-14 samples were taken, but were not submitted for processing.
Feature 19	
Provenience:	95N/191E 96N/191E
Elevation:	100.67 - 100.27 m
Description and Assessment:	Charcoal stain measuring 180 cm across and 40 cm deep. Feature was encountered during backhoe trenching of site. No cultural material was found in association. No samples were taken.

AD-A173 934 ARCHAEOLOGICAL INVESTIGATIONS OF THREE SITES WITHIN THE WIPP CORE AREA ED..(U) CHAMBERS CONSULTANTS AND PLANNERS ALBUQUERQUE NM K J LORD ET AL. JUN 85 2/4

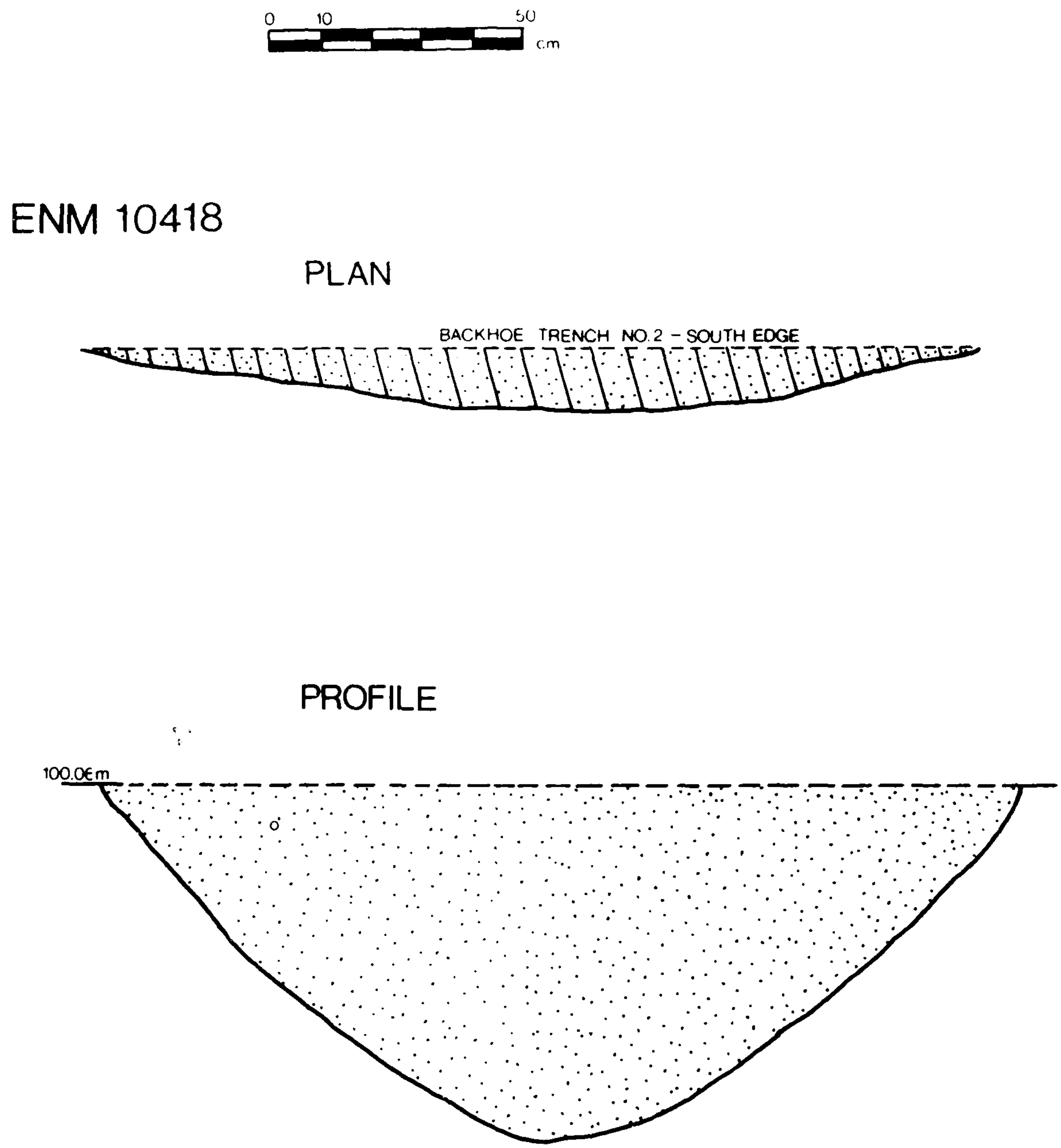
UNCLASSIFIED DACW47-83-D-0069 F/G 5/6 NL





FEATURE 16 - 104-106N 102E - backhoe trench

Figure 4.18



FEATURE 18 – 114N. 119-121E – backhoe trench

Figure 4.19

Additional Profiles

ENM 10418

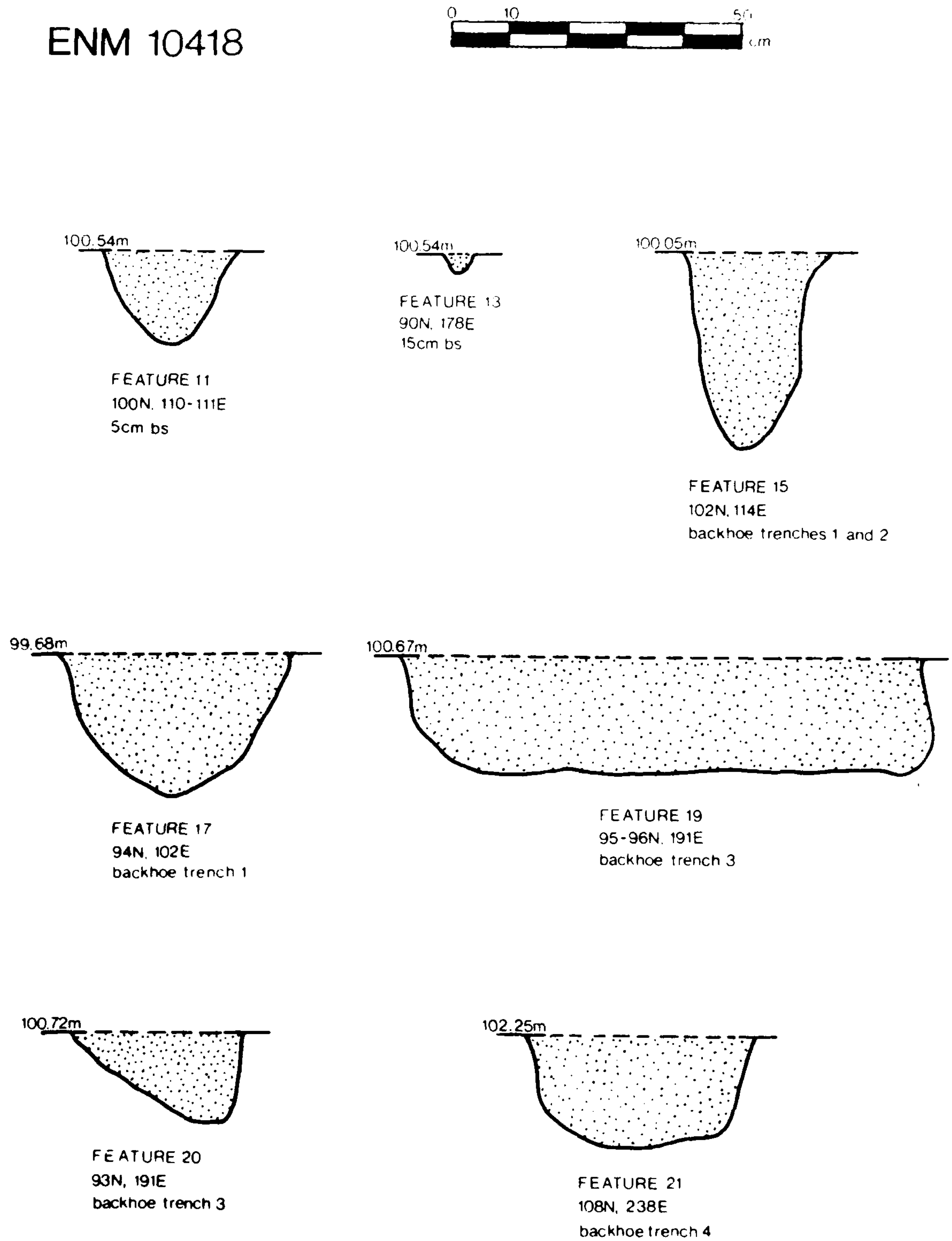


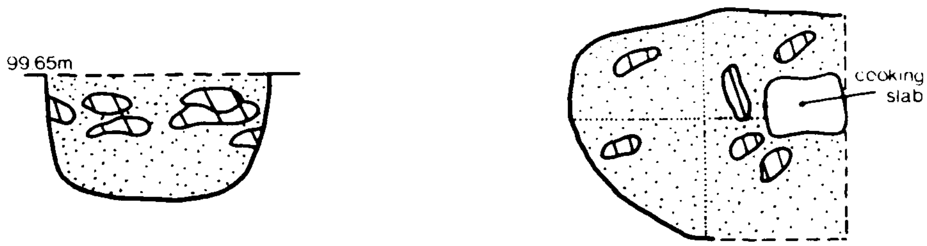
Figure 4.20

Table 4.8 (continued)
ENM 10418 Feature Descriptions

<u>Feature 20</u>	
Provenience:	93N/191E
Elevation:	100.72 - 100.32 m
Description and Assessment:	Charcoal filled pit measuring 60 cm in diameter and 40 cm deep. Feature was encountered during backhoe trenching of site. No cultural material found in association. No samples were taken.
<u>Feature 21</u>	
Provenience:	108N/238E
Elevation:	102.25 - 101.88 m
Description and Assessment:	Charcoal filled pit measuring 80 cm in diameter and 37 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material was found in association. No samples were taken.
<u>Feature 22</u>	
Provenience:	108N/238E 109N/238E
Elevation:	102.25 - 101.70 m
Description and Assessment:	Charcoal filled pit measuring 120 cm in diameter and 65 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material was found in association. No samples were taken.
<u>Feature 23</u>	
Provenience:	117N/238E 118N/238E
Elevation:	not recorded
Description and Assessment:	Charcoal and ash filled pit measuring 40 cm north-south by 30 cm east-west and 30 cm deep. Feature was encountered during backhoe trenching of site. No artifactual material was found in association. No samples were taken.
<u>Feature 25</u>	
Provenience:	129N/39E
Elevation:	99.65 - 99.43 m
Description and Assessment:	Charcoal filled pit measuring 40 cm north-south by 50 cm east-west and 22 cm deep. One flake and a cooking slab were found in association. Flotation, pollen and C-14 samples were taken. C-14 date Tx-5014 of 1350 ± 60 B.P.

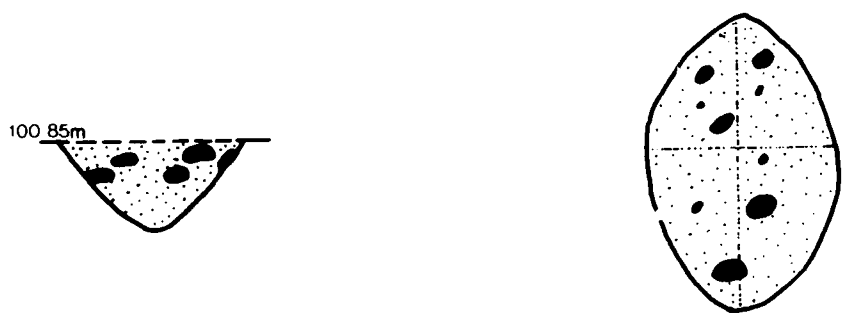
Profile   Plan

ENM 10418



FEATURE 25– 129N, 39E – 5cm bs

FEATURE 26 – 95N, 110E – 10cm bs



FEATURE 27 – 87N, 176E – 28cm bs

Figure 4.21

Table 4.8 (continued)
ENM 10418 Feature Descriptions

<u>Feature 26</u>

Provenience:	95N/110E
Elevation:	100.17 - 100.07 m
Description and Assessment:	Charcoal and ash stain measuring 30 cm east-west by 16 cm north-south and 10 cm deep. Fill contained numerous small burned caliche rocks and one flake. Pollen flotation and C-14 samples were taken. C-14 date Tx-5015 of 1650 ± 110 B.P. The results of the pollen and flotation analyses are discussed in Chapter 7.

<u>Feature 27</u>

Provenience:	87N/176E
Elevation:	100.85 - 100.69 m
Description and Assessment:	Charcoal filled pit measuring 33 cm east-west by 52 cm north-south by 16 cm deep. No cultural material was found in association. Flotation, pollen and C-14 samples taken. C-14 date Tx-5016 of 1740 ± 210 B.P. The results of the flotation analysis are discussed in Chapter 7.

<u>Feature 28</u>

Provenience:	98N/111E
Elevation:	100.19 - 100.17 m
Description and Assessment:	Charcoal filled pit measuring 30 cm in diameter by 11 cm deep. Fire-cracked caliche and shell fragments occur in fill. Flotation and C-14 samples taken. C-14 sample not submitted. The results of the flotation analysis are discussed in Chapter 7.

<u>Feature 29</u>

Provenience:	94N/111E 95N/111E
Elevation:	100.19 - 100.09 m
Description and Assessment:	Charcoal filled pit measuring 42 cm east-west by 30 cm north-south by 10 cm deep. Fill was charcoal/ash stain with numerous burned caliche rocks. No artifactual material was found in association. Flotation and C-14 samples were taken, but not submitted for processing.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 30

Provenience:	105N/112E
Elevation:	100.28 - 100.18 m
Description and Assessment:	Charcoal filled pit measuring 190 cm north-south by 170 cm east-west by 10 cm deep. Fill was charcoal/ash stain with numerous burned caliche rocks. A mano was recovered from fill. C-14, flotation and pollen samples taken. C-14 date Tx-5017 of 760 ± 70 B.P. The results of the flotation analysis are discussed in Chapter 7. The pollen sample was not submitted for processing.

Feature 31

Provenience:	105N/114E
Elevation:	100.40 - 100.20 m
Description and Assessment:	Charcoal filled pit measuring 80 cm in diameter by 20 cm deep. Two flakes, a projectile point and numerous burned caliche rocks were intermixed in charcoal/ash fill. Flotation, pollen and C-14 samples were taken. C-14 date Tx-5018 of 1290 ± 70 B.P. A discussion of the results of the flotation analysis are discussed in Chapter 7. The pollen samples were not submitted for processing.

Feature 32

Provenience:	98N/118E
Elevation:	100.51 - 100.26 m
Description and Assessment:	Charcoal filled pit measuring 40 cm in diameter by 25 cm. Fill was dense charcoal with numerous burned caliche rocks. Two ceramics were recovered from Level 2 outside of feature. Flotation, pollen and C-14 samples taken. C-14 date Tx-5019 of 500 ± 100 B.P. Flotation analyses results are discussed in Chapter 7. The pollen sample was submitted for processing.

Feature 33

Provenience:	107N/125E
Elevation:	100.26 - 99.76 m
Description and Assessment:	Charcoal filled pit measuring 35 cm north-south by 50 cm east-west by 48 cm deep. Feature is highly disturbed by rodent activity. No cultural material found in association. C-14 samples were taken. C-14 date Beta-10463 of 1720 ± 70 B.P.

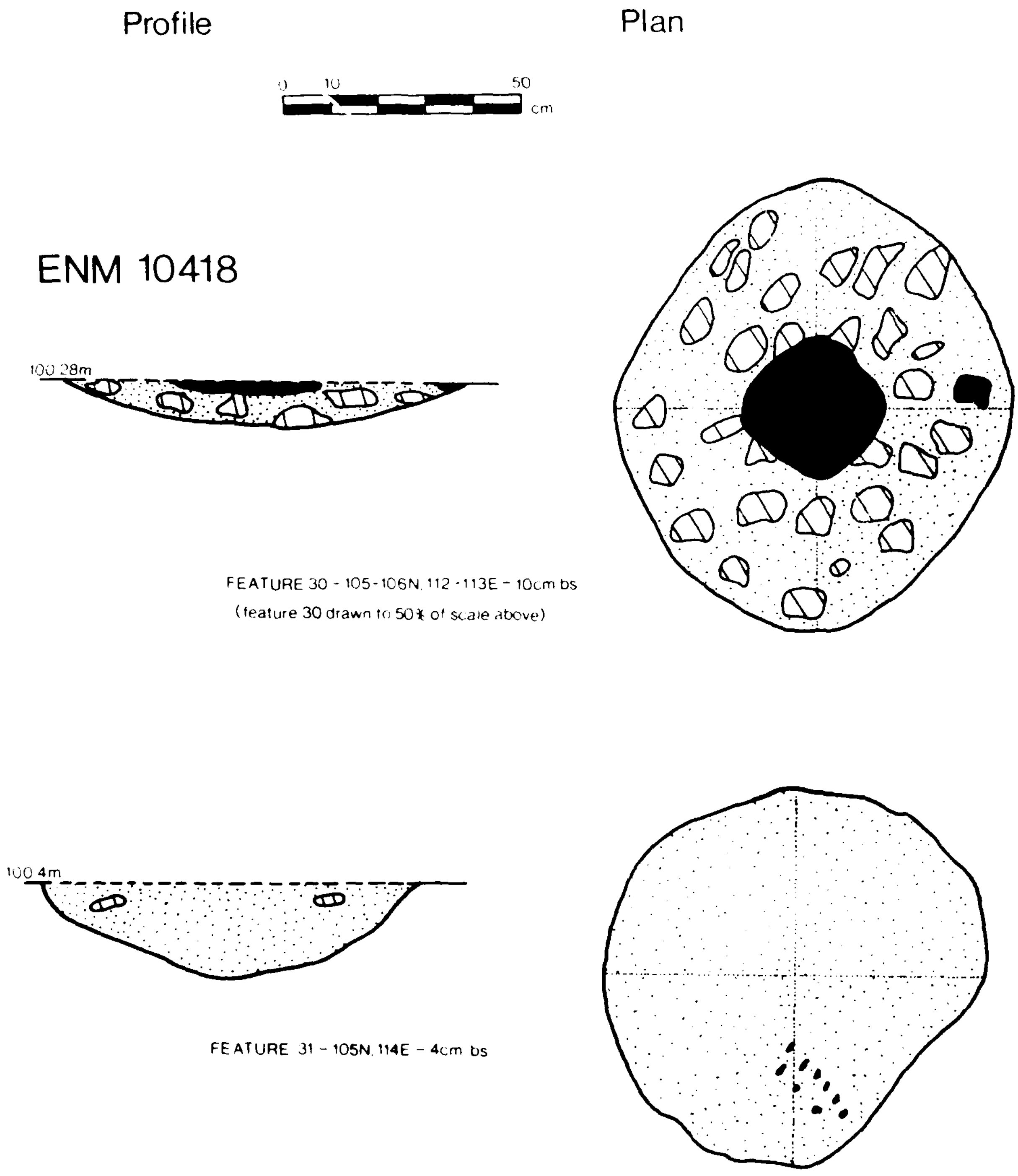

Profile
Plan
0 10 50
cm
ENM 10418
100.28m
FEATURE 30 - 105-106N, 112-113E - 10cm bs
(feature 30 drawn to 50% of scale above)
100.4m
FEATURE 31 - 105N, 114E - 4cm bs

Figure 4.22

Additional Profiles

ENM 10418

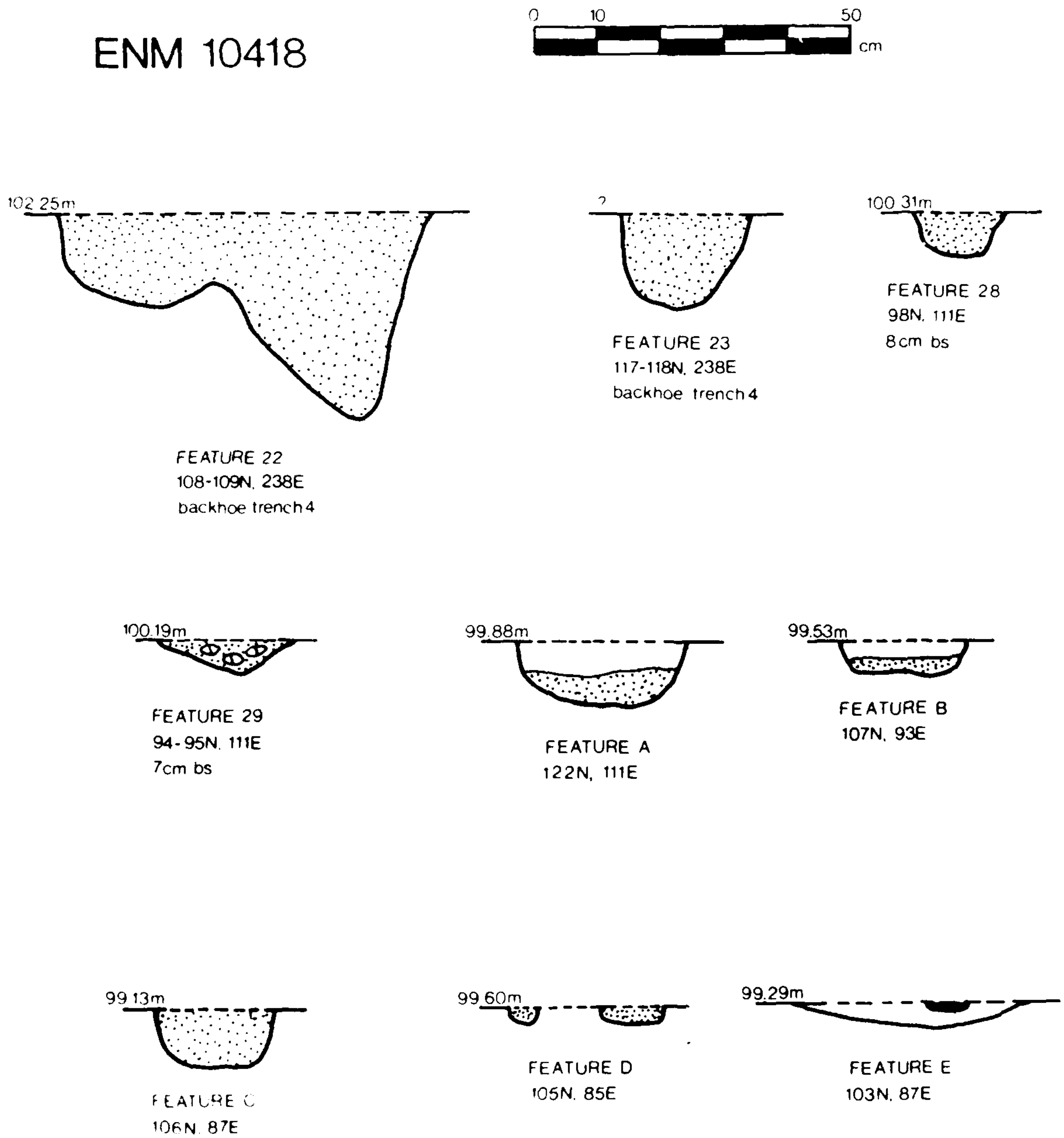


Figure 4.23

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 34

Provenience:	105N/114E
Elevation:	100.06 - 99.92 m
Description and Assessment:	Charcoal filled pit measuring 45 cm in diameter and 14 cm deep. Fill was dense charcoal with numerous small burned caliche rocks. No artifactual material in fill, but one flake recovered from grid outside of feature. Flotation and C-14 samples taken. C-14 date Tx-5020 of 1460 ± 70 B.P. The flotation sample was not processed.

Feature 35

Provenience:	85N/140E
Elevation:	100.52 - 100.35 m
Description and Assessment:	Charcoal filled pit measuring 40 cm in diameter and 17 cm deep. Fill was a dense charcoal stain. No cultural material was found in association. Flotation, pollen and C-14 samples taken. C-14 date Tx-5021 of 1430 ± 80 B.P. The results of the flotation analysis are discussed in Chapter 7. The pollen sample was not processed.

Feature 35 - Pit 2

Provenience:	85N/140E
Elevation:	100.51 - 100.35 m
Description and Assessment:	Charcoal filled pit measuring 40 cm in diameter by 16 cm deep. Fill was dense charcoal stain. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 sample Tx-5022 too small to date.

Feature 36

Provenience:	104N/145E
Elevation:	100.76 - 100.50 m
Description and Assessment:	Charcoal filled pit measuring 75 cm in diameter by 27 cm deep. Two flakes were recovered from feature fill and a point was found in Level 3 outside of feature. Flotation, pollen and C-14 samples taken. C-14 date Tx-5023 of 2830 ± 140 B.P. The results of the pollen and flotation analysis are discussed in Chapter 7.

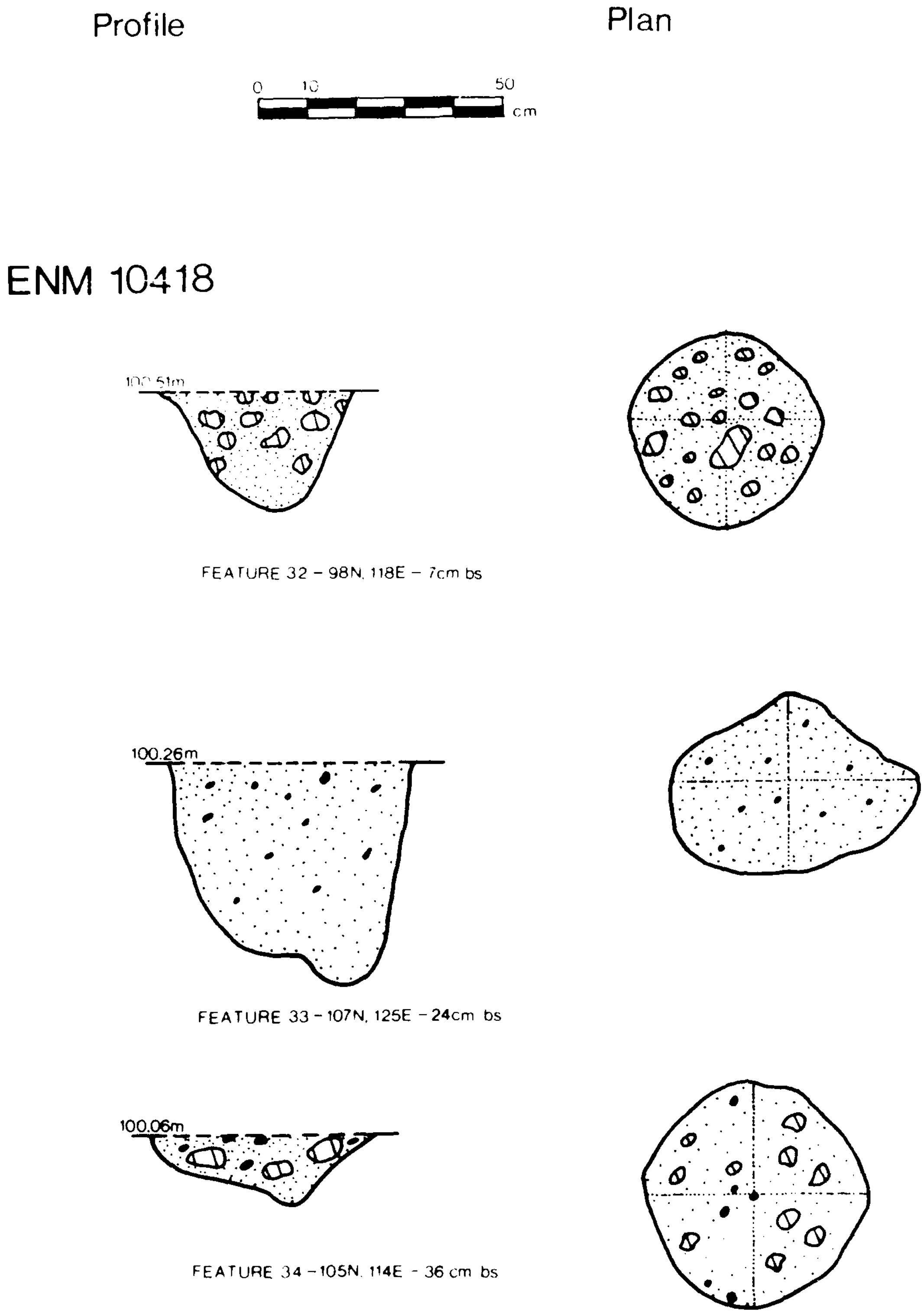

Profile
Plan
0
50
cm
ENM 10418
FEATURE 32 – 98N, 118E – 7cm bs
100.26m
FEATURE 33 – 107N, 125E – 24cm bs
100.06m
FEATURE 34 – 105N, 114E – 36 cm bs

Figure 4.24

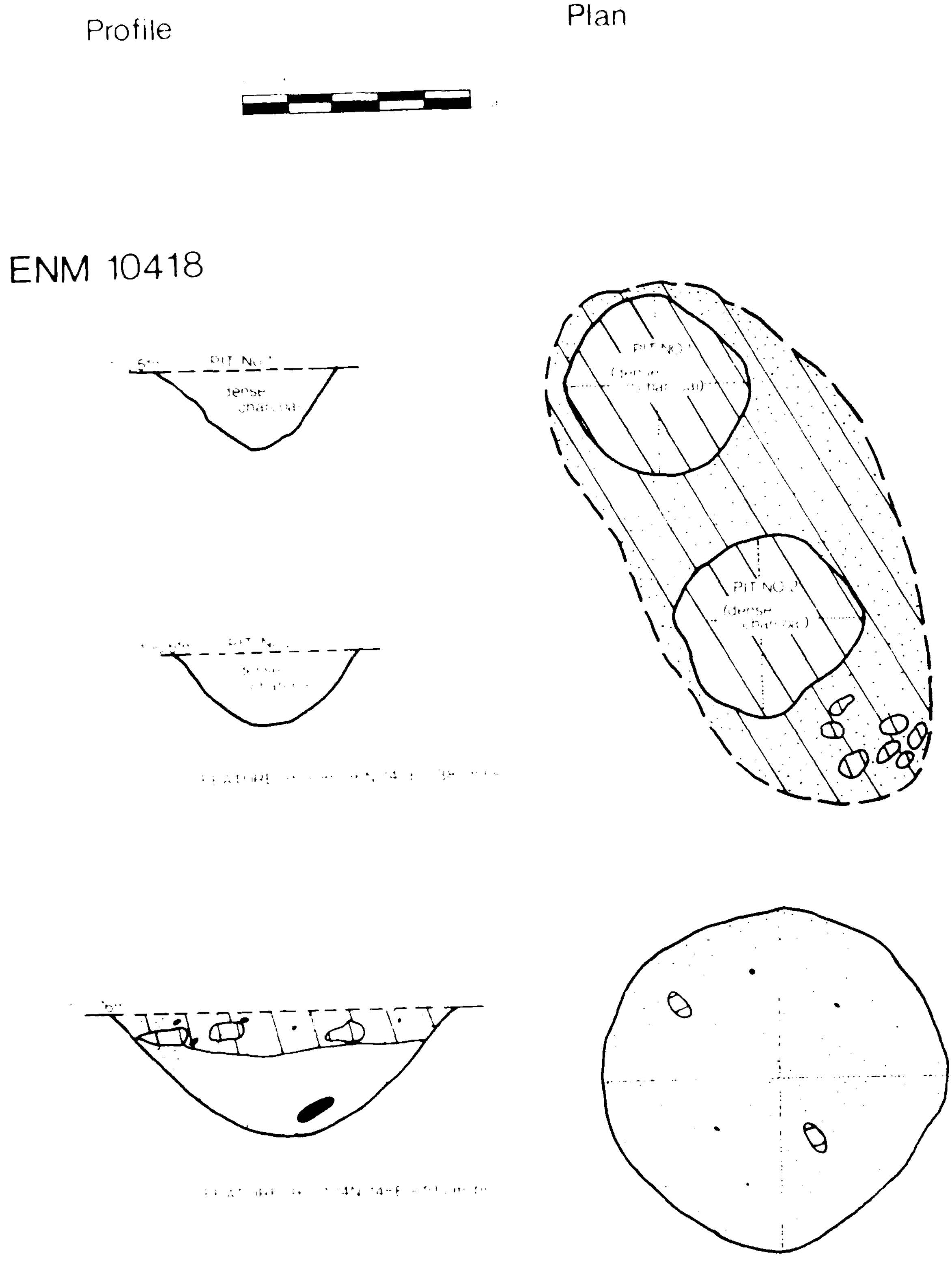


Figure 4.25

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature 37	
Provenience:	106N/111E 106N/112E
Elevation:	100.14 - 99.95 m
Description and Assessment:	Charcoal filled pit measuring 50 cm in diameter and 20 cm deep. Fill was a dense charcoal stain with numerous fire-cracked caliche rocks. One flake and a mano fragment (collected for pollen) were recovered from fill. C-14, flotation and pollen samples taken. C-14 date Beta-10464 of 1270 ± 90 B.P. The flotation analysis results are discussed in Chapter 7.
Feature 38	
Provenience:	128N/19E 128N/20E
Elevation:	99.81 - 99.61 m
Description and Assessment:	Charcoal filled pit measuring 25 cm in diameter by 20 cm deep. Fill was charcoal and ash stained soil. No cultural material in association. C-14 sample taken. C-14 date Tx-5024 of 1230 ± 80 B.P.
Feature A	
Provenience:	122N/111E
Elevation:	99.88 - 99.66 m
Description and Assessment:	Charcoal filled pit measuring 53 cm north-south by 45 cm east-west by 20 cm deep. Feature was encountered during blading of site. No cultural material was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples were taken. C-14 sample not submitted. The flotation sample results are discussed in Chapter 7.
Feature B	
Provenience:	107N/93E
Elevation:	99.53 - 99.42 m
Description and Assessment:	Charcoal filled pit measuring 40 cm north-south by 32 cm east-west by 9 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. The pollen and C-14 samples were not submitted. The results of the flotation analysis are discussed in Chapter 7.

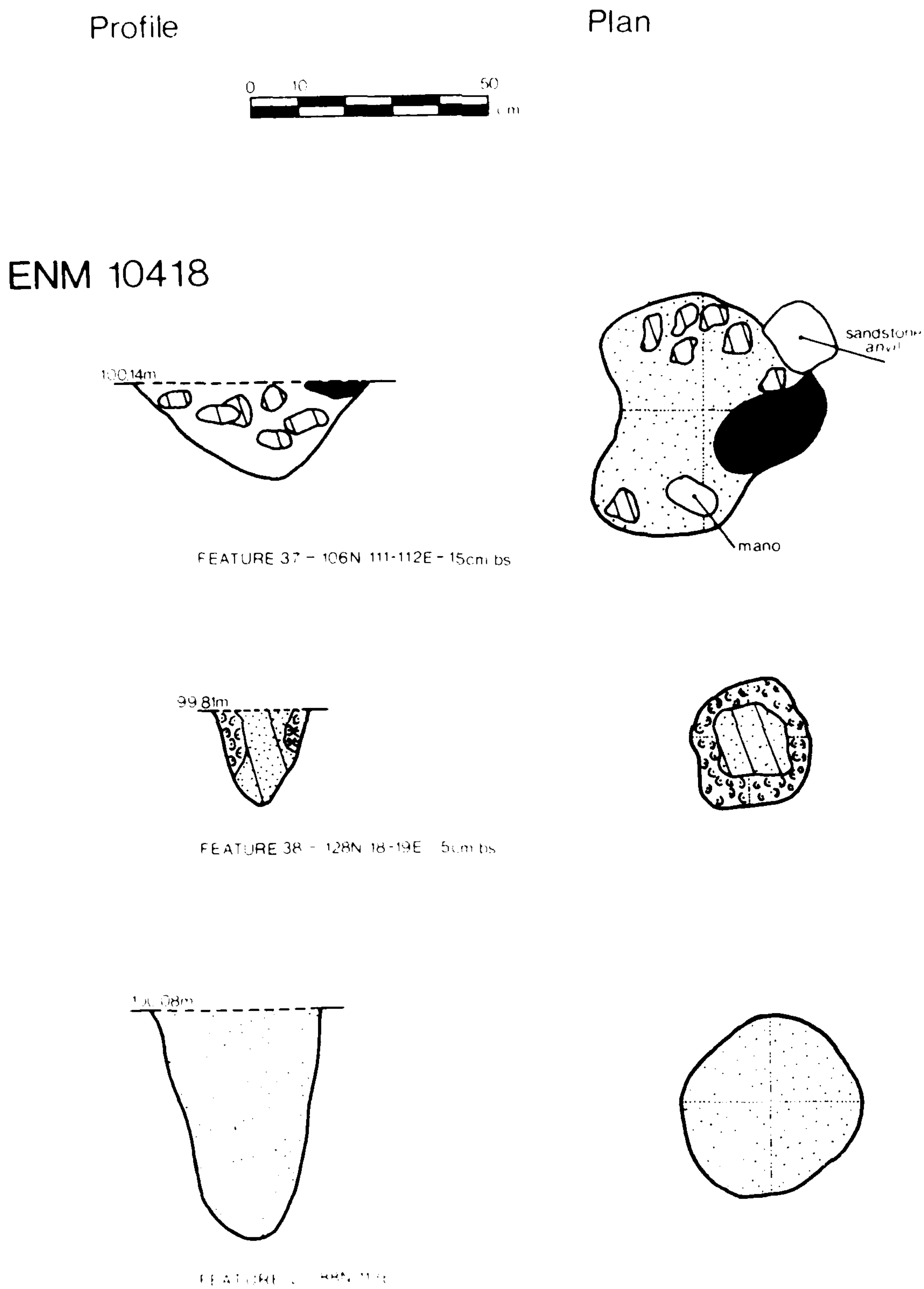

Profile
Plan
0
10
50
cm
ENM 10418
100.14m
sandstone anvil
mano
FEATURE 37 - 106N 111-112E - 15cm bs
99.81m
FEATURE 38 - 128N 18-19E 5cm bs

Figure 4.26

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature C	
Provenience:	106N/87E
Elevation:	99.13 - 99.14 m
Description and Assessment:	Charcoal filled pit measuring 37 cm north-south by 42 cm east-west by 17 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. The pollen and C-14 samples were not submitted. Flotation analysis results are discussed in Chapter 7.
Feature D	
Provenience:	105N/85E
Elevation:	99.60 - 99.56 m
Description and Assessment:	Three small ash stains situated within an area 57 cm east-west by 50 cm north-south by 4 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation sample taken with the results discussed in Chapter 7.
Feature E	
Provenience:	103N/87E
Elevation:	99.29 - 99.21 m
Description and Assessment:	Charcoal and ash stain measuring 75 cm north-south by 62 cm east-west by 8 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation and C-14 samples taken. C-14 and flotation samples were not processed.
Feature F	
Provenience:	101N/91E
Elevation:	99.45 m
Description and Assessment:	Charcoal filled pit measuring 44 cm north-south by 64 cm east-west. Feature was encountered during blading of the site. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 and pollen samples were not submitted. The results of the flotation analysis are discussed in Chapter 7.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature G	
Provenience:	96N/86E
Elevation:	99.34 - 99.23 m
Description and Assessment:	Charcoal filled pit measuring 45 cm north-south by 48 cm east-west by 12 cm deep. Feature was encountered during the blading of site. One flake was recovered from fill. Flotation, pollen and C-14 samples taken. C-14 sample Tx-5025 too small. The results of the flotation analysis are discussed in Chapter 7.
Feature H	
Provenience:	97N/95E
Elevation:	99.70 - 99.60 m
Description and Assessment:	Charcoal filled pit measuring 31 cm north-south by 40 cm east-west and 10 cm deep. Feature was encountered during blading of site. One piece of burned caliche was noted in fill. No cultural material found in association.
Feature I	
Provenience:	94N/91E
Elevation:	99.53 - 99.45 m
Description and Assessment:	Charcoal filed pit measuring 42 cm north-south by 48 cm east-west and 8 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken but were not submitted for processing.
Feature J	
Provenience:	87N/101E
Elevation:	99.85 - 99.75 m
Description and Assessment:	Charcoal filled pit measuring 87 cm north-south by 74 cm east-west by 10 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken but were not submitted.
Feature K	
Provenience:	83N/111E
Elevation:	99.87 - 99.75 m
Description and Assessment:	Charcoal filled pit measuring 125 cm north-south by 75 cm east-west by 12 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken but were not submitted.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature L
Provenience: 88N/113E
Elevation: 100.08 - 99.62 m
Description and Assessment: Charcoal filled pit measuring 37 cm in diameter, by 46 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Beta-10468 of 1100 ± 60 B.P. Flotation and pollen samples not submitted.

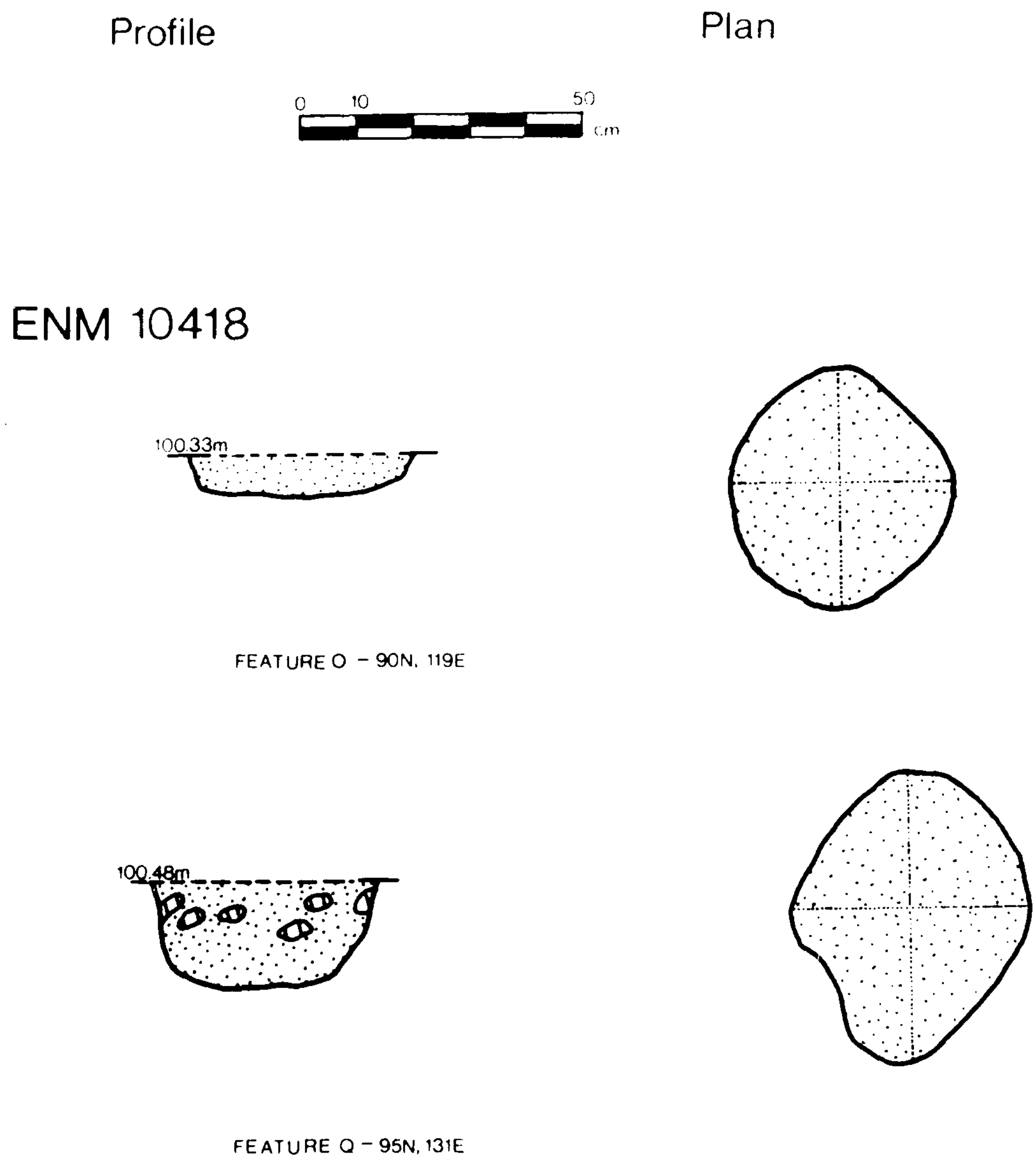
Feature M
Provenience: 83N/118E
Elevation: 100.03 - 99.78 m
Description and Assessment: Charcoal filled pit measuring 60 cm north-south by 70 cm east-west by 25 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation and pollen samples taken but were not submitted.

Feature N
Provenience: 86N/118E
Elevation: 100.26 - 100.25 m
Description and Assessment: Charcoal stain measuring 20 cm in diameter by 1 cm thick. Stain was encountered during the blading of the site. No cultural material was found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit that was impacted by blading operations.

Feature O
Provenience: 90N/119E
Elevation: 100.33 - 100.26 m
Description and Assessment: Charcoal filled pit measuring 42 cm north-south by 40 cm east-west by 7 cm deep. Stain was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken but were not submitted.

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature P	
Provenience:	101N/129E
Elevation:	100.17 - 100.16 m
Description and Assessment:	Charcoal stain measuring 28 cm in diameter by 1 cm deep. Stain was encountered during blading of site. No cultural material found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit which was impacted by blading operations.
Feature Q	
Provenience:	95N/131E
Elevation:	100.48 - 100.26 m
Description and Assessment:	Charcoal filled pit measuring 52 cm north-south by 42 cm east-west by 22 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Beta-10469 of 1520 ± 60 B.P. Flotation and pollen samples not submitted.
Feature R	
Provenience:	86-89N/148E 86-89N/149E
Elevation:	100.68 m
Description and Assessment:	Charcoal stain measuring 3 m north-south by 2 m east-west. Feature was encountered during blading of site. Feature was excavated in quads. Two flakes were recovered from fill. Excavation revealed two charcoal filled pits within the larger stain (Feature R - Pits 1 and 2). It is believed that deflation and mixing of the fill of these pits produced this large stain.
Feature R - Pit 1	
Provenience:	89N/148E
Elevation:	100.66 - 100.26 m
Description and Assessment:	Charcoal filled pit measuring 4C cm in diameter by 39 cm deep. Feature was found within large charcoal/ash stain (Feature R). No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Tx-5026 of 2640 ± 420 B.P.



Profile
Plan
0
10
50
cm
ENM 10418
100.33m
FEATURE O - 90N, 119E
100.48m
FEATURE Q - 95N, 131E

Figure 4.27

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature R - Pit 2	
Provenience:	86N/147E
Elevation:	100.36 - 100.14 m
Description and Assessment:	Charcoal filled pit measuring 40 cm north-south by 38 cm east-west by 22 cm deep. Feature was found within large charcoal/ash stain (Feature R). No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Tx-5027 of 2270 ± 80 B.P.
Feature S	
Provenience:	87N/155E
Elevation:	100.64 - 100.63 m
Description and Assessment:	Charcoal stain measuring 20 cm in diameter by 1 cm deep. Feature was encountered during blading of site. No cultural material found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit that was impacted by blading operations.
Feature T	
Provenience:	85N/158E
Elevation:	100.67 - 100.66 m
Description and Assessment:	Charcoal stain measuring 30 cm in diameter by 1 cm in depth. Feature was encountered during blading of site. No cultural material found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit that was impacted by blading operations.
Feature U	
Provenience:	96N/156E
Elevation:	100.85 - 100.73 m
Description and Assessment:	Charcoal filled pit measuring 42 cm north-south by 36 cm east-west by 12 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Beta-10470 of 1610 ± 60 B.P.

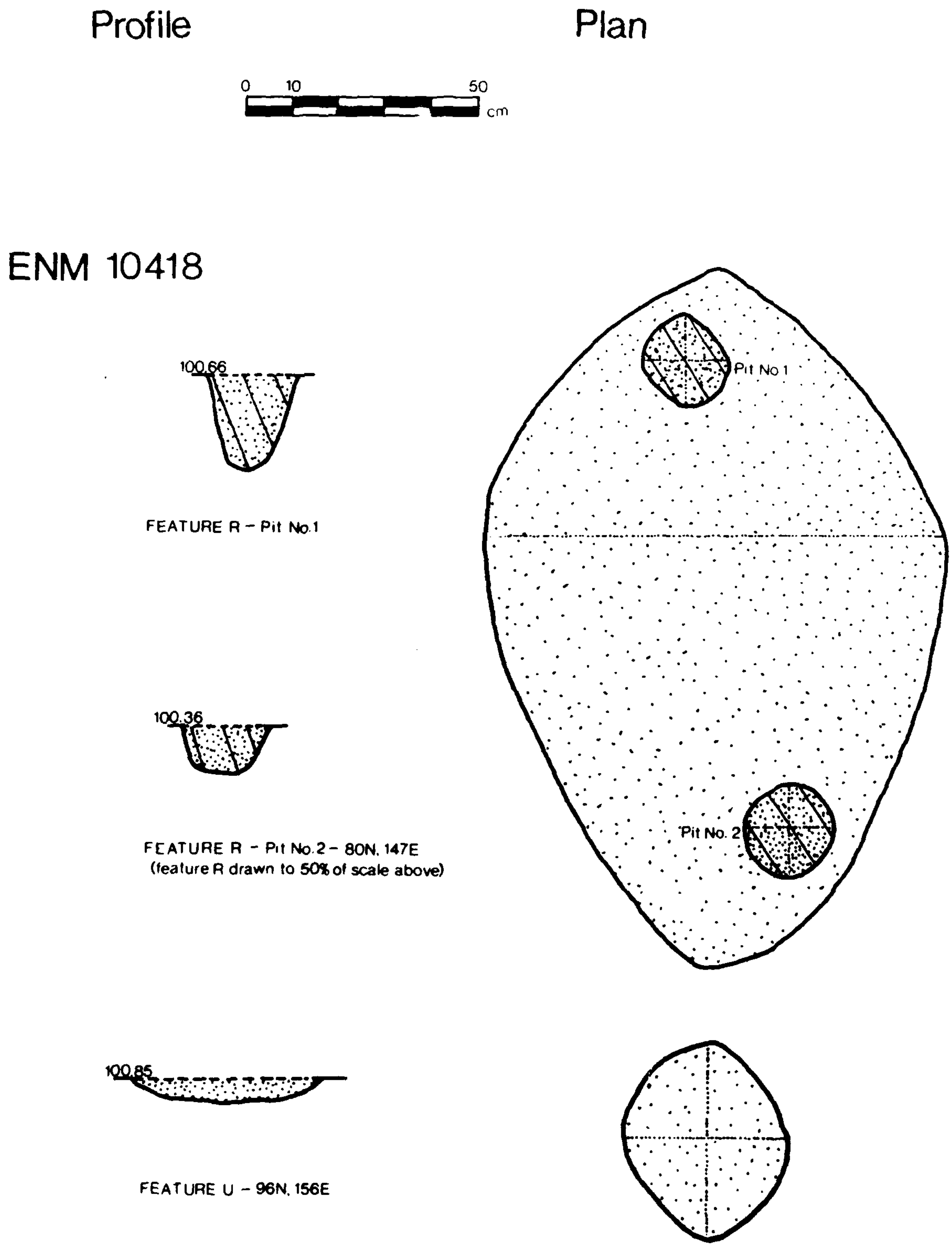
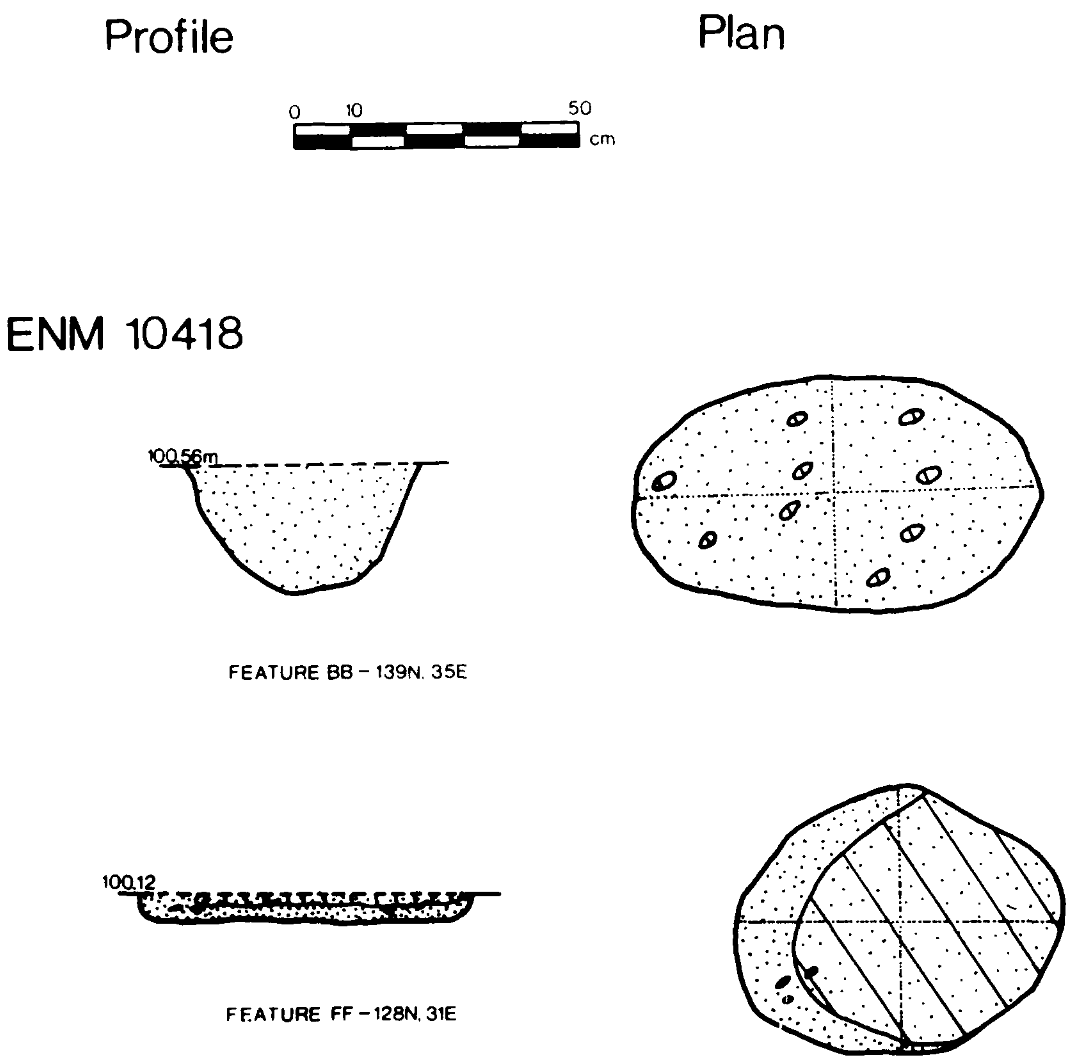

Profile
Plan
0 10 50
cm
ENM 10418
100.66
Pit No 1
FEATURE R – Pit No.1
100.36
Pit No. 2
FEATURE R – Pit No.2 – 80N, 147E
(feature R drawn to 50% of scale above)
100.85
FEATURE U – 96N, 156E

Figure 4.28

Table 4.8 (continued)
ENM 10418 Feature Descriptions

Feature AA	
Provenience:	144N/31E
Elevation:	100.61 - 100.56 m
Description and Assessment:	Charcoal filled pit measuring 34 cm north-south by 40 cm east-west by 5 cm deep. Feature was encountered during blading of site. No cultural material was found in association. Flotation, pollen, and C-14 samples taken. C-14 sample not submitted. The results of the flotation analysis are discussed in Chapter 7.
Feature BB	
Provenience:	139N/35E
Elevation:	100.56 m
Description and Assessment:	Charcoal filled pit measuring 72 cm east-west by 42 cm north-south by 18 cm deep. Feature was encountered during blading of site. No cultural material was found in association. Flotation, pollen and C-14 samples taken. C-14 date Beta-10465 of 340 ± 80 B.P. The results of the flotation analysis are discussed in Chapter 7.
Feature CC	
Provenience:	133N/35E
Elevation:	100.46 - 100.45 m
Description and Assessment:	Charcoal stain 27 cm north-south by 25 cm east-west by 1 cm deep. Feature was encountered during the blading of site. No cultural material found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit that was impacted by blading operations.
Feature DD	
Provenience:	136N/32E
Elevation:	100.49 - 100.48 m
Description and Assessment:	Charcoal stain measuring 37 cm east-west by 40 cm north-south by 1 cm deep. Feature was encountered during the blading of site. No cultural material found in association. No samples were taken. Stain may represent the remains of a charcoal filled pit that was impacted by blading operations.



Profile
Plan
0
10
50
cm
ENM 10418
100.56m
FEATURE BB - 139N. 35E
100.12
FEATURE FF - 128N. 31E

Figure 4.29

Table 4.8 (continued)
ENM 10418 Feature Descriptions

<u>Feature FF</u>	
Provenience:	128N/31E
Elevation:	100.12 - 100.08 m
Description and Assessment:	Charcoal/ash stain measuring 58 cm east-west by 48 cm north-south by 4 cm deep. Feature was encountered during blading of site. No cultural material was found in association. Flotation and pollen samples taken but were not submitted. C-14 date Beta-10466 of 530 ± 90 B.P.
<u>Feature II</u>	
Provenience:	122N/27E
Elevation:	99.89 - 99.82 m
Description and Assessment:	Charcoal filled pit measuring 35 cm in diameter by 7 cm deep. Feature was encountered during blading of site. No cultural material found in association. Flotation, pollen and C-14 samples taken. C-14 date Beta-10467 of 1080 ± 70 B.P. Flotation and pollen samples not submitted.

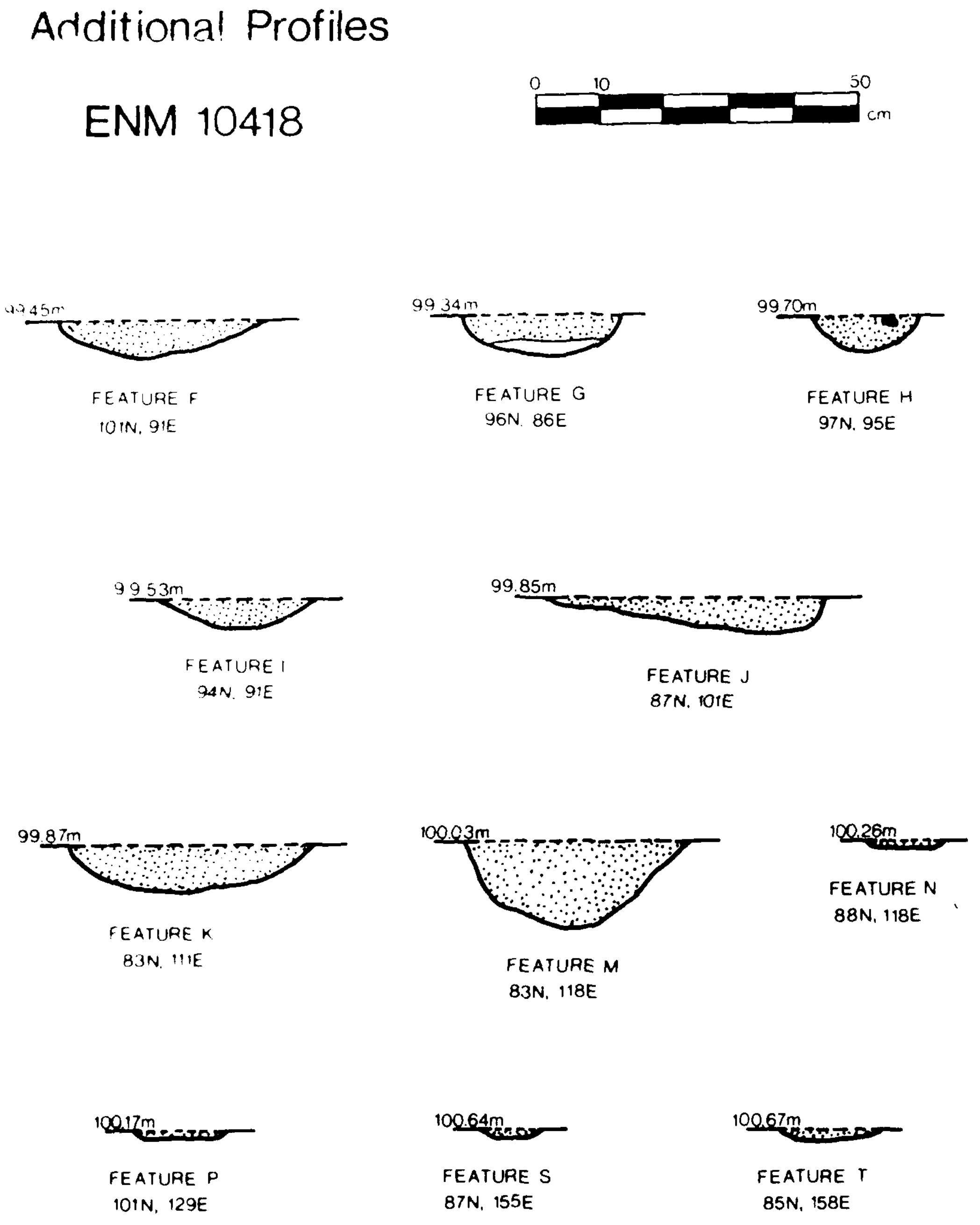

Additional Profiles
ENM 10418
0
10
50
cm
99.45m
FEATURE F
101N, 91E
99.34m
FEATURE G
96N, 86E
99.70m
FEATURE H
97N, 95E
99.53m
FEATURE I
94N, 91E
99.85m
FEATURE J
87N, 101E
99.87m
FEATURE K
83N, 111E
100.03m
FEATURE M
83N, 118E
100.26m
FEATURE N
88N, 118E
100.17m
FEATURE P
101N, 129E
100.64m
FEATURE S
87N, 155E
100.67m
FEATURE T
85N, 158E

Figure 4.30

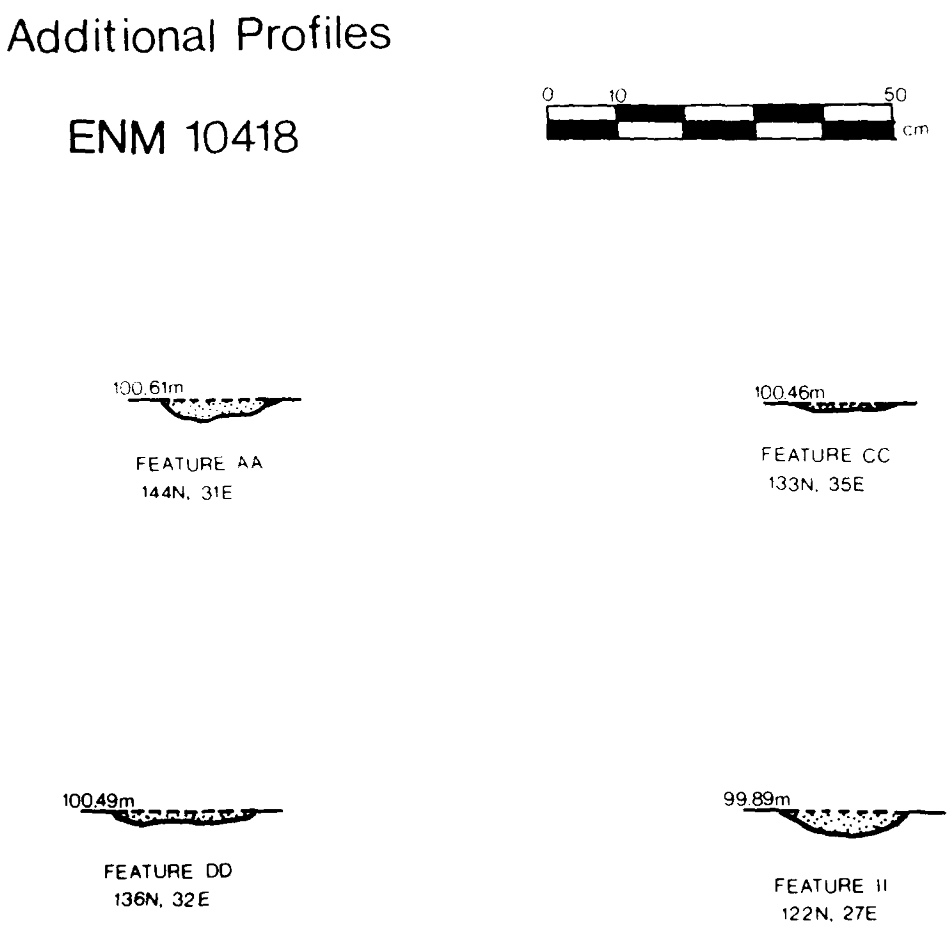

Additional Profiles
ENM 10418
0
10
50
cm
100.61m
FEATURE AA
144N, 31E
100.46m
FEATURE CC
133N, 35E
100.49m
FEATURE DD
136N, 32E
99.89m
FEATURE II
122N, 27E

Figure 4.31

Chapter 5

CERAMICS

Jon Frizell

INTRODUCTION

A total of 185 ceramic artifacts was recovered from surface sampling and subsurface testing of the sites in the WIPP project area. No whole vessels were recovered.

The random and biased surface sampling of ENM 10230 produced 90 ceramic sherds which were classified as follows: 71 undifferentiated brownware (78.8%), 14 Jornada Brownware (15.5%), 3 Roswell Brownware (3.3%), 1 Jornada Corrugated (1.1%), and 1 Jornada Black-on-brown (1.1%). The ceramic sample from ENM 10418 is made up of 7 surface artifacts and 88 subsurface artifacts making a total of 95. The collection from ENM 10418 was classified as follows: 27 Jornada Brownware (28.4%), 12 El Paso Brownware (12.6%), 30 Roswell Brownware (31.5%), 11 San Andres Red-on-terracotta (11.5%), 8 Chupadero Black-on-white (8.4%), 6 Chupadero Whiteware (6.3%), and 1 South Pecos Brown (1.05%). No sherds were recovered from ENM 10222, although Schermer (1980) mentions the presence of El Paso Brownware sherds in his survey report.

METHODOLOGY

In order to evaluate the variability within the ceramic assemblage a series of attributes were selected which had the potential to provide information on the type and and range of activities which occurred at the site. Table A2.1 in the Ceramic Appendix shows the attributes monitored and the possible variables for each attribute.

Vertical and horizontal provenience were recorded in order to evaluate the spatial and possibly temporal distribution of ceramic artifacts and define their relationship to other cultural manifestations. Vertical provenience was defined by both 10 cm level and elevation of the top and base of each level. Horizontal provenience was listed by 1 by 1 m grid units defined by three digit north-south, east-west coordinates. Ceramic artifacts were numbered sequentially within each site. Each artifact was measured using a vernier caliper with length and width measured to the nearest millimeter and thickness measured to the tenth millimeter.

The first objective of the analysis was the determination of vessel form. An attempt was made to place each artifact into a functional category, i.e., jar, bowl or other. The classification of vessel form and the ratio oi jar versus bowl forms within each ceramic type can provide functional information useful for determining the type and range of activities performed at each locale. The determination of vessel form was made largely on the basis of surface treatment. The criterion used for this evaluation was the presence of surface smoothing, polish or decoration. For example, a sherd with a smoothed exterior and a rough interior would be classified as a jar form. A polished surface took precedence over a smoother or plain surface, therefore if a sherd was smoothed on one or both surfaces but polished on only one surface it would be classified according to the polished surface. And finally, a painted or decorated surface took precedence over all other forms of surface treatment in the determination of vessel form. In many cases the small size of the sherds and presence of one or more eroded surfaces made the determination of vessel form impossible. Many more sherds exhibited two identical surfaces, i.e., both surfaces smoothed or polished which excluded them from classification. Those sherds which could not confidently be placed within the jar or bowl categories were classified as undetermined form. Rim form was monitored using wall lip direction and lip style derived from the method established by Colton (1953:44). The degree of curvature of rims was monitored and the diameter estimated to determine vessel size and capacity.

The second objective of the analysis was to define the surface treatment of both the interior and exterior of each sherd. A series of variables were monitored which pertain to surface treatment. Each surface was first classified as plain, corrugated or decorated. Those surfaces classified as plain were further divided into rough or smoothed plain surfaces. Corrugated surfaces were classified according to the type and width of corrugations. Decorated surfaces were defined by paint and/or slip color type and locations. In addition to this initial description each surface was examined microscopically for the presence of polish. Munsell colors were also recorded on both the interior and exterior surfaces.

The third objective was the evaluation of the material used in the manufacture of pottery, i.e., clay or paste and temper. A corner of each sherd was snapped off and the fresh break was examined using a 30x binocular microscope. Paste was classified by Munsell color and temper classified by mineral constituents and crystal size and shape. Table A2.2 in the Ceramic Appendix defines temper groupings and lists ceramic type characteristics of each group. Table 5.1 shows the breakdown of ceramic types by temper type.

The final objective of the analysis was to attempt to place each sherd into an existing typological classification. This assessment proved to be difficult for a number of reasons. The factors which made the determination of vessel form difficult, i.e., small sherd size, and damaged or undiagnostic surfaces, also affect the determination of ceramic type.

There are also numerous problems inherent in the existing typological classification of brownware ceramics. Brownware sherds which appear nearly identical have been given local designations often based on a single attribute such as temper. Brownware types recovered from ENM 10230 and ENM 10418 include Jornada Brown, El Paso Brown, Roswell Brown, and South Pecos Brown. The identification of Roswell Brown and South Pecos Brown was made largely on the basis of diagnostic tempering material (Table A2.2). To date no differentiation has been made between the tempering material used in Jornada Brown and El Paso Brown. The criterion generally used to differentiate the two brownware types is based

Table 5.1
Breakdown of Ceramic Type by Temper Type

		1		2		3		4		5		6		7		8		9		TOTAL	
	Site	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Jornada	10230	8	57.1	2	14.3	2	14.3	0	0	0	0	0	0	2	14.3	0	0	0	0	14	15.5
Brown	10418	5	18.5	20	74.0	1	3.7	0	0	0	0	0	0	1	3.7	0	0	0	0	27	28.4
Roswell	10230	0	0	0	0	3	100.0	0	0	0	0	0	0	0	0	0	0	0	0	3	3.3
Brown	10418	0	0	0	0	30	100.0	0	0	0	0	0	0	0	0	0	0	0	0	30	31.5
San Andres Red-on-	10230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
terracotta	10418	0	0	2	18.2	0	0	0	0	5	45.5	0	0	2	18.2	2	18.2	0	0	11	11.5
Chupadero Black-on-	10230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
white	10418	0	0	0	0	0	0	7	87.5	0	0	0	0	0	0	0	0	1	12.5	8	8.4
Chupadero	10230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiteware	10418	0	0	0	0	0	0	6	100.0	0	0	0	0	0	0	0	0	0	0	6	6.3
Corrugated	10230	0	0	0	0	0	0	0	0	1	100.0	0	0	0	0	0	0	0	0	0	0
Jornada	10418	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jornada Black-on-	10230	1	100.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1
plain	10418	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
El Paso	10230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown	10418	3	25.0	9	75.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12.6
South Pecos	10230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown	10418	0	0	0	0	1	100.0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.05
Undetermined	10230	22	31.0	15	21.3	0	0	0	0	0	0	1	1.4	33	46.5	0	0	0	0	71	78.9
Brownware	10418	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

on surface polish: Jornada Brown exhibits polish and El Paso Brown is unpolished. While the distinction between these types could be made with some confidence on the subsurface material, the surface artifacts presented some problem. Brownware sherds are characteristically soft, friable, and vulnerable to erosion and weathering, a problem which is magnified by the active dune situation present at the site locations. Since it is impossible to determine if these unpolished surface ceramics were ever polished, they were classified as undetermined brownwares. The painted and corrugated sherds presented little problem in typing. Jornada Black-on-brown, Jornada Corrugated, San Andres Red-on-terracotta, and Chupadero Black-on-white were easily identifiable based on diagnostic attributes.

The data derived from the attribute analysis was subjected to a program of intensive cross tabulation using the University of New Mexico's computer facilities. Virtually every possible relationship was examined with the results showing varying degrees of significance. The following discussion will be oriented toward an examination of the relationship between variables which yield significant information on vessel form, surface treatment, ceramic typology, and elements of manufacture.

The first series of relationships to be examined dealt with vessel form. Several general statements can be made concerning the range of vessel forms occurring on the sites. The most striking observation is the ratio of bowl to jar forms: 1 to 3.76 in the combined collection. The assemblage from ENM 10418 exhibits a ratio of 1 to 3 with 15 bowl fragments (15.8%), 45 jar fragments (47.3%), and 35 unidentified fragments (36.8%). The assemblage from ENM 10230 exhibits a ratio of 1 to 5.7 with 6 bowl fragments (6.7%), 34 jar fragments (37.7%), and 50 unidentifiable fragments (55.5%). The breakdown of ceramic type by vessel form can be seen in Table 5.2. Both sites display a wider range of ceramic types within the jar forms than within the bowl forms.

The assemblage from ENM 10418 includes fragments of bowl and jar forms of four ceramic types: Jornada Brown, Roswell Brown, San Andres Red-on-terracotta, and El Paso Brown. Jar fragments of Chupadero Black-on-white and Chupadero Whiteware are also included. The assemblage from ENM 10230 includes fragments of bowl and jar forms of only one ceramic type, Jornada Brown. In addition jar fragments of Roswell Brown, Jornada Corrugated and Jornada Black-on-plain were also recovered. The relationship between vessel form and temper can be seen in Table 5.3.

The difference between the ratios of bowl to jar forms may reflect certain functional differences between the two sites. The fact that the percentage of bowls to jars is twice as high on ENM 10418 than on ENM 10230 may indicate a more permanent settlement with a wider range of activities at ENM 10418. The high frequency of jar forms at ENM 10230 appears to indicate limited range of activities oriented toward food gathering and processing. Further evidence of this hypothesis is the near absence of decorated wares at ENM 10230.

Eleven rim sherds were recovered from ENM 10418 representing 11.7% of the site assemblage. Ten of the rim sherds were classified as direct and one Jornada Brown sherd was classified as a strong flare (see Plate 5.1). Direct rims are considered common throughout the brownware period (A.D. 900 to 1350) with a

Table 5.2
Breakdown of Ceramic Type by Vessel Form

	Undetermined	Jornada Brown	Roswell Brown	San Andres Red-on-terracotta	Chupadero Black-on-White	South Pecos Brown	Chupadero Whiteware	Jornada Corru-gated	Jornada Black-on-plain	El Paso Brown	TOTAL
ENM 10418											
Undetermined Vessel Form	0	8 (29.6%)	13 (43.3%)	0	0	1 (100%)	4 (66.6%)	0	0	9 (66.6%)	35 (36.9%)
Jar Forms	0	13 (48.1%)	15 (50.0%)	5 (45.5%)	8 (100%)	0	2 (33.3%)	0	0	2 (16.6%)	45 (47.3%)
Bowl Forms	0	6 (22.2%)	2 (6.7%)	6 (54.5%)	0	0	0	0	0	1 (8.3%)	15 (15.8%)
Total	0	27	30	11	8	1	6	0	0	12	95
ENM 10230											
Undetermined	44 (61.9%)	5 (35.7%)	1 (33.3%)	0	0	0	0	0	0	0	50 (55.6%)
Jar Forms	26 (36.6%)	4 (28.6%)	2 (66.6%)	0	0	0	0	1 (100%)	1 (100%)	0	34 (37.7%)
Bowl Forms	1 (1.4%)	5 (35.7%)	0	0	0	0	0	0	0	0	6 (6.7%)
Total	71	14	3	0	0	0	0	1	1	0	90

Table 5.3
Breakdown of Temper Type by Vessel Form

	Temper Group 1	Temper Group 2	Temper Group 3	Temper Group 4	Temper Group 5	Temper Group 6	Temper Group 7	Temper Group 8	Temper Group 9
ENM 10418									
Undetermined Vessel Form	4 (50%)	12 (38.7%)	15 (46.9%)	4 (30.8%)	0	0	0	0	0
Jar Forms	4 (50%)	10 (32.2%)	15 (46.9%)	9 (69.2%)	5 (100%)	0	1 (33.3%)	0	1 (100%)
Bowl Forms	0	9 (29.0%)	2 (6.3%)	0	0	0	2 (66.6%)	2 (100%)	0
Total	8	31	32	13	5	0	3	2	1
ENM 10230									
Undetermined Vessel Form	20 (64.5%)	9 (52.9%)	1 (20%)	0	0	1 (100%)	19 (54.3%)	0	0
Jar Forms	7 (22.6%)	7 (41.1%)	3 (60%)	0	1 (100%)	0	16 (45.7%)	0	0
Bowl Forms	4 (12.9%)	1 (5.9%)	1 (20%)	0	0	0	0	0	0
Total	31	17	5	0	0	1	35	0	0

strong flare being introduced near the end of the period (A.D. 1150 to 1350). Similar rim forms have been noted on a number of the sherds from the Crockett Canyon site (LA 2315) on the Rio Bonito. This trend may coincide with the appearance and growing popularity of Corona Corrugated in the Sierra Blanca region (Wiseman, personal communication).

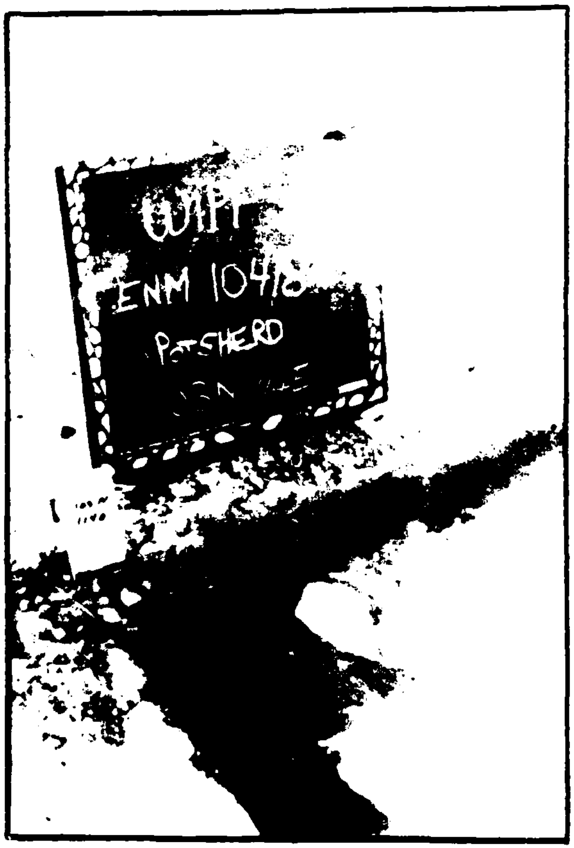


Plate 5.1
Jornada Brownware Rim Sherd (direct)
In Place (Note depth below present ground surface)

Vessel thickness was correlated with vessel form (Table 5.4) and ceramic type (Table 5.5). Jar forms were substantially thicker than bowl forms at both sites. ENM 10418 has a mean thickness of 5.91 mm for jar forms and 5.68 mm for bowl forms. ENM 10230 has a mean thickness of 4.89 mm for jar forms and 5.23 mm for bowl forms. The most reliable ceramic types for the evaluation of temporal framework are the brownware groups. Mean wall thicknesses for ENM 10418 are El Paso Brown (5.58 mm), Jornada Brown (5.85 mm) and Undifferentiated Brown (5.71 mm). Mean wall thicknesses for ENM 10230 are Jornada Brown (4.98

mm) and Undifferentiated Brown (4.50 mm). Comparisons of these were made to rim forms and wall thickness with the tentative seriation developed for El Paso Brown in the Hueco Bolson located east and north of El Paso, Texas (Whalen 1978:58-70). That study indicated that wall thickness, rim form and surface treatment of El Paso Brown vessels changed through time. "Earlier El Paso Brown vessels seem to be both smaller and thicker walled than any of their successors. Mean vessel wall thickness for a sample of 100 body sherds is 5.6 mm (s.d. = 1.1)" (Whalen 1978:59-60). Later El Paso Brown appears to decrease in vessel wall thickness. Mean wall thickness is 5.0 mm (s.d. = .09) in a sample of 100 sherds. Radiocarbon dates obtained in the eastern Hueco Bolson suggest dates of A.D. 400 to 700 for the earlier El Paso Brown and A.D. 1100 to 1350 for the later variant (Whalen 1978:63). The dates for the early variant are substantially earlier than the A.D. 900 to 1300 range postulated by Jelinek (1967) and Runyan and Hedrick (1973). Assuming that the tentative developmental sequence developed by Whalen is valid beyond the Hueco Bolson and applicable to the WIPP project area, we can speculate that a portion of the ceramic assemblage from ENM 10418 represents an earlier occupation than ENM 10230.

Table 5.4
Breakdown of Vessel Thickness by Vessel Form
(Difference of Means)

	Mean	N	Standard Deviation	Mode/Cases	T Score
Undetermined Vessel Form					
ENM 10418	5.71 mm	35	.736	6/6	7.716
ENM 10230	4.51 mm	50	.89	5/6	sig > .001
Jar Forms					
ENM 10418	5.91 mm	45	.849	5.5/6	4.98
ENM 10230	4.89 mm	34	.94	6.3/4	sig > .001
Bowl Forms					
ENM 10418	5.68 mm	15	.480	5 & 6/3	1.50
ENM 10230	5.23 mm	6	.80	4.9/2	not sig

Table 5.5
Ceramic Type by Vessel Thickness
(Difference of Means)

	Mean	N	Standard Deviation	Mode/Cases	T Score
Jornada Brown					
ENM 10418	5.85 mm	27	.55	6/6	4.62
ENM 10230	4.98 mm	14	.57	4.9/3	sig > .001
Roswell Brown					
ENM 10418	5.92 mm	30	.51	6/8	5.32
ENM 10230	4.07 mm	3	.90		sig > .001

Table 5.5 (continued)
Ceramic Type by Vessel Thickness
(Difference of Means)

	Mean	N	Standard Deviation	Mode/Cases	T Score
San Andres Red-on-terracotta					
ENM 10418	5.69 mm	11	.611	5.1 & 5.5/2	
ENM 10230					
Chupadero Black-on-white					
ENM 10418	5.8 mm	14	1.11	5/2	
ENM 10230					
South Pecos Brown					
ENM 10418	5 mm	1			
ENM 10230					
Chupadero Whiteware					
ENM 10418	5.8 mm	14	1.11	5/2	
ENM 10230					
Corrugated Jornada					
ENM 10418					
ENM 10230	6.4 mm	1			
Jornada Black-on-plain					
ENM 10418					
ENM 10230	4 mm	1			
El Paso Brown					
ENM 10418	5.58 mm	12	1.24	5.5/4	
ENM 10230					
Undifferentiated Brownware					
ENM 10418	5.71 mm	35	.736	6/6	6.55
ENM 10230	4.50 mm	71	.95	5/6	sig > .001

Tempering material was perhaps the single most important factor in the determination of ceramic type. The relationship between temper type and ceramic type can be seen in Table A2.2. Temper was classified into broad groups with variants listed for each group. The term 'temper group' as used here suggests a compositionally unique rock type obtained from a source and employed as a tempering agent in the manufacture of pottery. The differential usage of the various temper types may reflect spatial, cultural or random selection of tempering resources. The ceramic type showing the most variation of tempering material is Jornada Brown. A significant difference can be seen in the proportions of the various temper variants of temper group between the two sites. The dominant tempering material used in Jornada Brown at ENM 10418 is temper variant 2 occurring in 74% of the sherds as opposed to 14% at ENM 10230. The dominant tempering material for Jornada Brown at ENM 10230 is variant 1 represented in 57% of the sherds as opposed to 18% at ENM 10418. Temper variants 3 and 7 occur in relatively equal proportions at the two sites. The variation in the proportions of tempering material may be attributable to temporal variability between sites, utilization of different resource areas or possibly utilization by different groups or bands.

Roswell Brown was tempered exclusively with temper variant 3 on both sites.

San Andres Red-on-terracotta occurred only on ENM 10418 where a wide range of tempering material was noted. Two variants of temper group 2 are included, temper variant 5 represented in 45% of the sherds and temper variant 8 represented in 18% of the sherds. Two variants of temper group 1 were also included. Temper variants 2 and 7 were each represented in 18% of the San Andres sherds.

Chupadero Black-on-white and Chupadero Whiteware occur only on ENM 10418 and are tempered exclusively with temper variants 4 and 9 of temper group 4.

South Pecos Brown was represented by only one sherd on ENM 10418 which was tempered with temper variant 5 of temper group 2.

Corrugated Jornada and Jornada Black-on-brown were each represented by one sherd on ENM 10230. The Corrugated Jornada sherd was tempered with temper variant 5 of temper group 2, and the Jornada Black-on-brown was tempered with variant 1 of temper group 1.

El Paso Brown was identified only on ENM 10418 where 75% of the sherds were tempered with variant 1 and 25% of variant 2 of temper group 1.

The large population of undifferentiated brownware sherds recovered from ENM 10230 are tempered with approximately the same ratios of temper variants 1, 2, 6 and 7 as the Jornada Brown. One exception is that a higher proportion of temper variant 7 was found in the undifferentiated sherds than the Jornada Brown (47% to 14%).

The assessment of the temporal span of the two sites based on the ceramic assemblages indicates a possible range of 1,150 years. This range is from the earliest proposed date of El Paso Brown (A.D. 400) to the termination date for Chupadero Black-on-white (A.D. 1450). A detailed discussion of projected dates of occupation based on the association of ceramic artifacts, diagnostic projectile points, and radiocarbon dates can be found in Chapter 8. Although it is difficult to assign dates to the brownware ceramics, certain other types provide tighter dating potential.

Chupadero Black-on-white came into existence around A.D. 1150. The production area for Chupadero Black-on-white is centered around Chupadero Mesa in central New Mexico, in portions of the northern Tularosa Basin and the upper Jornada del Muerto. This type may have also been manufactured near the Rio Grande between Belen and Socorro (Hayes 1977:1). Its type site is Gran Quivera, New Mexico (Human Systems Research 1973a). Chupadero Black-on-white has been more firmly dated as a trade product than in an indigenous context. It appears as early as A.D. 1150 and lasts until at least A.D. 1400 (Breternitz 1966:58). It appears that the type first became established throughout the northern section of the Tularosa Basin then quickly spread into the southern brownware areas (Knight 1980). Smiley, Stubbs, and Bannister (1953:58) have suggested a post-Spanish contact termination date for Chupadero Black-on-white of about A.D. 1675. In southeastern New Mexico, it has been suggested that the type is no longer present in the area (Lea and Eddy Counties) by the proposed Ochoa phase, approximately A.D. 1300 to 1450 (Corley 1965:36).

Established dates for San Andres Red-on-terracotta indicate the type was contemporaneous with Chupadero Black-on-white (approximately A.D. 1100 to 1300). As in the case of Chupadero Black-on-white, it is believed that San Andres Red-on-terracotta first became established in the northern Tularosa Basin, then spread quickly southward. The type site for San Andres Red-on-terracotta is HSR 702-1, Dona Ana County, New Mexico. The emergence of this type appears to correspond with the Three Rivers and San Andres phases of the Northern Jornada Branch of the Mogollon (Lehmer 1948:88-89). San Andres resembles the later Three Rivers Red-on-terracotta and probably existed as a somewhat parallel ware, according to Mera and Stallings (1931:4).

El Paso Black-on-brown Bichrome styles are considered uncommon and are believed to be forerunners of El Paso Polychrome. Indications are that these styles had an extremely short period of existence (i.e., A.D. 1000 to 1100). Los Tules is the type site for the El Paso Bichrome styles.

The presence of Chupadero Black-on-white and San Andres Red-on-terracotta sherds on ENM 10418 indicates a late occupation date of A.D. 1100 to 1300. The single Jornada Black-on-brown sherd recovered from ENM 10230 indicates an occupation date of A.D. 1000 to 1100. Although no Chupadero Black-on-white ceramics were included in the sample from ENM 10230, two Chupadero Black-on-white jar fragments were noted on the portion of the site impacted by well pad construction.

Certain outside factors may have conditioned the nature of the assemblage. Probably the single most important factor affecting the assemblage is the human element. Interviews with local landowners and collectors indicate that all three of the sites have been collected intensively over a long period of time. ENM 10230 has been especially vulnerable due to its location on a highly visible ridgetop. During the short time the fieldwork was underway we had numerous visits from collectors who have been collecting off the site for years. Although ENM 10418 and ENM 10222 are less visible they have also been heavily impacted by collectors.

Erosional factors may also play an important role in conditioning the assemblage. Material exposed on the surface over an extended period of time may have their surface characteristics altered. This can be evidenced by examining the topographic and physiological settings of the sites. ENM 10230 is situated on a high ridgetop in an active dune situation while ENM 10418 is located on a gently rolling plain in a stabilized dune formation. The continual sandblasting of artifacts in an active dune situation will alter surface characteristics as evidenced by the high percentage of unidentified brownwares on ENM 10230. Attributes such as polishes, slipped or painted surfaces may be undistinguishable. Another attribute which may be altered by exposure is sherd size and thickness. The continual exposure to wind, rain and temperature change may account for the small size and consequently the number of ceramics. It is hard to determine to what degree this exposure has affected vessel thickness. The lower mean vessel thickness on ENM 10230 may be partially or completely attributable to erosional processes.

Chapter 6

LITHICS AND GROUND STONE

Lee Heinsch, J. Steven Meyer, and Kenneth J. Lord

INTRODUCTION

Test excavations on three prehistoric sites located within the WIPP area yielded stone artifacts manufactured from a variety of raw materials. Analysis of these artifacts was approached through a format designed to obtain information about the technological procedures used in the production of these artifacts. On the basis of variability in the artifact assemblages intra- and intersite differences among the assemblages could be postulated. Stone artifacts represent a partial record of past human behavior. Through analysis of these artifacts empirical data can be generated to help determine the processes underlying their manufacture, deposition, and use.

CHIPPED STONE

OBJECTIVES

The analysis of lithic materials recovered from the WIPP study area was designed to meet several major goals. The first goal was to attempt to determine the variability present in the lithic reduction technologies and trajectories employed by the prehistoric populations in the study area in the manufacture of stone tools. Analyses were built on the pioneering work of Crabtree (1966) and Bordes (1969), and 12 attributes were used in an attempt to distinguish differences in reduction strategies through time. The analytical format and a glossary of terms are provided in Appendix 3. The second goal was to determine the variability in material type selection, particularly whether certain material types were selected for task specific tools and if material type selection varied through time. The availability of lithic resources in the region was taken into consideration.

ANALYTICAL APPROACH

The main purpose of this analysis was to establish a new way of looking at supposedly nondiagnostic lithic debris found on prehistoric sites, i.e., flake fragments, cores, and angular debris. The goal of this analysis is to help establish chronometric control of prehistoric sites through the measurement of artifact attributes. Measurement of debitage and core attributes were selected to monitor two basic reduction trajectories within manufacturing strategies: core/flake reduction and core/biface reduction.

A reduction trajectory is defined as one line of development arising from a technique or set of techniques to move from the starting point in a manufacturing sequence to an end product. The core/flake reduction trajectory therefore would follow the sequence of core to flake to final tool. The core/biface reduction trajectory would have a sequence of core to bifacial core to bifacial tool.

Lithic analysts in the past have used criteria such as presence or absence of cortex and artifact size to equate flakes with the three major stages of reduction: primary, secondary, and tertiary. However, this methodology does not adequately recognize or explain the many trajectories and vectors that may fall within any of the thre major reduction stages. Reduction trajectories on the other hand attempt to explain major differences in the processes used to produce the end product of lithic reduction. Identification of the trajectories can provide valuable information on the types of tools produced and thus have implications about tool function. Differences in reduction trajectories may also have temporal implications with the core/biface trajectory potentially representative of a more Archaic-like reduction strategy while the core/flake trajectory is more like a Neoarchaic reduction strategy (Chapman 1982; Duran and Laumbach 1981). The recognition of these two reduction trajectories using attribute analysis can be approached using a hypothetical model similar to the one displayed in Figure 6.1.

The first concern in any reduction sequence is the selection of a raw material that will be suitable for both the manufacturing process and the specific task under which the finished product must function. Lithic manufacturing and tool use therefore may be affected by the availability, size, shape, and internal morphology of the raw material.

Raw materials are available in a variety of shapes and masses with different internal morphologies which make certain raw materials more amenable to specific reduction techniques. The degree to which a given culture or social group adapted their reduction techniques to locally available materials or invested time and energy in the selection and transportation of raw materials to fulfill the needs of these manufacturing techniques may provide some insight concerning the degree of specialization in tool manufacturing techniques. The spatial location of various raw materials and the suitability of these materials for particular tasks should indicate the degree of movement of prehistoric groups, the amount of extra local trade and the importance of the specific raw material for specific functional uses of the finished product.

If the source areas of the raw materials are known, it may be possible to determine whether segments of a culture were circulating between source locations or whether materials were being circulated between site locations as end products: prepared cores, blades, preforms, or finished tools. Thus documentation of raw material variability could be used as an indicator of degree and direction of mobility of any given culture.

In summary, technological behavior can be divided into three subsets: 1) selection and procurement of raw materials; 2) manufacture of tools; and 3) the use and discard of these tools.

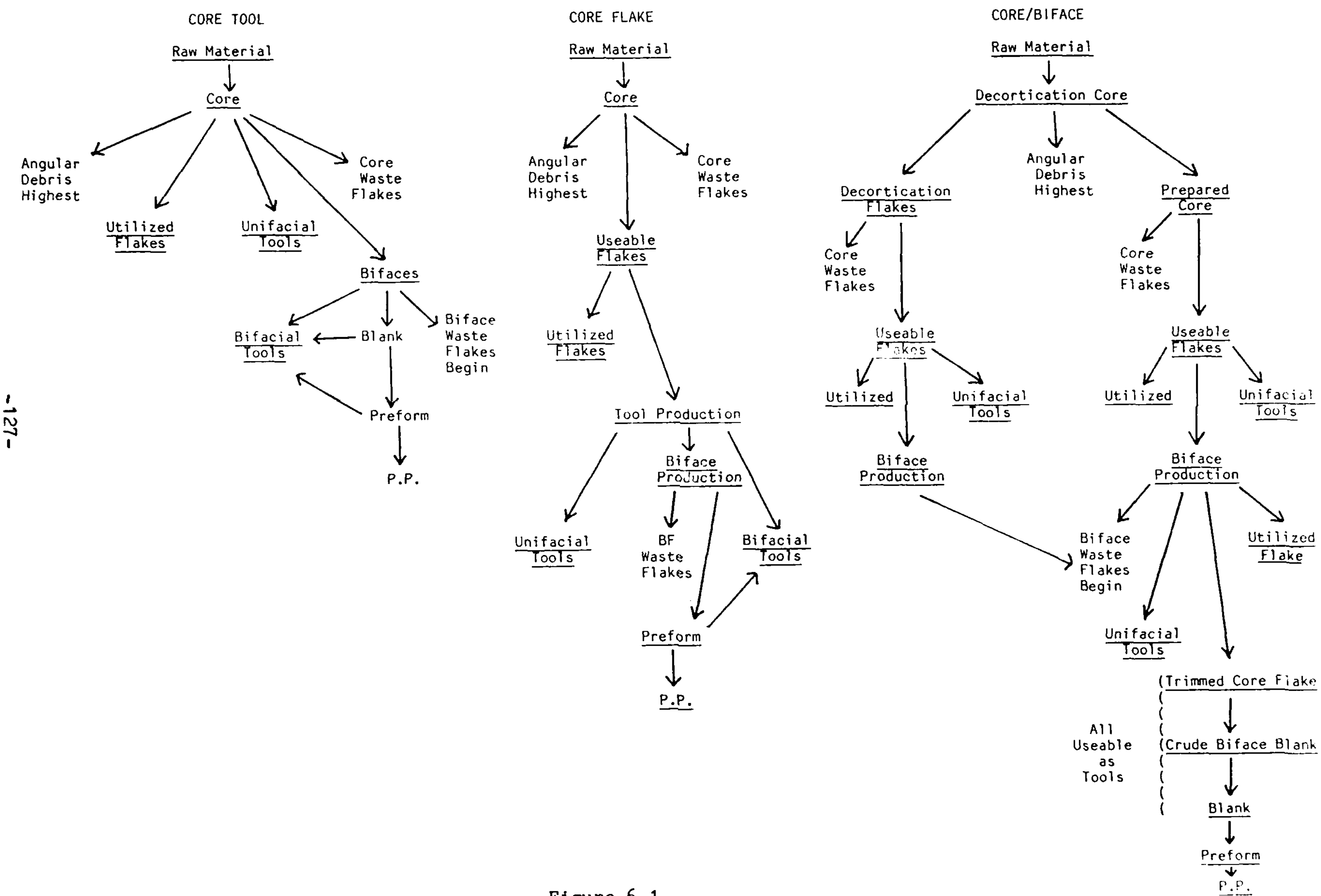


Figure 6.1
Idealized Lithic Reduction Strategy Trajectories (simplified)

Raw Material Selection in the WIPP Area

The raw materials selected for the manufacture of tools in the southwestern United States differ considerably in internal structure, fracture characteristics and availability. Materials commonly range from quartzites and chalcedonies to a variety of cherts and volcanically derived materials. A list of materials encountered during analyses, their description and probable source area is given below and in Appendix 3.

Surface collections and excavation at the three prehistoric sites in the WIPP area yielded 46 different material types that were collapsed into 16 different material classes. The 16 classes were defined on the basis of 1) similar source locations and/or 2) macroscopically similar internal morphology. Raw materials from unknown sources were categorized by a gross geological term; for example, basalts were given a separate alphametric designation. The raw material classes and their probable source areas are listed below.

A. Basalt - closest known source is approximately 40 miles north of Roswell, New Mexico.

B. Ogallala Gravels - consisting of cherts and quartzites with some chalcedonies and silicified woods. They are found in virtually the entire Pecos River Valley and the Llano Estacado in southeastern New Mexico and western Texas.

C. Ogallala Opal - found in the Pecos River Valley in southeastern New Mexico.

D. Obsidian - source unknown, possibly the Jemez Mountains of north-central New Mexico.

E. Welded Tuff - Plains of San Augustine in west-central New Mexico.

F. Fossiliferous Chert - Hueco formation limestones of southern New Mexico and western Texas.

G. Pecos Chalcedony - Pecos River Valley in southeastern New Mexico.

H. White Chert - source unknown.

I. Quartzite Cobbles - Pecos River Valley and its tributaries.

J. San Andres Chert - northwest of Roswell, New Mexico along the Arroyo del Macho.

K. Washington Pass Chert - northwestern New Mexico.

L. Yeso Arroyo Chert - macroscopically similar to Alibates chert; this chert is found around the canyons near Yeso, New Mexico.

M. Brown Silicified Wood - Source unknown; may come from Ogallala gravels, however the San Juan Basin is the closest area known by the author.

N. <u>Hydrous Quartz</u> - the Laguna Plata region of southeastern New Mexico.

O. <u>Mudstone</u> - eastern slopes of the Guadalupe Escarpment and the Pecos River Valley north of Roswell, New Mexico.

P. <u>Jasper</u> - source unknown.

Material type source areas were provided by Drs. Fred Nials and Phil Shelly of Eastern New Mexico University and represent the most recent interpretation of lithic raw material source areas.

The environmental setting of the WIPP area contains a number of raw materials found primarily in the Ogallala gravels. Most of these raw materials are suitable for the manufacturing the lithic tools. These raw materials are generally macroscopically similar and have been traced to specific localities which surround the WIPP area at varying distances and directions.

Because of the variety of raw materials found on the sites, it was hypothesized that each site could be a sensitive measure of the degree of mobility of the groups using the area. Differences in the selection of raw materials for specific tool types through time was also hypothesized. A distinct lack of formal tools on all three sites, with the exception of projectile points, and depositional characteristics at the three sites made it virtually impossible to detect occupational strata.

Since raw materials have unique spatial distributions, the kinds of materials selected for tool manufacture can be informative about behavioral responses of a given cultural group. One test for these behavioral responses is a qualitative model termed the distance decay model (Chapman 1977; Chapman and Schutt 1977; Bearden 1979; Gomalak and Heinsch 1982). The model postulates that as the distance from a raw material source area increases, the percentage of primary reduction decreases and the assemblages should reflect more of the later stages of reduction. Furthermore, the percentage of artifacts with cortex should exhibit a negative correlation with distance for the source materials. Since most of the source areas are not in the immediate vicinity of the project area it should be possible to test the distance decay model. The project area data indicate that over 95% of the lithic assemblage is represented by secondary core flakes, as it should be if the model is correct.

Further discussions on material type selection and the distance decay model will be discussed on both an inter- and intrasite level in the concluding portions of this chapter.

Reduction Strategies

The term "reduction" is defined as a set of procedures used to manufacture lithic implements from pieces of raw material (Chapman 1977). The first stage in any reduction sequence is the selection of the raw material for manufacture. This stage will determine the eventual size and shape of the end product since material type size dictates the size of the end product. The piece of parent material is termed a 'core', which in turn can be reduced using a variety of techniques. For the purpose of this analysis it was hypothesized that the core/flake trajectory would dominate the assemblage as opposed to either the core/tool or core/biface trajectories (see Figure 6.1). The core/flake trajectory of manufacturing is outlined below.

Primary Reduction:

This refers to the initial stages of stone tool manufacture. The initial stages of reduction can be recognized as pieces of debitage detached from a core. Primary reduction was not monitored as a specific category but was inferred for any artifact with cortex on the dorsal surface.

Secondary Reduction:

This term refers to lithic debris with cortex on the platform only. Secondary flakes are generally smaller than primary flakes but larger than tertiary flakes. Again, secondary reduction was not monitored directly, but was derived from cortex location and relative size of the flake.

Tertiary Reduction:

The critical variable for identification of tertiary reduction debris is the complete lack of cortex. Tertiary reduction is often associated with prepared platforms. It is often the last stage of manufacture in formal tool production in the core/biface manufacturing sequence. It can also be associated with secondary reduction when a secondary flake is used as a tool without facial flaking. Tertiary flakes usually result from initial strengthening or sharpening of an unmodified secondary flake.

Reduction Steps:

Flint knapping is a subtractive technology by nature and produces a series of stages antecedent to the final form of each implement produced. In the extreme, each flake removed from a piece of raw material or core is a stage of manufacture (Muto 1971:111). Each knapper has a preconceived idea of the shape and size a flake will have after its removal. Primary reduction usually requires the preparation of a primary core for the secondary stages of manufacture when the size and form of the finished tool is approximated. Flakes removed at this time are referred to as secondary core flakes.

Secondary flakes are produced through the reduction of a primary core. However, the trajectory of manufacture changes from one of reducing the primary core to a finished tool to that of reducing the secondary core into a finished tool (see Figure 6.1). At this point in the manufacturing process the knapper has a choice of trajectories: 1) the secondary flake may be used as a tool with little or no modification, or 2) it may be marginally or facially flaked on either the ventral and/or dorsal surfaces. Marginal flaking refers to the removal of a flake or flakes along the edge margin that does not exceed more than one-third of the width of the artifact. Facial flaking refers to the removal of a flake perpendicular to the proximal/distal axis extending more than one-third the width of the flake. When only one surface of the artifact is facially flaked it is termed a uniface, when both surfaces are facially flaked the artifact is termed a biface.

It must be pointed out that any stage of tool production can be somewhat arbitrary and may grade into a stage above or below. For example, finished projectile points have been recovered with cortex on parts of the dorsal surface which would indicate that the projectile point was manufactured from a primary flake.

The hypothesized reduction trajectory for broad focused hunter-gatherer groups would revolve around the use of secondary flakes as cores. The reason for this seems obvious; why carry a primary core from place to place when a secondary core is much lighter and can be manufactured into a finished tool with less energy invested in transportation (Lee 1968).

Since it has been postulated that groups inhabiting the WIPP area were engaged in a broad-based, hunter-gatherer subsistence strategy, the emphasis of the analysis will be centered around the core/flake reduction trajectory. A step by step process of biface and uniface manufacture from a core/flake reduction trajectory is outlined below.

1. Removal of the cortex from a primary core to prepare for the detachment of secondary flakes.

2. Detachment of a secondary flake that will approximate the shape, size and cross section of the finished tool.

3. Producing the final outline and cross section of the formal tool by bifacial or unifacial thinning of the secondary core. These flakes are characterized by perpendicular negative scars on the dorsal surface and generally have prepared striking platforms.

4. The final stage of manufacture involves marginal flaking of the edges.

Differences in the three reduction trajectories outlined in Figure 6.1 can be identified by analytical methods. These differences can be easily identified by noting the differences in percentages of types of flakes recovered at a site. Both the core/tool and core/biface trajectories should contain a number of core fragments and higher percentages of primary flakes should be present within a site. Following these initial reduction stages, the processes for all three trajectories should be roughly similar. The core/flake trajectory therefore shou. have few cores and primary flakes since these early stages of reduction generally occur at raw material source areas. The results of the lithic analysis for the three sites in the WIPP area suggest that the core/flake trajectory was employed throughout the occupational sequences at the sites.

ENM 10222 LITHICS DATA AND SITE INTERPRETATION

A total of 198 lithic artifacts was recovered from the surface collection and test pits at ENM 10222. Whole flakes account for 29.3% of the assemblage with flake fragments and angular debris accounting for 70.7% of the total. The locations of surface collected artifacts (75.2%) appear to be the result of natural environmental processes, i.e., aeolian, rather than cultural activity. The remaining 24.7% indicate that intact subsurface deposits are present at the site to a depth of 70 cm below the modern ground surface with a mean depth 20 cm below the surface.

Material Type Selection

Fifteen different material taxa were represented at the site with 59.5% of the artifacts from source areas adjacent to or within the project area (see Table 6.1). Flakes containing cortex account for 5.5% of the total assemblage with 90.1% of these flakes from local material source areas. This frequency verifies the distance decay model involving cortex attributes. Flakes without cortex account for 94.5% of the assemblage with 39.9% of these flakes coming from non-local source areas.

Table 6.1
ENM 10222 Material Classes by Flake Type
(* indicates local source)

Material Class	Cortex Present	Cortex Absent	Biface Retouch	Biface Thinning	Primary Core	Secondary Core	Tertiary Core	Total	
A	-	1	-	1	-	-	-	2	1.0%
* B	3	42	3	4	5	4	1	62	31.3%
* C	-	8	1	2	1	-	-	12	6.1%
D	-	3	1	-	-	-	-	4	2.0%
E	-	-	-	1	-	-	-	1	.5%
F	-	20	4	10	-	3	-	37	18.7%
* G	1	21	-	5	-	-	-	27	13.6%
H	-	3	-	-	-	1	-	4	2.0%
I	-	-	-	-	-	-	-	-	-
J	-	3	-	-	-	-	-	3	1.5%
K	-	-	-	1	-	-	-	1	.5%
L	1	24	1	1	-	-	1	28	14.1%
* M	-	2	1	-	-	-	-	3	1.5%
* N	-	-	-	-	-	2	-	2	1.0%
* O	-	6	2	1	-	-	-	9	4.5%
* P	-	2	-	1	-	-	-	3	1.5%
Total	5	135	13	27	6	10	2	198	100.0%

Flake Attribute Analysis

A total of 58 whole flakes was recovered from ENM 10222. This represents 29.3% of the lithics assemblage. Core flakes account for 31.0% of the assemblage while biface flakes account for 69.0%. Faceted, ground faceted, and multi-faceted platforms represent 83.3% of the total number of flakes with platforms present. The remaining 16.7% were simple cortical platforms. This platform type was confined to primary and secondary core flakes. The mean widths, lengths, and thicknesses of the five whole flake categories are shown in Table 6.2. Flake size attributes generally covary with the reduction stage, for example, primary core flakes are generally larger than either secondary or tertiary core flakes.

Table 6.2
ENM 10222 Metric Attributes of Whole Flakes

	Primary Core	Secondary Core	Tertiary Core	Biface Thinning	Biface Retouch
Length					
N	6	10	2	27	13
Mean	36.5 mm	24.72 mm	16.0 mm	17.19 mm	9.92 mm
Std. Dev.	13.368	7.938	3.559	5.067	3.604
Width					
N	6	10	2	27	13
Mean	24.83 mm	19.36 mm	15.5 mm	13.27 mm	9.25 mm
Std. Dev.	3.816	8.755	2.380	4.944	4.202
Thickness					
N	6	10	2	27	13
Mean	10.0 mm	7.0 mm	7.0 mm	3.5 mm	1.83 mm
Std. Dev.	.632	3.162	1.414	3.114	1.029
Platform Angle					
N	6	10	2	24	11
Mean	57.5°	73.1°	57.2°	60.5°	25.54°
Std. Dev.	45.34	13.44	5.61	22.98	29.53

The length, width, and thickness measurements for the five flake types indicate that a logical progression in flake size can be documented. This fits well with the hypothesized reduction series for the production of finished artifacts. The low numbers of primary core flakes and the complete lack of cores seem to verify the core/flake reduction trajectory at ENM 10222. The relatively high frequency of biface thinning flakes suggests that production of unifaces and bifaces was the dominant lithic activity. The sparse amount of either completed tools or failures cannot be adequately explained. A single complete projectile point, two projectile point tips, and one retouched flake comprise the only "tools" found at the site. Three possibilities may account for this lack: 1) the rate of tool production was extremely low with finished tools curated; 2) deposition at the site is masking the locations of tools; or 3) tools were present at the site and have subsequently been collected. This third possibility may in fact explain the lack of formal tools since the original survey report lists additional tool categories (Schermer 1980:30).

Spatial Analysis

A discrete occupational area was identified around Feature 2. This feature is a circular basin shaped hearth filled with charcoal and fire-cracked caliche. It has been radiocarbon dated at 1140 B.C. ± 190. A total of 43 flakes was recovered from five 1 by 1 m squares surrounding the feature. This represents 21.7% of the total number of flakes found at the site. Nine different material taxa were represented in frequencies roughly similar to those for the entire site. Nine biface thinning and retouch flakes and one secondary core flake were found in this concentration.

This area surrounding Feature 2 probably represents a lithic reduction area surrounding an Archaic hearth. The implications for this reduction area suggest that additional discrete occupational units probably exist at ENM 10222. Comparisons between this unit and the remainder of the site assemblage have not been attempted since the low number of cases within a subsurface sample will not produce statistically valid results. If additional occupational units within the site can be identified with a sufficient number of cases, statements about Archaic lithic reduction strategies may be made. Comparisons of the lithic reduction strategies on an intrasite basis will be discussed later in this chapter.

ENM 10230 LITHICS DATA AND SITE INTERPRETATION

A total of 1,478 lithic artifacts was recovered from the surface collection sample and test pits at ENM 10230. Whole flakes account for 12.0% of the assemblage with flake fragments and angular debris accounting for 88.0% of the total. The locations of surface collected artifacts (95.4%) appear to be the result of a mixture of cultural and natural environmental processes i.e., aeolian and cultural deposition. The remaining 4.6% of the assemblage was found in subsurface context and suggest that a substantial portion of the site contains relatively intact cultural deposits. Within the excavated portions of the site lithics were found at a maximum depth of 110 cm below the present ground surface underlying dune margins. Cultural materials were also found below some of the aeolian blowouts found across the site.

Material Type Selection

Fifteen different material taxa were represented at the site with 56.5% of the lithics from source areas adjacent to or within the project area (see Table 6.3). Flakes containing cortex account for 2.2% of the assemblage; 59.4% of these flakes are from local source areas. In this instance the distance decay model may in fact not be in effect. Flakes without cortex account for 97.8% of the total assemblage with 44.9% of the flakes coming from non-local source areas.

Table 6.3
ENM 10230 Material Classes by Flake Type
(* indicates local source)

Material Class	Cortex Present	Cortex Absent	Biface Retouch	Biface Thinning	Primary Core	Secondary Core	Tertiary Core	TOTAL	
A	-	1	-	-	-	-	-	1	.07%
* B	5	381	4	12	4	6	2	414	28.0%
* C	-	15	3	1	-	1	-	20	1.3%
D	-	6	-	-	-	-	-	6	.4%
E	-	3	-	-	-	-	-	3	.2%
F	1	326	8	37	3	5	5	385	26.0%
* G	1	207	4	18	6	7	2	245	16.6%
H	-	12	1	2	1	-	1	17	1.1%
I	-	40	1	4	-	1	-	46	3.1%
J	2	19	-	2	1	1	-	25	1.7%
K	-	-	-	-	-	-	-	-	
L	3	141	5	7	2	-	1	159	10.7%
* M	-	11	1	4	-	1	-	17	1.1%
* N	-	1	-	-	1	-	-	2	.1%
* O	-	123	-	7	2	3	-	135	9.1%
* P	-	3	-	-	-	-	-	3	.2%
Total	12	1289	27	94	20	25	11	1478	100%

Flake Attribute Analysis

A total of 177 whole flakes was recovered from ENM 10230 representing only 12.0% of the assemblage. Core flakes account for 31.6% of the whole flake assemblage with biface flakes contributing 68.4%. Faceted, ground-faceted, and multifaceted platform types account for 70.2% of the total number of flakes with platforms. The remaining platform types account for 28.8% with crushed platforms (18.1%) and simple cortical platforms (7.6%) accounting for the majority of these types. Faceted and multifaceted platforms were usually found on biface thinning and biface retouch flakes. The mean lengths, widths, and thicknesses of the five whole flake categories are displayed in Table 6.4. As with ENM 10222, flake size attributes generally covary with the stages of reduction: primary flakes are larger than any of the other categories.

Table 6.4
ENM 10230 Metric Attributes of Whole Flakes

	Primary Core	Secondary Core	Tertiary Core	Biface Thinning	Biface Retouch
Length					
N	20	25	11	92	26
Mean	27.0 mm	19.44 mm	14.5 mm	12.18 mm	8.42 mm
Std. Dev.	11.947	7.399	5.161	6.229	3.817
Width					
N	20	25	11	92	26
Mean	19.8 mm	17.6 mm	12.08 mm	11.05 mm	6.8 mm
Std. Dev.	9.897	7.583	4.925	5.067	3.162
Thickness					
N	20	25	11	92	26
Mean	6.7 mm	5.76 mm	3.83 mm	2.47 mm	1.46 mm
Std. Dev.	3.229	3.017	1.193	1.244	.859
Platform Angle					
N	16	21	11	72	17
Mean	78.1°	73.4°	78.2°	69.6°	67.3°
Std. Dev.	14.875	10.773	8.942	12.195	10.611

The length, width, and thickness measurements follow a logical progression in flake size and suggest that complete reduction sequences took place at the site with the manufacture of unifaces and bifaces predominating. The complete lack of cores and the high frequency of biface flakes indicate that a core/flake reduction trajectory was employed at ENM 10230. Only two formal lithic tools, excluding the eight projectile points found at the site were recovered. Two unifacial "knives" were recovered and would seem to indicate some type of plant processing. The lack of formal tools again cannot be explained although similar processes to those discussed at ENM 10222 may have been in effect.

Spatial Analysis

Spatial distributions of lithic material classes were statistically analyzed using radiocarbon dates and ceramic distributions within the 15 blowouts which were intensively sampled. Blowouts 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, and 15 were assigned to a Neoarchaic occupation. The term Neoarchaic is used to identify those cultures wherein ceramics and/or the bow and arrow were adopted but in which agriculture was never practiced or in which agriculture did not emerge as a dominant economic pattern (Prewitt 1981:68 from Prewitt and Nance 1980:3-4). Blowouts 1, 3, and 8 were assigned to an Archaic occupation. More detailed explanations on how these assignments were made are discussed in Chapter 8. Differences in the frequencies of the 15 materials of the Neoarchaic and Archaic occupations from ENM 10230 were evaluated using the

Kolmogorov-Smirnov Two Sample Test (Thomas 1976:322-326). This test involves a rather simple underlying theory. Two ordinal samples are arranged into a set of cumulative proportions. The null hypothesis of the K-S test asserts that the cumulative proportions of the first sample shall be essentially similar to those of the second sample. The larger the absolute differences between the cumulative proportions, the less likely becomes the null hypothesis. The critical values of the two tailed D statistic at the 0.05 level are defined as:

$$1.36 \sqrt{\frac{N_1 + N_2}{N_1 N_2}}$$

The percentages of material classes of the Neoarchaic and Archaic lithics distributions are presented in Table 6.5. In this instance D must be greater than:

$$1.36 \sqrt{\frac{27 + 1143}{27 \times 1143}}$$

or .2648 to reject the null hypothesis at the 0.05 level. The D value for the K-S test was .2027 and thus the two sample populations are essentially similar. This suggests that the material type selection criteria remained essentially stable throughout the entire occupational sequence at ENM 10230.

Table 6.5
ENM 10230 Material Type Selection

Material Class	ARCHAIC Number	ARCHAIC Frequency	NEOARCHAIC Number	NEOARCHAIC Frequency
A	0	0.0	1	.0008
B	12	0.444	341	.298
C	0	0.0	15	.013
D	2	0.074	4	.003
E	0	0.0	3	.0026
F	4	.148	290	.254
G	2	.074	186	.162
H	1	.037	9	.007
I	2	.074	30	.026
J	1	.037	14	.012
K	0	0.0	0	0.0
L	2	.074	128	.112
M	0	0.0	10	.008
N	1	.037	0	0.0
O	1	.037	10	.008
P	0	0.0	2	.002
Total	27	1.0	1143	1.0

Comparisons of whole flakes for the Neoarchaic and Archaic occupations were severely limited due to sample size for the Archaic assemblage. Only two whole flakes (tertiary core) were recovered. The Neoarchaic occupational blowouts contained 16 primary core flakes, 24 secondary core flakes, 11 tertiary core flakes, 80 biface thinning flakes, and 25 biface retouch flakes.

The lack of whole flakes within the Archaic occupational blowouts may be due to a lack of sufficient exposure. In retrospect, excavations within the blowouts assigned to the Archaic should have been undertaken in order to increase the sample size. Since the site remains relatively intact certain areas should be further studied in an attempt to determine if differences in Neoarchaic and Archaic trajectories can be documented.

Based on current analysis of the lithic assemblages at ENM 10230 the manufacture and maintenance of bifacially shaped artifacts using secondary cores or flake blanks was the primary lithic activity. This coupled with the continued usage of the same lithic source areas throughout the occupational history of the site suggests a very conservative cultural group utilized the region.

ENM 10418 LITHICS DATA AND SITE INTERPRETATION

A total of 314 lithic artifacts was recovered from the surface collections and test pits an ENM 10418. Whole flakes account for 23.2% of the assemblage with flake fragments and angular debris accounting for 76.8% of the total. The vast majority of the flakes (95.5%) were from subsurface deposits suggesting that a large portion of the site remains intact. Cultural materials were represented to 80 cm below the modern ground surface with average depths of cultural deposits at 31 cm.

Material Type Selection

Twelve different material taxa were represented at the site with 59.2% of the artifacts from source areas adjacent to or within the project area (see Table 6.6). Flakes containing cortex account for only 1.6% of the total assemblage; 60.0% of these flakes are from local source areas. The distance decay model in this instance may not be verified. Flakes without cortex account for 98.4% of the assemblage with 40.1% of these flakes coming from non-local source areas.

Flake Attribute Analysis

A total of 73 whole flakes was recovered from the site representing 23.2% of the assemblage. Core flakes represent 47.9% of the whole flake assemblage with biface flakes contributing 52.1%. Faceted, ground faceted, and multifaceted platforms account for 57.7% of the total number of flakes with platforms. Crushed platforms (25.6%) and simple cortical platforms (8.9%) are next in importance followed by cortical ground (5.1%) and multifaceted ground (2.5%). The mean lengths, widths, thicknesses, and platform angles of the whole flakes are presented in Table 6.7. The length, width, and thickness measurements for whole flakes at ENM 10418 do not follow a logical reduction sequence. This would indicate that other factors such as material type selection may have been a controlling factor in flake sizes and reduction techniques. No formal prepared cores were recovered from the site and a low number of formal tools excluding projectile points were found. This situation suggests that little tool manufacturing occurred at the site and tool repair and resharpening activities were probably predominate. The lack of formal tools suggests that activities carried out at ENM 10418 required few formal bifaces or unifaces. The number of projectile points (11) suggests that hunting may have been a primary activity. The presence of projectile points and the high number of fire related features coupled with the low incidence of groundstone and other tool categories suggests that ENM 10418 may have functioned as a hunting oriented rearmament camp. Hunting, therefore, would have been carried out at locations away from the site with hunting parties returning to ENM 10418 to resharpen and rehaft weapons.

Table 6.6
ENM 10418 Material Classes by Flake Type
(* indicates local source)

Material Class	Cortex Present	Cortex Absent	Biface Retouch	Biface Thinning	Primary Core	Secondary Core	Tertiary Core	TOTAL	
A	-	-	-	-	-	-	-	0	0.0%
* B	-	93	2	4	3	10	4	116	36.9%
* C	-	1	-	1	-	-	-	2	.6%
D	-	-	-	-	-	-	-	0	0.0%
E	-	-	-	-	1	-	-	1	.3%
F	-	62	2	2	-	2	-	68	21.6%
* G	-	26	3	7	-	3	2	35	11.1%
H	-	-	-	1	-	-	-	1	.3%
I	-	6	1	1	1	3	-	12	3.8%
J	-	4	2	4	-	1	2	13	4.1%
K	-	1	-	-	-	-	-	1	.3%
L	-	22	3	5	-	1	1	32	10.2%
* M	-	-	-	-	-	-	-	0	0.0%
* N	-	5	-	-	-	-	1	6	1.9%
* O	-	27	-	-	-	-	-	27	8.6%
* P	-	-	-	-	-	-	-	0	0.0%
Total	0	241	13	25	5	20	10	314	100.0%

Table 6.7
ENM 10418 Metric Attributes of Whole Flakes

	Primary Core	Secondary Core	Tertiary Core	Biface Thinning	Biface Retouch
Length					
N	5	20	10	25	13
Mean	21.17 mm	23.0 mm	22.63 mm	14.16 mm	13.92 mm
Std. Dev.	10.833	10.099	9.708	5.550	7.522
Width					
N	5	20	10	25	13
Mean	20.17 mm	15.4 mm	18.27 mm	12.6 mm	12.84 mm
Std. Dev.	9.867	5.852	5.461	4.434	5.490
Thickness					
N	5	20	10	25	13
Mean	4.83 mm	5.05 mm	5.64 mm	3.08 mm	3.08 mm
Std. Dev.	1.329	2.064	2.656	1.777	1.891
Platform Angle					
N	4	16	9	21	5
Mean	82.7°	74.7°	71.8°	70.2°	72.2°
Std. Dev.	9.844	9.147	15.374	7.374	10.986

Spatial Analysis

Lithic materials at ENM 10418 were spatially analyzed in an attempt to determine if different reduction trajectories or material source areas were utilized through time. The analysis divided the site into Archaic and Neoarchaic components based on the presence of ceramics, projectile point types and radiocarbon dated features. The methodology used to separate these two components will be discussed in detail in Chapter 8.

The first test used to separate the two components at ENM 10418 revolved around the frequency of material types present at the sites. Table 6.8 shows the frequencies of the material types present in the two components. Differences in the cumulative frequencies in material type selection strategies were evaluated using the Kolmogorov-Smirnov two sample test (Thomas 1976). The largest difference between the two sample populations was only .1174, far below the D value of .2357 which would be significant at the 0.05 significance level. The null hypothesis therefore cannot be rejected and material type selection strategies between the Neoarchaic and Archaic are not significant.

The K-S two sample test was also used to examine both platform types in general and platform types in relation to flake types. In both instances the null hypothesis cannot be rejected and the two sample populations are statistically similar.

Table 6.8
ENM 10418 Neoarchaic and Archaic Material Types

Material Class	NEOARCHAIC Number	NEOARCHAIC Frequency	ARCHAIC Number	ARCHAIC Frequency
A	0	0.0	0	0.0
B	51	.398	13	.289
C	1	.008	0	0.0
D	0	0.0	0	0.0
E	0	0.0	0	0.0
F	25	.195	8	.178
G	14	.109	8	.178
H	1	.008	0	0.0
I	3	.023	3	.067
J	3	.023	1	.022
K	0	0.0	0	0.0
L	12	.094	6	.133
M	0	0.0	0	0.0
N	3	.023	1	.022
O	14	.109	5	.111
P	1	.008	0	0.0
Total	128	.998	45	1.000

Differences in the metric attributes of flake types were also examined to determine if flake size varied between the Neoarchaic and Archaic populations. The mean measurements and standard deviations of flakes are presented in Table 6.9. Primary core flakes were not included in this table since no primary core flakes were found in Archaic components.

Table 6.9
ENM 10418 Difference of Means Test for Flake Types

	ARCHAIC N	ARCHAIC $\bar{X}$ (mm)	ARCHAIC s.d.		NEOARCHAIC N	NEOARCHAIC $\bar{X}$ (mm)	NEOARCHAIC s.d.
Secondary Core Flake							
Length	4	24	12.0277	t = .197 not significant	9	22.44	12.1461
Width	4	13.5	2.0817	t = .4292 not significant	9	14.55	4.304
Thickness	4	4.0	1.825	t = .737 not significant	9	5.0	2.179

Table 6.9 (continued)
ENM 10418 Difference of Means Test for Flake Types

	ARCHAIC				NEOARCHAIC		
	N	$\bar{X}$ (mm)	s.d.		N	$\bar{X}$ (mm)	s.d.
Tertiary Core Flake							
Length	2	34.00	19.799	t = .994 not significant	9	25.11	6.603
Width	2	26.5	4.949	t = 3.311 significant at .05 degrees of freedom = 9	9	15.89	3.371
Thickness	2	9.5	2.121	t = 2.792 significant at .05 degrees of freedom = 9	9	5.0	1.803
Biface Thinning Flake							
Length	4	12.75	5.252	t = .315 not significant	12	13.67	4.519
Width	4	10.75	5.909	t = .402 not significant	12	12.75	3.165
Thickness	4	2.0	.816	t = .789 not significant	12	2.5	1.087
Biface Retouch Flake							
Length	3	13.67	9.866	t = .141 not significant	3	12.67	1.527
Width	3	17.67	10.0167	t = .814 not significant	3	11.67	2.886
Thickness	3	4.0	2.646	t = .653 not significant	3	2.67	1.155

Based on the results of the Difference of Means tests (Blalock 1972:220-230) performed above, only the tertiary core flakes differed between the Archaic and Neoarchaic components. Since these differences occurred in both the width and thickness of the flakes and not the length, a number of tentative hypotheses can be generated. Since no significant differences in length could be noted it is assumed that raw materials for both components came from the same source areas. This can be verified by the K-S tests for material type selection. Significant differences occur in width and thickness measurements for tertiary core flakes. These differences may be related to reduction trajectories with Archaic tertiary flakes being produced for functional tasks which are not represented in the Neoarchaic components. Since few formal tool categories were recovered from ENM 10418, with the exception of projectile points, the differences may be related to widths and thicknesses of Archaic projectile points as opposed to Neoarchaic projectile points. The mean widths and thicknesses of Archaic projectile point at ENM 10418 is 19.24 mm and 6.34 mm respectively. Neoarchaic projectile widths and thicknesses are 15.48 mm and 3.86 mm. The differences in tertiary flakes as opposed to projectile point attributes seem to indicate that Archaic component tertiary flakes could have been used to produce Archaic projectile points and Neoarchaic component tertiary flakes could have been used to produce Neoarchaic projectile points. These comparisons should be viewed with caution since the sample sizes of both tertiary flakes and projectile points are very small. This hypothesis however should be tested with larger sample sizes.

The results of the spatial analysis of the lithic assemblages at ENM 10418 indicate that the same lithic source areas were used throughout the entire occupational sequence at the site. Platform types and metric attributes of the flakes also indicate a relatively stable reduction trajectory. These findings suggest that a relatively conservative population with regard to lithic reduction strategies occurred in the southeastern portion of New Mexico. These data should be considered as preliminary since ENM 10418 was represented by such a small sample size. Examination of additional sites with larger populations which can be split into components should be attempted.

ENM 10418 in general seems to follow the manufacturing patterns noted at ENM 10222 and ENM 10230. The dominant lithic reduction activity revolved around the production of unifaces and bifaces. The reduction trajectory was a core/flake process where all primary reduction takes place at another location with secondary cores reduced to finished tools as needed.

INTERSITE COMPARISONS

The lithics data from ENM 10222, ENM 10230, and ENM 10418 were compared both by whole assemblages and by the postulated components. ENM 10222 could not be separated into separate Archaic and Neoarchaic components; however both ENM 10230 and ENM 10418 were separated. Three major categories of the lithic assemblages were examined: material type selection; platform types; and metric attributes of the five flake types.

Material type selection was statistically evaluated using the Kolmogorov-Smirnov two sample test. The percentages of the material types for ENM 10222,

Table 6.10
Cumulative Frequencies of Material Classes

Material Class	ENM 10222 N	ENM 10222 %	ENM 10222 Cum %	ENM 10230 Neoarchaic N	ENM 10230 Neoarchaic %	ENM 10230 Neoarchaic Cum %	ENM 10230 Archaic N	ENM 10230 Archaic %	ENM 10230 Archaic Cum %	ENM 10230 Combined N	ENM 10230 Combined %	ENM 10230 Combined Cum %	ENM 10418 Neoarchaic N	ENM 10418 Neoarchaic %	ENM 10418 Neoarchaic Cum %	ENM 10418 Archaic N	ENM 10418 Archaic %	ENM 10418 Archaic Cum %	ENM 10418 Combined N	ENM 10418 Combined %	ENM 10418 Combined Cum %
A	2	1.0	1.0	1	.09	.09	0	0.0	0.0	1	.07	.07	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
B	62	31.3	32.3	341	29.8	29.9	12	42.8	42.8	414	28.0	28.1	51	39.8	39.8	13	28.9	28.9	116	36.9	36.9
C	12	6.1	38.4	15	1.3	31.2	0	42.8	42.8	20	1.3	29.4	1	.9	40.7	0	0.0	28.9	2	.6	37.5
D	4	2.0	40.4	4	.4	31.6	2	7.1	49.9	6	.4	29.8	0	0.0	40.7	0	0.0	28.9	0	0.0	37.5
E	1	.5	40.9	3	.3	31.9	0	0.0	49.9	3	.2	30.0	0	0.0	40.7	0	0.0	28.9	1	.3	37.8
F	37	28.7	59.6	290	25.4	57.3	4	14.3	64.2	385	26.0	56.0	25	19.5	60.2	8	17.8	46.7	68	21.6	59.4
G	27	13.6	73.2	186	16.3	73.6	2	7.1	71.3	245	16.6	72.6	14	10.9	71.1	8	17.8	64.5	35	11.1	70.5
H	4	2.0	75.2	9	.8	74.4	1	3.6	74.9	17	1.1	73.7	1	.8	71.9	0	0.0	64.5	1	.3	70.8
I	0	0.0	75.2	30	2.6	77.0	3	10.7	85.6	46	3.1	76.8	3	2.3	74.2	3	6.7	71.2	12	3.8	74.6
J	3	1.5	76.7	14	1.2	78.2	1	3.6	89.2	25	1.7	78.5	3	2.3	76.5	1	2.2	73.4	13	4.1	78.7
K	1	.5	77.2	0	0.0	78.2	0	0.0	89.2	0	0.0	78.5	0	0.0	76.5	0	0.0	76.5	1	.3	79.0
L	28	14.1	91.4	128	11.2	89.4	2	7.1	96.3	159	10.8	89.3	12	9.4	85.9	6	13.3	86.7	32	10.2	89.2
M	3	1.5	92.9	10	.9	90.3	0	0.0	96.3	17	1.1	90.4	0	0.0	85.9	0	0.0	86.7	0	0.0	89.2
N	2	1.0	93.9	0	0.0	90.3	1	3.6	100.0	2	.1	90.5	3	2.3	88.2	1	2.2	88.9	6	1.9	91.1
O	9	4.5	98.5	110	9.6	99.9	0	0.0	100.0	135	9.1	99.6	14	10.9	99.1	5	11.1	100.0	27	8.6	100.0
P	3	1.5	100.0	2	.2	100.0	0	0.0	100.0	3	.2	100.0	1	.8	100.0	0	0.0	100.0	0	0.0	100.0
Totals	198			1143			28			1478			128			45			314		

Table 6.11
Kolmogorov-Smirnov Two Sample Tests
(D Significant at .05 underlined)

	ENM 10222	ENM 10230 Neoarchaic	ENM 10230 Archaic	ENM 10230 Combined	ENM 10418 Neoarchaic	ENM 10418 Archaic	ENM 10418 Combined
ENM 10230 Neoarchaic	D > .105 D = .090	-	-	-	-	-	-
ENM 10230 Archaic	D > .275 D = .125	D > .260 D = .183		-	-	-	-
ENM 10230 Combined	D > .103 D = .109	D > .053 D = .018	D > .259 D = .201	-	-	-	-
ENM 10418 Neoarchaic	D > .154 D = .075	D > .127 D = .099	D > .284 D = .127	D > .125 D = .113	-	-	-
ENM 10418 Archaic	D > .225 D = .120	D > .207 D = .106	D > .327 D = .210	D > .206 D = .093	D > .236 D = .135	-	-
ENM 10418 Combined	D > .123 D = .037	D > .086 D = .070	D > .268 D = .124	D > .084 D = .088	D > .143 D = .033	D > .217 D = .127	-

ENM 10230, and ENM 10418 are displayed in Tables 6.10, 6.11, and 6.12. Table 6.10 is a composite of all three sites along with the components for ENM 10230 and ENM 10418.

Comparisons from Table 6.11 using the K-S two sample test were calculated at the 0.05 significance level. ENM 10222 compared to ENM 10230 Neoarchaic needs a D value of .105 to be significant. The highest value difference for the cumulative frequencies is only .090. The various significant D values and the highest cumulative frequency differences for each comparison are shown in Table 6.11.

Based on the K-S two sample test the distribution of material types failed to meet the null hypothesis in two cases: ENM 10222 versus ENM 10230 combined and ENM 10418 combined versus ENM 10230 combined. In these two instances the differences in the cumulative frequencies of the material types suggests that the differences are not random. The implications for this difference revolving around ENM 10230 may be due to the sample sizes or may possibly be related to a slightly different utilization of material types. This could be related to the occupation history of the site. This line of evidence will be further expanded in Chapter 8.

Platform types were also examined using the K-S two sample test. Since only whole flakes and proximal fragments have platform attributes, ENM 10230 and ENM 10418 were not separated into components due to small sample sizes. The types, numbers and percentages of platforms for the three sites are displayed in Table 6.12.

Table 6.12
Platform Type Cumulative Percentages

	ENM 10222			ENM 10230			ENM 10418		
	N	%	Cum. %	N	%	Cum. %	N	%	Cum. %
Cortical	8	16.7	16.7	13	7.6	7.6	7	9.0	9.0
Cortical Ground	0	0.0	16.7	2	1.2	8.8	4	5.1	14.1
Faceted	20	41.7	58.4	39	22.8	31.6	16	20.5	34.6
Faceted Ground	11	22.9	81.3	46	26.9	58.5	23	29.5	64.1
Multifaceted	9	18.7	100.0	35	20.5	79.0	6	7.7	71.8
Multifaceted Ground	0	0.0	100.0	5	2.9	81.9	2	2.6	74.4
Crushed	0	0.0	100.0	31	18.1	100.0	20	25.6	100.0
Total	48			171			78		

K-S comparisons for ENM 10222 versus ENM 10230 should have a D value greater than .222 to be significant. The differences in the cumulative frequencies is .544: the null hypothesis therefore is rejected. K-S comparisons of ENM 10222 versus ENM 10418 should have a D value greater than .249 to be significant. The greatest difference in the cumulative frequencies is .282 and the null hypothesis is again rejected. K-S comparisons of ENM 10230 and ENM 10418 should have a D value greater than .186 to be significant. The largest difference in the cumulative frequencies is .075 and the null hypothesis cannot be rejected. Based on the K-S two sample tests ENM 10222 has platform type frequencies which differ significantly from either of ENM 10230 and ENM 10418. These differences may be attributable to the lack of crushed platforms. This lack of crushed platforms may be due to sample size problems and additional samples from other sites in the region should be investigated.

The final group of statistical tests involved the mean sizes of the five flake categories. These were evaluated using the Difference of Means test (Blalock 1972:220-230). The number of cases, means and standard deviations used to calculate this test are presented in Tables 6.2, 6.4, and 6.7. The results of the difference of means tests are presented in Table 6.13. Based on the Table 6.13 results tertiary core flakes were significantly different between ENM 10230 Neoarchaic and ENM 10418 Neoarchaic and Archaic and between ENM 10418 Neoarchaic and ENM 10418 Archaic. These results suggest that tertiary core flakes from ENM 10230 were significantly smaller. At this time it is difficult to assess why ENM 10230 tertiary core flakes were smaller than either ENM 10418 Neoarchaic and Archaic component flakes.

Significant differences also exist in biface thinning flakes between ENM 10222 and ENM 10230. The flakes from ENM 10230 are significantly smaller than those from ENM 10222. Finally biface retouch flakes at ENM 10230 are significantly different than those from the ENM 10418 Archaic component. Again the ENM 10230 flakes are significantly smaller.

These differences suggest that material type selections at ENM 10230 were in general significantly smaller than those from ENM 10222 or either of the components at ENM 10418. The differences in the material type selections are also seen in the K-S tests for ENM 10230. At present these differences cannot be adequately interpreted; however, ENM 10230 apparently differed in material type selection criteria which was also reflected in flake size. While there are no significant differences in reduction trajectories, ENM 10230 groups apparently used a strategy which selected for smaller parent material. These differences probably revolve around site functions.

Table 6.13
Difference of Means
(significance > .1 underlined)

	ENM 10418 Neoarchaic vs. ENM 10222	ENM 10418 Archaic vs. ENM 10222	ENM 10230 Neoarchaic vs. ENM 10222	ENM 10230 Neoarchaic vs. ENM 10418 Archaic	ENM 10230 Neoarchaic vs. ENM 10418 Neoarchaic	ENM 10418 Archaic vs. ENM 10418 Neoarchaic
Primary Core:						
Length	.183	-	1.559	-	.850	-
Width	.459	-	1.300	-	.347	-
Thickness	7.325	-	2.341	-	.447	-
Secondary Core:						
Length	.479	.125	2.295	1.265	1.249	.197
Width	1.428	1.234	.570	1.060	1.134	.429
Thickness	1.528	1.749	.421	1.329	1.117	.737
Tertiary Core:						
Length	2.389	1.439	.591	2.638	4.026	.994
Width	.192	3.000	1.647	4.339	2.668	3.311
Thickness	1.808	1.204	3.449	4.805	1.412	2.792
Biface Thinning:						
Length	2.006	1.569	3.281	.073	.584	.315
Width	.949	.891	2.460	.121	.863	.402
Thickness	1.050	.927	2.306	.676	.059	.789
Biface Retouch:						
Length	1.204	.989	1.145	1.746	1.907	.141
Width	.877	2.076	1.523	8.450	2.061	.814
Thickness	1.143	2.087	.215	2.095	.977	.653

GROUND STONE

INTRODUCTION

The ground stone artifact assemblage recovered during the WIPP testing and mitigation phases was classified using form and functional attributes. Grinding tools include manos, metates, and a pestle. Ground stone tools were principally used in vegetal processing. The attributes used for the ground stone analysis are discussed in Appendix 3.

Manos

One general taxon of manos was defined for the site assemblages since only one-hand manos were identified. One-hand manos are circular to oval in outline and exhibit one or more smooth facets produced through grinding. One-hand manos were generally used in reciprocal motion against a metate.

Metates

Three taxa of metates were identified based on the characteristics of the grinding surface.

1. Slab metate - The grinding surface on each slab is irregular in outline. These artifacts are generally flat to slightly concave in cross section.

2. Basin metate - The grinding surface is generally narrow with a distinctly concave surface. This surface is generally deeply set into the surface of the metate.

3. Basin-slab metate - This artifact taxon contains characteristics of both slab and basin metates.

Pestle

One conical shaped limestone fragment with battering on one end was identified. This artifact may have functioned as a pestle.

Materials

The materials used for the production of ground stone implements are locally available and consist of gray to reddish brown sandstones, fossiliferous sandstone, and gray-white limestone. The sandstones probably consist of Santa Rosa and Dewey Lake Redbed sandstones.

Other Artifact Types

Two unusual artifacts were recovered. One consisted of a crescentic-shaped tabular limestone slab that appears to have been flaked. This artifact resembles one found at NMSU 1394 (Kauffman 1983:Figure 7d). A small pebble which shows signs of abrasion and polishing was also recovered.

ENM 10222 GROUND STONE

This site contained two manos and four undifferentiated pieces of ground stone. Both manos were of the one-hand variety. One is oval in shape with a convex-plano cross section. It was shaped by pecking and was characterized by latitudinal striations. The second mano is circular in shape with a plano-plano wedge cross section. It was shaped by pecking and grinding and was characterized by latitudinal striations. Metric attributes are shown in Table 6.14.

Table 6.14
ENM 10222 Metric Attributes for Ground Stone Fragments

	Mean	Standard Deviation
One-Hand Manos (N = 2)		
Length (mm)	57.5	10.61
Width (mm)	88.5	23.33
Thickness (mm)	42.0	11.31
Weight (g)	192.0	11.31

ENM 10230 GROUND STONE

This site contained 13 one-hand manos, 4 slab metates, 8 basin metates, 1 basin-slab metate, and 16 undifferentiated ground stone fragments. One-hand manos are primarily oval in shape (9) with a plano-plano wedge cross section (7). All of the manos were shaped by pecking and grinding. Slab metates were represented by fragments only and all have a plano-plano tabular cross section. Basin metates are also represented by only fragments. They are generally concave-plano in cross section and were produced by pecking and or pecking and grinding.

The basin-slab metate was complete. It has an oval shape with a concave-concave cross section. It was shaped by pecking and grinding.

The metric attributes for the ground stone from ENM 10230 are shown in Table 6.15.

Table 6.15
ENM 10230 Metric Attributes for Ground Stone

	Mean	Standard Deviation
One-Hand Manos (N = 13)		
Length (mm)	69.61	22.51
Width (mm)	69.23	17.86
Thickness (mm)	29.23	7.81
Weight (g)	178.69	87.13
Slab Metates (N = 4)		
Length	106.75	32.49
Width	90.0	24.49
Thickness	31.75	14.86
Weight	442.25	450.65

Table 6.15 (continued)
ENM 10230 Metric Attributes for Ground Stone

	Mean	Standard Deviation
Basin Metates (N = 8)		
Length	104.12	42.13
Width	83.0	46.88
Thickness	29.37	8.52
Weight	474.62	517.15
Basin-Slab Metate (N = 1)		
Length	122.0	
Width	145.0	
Thickness	44.0	
Weight	887.0	

ENM 10418 GROUND STONE

This site contained eight one-hand manos, one slab metate, one basin metate, one pestle, one limestone knife, one polishing stone and five undifferentiated ground stone fragments. The one-hand manos are oval (2) or circular (3) in shape with plano-plano tabular or plano-plano wedge cross sections. They were manufactured by pecking or pecking and grinding. The slab metate fragment has a plano-plano tabular cross section while the basin metate has a concave-irregular cross section. Metric attributes for the ground stone assemblage from ENM 10418 are shown in Table 6.16.

Table 6.16
ENM 10418 Metric Attributes for Ground Stone

	Mean	Standard Deviation
One-Hand Manos (N = 8)		
Length (mm)	70.5	26.03
Width (mm)	68.12	32.65
Thickness (mm)	29.37	13.69
Weight (g)	192.37	183.04
Slab Metate (N = 1)		
Length	85.0	
Width	80.0	
Thickness	16.0	
Weight	195.0	
Basin Metate (N = 1)		
Length	77.0	
Width	51.0	
Thickness	26.0	
Weight	113.0	

Hammerstones

Three hammerstones were recovered from ENM 10418. The specimens varied between two unmodified cobbles and one intentional shaped oval form. The size and wear patterns indicate they were hand held. All three hammerstones were quartzite cobbles.

Two of the hammerstones exhibit utilized edges with one ground the entire periphery, with the third exhibiting utilized edges around half of the periphery. The wear patterns occur along natural ridges, manufactured edges, and one edges fractured during utilization.

Table 6.17
ENM 10418 Metric Attributes for Hammerstones

	Range	Mean	Standard Deviation
Hammerstones (N = 3)			
Length	63-68	65.67	2.52
Width	52-58	56.00	3.46
Thickness	44-59	50.33	7.77

SUMMARY

The sample size for the ground stone and the fragmentary condition of most of the artifacts make it difficult to determine functions. The majority of the artifacts had modified surfaces from slightly ground on one side to heavily ground on both surfaces.

The manos appear to have been used with consistent pressure applied to one side, resulting in a wedge shaped cross section. This suggests that the manos were not reversed during use to balance wear.

Intersite comparisons of one-hand manos indicate that similar sizes were used at all three sites with variability represented by numbers present.

The limited amount of ground stone recovered from the sites suggests that plant processing was carried out; however, with the exception of ENM 10230, the amount of ground stone suggests that plant processing using grinding implements represented only a small fraction of the set of activities represented. Based on the small sample size and the lack of pollen adhering to the ground stone surfaces it is difficult to speculate on the plant materials that were processed. If mesquite and acorns were being processed, as has been suggested in other portions of this report, ground stone implements may not have been necessary.

PROJECTILE POINTS

DART POINTS

The projectile points recovered from the WIPP project area generally conform to the typological sequence established by Leslie (1978). The styles of projectile points are based primarily on morphological attributes and have been placed into types. The types of points recovered from the WIPP sites closely resemble point styles examined by Leslie (1978) and probably fall into three general groups. The first group consists of dart points which according to Leslie (1978) generally predate A.D. 950. Based on weight characteristics five projectile points recovered from the project area fall into this category (see Table 6.18). The dart points weigh between 2.6 and 5.5 grams.

Projectile points falling into this category from ENM 10418 and ENM 10230 are Types 8 and 9 in Leslie's typology (1978). The generalized descriptions for the most likely projectile points are given below.

TYPE 8-D

Blade Outline:	Triangular
Blade Edges:	Convex, straight, or concave, sometimes different on same specimen; recurved and apparent reworked specimens are common.
Notches:	Corner-wide, with pronounced to well barbed shoulders
Stem:	Wide-expanding with stem length almost half of the total length.
Base:	Convex
Length:	3 to 6 cm, average = 5 cm
Width:	2 to 2.5 cm at shoulders, average = 2.4 cm
Thickness	.4 to .9 cm, average = .6 cm
Date:	Possibly pre A.D. 900
Associated Point Types:	All of types 7, 8, 9, and 10; possibly 4, 5, and 6.
Associated Ceramics:	None known
Name:	Carlsbad Point

TYPE 9

Blade Outline:	Triangular
Blade Edges:	Straight, slightly convex or slightly concave
Notches:	Side opposed near base with two varieties medium in width and depth and wide and shallow forming a wide long stem. Shoulders are weak to pronounced; some have short dull barbs.
Base:	Convex
Date:	Possibly pre A.D. 950
Associated Point Types:	All styles in type 7, 8, and 10. Late in its period of use Types 4, 5, and 6.
Associated Ceramics:	None known

Table 6.18. Projectile Point Attributes

Site ENM-	Provenience	Point Type	Figure Ref.	Length	Thick-ness	Body Width	Neck Width	Base Width	Weight (g)	Haft Angle	Notch Location	Blade Type	Stem Type	Base Type	Material Class
10418	112N/216E Surface	Edgewood/ Fairland	6.2A	34.1	6.6	18.7	11.3	15.0	3.9	116°	Shallow side/corner	Convex	Expanding	Concave	G - heat treated tan chalcedony
10418	80N/130E 100.30-100.20	9	6.2E	35.8*	6.4	18.2	13.1	15.9	4.3	107°	Shallow side	Straight convex	Slight expanding	Convex	F - heat treated gray banded
10418	107N/117E 100.49-100.43	8-D	6.2B	35.4	7.0	18.0*	14.2*	19.7	5.1	110°	Shallow side/corner	Straight	Expanding	Convex	H - heat treated pink banded chert
10418	117N/136E 100.91-100.81	8-D	6.2C	37.4	6.5	22.4*	16.6	20.3	4.9	94°	Shallow side/corner	Straight	Expanding	Convex	B?- heat treated light brown chert
10230	109S/163E Surface	8 ?	6.2D	?	5.7	?	13.4	19.3	3.0*	93°	Corner	?	Expanding	Convex	F - white/buff chert
10418	103N/144E 100.75-100.65	8-D?	6.2F	26.8	5.2	18.9	14.4	19.9	2.6	93°	Shallow side	Convex	Expanding	Convex	F or J - gray mottled chert
10230	50S/69E Surface	6-C	6.3A	27.9	5.4	23.9	12.6	13.5	2.8	75°	Corner	Convex	Straight	Straight	B - brown mottled chert
10230	85S/180E Surface	6-C	6.3B	33.8	5.9	22.6	11.8	11.8	2.6	72°	Corner	Straight convex	Straight	Straight	B - yellow quartzite
10230	85S/181E Surface	6-A	6.3C	27.5	4.1	20.8	12.3	16.9	2.1	75°	Corner	Straight concave	Expanding	Slight convex	F or J - gray mottled chert
10230	97S/179E Surface	6-A	6.3D	25.6	6.2	20.5	11.4	15.2	2.4	70°	Corner	Straight	Expanding	Slight convex	F - gray mottled chert
10230	88S/164E Surface	1-A or C	6.4B	15.7	3.0	13.4	-	13.4	1.0	-	-	Convex	-	Concave	J - gray chert
10222	81N/172E Surface	1-A or C	6.4A	19.2	3.0	17.4	-	17.4	.6	-	-	Convex	-	Concave	B - gray/brown mottled chert
10230	308S/391E Surface	2-A	6.4E	25.5*	3.6	12.5	5.5	8.6	1.2	71°	Side	Straight	Expanding	Convex	H - heat treated tan chert
10418	111N/187E Surface	2-?	6.4F	19.7*	2.6	16.1	?	?	.7*	?	?	Straight	?	?	B - heat treated red chert
10418	105N/114E 100.48-100.40	3-C,D,E	6.4I	21.1*	3.4	15.5	4.9	4.4	.9	56°	Corner	Concave	Straight contracting	Slight convex	F or J - gray mottled chert
10418	111N/244E 102.14-102.04	3-C,D,E	6.4H	26.9	4.0	14.7*	4.5	5.0	1.0	71°	Corner	Concave	Straight	Slight convex	G - heat treated red/orange chalcedony
10418	105N/113E 100.38-100.28	3?	6.4G	19.1*	3.7	15.9	6.9	5.0	1.0	?	Corner	Straight	Slight contracting	?	B - buff chert
10418	105N/113E 100.48-100.38	Clifton/ Perdiz	6.4D	27.5	4.9	17.0	-	5.0	1.7	138°	Corner	Straight	Contracting	Point	F - cream chert
10418	85N/140E 100.71-100.61	?	6.4C	21.9	4.6	13.7	7.7	5.9	1.1	116°	Corner	Straight	Contracting	Straight	F - gray mottled chert

* = Incomplete measurement

EDGEWOOD

Blade Outline:	Short triangular blade with edges sometimes straight, usually convex. Shoulders prominent to well barbed. Stem edges expand widely with base often as wide as shoulders. Base is usually concave.
Length:	3 to 5 cm, average = 4 cm
Width:	2 to 3 cm
Stem Width:	1.5 to 2 cm; stem is usually 1/3 to 1/2 total length
Estimated Age:	Probably late in Archaic stage, appearing shortly before or after A.D. 0.
Distribution:	Principally found in northeast Texas and sporadically from there toward central and north-central Texas, perhaps also toward coastal plain.

FAIRLAND

Blade Outline:	Triangular blade with edges sometimes straight, usually convex. Shoulders narrow, seldom barbed. Stem formed by long shallow notches so that strongly flaring base usually as wide as, or wider than shoulders. Base characterized by wide, deep concavity which produced very sharp corners.
Length:	3.5 to 7 cm, average = 5 cm
Width:	2 to 3 cm at shoulders
Stem:	nearly 1/5 to 1/2 of total length
Estimated Age:	Possibly 1000 B.C. to A.D. 500. Prewitt (1981) dates this point 300 B.C. to approximately A.D. 550.
Distribution:	Central Texas

One projectile point style from ENM 10418 has been discussed by Leslie (1978:146). This point (Figure 6.2A) appears to be within the Fairland or Edgewood type according to Suhm and Jelks (1962). Leslie (1978:146) states that these points are dated between 1000 B.C. to A.D. 1000 and are generally found along the Mescalero Ridge south and west of Hobbs. A new dating basis for Fairland has been established in central Texas indicating that this point style ranges in age from 300 B.C. to A.D. 550. Unfortunately the specimen recovered from ENM 10418 was from a surficial context and could not be placed within the C-14 chronological controls.

Two additional dart point styles were recovered from both ENM 10418 and ENM 10230. Type 8-D (Figure 6.2B,C,D) and Type 9 (Figure 6.2E). Again these projectile points were not found in contexts which have been adequately dated. While no secure dates for these projectile points has been determined by this project, the date ranges for both point styles fall within the range of the radiocarbon dates available for ENM 10418 and 10230, thus Leslie's (1978) assertion that these point styles pre-date A.D. are apparently correct. The date range given for Fairland points (300 B.C. - A.D. 550) may be similar to those for Types 8-D and 9 based on the radiocarbon dates currently available for ENM 10230 and ENM 10418.

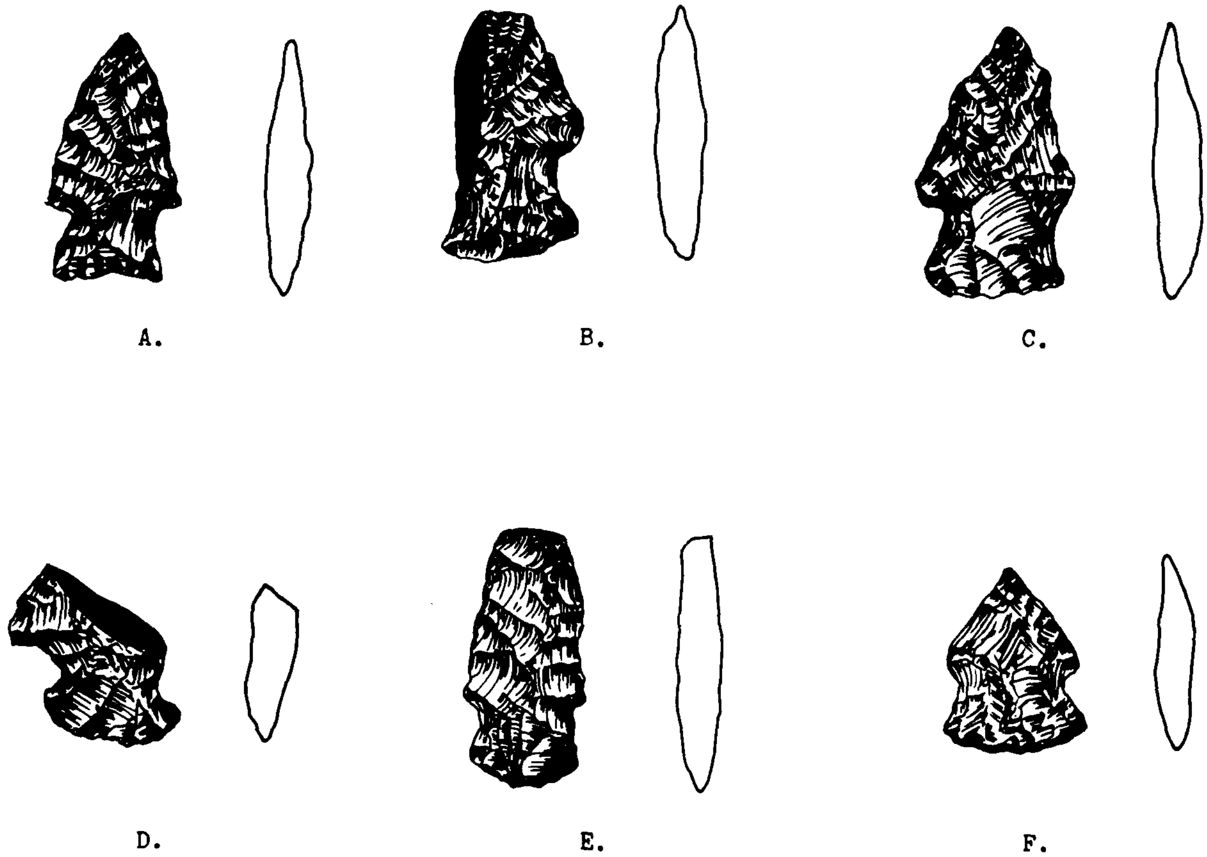


Figure 6.2
Late Archaic Projectile Points

The metric and morphological attributes for these point styles are shown in Table 6.18. One projectile point from ENM 10418 is somewhat of an anomaly. This point (see Figure 6.2F) is visually similar to the 6-A type in Leslie's (1978) typological sequence, however the metric attributes, particularly neck width, base width, and hafting angle, fall within the 8-D type. Apparently the blade on the point was broken and subsequently re-pointed. The point was found in indirect association with Feature 36 which has been radiocarbon dated to 880 ± 140 B.C. This radiocarbon date would suggest that the point illustrated in Figure 6.2F would fall into the 8-D point style which Leslie (1978) places at pre-A.D. 900. The major drawback to the Leslie typology is a lack of radiocarbon dated sites. Based the the metric attributes and the radiocarbon date, the point has been tentatively identified as an 8-D.

TRANSITIONAL POINTS

The next major grouping of projectile points from ENM 10418 and ENM 10230 have been typed to the 6 series within Leslie's (1978) classification system (see Table 6.18). The generalized descriptions for these projectile point types are given below.

TYPE 6-A

Blade Outline:	Triangular
Blade Edges:	Convex, straight to slightly concave
Notches:	Corner, medium to wide with pronounced shoulders to well barbed.
Stem:	Wide, expanding
Base:	Convex
Length:	2.5 to 3.5 cm, average = 3 cm
Width:	2 to 2.8 cm, average = 2.5 cm
Thickness:	.5 to .8 cm, average = .6 cm
Date:	A.D. 850 to 1000; could have started earlier and lasted later.
Associated Point Types:	Types 3-A and 3-B; 5, all other styles in Type 6 and probably some of Types 7, 8, 9, and 10.
Associated Ceramics:	Early varieties of Jornada Brown, Red Mesa Black-on-white, Cebolleta Black-on-white, and possibly Mimbres Black-on-white.

TYPE 6-B

Blade Outline:	Triangular
Blade Edges:	Straight, slightly convex and slightly concave
Notches:	Corner, medium to wide; shoulders are pronounced at right angles to the stem, some well barbed.
Stem:	Commonly wide, expanding
Base:	Straight with some specimens having slightly convex or concave bases.
Length:	2.5 to 3.5 cm, average = 3 cm
Width:	1.8 to 2.5 cm at shoulders, average = 2.1 cm
Thickness:	average about .6 cm
Dates:	A.D. 850 to 1000
Associated Point Types:	Types 3-A and 3-B, 5, all other styles of Type 6, and probably some of Types 7, 8, 9, and 10.
Associated Ceramics:	Early varieties of Jornada Brown, Red Mesa Black-on-white, Cebolleta Black-on-white, and possibly Mimbres Black-on-white.

TYPE 6-C

Blade Outline:	Triangular
Blade Edges:	Convex, straight, or slightly concave
Notches:	Wide corner with slight to pronounced shoulders; some have weak barbs that are usually short and dull.
Stem:	Wide; straight to contracting or slightly expanding
Base:	Both convex and straight
Length:	2.8 to 3.5 cm, average = 3 cm
Width:	1.6 to 2.2 cm, average = 2 cm
Thickness:	.4 to .7 cm, average = .6 cm
Date:	A.D. 850 to 1000
Associated Point Types:	Types 3-A and 3-B; 4, 5, all other styles of Type 6; possibly Types 7, 8, 9, and 10.
Associated Ceramics:	Early varieties of Jornada Brown, Red Mesa Black-on-white, Cebolleta Black-on-white, and possibly Mimbres Black-on-white.

ELLIS

Blade:	Short triangular blade with edges straight to convex. Shoulders prominent to well barbed. Stem expands toward base but never as broad as shoulders; stem tends to be straighter than in most types with cut-out corners. Bases straight to convex.
Length:	3 to 5 cm
Width:	2 to 3 cm at shoulders
Stem Width:	1.5 to 2 cm. Stems equal to 1/4 to nearly 1/2 of total length
Estimated age:	Possibly 1000 B.C. to A.D. 500 or 1000
Distribution:	Widely distributed in Archaic stage more or less throughout Texas except for southwest section and probably the upper Panhandle.

Leslie (1978) has placed these point styles within the A.D. 800 to 1000 range based primarily on ceramic associations. Based on the finding of this project the date range for brownware ceramics may extend back to A.D. 600. The four projectile points within the 6 series from ENM 10230 have been radiocarbon dated by blowout association to A.D. 570 ± 150, A.D. 580 ± 60, A.D. 670 ± 60, and A.D. 880 ± 140 (Figure 6.3:A-D). These date ranges suggest that the points in the 6 series according to Leslie's (1978) typological classifications extend back an additional 200 years in time.

These point styles therefore appear to be transitional between Archaic point types and Neoarchaic style points. The points are generally reduced in size and are intermediate between the Archaic and Neoarchaic styles particularly in overall length, width, neck width, and weight measurements (see Table 6.18).

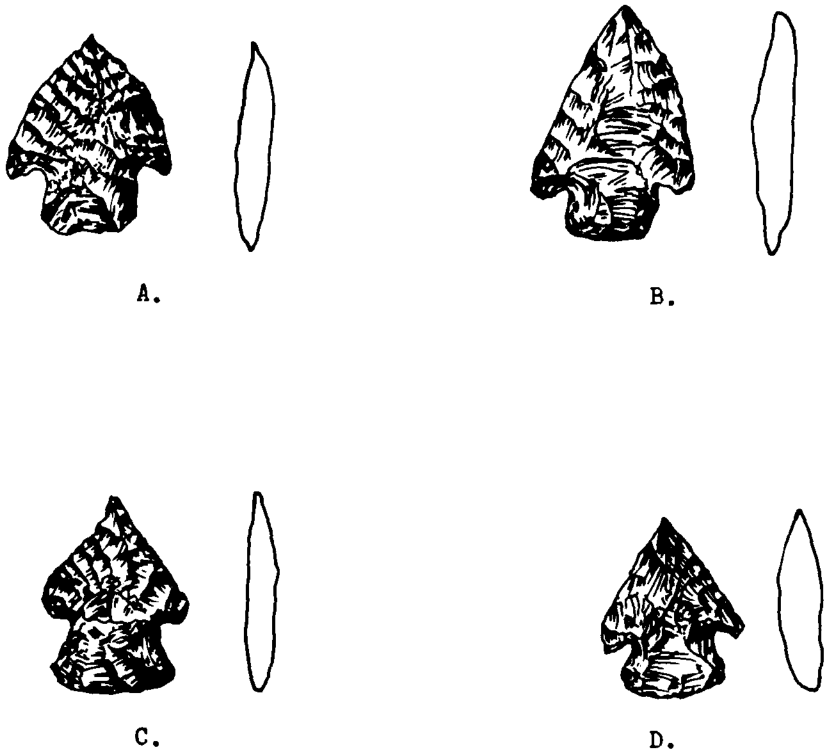


Figure 6.3
Transitional Projectile Points from ENM 10418

ARROW POINTS

The final category of projectile point types includes examples from ENM 10418, ENM 10230 and ENM 10222. These points include Types 1, 2, and 3 in the Leslie (1978) typology (see Table 6.18). One point (Figure 6.4D) resembles the Cliffton/Perdiz or Livermore type defined by Suhm and Jelks (1962). Another point (Figure 6.4C) could not be reliably placed within a named point type. This point was recovered in direct association with Feature 35 at ENM 10418 which has been radiocarbon dated to A.D. 520 ± 80.

Three projectile points were found in indirect association with Features 30 and 31 from ENM 10418. These two features date to A.D. 1190 ± 70 and A.D. 660 ± 70 respectively. These points represent 3C, D, or E (Figure 6.4:G,H) in Leslie's typology and the Cliffton/Perdiz or Livermore specimen (Suhm and Jelks 1962). Generalized descriptions of these points are given below.

TYPE 3-C

Blade Outline:	Triangular
Blade Edges:	Convex, straight, or concave. Rare specimens have serrated edges.
Notches:	Corner, wide, and deep forming strong shoulders at right angles to the stem with rare specimens having short barbs.
Base:	Straight to slightly convex
Length:	2.3 to 3.2 cm, average = 3 cm
Width:	1.5 to 2.5 cm, average = 1.8 cm
Thickness:	.3 to .7 cm, average = .4 cm
Date:	Probably first appeared around A.D. 1000-1050 and lasted until a short time before A.D. 1200.
Associated Point Types:	All styles in Types 1 and 3; possibly Types 2-A and 2-B.
Associated Ceramics:	All varieties of Jornada Brown, Three Rivers Red-on-terracotta, early varieties of El Paso Polychrome, Mimbres Black-on-white, Chupadero Black-on-white.

TYPE 3-D

Blade Outline:	Triangular
Blade Edges:	Convex, straight or concave. Rare specimens have serrated edges.
Notches:	Corner wide forming weak to strong shoulders; some specimens have short barbs that are dull.
Base:	Convex to rounded
Length:	2 to 3.5 cm, average = 3 cm
Width:	1 to 1.8 cm, average = 1.3 cm at shoulders
Thickness:	.3 to .7 cm, average = .4 cm
Date:	Probably first appeared around A.D. 1000-1050, lasting until shortly before A.D. 1200.
Associated Point Types:	All styles in Types 1 and 3; possibly Types 2-A, 2-B.
Associated Ceramics:	All varieties of Jornada Brown, Three Rivers Red-on-terracotta, early varieties of El Paso Polychrome, Mimbres Black-on-white, Chupadero Black-on-white.

TYPE 3-E

Blade Outline:	Usually long slender triangular to leaf-shape
Blade Edges:	Both convex and concave; a notch is usually just above the barbs on convex edges; specimens with concave edges are usually in-cut from tip to the outer point of the barb.
Notches:	Corner-wide
Barbs:	long projecting out at right angles to stem or projecting downward at 45^{o} angles.
Stem:	Long, slender, straight to contracting, some pointed, round
Base:	Straight, pointed, convex, rounded

Length:	2.5 to 4 cm, average = 3 cm
Width:	1.3 to 2.2 cm, average = 1.5 cm
Thickness:	.4 to .7 cm, average = .6 cm
Date:	A.D. 1050-1200
Associated Point Types:	1-A, 1-B; 2-A, 2-B; all styles of Type 3
Associated Ceramics:	All varieties of Jornada Brown, Three Rivers Red-on-terracotta, early varieties of El Paso Polychrome, Mimbres Black-on-white, Chupadero Black-on-white.

ALBA

Outline:	Triangular blade with edges usually concave or recurved, seldom straight. Shoulders wide, outflaring, usually barbed. Stem edges usually parallel, occasionally contracted or expanded slightly. Base straight or slightly convex.
Length:	1.8 to 3.5 cm
Width:	1.5 cm, seldom more or less
Stem Length:	.7 cm
Estimated Age:	About time of Christ to A.D. 1200 or later
Distribution:	All of east Texas and adjacent states; southward to Coastal plain, and westward with decreasing frequency into north-central and central Texas.

BONHAM

Outline:	Slender triangular blade with edges usually straight but sometimes slightly concave or recurved. Shoulders sometimes squared but usually have small barbs. Stem very narrow and parallel edged. Base straight or slightly convex.
Length:	2 to 4 cm
Width:	1 to 1.5 cm
Stem Length:	.5 to .7 cm
Estimated Age:	A.D. 800 to 1200
Distribution:	Northern part of east Texas, especially Red River Valley, eastern Oklahoma, and north-central Texas. A few specimens from northern part of central Texas and possibly as far west as Pecos River.

LIVERMORE

Outline:	More or less of a cross due to very slender in-cut blade, widely flaring shoulders, and narrow stem. Base pointed or rounded. Blade edges frequently serrated, often some teeth considerably longer than others.
Length:	2.5 to 5 cm
Width:	1.2 to 3 cm across shoulders
Stem:	stem may be same width as blade, sometimes less, sometimes more
Estimated Age:	A.D. 800 to 1200
Distribution:	Principally in central part of Trans-Pecos Texas, extends into Jornada Mogollon area.

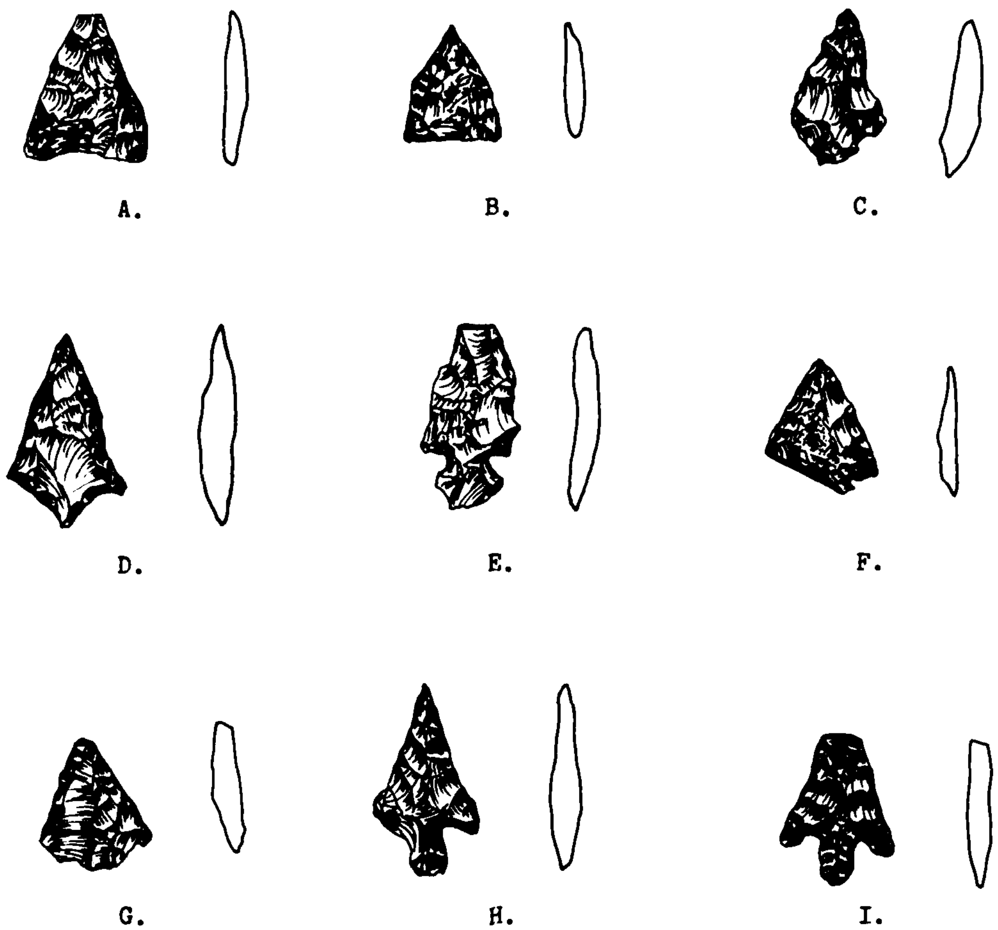


Figure 6.4
Neoarchaic Projectile Points

According to Leslie (1978) dates for these projectile point styles range in age from A.D. 1000 to 1200. This date range fits the radiocarbon date for Feature 30. The associated ceramics found on ENM 10418 also fit with the Leslie (1978) typological descriptions. Another Type 3 projectile point was recovered from ENM 10418 (Figure 6.4H). This point was recovered from the extreme eastern edge of the site with no feature or ceramic associations.

Type 2 projectile points were recovered from both ENM 10418 and ENM 10230 (see Table 6.18). The description of Type 2 points by Leslie (1978) and the

Scallorn point in the Texas classification (Suhm and Jelks 1982) are discussed below.

TYPE 2-A

Blade Outlines:	Triangular
Blade Edges:	Mostly convex, rarely straight or recurved.
Notches:	Side opposed; medium to narrow in width; depth shallow to deep. Distance between notches (neck width) from .5 to 1 cm.
Base:	Convex
Length:	1.8 to 3 cm, average = 2.5 cm
Width:	1 to 1.6 cm, average = 1.5 cm
Thickness:	.2 to .6 cm, average = .5cm
Date:	Probably a short time before A.D. 1200 until A.D. 1300
Associated Point Types:	1-A, 1-B, 1-C; 2-B, 2-C; 3-A, 3-B
Associated Ceramics:	All varieties of Jornada Brown except South Pecos Brown, Three Rivers Red-on-terracotta, Lincoln Black-on-red, El Paso Polychrome, Ramos Polychrome, Gila Polychrome, Playas Red and Incised, Corona Corrugated, Roswell Corrugated, Chupadero Black-on-white.

SCALLORN

Outline:	Broad to slender triangular blades with edges straight to convex, occasionally concave. Shoulders may be squared but usually well barbed. Stem formed by notching into corners at various angles making it expand from a broad wedge shape to rounded extremities as wide as the shoulders. Base straight, concave and convex.
Length:	2.5 to 4.5 cm
Width:	1.5 to 2 cm
Estimated Age:	A.D. 700 to 1500 [Prewitt (1981) dates points from Central Texas to A.D. 700 to 1300.]
Distribution:	More or less a broad central belt through Texas from Red River Valley to Gulf Coast but absent in east Texas and eastern and southern extremities of the coast.

The Type 2 projectile point from ENM 10418 (Figure 6.4F) was found on the surface near the northeastern limits of the site. The base of this point has been broken off thereby limiting the typological classification. Leslie (1978) provides a date range for this point between A.D. 1200 and 1300. The Scallorn point has been dated to between A.D. 700 and 1500 by Suhm and Jelks (1962). Prewitt (1981) suggests a range between A.D. 700 and 1300.

A single Type 2 point was recovered from ENM 10230. This point (Figure 6.4E) has been classified as a 2-A type in Leslie's (1978) classification scheme and fits into some of the Scallorn types described by Suhm and Jelks (1962). No datable materials were found in association with this projectile point;

however, the A.D. 1200 to 1300 date range assigned by Leslie (1978) falls within the range of radiocarbon dates for ENM 10230.

A fourth group of Neoarchaic projectile points recovered from the WIPP sites have been classified as 1-A or 1-C within the Leslie (1978) system or Fresno within the Texas typology (Suhm and Jelks 1962). These points are simple triangles with no notches (see Table 6.18). The specimens from ENM 10230 (Figure 6.4B) and ENM 10222 (Figure 6.4A) vary only slightly in size. Generalized descriptions of these types are given below.

TYPE 1-A

Blade Outline:	Triangular to leaf shape
Blade Edges:	Usually convex; a small number may be straight or concave.
Notches:	None
Base:	Convex
Length:	1.5 to 3 cm, average = 2.5 cm
Width:	1 to 1.7 cm, average = 1.5 cm
Thickness:	.2 to .6 cm, average = .5 cm
Dates:	First appeared around A.D. 950-1000 to A.D. 1300. Appears again in Late Ochoa phase (A.D. 1400-1500)
Associated Point Types:	3-A, 2-A, 2-F
Associated Ceramics:	All varieties of Jornada Brown, Three Rivers Red-on-terracotta, Lincoln Black-on-red, Glaze A red and yellow, El Paso Polychrome, Ramos Polychrome, Gila Polychrome, Playas Red and Incised, Corona Corrugated, Roswell Corrugated, Ochoa Corrugated, Ochoa Indented, Red Mesa Black-on-white, Cebolleta Black-on-white, Mimbres Black-on-white, Chupadero Black-on-white.

TYPE 1-C

Blade Outline:	Triangular
Blade Edges:	Straight, convex, concave. Recurving is common.
Notches:	None
Base:	Slight to deeply concave; various degrees of flaring on some specimens.
Length:	1.6 to 3.5 cm, average = 2.5 cm
Width:	1 to 1.5 cm, average = 1.2 cm
Thickness:	.2 to .5 cm, average = .4 cm
Dates:	First appeared around A.D. 1250 to 1500
Associated Point Types:	All forms of Types 1 and 2
Associated Ceramics:	All varieties of Jornada Brown, Three Rivers Red-on-terracotta, Lincoln Black-on-red, El Paso Polychrome, Ramos Polychrome, Gila Polychrome, Roswell Corrugated, Corona Corrugated, Ochoa Corrugated, Ochoa Indented, Playas Red and Incised, Glaze A red and yellow, Chupadero Black-on-white.

FRESNO

Blade Outline:	Simple triangles with straight to slightly convex edges, bases usually straight but may be concave or slightly convex.
Length:	2 to 3.5 cm
Width:	1 to 2 cm
Estimated Age:	A.D. 800 or 900 to 1600
Distribution:	Practically statewide in Texas, lacking only eastern-most counties next to Louisiana.

This point style ranges in age from A.D. 950 to 1300 and appears again in the Late Ochoan phase between A.D. 1400-1500 (Leslie 1978). These date ranges also apply to the Fresno style in Texas (Suhm and Jelks 1962).

This point style and the date ranges assigned to it are within the radiocarbon chronology established from ENM 10230. The ceramic assemblage for ENM 10230 consists entirely of brownwares although Chupadero Black-on-white was noted at the site and in local collections.

Great difficulties exist in placing this projectile point style within the context of the work done at ENM 10222. This was the only projectile point which could be placed within the projectile point classification scheme. Two radiocarbon dates were processed for ENM 10222: A.D. 720 ± 590 and 1140 ± 190 B.C. The extreme range in standard deviations for the former make the association tentative. In addition, during fieldwork at the site no ceramics were recovered. The original survey report indicates that the site contained El Paso Brownware sherds and two projectile points "both of which appear somewhat Archaic" (Schermer 1980:30). A discussion with Scott Schermer indicates that these materials were not collected and were probably collected by unauthorized persons.

SUMMARY

Although the WIPP archaeological project recovered a limited number of projectile points, a number of trends can be placed within a regional sequence. The Archaic (Types 8 and 9) and Transitional (Type 6) projectile points recovered from ENM 10418 and ENM 10230 may represent a regional expression in the Late Archaic which probably developed in situ. The exact range of this distribution is unknown at present; however, similar styles have been noted west of the Pecos River at Three Rivers (Wimberly and Rogers 1977) and in the Guadalupe Mountain foothills (Mera 1938). On the east side of the river, projectile points similar in morphology to those found at WIPP have been found from Santa Rosa to the north (Schelberg in press) in the Roswell area (Kemrer and Kearns 1984) and numerous areas around Carlsbad (Leslie 1978). The eastern and southern limits of this distribution have not yet been defined.

The antecedents of these projectile point styles are difficult to determine due to a notable lack of Early and Middle Archaic sites in the region. Some Middle Archaic projectile points have been found east of the project area. These point types strongly resemble Texas projectile point styles. The shift to expanding stems and rocker (convex) bases found in eastern New Mexico is not represented in the Texas sequence.

The Neoarchaic projectile points have a wider distributional range. These styles as represented in southeastern New Mexico extend from eastern Texas, across to the Great Basin of Nevada and Utah to the Colorado area. The style generally occurs among ceramic producing groups and Neoarchaic groups (Prewitt 1981). This distribution may indicate widespread contact across a vast expanse of territory. At present, the locus for this distribution, if indeed a single locus is present, is not known. Much finer chronological control is needed in order to document the origins of the various Archaic and Neoarchaic projectile point styles.

Chapter 7

BIOLOGICAL STUDIES

Kenneth J. Lord and Karen H. Clary

FLOTATION ANALYSES

Botanical Remains

Sixty-two flotation samples were collected from ENM 10222, ENM 10230 and ENM 10418. Provenience information for the samples is shown in Table 7.1. All samples collected consisted of at least one liter of soil. All samples collected from the site were processed by the CCP staff to determine if sufficient materials were present for further analysis. Processing of flotation samples took place in the laboratory. All samples were wet screened through 1/16" window screen mesh in 5-gallon buckets. The materials were agitated to allow lighter materials to float to the surface. The light fraction was skimmed off using nylon stockings stretched across embroidery hoops. The light fraction was then rinsed and gently tapped out on to paper towels for air drying. The heavy material was caught in the 1/16" mesh, rinsed, and also air dried. After drying, the light and heavy fractions were manually sorted using a 10x ring light and tweezers. Materials were sorted into seed categories, snails, bone, charcoal, and residue. The residue generally consisted of roots, rootlets, and small pebbles.

Table 7.1
Flotation Samples Collected
(* = analyzed)

Excavation Unit	Feature Number	Level	Elevation	FS No.
ENM 10222				
89N/111E	2	0-10	99.44-99.34	1
* 89N/111E	2	10-20	99.34-99.24	
ENM 10230				
46S/66E	1	3-8	95.46-95.41	4
* 46S/66E	1	10-17	95.39-95.32	7
46S/66E	1	23-25	95.26-95.24	9
* 45S/66E	2		95.69-95.49	3
* 69S/167E	5	+6	no elevation	3
* 69S/167E	5	0-10	no elevation	4
* 173S/244E	6	0-10	99.47-99.37	1
* 173S/244E	6	10-20	99.37-99.27	5

Table 7.1 (continued)
Flotation Samples Collected
(* = analyzed)

Excavation Unit	Feature Number	Level	Elevation	FS No.
ENM 10418				
* 108N/115E	4		100.51-100.41	1
* 85N/79E	6	3-13	98.73-98.63	1
* 95N/48E	7	45	96.88	1
* 95N/48E	7	80	96.53	3
* 95N/48E	7	87	96.46	2
* 100N/113E	9	17-20	100.40-100.37	4
* 100N/114E	10	15-20	100.44-100.39	4
* 101N/111E	12	10-15	100.44-100.39	2
* 108N/129E	14	20-30	100.33-100.23	2
108N/129E	14	30-40	100.23-100.13	4
* 104-106N/102E	16	20-30	99.87-99.77	1
94N/102E	17	20-30	99.48-99.38	1
114N/119-121E	18	60-70	100.27-100.17	2
* 129N/39E	25	5-15	99.55-99.45	2
129N/39E	25	5-20	99.55-99.40	4
* 129N/39E	25	10-20	99.50-99.40	5
95N/110E	26	10-20	100.17-100.07	4
* 87N/176E	27	0-10	100.95-100.85	4
87N/176E	27	20-40	100.75-100.55	7
* 98N/111E	28	+2-12	100.31-100.17	2
94-95N/111E	29	20-30	100.19-100.09	1
* 105N/112E	30	10-20	100.28-100.18	6
* 105N/114E	31	10-20	100.40-100.20	6
98N/118E	32	10-20	100.41-100.31	5
* 98N/118E	32	20-30	100.31-100.21	7
105N/114E	34	30-40	100.08-99.92	3
85N/140E	35 - Pit 1	40-50	100.51-100.41	2
85N/140E	35 - Pit 2	40-50	100.51-100.41	3
104N/145E	36	10-20	100.60-100.50	6
* 104N/145E	36	20-30	100.50-100.40	9
* 106N/111E	37		100.14-99.95	1
103N/169E	40	10-30	100.85-100.75	1-2
* 122N/111E	A		99.88	1
* 107N/93E	B		99.53-99.42	1
* 106N/87E	C		99.31-99.16	1
* 105N/85E	D		99.60-99.54	1
* 103N/87E	E		99.29-99.21	1
* 101N/91E	F		99.45	1
* 96N/86E	G		99.34-99.23	1
* 97N/95E	H		99.70-99.60	3
94N/91E	I		99.53-99.45	2
* 87N/101E	J		99.85-99.75	1
* 83N/111E	K		99.87-99.75	3
* 88N/113E	L		100.08-99.62	1

Table 7.1 (continued)
Flotation Samples Collected
(* = analyzed)

Excavation Unit	Feature Number	Level	Elevation	FS No.
ENM 10418 (continued)				
83N/118E	M		100.03-99.78	2
90N/119E	O		100.33-100.26	1
* 95N/131E	Q		100.48-100.26	1
* 89N/148E	R - Pit 1		100.66-100.26	4
* 86N/147E	R - Pit 2		100.36-100.14	1
* 96N/156E	U		100.85-100.73	1
* 144N/31E	AA		100.61-100.56	1
* 133N/35E	BB		100.56	1
* 128N/31E	FF		100.12-100.08	2
* 122N/27E	II		99.89-99.82 3	
* 104N/114E		15-25		5
132N/23E		0-10	99.91-99.81	1
* 132N/23E		10-20	99.81-99.71	2
* 132N/23E		20-30	99.71-99.61	4

After initial processing, samples were selected for detailed identification based on the number of remains present. All seeds, bones and snails were tabulated from the samples listed in Table 7.2. Charcoal was not identified although numerous specimens are identifiable. Seeds were identified by Dr. Lord using Martin and Barkley (1961) with verifications and/or corrections of all seed types made by Mollie S. Toll of the Castetter Laboratory for Ethnobotanical Studies at the University of New Mexico. The results of the flotation analyses are provided below by site.

ENM 10222:

One sample was completely processed from this site. Feature 2 was a large 60 cm by 50 cm circular basin-shaped hearth filled with charcoal and fire-cracked calcium carbonate. It has been radiocarbon dated at 1140 ± 190 B.C. (Tx-5040). A total of 39 seeds and 36 unidentifiable seed fragments was recovered from the sample. No bones, snails, insects, or lithics were recovered. Unfortunately, few of the seeds could be identified to the genus level. Euphorbia sp. seeds were the only seeds which could be positively identified. Other seeds present include seeds which look like Malva sp. and an unknown seed type which resembles Salvia or Brassica. The results from flotation analyses at ENM 10222 produced no known food items.

Table 7.2
Analyzed Flotation Samples - Botanical Remains
(* = uncharred)

Feature No.	*Euphorbia* sp.	*Prosopis glandulosa*	*Circium* sp.	*Sporobolus* sp.	*Setaria* sp.	*Quercus havardii*	*Dithryrea* sp.	Malvaceae?	Salvia/ Brassica-like	Compositae	Unknown	Unidentifiable Fragments
ENM 10222												
2	-	-	-	-	-	-	-	3	28	1*	-	36
ENM 10230												
1	-	-	-	-	-	2	-	-	5	-	-	10
2	-	1	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	5/9*	1*	1	10	-	-	4/8*
6	2*	-	-	-	-	-	-	-	-	-	-	4
ENM 10418												
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	9	-	-	-	-	-	-	-	-	-	13*
14	-	-	-	-	-	-	-	-	-	-	-	1
16	8	-	-	-	-	-	-	-	-	-	-	1*
25	10	22	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	1
28	-	31	-	-	-	-	-	-	-	-	-	-
30	-	19	-	-	-	-	-	-	-	-	-	-
31	-	6	-	-	-	-	-	-	-	-	-	2*
32	-	-	-	-	-	-	-	-	-	-	-	-
35	2	1	-	5*	-	-	-	-	-	-	-	2
36	2	-	-	-	1	-	-	-	-	-	-	-
37	-	7	-	-	-	-	-	-	-	-	-	3
A	11	-	-	-	-	-	-	-	-	-	-	-
B	8	1	-	-	-	-	-	-	-	-	-	8
C	-	44	-	-	-	-	-	-	-	-	-	-
D	-	9	-	-	-	-	-	-	-	-	1	12
F	-	4	-	-	-	-	-	-	-	-	-	-
G	8	9	-	-	-	-	-	-	-	-	-	3
H	-	-	-	-	-	-	-	-	-	-	-	7*
AA	65	-	-	-	-	-	-	-	-	-	-	-
BB	1	15	-	-	-	-	-	-	-	-	-	-
132N/23E	85	-	-	-	-	-	-	-	-	-	-	3
104N/114E	21	-	1	-	-	-	-	-	-	-	-	-

ENM 10230:

Five samples from this site were selected for identification. Feature 1 consists of a charcoal filled pit measuring 27 cm in diameter and 27 cm deep. It has been radiocarbon dated at A.D. 670 ± 60 (Tx-5030). This feature contained *Quercus havardii*, Salvia/Brassica?, and unknown seed fragments.

Feature 2 is a basin-shaped charcoal filled pit measuring 40 by 57 by 15 cm. A single charred *Prosopis glandulosa* seed was recovered. The radiocarbon sample from this feature was too small to process.

Two samples from Feature 5 were analyzed. This feature consists of a fire-cracked rock concentration measuring 55 by 70 by 10 cm with a dark charcoal stain evident just below the rock layer. The hearth has been radiocarbon dated to A.D. 260 ± 150 (Tx-5033). The two samples contained charred and uncharred pieces of *Quercus havardii*, an uncharred *Dithyrera* sp. seed, Malva?, Salvia/Brassica?, and unidentifiable seed fragments.

Feature 6 is a fairly deep basin-shaped depression filled with charcoal which measures 49 by 30 by 28 cm. It has been radiocarbon dated to A.D. 1310 ± 40 (Tx-5037). Only uncharred plant materials and insect parts were recovered from the sample.

The flotation samples recovered from ENM 10230 contain two seed types which were utilized by prehistoric populations. Both *Prosopis* and *Quercus* produce edible seeds which probably formed a significant portion of the diet. The low numbers of seeds present may indicate that processing using fires was not necessary and the seed remains may represent use as fuel rather than plant processing.

ENM 10418:

A total of 26 flotation samples was processed for botanical analyses. The majority of these samples are from the fill of features. Feature descriptions and radiocarbon dates when available are displayed in Chapter 4, Table 4.8. Botanical remains from ENM 10418 are shown in Table 7.2. The samples generally contain similar types of plant remains. *Prosopis glandulosa* and/or *Euphorbia* sp. seeds were found in all of the samples with the exception of five features. All of these specimens were charred. In addition to these dominant species, one sample each contained *Cirsium* sp. (104N/114E), *Sporobolus* sp. (Feature 35), and *Setaria* sp. (Feature 36).

Prosopis glandulosa is the only species which could be considered to be an economic plant based on the number of seeds. The presence of *Euphorbia* seeds is puzzling. Castetter (1935:29) indicates that *Euphorbia serpyllifolia* roots were gathered and stored in sacks by the Zuni. A small piece of the root is placed in the mouth for two days being removed just before beginning the process of sweetening freshly and finely ground corn meal. The saliva, containing the enzyme diastase, changes the starch of the corn meal into sugar, and the Euphorbia root is probably kept in the mouth for the purpose of stimulating secretion of the enzyme. ENM 10418 contains no evidence of corn being utilized and the reasons for large numbers of charred Euphorbia seeds in the features is a mystery.

A listing and description of all of the economically useful plants found within the WIPP area are provided below.

Agavaceae

Yucca campestris	Dune yucca
Y. elata	Palmilla, soaptree yucca
Y. torreyi	Torrey yucca, Spanish dagger

Yucca baccata fruits were widely used as a food resource across the southwest. It may be eaten raw or boiled. A conserve is also made from the pared fruit (Castetter 1935:54). The Pima use Yucca baccata as a source of food by boiling, drying and grinding the fruit and boiling the resulting meal with wheat flour (Castetter 1935:54). The fruit can also be boiled, dried, and stored for winter use. The flowers of various yucca species can also be eaten as food (Castetter 1935:56).

Amaranthaceae

Amaranthus albus	Tumble pigweed
A. blitoides	Tumble pigweed
A. hybridus	Green amaranth or pigweed
A. palmeri	Red root pigweed
A. prostrata	Prostrate pigweed

Amaranthaceae were commonly used as food by prehistoric inhabitants of the Southwest. The young plants can be used as greens, being boiled and eaten or dried for winter use (Castetter 1935:15-16). The mature seeds were also eaten as food. The seeds are ground and made into a mush (Castetter 1935:21-23).

Rhus microphylla	Little leaf sumac

The fruit is eaten fresh or after being ground to form a meal by the Navajo, the Pueblo Indians of the Rio Grande Valley, the Hopi, and the Mescalero Apache (Castetter 1935:49).

Asclepiadaceae

Asclepias arenaria	Dune milkweed
A. nyctaginifolia	Four-o-clock milkweed
A. oenotheriodes	Primrose milkweed
A. viridiflora	Green-flowered milkweed.

While Castetter (1935) does not specifically mention any of these species of milkweed, he does state that A. galioides and A. speciosa were used as food.

The roots and unripe pods of *A. galioides* can be eaten raw and the leaves and young shoots of *A. speciosa* are boiled with meat and eaten by the Hopi (Castetter 1935:17). The milky stems of *A. speciosa* is collected by the Acoma and Laguna and allowed to harden before being used as chewing gum (Castetter 1935:31).

Lithospermum multiflorum	Stoneseed

Among the Pima the fresh leaves are eaten as food (Castetter 1935:33).

Cactaceae

Echinocactus macromeris	Texas devilshead
Echinocereus caespitosus	Caespitose hedgehog
E. fendleri	Fendler hedgehog
Opuntia davisii	Davis cholla
O. kleiniae	Klein cholla
O. leptocaulis	Christmas cactus
O. phaeacantha	Prickly pear

Fruits of most cactaceae are edible. The Echinocereus fruit may be eaten fresh after removing the spines by burning. The fruit may be sliced and baked like squash (Castetter 1935:26). The Opuntias provide food in two forms: the fruits may be eaten fresh, split, dried and ground, and made into a meal for winter consumption or fruits of certain species may be pit baked in preparation for storage (Castetter 1935:35-36). The pads themselves may be roasted and eaten or young pads could be split lengthwise, dried, and stored for winter use (Castetter 1935:35).

Chenopodiaceae

Allenrolfea occidentalis	Pickleweed
Atriplex canescens	Four-wing saltbush
Chenopodium desiccatum	Thickleaf goosefoot
C. hians	Fetid goosefoot
C. incanum	Gray goosefoot
Cyloloma atriplicifolia	Winged pigweed

Chenopods can be eaten either as greens or the seeds can be consumed. Allenrolfea seeds have had an important role in the Great Basin for thousands of years (Fry 1970). Atriplex can be used as a flavoring and the young leaves of some species may be boiled and eaten as greens (Castetter 1935:18).

Chenopodium can also be eaten as a green in early spring to summer and the seeds can be ground and eaten alone or mixed with other seed plants, much like Amaranths.

Compositae

Artemisia filifolia	Sand sagebrush
A. ludoviciana	Wormwort
Berlandiera lyrata	Lyrate greeneyes
Chrysothamnus pulchellus	Southwest rabbitbrush
C. spathulatus	Bluntleaf rabbitbrush
Circium sp.	Thistle
Helianthus petiolaris	Prairie sunflower
Hymenopappus flavescens	White ragweed
Hymenoxys spaposa	Smooth hymenoxys

Composites make up a large portion of the plants presently found in the area and provide a variety of food types. Artemisia seeds can be ground and eaten (Castetter 1935:21). The flower buds of Chrysothamnus are salted and eaten by the San Felipe Pueblos (Castetter 1935:24). Portions of Circium can be eaten as greens. Helianthus seeds can be ground with the resulting flour made into cakes. Certain species of Hymenopappas and Hymenoxys roots can be used as a substitute for chewing gum (Castetter 1935:30-31).

Cruciferae

Descurainia pinnata	Tansy mustard
Lepidium montanum	Mountain peppergrass
Lepidium virginicum	Peppergrass

Descurainia can be eaten as a green much like spinach (Castetter 1935:25).

Cyperus schweinitzii	Flatsedge

The small tuberous roots of a Cyperus species are eaten as food by the Laguna and Acoma (Castetter 1935:25).

Euphorbiaceae

Euphorbia fendleri	Fendler spurge
E. glyptosperma	Ridge-seed spurge
E. heterophylla	Catalina
E. lata	Spurge
E. micromera	Spurge
E. missurica	Spreading spurge
E. prostrata	Flat spurge
E. serpens	Serpent spurge
E. serpyllifolia	Thymeleaf spurge
E. serrula	Serrulate spurge

E. serpyllifolia roots are gathered and stored in sacks by the Zuni. A small piece of the root is placed in the mouth for two days being removed just before beginning the process of sweetening freshly and finely ground corn meal. The saliva, containing the enzyme diastase, changes the starch of the corn meal into sugar, and the spurge root is probably kept in the mouth for the purpose of stimulating secretion of the enzyme (Castetter 1935:29).

Quercus havardii	Havard oak, shinnery oak

A wide variety of oak trees produce edible acorns. The acorns from Q. havardii are the largest found in New Mexico. Castetter (1935:47) indicates that "acorns were boiled like beans or roasted on coals by the Navajo. Among the Pima acorns....were parched and ground to make meal". It is not known whether Q. havardii contains large enough amounts of tannic acid to require special processing.

Gramineae

Panicum capillare	Common witchgrass
P. obtusum	Vine-mesquite
Sporobolus contractus	Spike dropseed
S. cryptandrus	Sand dropseed
S. flexuousus	Mesa dropseed
S. giganteus	Giant dropseed

These grasses produce edible seeds which have been utilized by Indian groups across western North America. The Navajo make dumplings, rolls, and griddle-cakes from the ground seeds of S. cryptandrus, while among the Hopi seeds of this species as well as of P. capillare are ground and mixed with corn meal for food (Castetter 1935:28).

Monarda punctata var. lasiodonta	Spotted horsemint

Among most of the Pueblo Indians of New Mexico as well as the Spanish-Americans horsemint is cooked with meats and soups as a flavoring and is often dried and stored for winter use. At Hano, however, the plant is cooked and eaten by itself (Castetter 1935:34).

Leguminosae

Dalea formosa	Featherbush
D. lanata	Woolly dalea
Hoffmanseggia densiflora	Hog potato
H. jamesii	Hog potato
Prosopis glandulosa	Honey mesquite

The roots of Dalea lanata are scraped and eaten as sweets by the Hopi (Castetter 1935:17). The tuberous, rather sweet but tough Indian potato (Hoffmanseggia densiflora) was commonly roasted and eaten by various Pueblos of the Rio Grande Valley of New Mexico, as well as by the Mescalero Apache. When roasted it tastes much like the Irish potato (Castetter 1935:52).

Prosopis glandulosa is one of the best known plants of the arid Southwest and in parts of southern New Mexico is of great economic importance. The flowers furnish excellent nectar for honey making, while the leaves and pods are extensively eaten by browsing animals of all kinds.

The seeds are gathered by some Indian peoples, who grind them and make the meal into a kind of bread. The Mescalero Apache grind the seeds into flour which is then made into a pancake. The beans are often boiled, then pounded on a hide or ground on a metate, after which they are kneaded with the hands until a thick jam-like substance is formed. The Apache also grind the mesquite pod to make flour and this flour is used in making pinole.

The Pima roast and grind the beans to make flour, first roasting them in pits lined with arrow bushes. They are placed in alternate strata with cockleburr leaves and the whole covered with earth. After baking several days they are removed, spread out to dry, then stored (Castetter 1935:44-45).

Loasaceae

Mentzelia humilis	Stickleaf
M. pumila	Golden blazing star
M. reverchonii	Reverchon stickleaf
M. strictissima	Prairie stickleaf

The Hopi parch and grind the seeds of Mentzelia albicaulis into a fine sweet meal and eat it in pinches (Castetter 1935:34). It is possible that one of the species listed above may have been similarly used.

Polygonaceae

Eriogonum abertianum	Abert buckwheat
E. annum	Winged buckwheat
E. leptocladon	
E. polycladon	Wooly buckwheat
E. rotundifolium	Roundleaf buckwheat
Rumex hymenosepalus	Wild rhubarb

Among the Hopi Eriogonum corymbosum leaves are boiled and, with some of the water in which they are boiled, they are rubbed on the mealing stone with corn meal, then baked into a type of bread (Castetter 1935:29).

The roots and stems of Rumex are eaten by the Pima. The stem is generally roasted in ashes. The leafy stems may be substituted for rhubarb (Castetter 1935:50).

Portulacaceae

Portulaca parvula	Small purslane
P. retusa	Retose purslane

Portulaca is a very important native plant in New Mexico. The fleshy leaves and stems are boiled and eaten as greens. The leaves may be slowly dried and stored as greens in the winter. The seeds may also be eaten (Castetter 1935:43).

Solanaceae

Physalis lobata	Lobed ground-cherry
P. lederaefolia	Clammy ground-cherry

Species of Physalis can be eaten fresh or boiled. The Zuni dry and grind them and the meal is made into bread (Castetter 1935:40).

Celtis reticlata	Netleaf hackberry

The berries of this species are eaten by many of the Pueblo Indians of the Rio Grande Valley (Castetter 1935:21).

Terrestrial Gastropods

In addition to the botanical remains recovered from the flotation analyses, terrestrial gastropods were also recovered. All of the land snails identified came from features at ENM 10418. These are listed in Table 7.3. An additional 19 samples from the flotation samples processed for ENM 10418 have been included in this analyses. Five species of land snails have been identified from the samples. They are in order of frequency: *Gastrocopta cristata* (124), *Pupoides albilabris* (11), *Heloidiscus singleyanus* (6), *Striatura meridionalis* (2), and *Gastrocopta tappaniana* (1). If Feature 7, a charcoal stain in a recent cut and fill episode of the arroyo at the site, is eliminated, *Pupoides albilabris* is the dominant species with *Gastrocopta cristata* second in importance. The range and habitat requirements for these species are presented below from Leonard (1959).

Pupoides albilabris (C. B. Adams)

Range: Eastern North America from southern Canada to the Gulf of Mexico, west to the Dakotas, Colorado and western Arizona.

Habitat: To the east of Kansas in Indiana and Illinois this species lives under sticks, logs, and leaf litter in wooded areas as well as in drier situations such as open pastures, railroad embankments, and rocky open country. It is a very hardy animal and has been collected from sagebrush flats in the western part of Kansas. It has a high tolerance to aridity and high temperatures.

Gastrocopta cristata (Pilsbry and Vanatta)

Range: Kansas, Oklahoma, Texas, New Mexico and Arizona.

Habitat: This snail can be found in timbered areas in both upland and flood-plain situations, as well as in grasslands.

Table 7.3
ENM 10418 Analyzed Flotation Samples - Gastropod Remains

Feature No.	Striatura meridionalis	Heliodiscus singleyanus	Gastrocopta tappaniana	Gastrocopta cristata	Gastrocopta sp.	Pupoides albilabris	Unidentifiable Fragments	Insect Parts
4	-	-	-	-	-	1	-	-
6	-	-	-	-	-	1	4	-
7	1	3	1	116	-	3	14	-
9	-	-	-	-	-	-	-	P*
10	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	P
14	-	-	-	-	-	-	-	P
16	-	-	-	-	-	1	-	-
25	-	-	-	-	-	-	2	P
27	-	-	-	-	1	-	10	P
28	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-
31	-	1	-	-	-	-	4	P
32	-	-	-	-	1	-	10	P
35	-	-	-	-	-	-	-	P
36	-	-	-	-	-	-	5	P
37	-	-	-	-	-	-	-	P
A	-	-	-	-	-	-	-	P
B	-	-	-	-	-	-	18	P
C	-	1	-	-	-	-	-	P
D	-	-	-	1	-	1	13	P
E	-	-	-	-	-	-	-	P
F	-	-	-	-	-	-	-	P
G	-	-	-	-	-	-	-	P
H	-	-	-	-	-	-	-	-
J	-	-	-	-	-	-	-	P
K	-	-	-	1	-	-	-	P
L	-	-	-	-	-	1	7	-
Q	-	-	-	-	-	-	-	P
R - Pit 1	-	-	-	-	2	-	-	-
R - Pit 2	-	1	-	-	-	-	-	P
U	-	-	-	-	-	-	-	P
AA	-	-	-	-	-	-	-	-
BB	-	-	-	1	-	-	22	P
FF	-	-	-	1	1	-	-	-
II	1	-	-	2	1	-	1	-
Backhoe Trench 1	-	-	-	1	-	1	5	-
132N/23E	-	-	-	-	-	2	-	-
104N/114E	-	-	-	-	-	-	-	-

* P = Presence

Heliodiscus singleyanus (Pilsbry)

Range: United States from New Jersey and Florida, west to South Dakota, southwest to Arizona.

Habitat: In Kansas it has been found in siftings of leaf litter, but many of the records are from drift and may be unreliable since the species is abundant in certain Pleistocene deposits.

Striatura meridionalis (Pilsbry and Ferriss)

Range: Eastern North America from Pennsylvania to Kansas, southward to Florida and Mexico.

Habitat: This species lives in the leaf litter and debris of the forest floor.

Gastrocopta tappaniana (C. B. Adams)

Range: North America from southern Canada and Alabama west to South Dakota and Arizona.

Habitat: This snail is found beneath wood logs and similar debris in moist places, especially on floodplains and in moist upland forested areas.

The majority of the terrestrial gastropods species indicate that climate conditions in the area have remained essentially stable. The presence of *Striatura meridionalis* and *Gastrocopta tappaniana* indicate a moist forested situation. This may be caused by a microhabitat within the arroyo system or may indicate inwashing from other more favorable areas.

POLLEN ANALYSIS

Nineteen pollen samples from three archaeological sites (ENM 10222, ENM 10230, and ENM 10418) from the WIPP Project were submitted to the Castetter Laboratory for Ethnobotanical Studies for extraction and analysis. The analysis of well-preserved fossil pollen from prehistoric vegetation may be useful in identifying specific plants used for subsistence by aboriginal peoples, as well as vegetation growing in the vicinity and at a distance from the sites. By sampling archaeological features such as hearths, floors, and pits, information regarding the botanical use of plants in relation to these features may be derived.

Analysis of the samples revealed that pollen preservation was extremely poor (see Table 7.4). Three separate slide preparations were made of each sample and these were scanned in search of pollen. In general, one or two deteriorated pollen grains were visible per preparation. These were pine, high-spine Compositae (Sunflower family), mesquite, juniper, oak, and grasses. In this context of poor preservation, they are not diagnostic. *Eucalyptus* control

Table .4
Pollen Analysis Results

No. of Pollen Grains Observed

Sample No.	ARBOREAL POLLEN: Pinus sp. (Pine)	ARBOREAL POLLEN: Juniperus sp. (Juniper)	ARBOREAL POLLEN: Quercus sp. (Oak)	NON ARBOREAL POLLEN: Prosopis sp. (Mesquite)	NON ARBOREAL POLLEN: Cheno-am Chenopod-Amaranth	NON ARBOREAL POLLEN: H.S. Compositae (High Spine Sunflower)	NON ARBOREAL POLLEN: Gramineae (Grasses)	NON ARBOREAL POLLEN: Unidentified, too weathered	Pollen Sum	Absolute No. pollen grains/gm. sediment
NM 10222										
. 36N/125E, FS 1, 30-40 cm, 98.88-98.78	-	-	-	-	-	1	-	1	2	[illegible]
35N/125E, FS 2, 70-80 cm, 98.45	-	-	-	-	-	-		-	0	0
. 89N/111E, FS 2, 8 cm, 99.39	2	1	-	2	-	2	2	-	9	248
. 22N/175E, FS 4, 40-50 cm, 99.23	-	-	-	-		-	-	-	0	0
5. 39N/111E, Fea. 2, FS 3, Strat. 3, East wall, 99.27	-	-	-	-	-	-		-	0	0
6 86N/125E, FS 2, East profile, 98.68-98.58	-	-	-	-	-	-	-	-	0	0
NM 10230										
. 95S/174E, FS 7, Lev. 11 60-70 cm, 97.72-97.62	-	-	-	-	-	-	-	-	0	0
173S/244E, FS 6, Fea. 6, Lev. 12, 10-20 cm, 97.37-97.27	1	1	1	-	-	1	-	-	4	120
. 46S/66E, FS 9, Fea. 1, Lev. 13, 23-25 cm, 95.26-95.24	-	-	-	-	-	-	-	-	0	0
12. 155S/287E, FS 5, Fea. 3, 44 cm	-	-	-	-	-	-	-	-	0	0
13. 46S/66E, Fea. 1, Lev. 1 3-8 cm, 95.46-95.24	-	-	-		-	-	-	-	0	0
17. 69S/167E, FS 2, 0-10 cm, 97.70-97.60	-	-	-	-	-	1	-	-	1	29
ENM 10418										
. 89N/147E, FS 7, Fea. 8-Pit 2, 100.36-100.14	-	-	-	-	-	-	-	-	0	0
. 101N/118E, FS 8, Lev. 8 60-70 cm, 100.17-100.07	-	-	-	-	-	1	-	-	1	27
- 101N/111E, FS 3, Lev. 2, 0-10 cm, 100.54-100.44	-	-	-	-	-	-	-	-	0	0
10. 100N/113E, FS 2, Fea. 9, Lev. 1, Mano, 100.47-100.37	-	-	-	-	-	-	-	-	0	0
. 106N/112E, FS 1, Lev. 2, 3-14 cm, Mano, 100.38-100.28	-	-	-	-	-	-	-	-	0	0
18. 104N/145E, FS 7, Fea. 36, Lev. 3, 100.50-100.40	-	-		-	-	-	-	-	0	0
9. 129N/39E, FS 3, Fea. 25, Levs. 2-3, 5-20 cm, 99.55-99.40	-	-	-	-	-	-	-	-	0	0

pollen added to the samples prior to chemical extraction indicated that there was an average of 240 fossil grains per gram of sediment for each sample, far below the 1000 estimated by Hall (1981) to be sufficient for reliable interpretation of pollen. The single major problem was abundance of charcoal and ash. All of the samples, with the exception of the two metate samples, were charcoal and ash laden. Charcoal obscured pollen and ash, in conjunction with water from soil moisture, most likely had a strongly corrosive effect on the pollen in the samples. Abundant fungal hyphae and spores attest to wetting and drying sequences.

The metate samples were composed of residues scrubbed from the metate surfaces with distilled water and a sterile scrub brush. They did not contain fossil pollen and were completely undiagnostic.

Pollen Extraction

The samples were processed using a modification of the method described by Mehringer (1967).

1. A 25 gram soil sample was taken from the bag and weighed on a triple beam balance.

2. The sample was washed through a 180 micron mesh brass screen with distilled water into a 600 milliliter beaker.

3. Tablets of fresh quantified Eucalyptus pollen were dissolved in each sample to serve as a control for pollen degradation or loss during the process and to calculate absolute pollen sums to determine whether or not sufficient pollen was available per sample for data interpretation (Stockmarr 1971).

4. Carbonates were removed by adding 50 mls of 40% hydrochloric acid (HCL) to each beaker. When effervescence ceased, each beaker was filled with distilled water and the sediments were allowed to settle for at least 3 hours. The water and dilute HCL were carefully poured off after settling, leaving the sediments and the pollen behind in the beaker.

5. Each beaker was filled again with distilled water, stirred, and allowed to settle for 3 hours before pouring off.

6. Beakers were filled one-third full with distilled water, stirred with clean stirring rods without creating a vortex, to suspend sediments and pollen. Three seconds after stirring stopped, the lighter soil particles and the pollen grains were poured off into a second clean beaker leaving the heavier sand particles behind in the first beaker. The procedure was repeated several times to physically separate the heavier sand from the lighter sediments and the pollen grains.

7. Silicates were removed by adding 50 mls of hydroflouric acid (HF) to each beaker. The beaker was allowed to sit overnight and the HF was poured off. Distilled water was added twice to rinse the samples.

8. The sediments were transferred to 50 ml test tubes.

9. Organics were removed by the following process: the samples were rinsed with 30 mls glacial acetic acid, centrifuged and poured off. A fresh acetolysis solution was prepared of 9 parts acetic anhydride to 1 part sulfuric acid. Thirty mls were added to each test tube, stirred, and placed in a hot water bath for 10 minutes. Tubes were removed and cooled, then centrifuged, the liquid poured off, then rinsed with glacial acetic acid, centrifuged and poured off.

10. The centrifuge tubes were filled with distilled water, stirred, centrifuged, and poured off. This was repeated twice.

11. Droplets of the pollen-bearing sediment were placed on microscope slides and mixed with glycerine. A cover slip was placed on each slide and the slides were sealed with fixative.

12. The slides were examined using a Nikon microscope under magnifications of 200x, 400x and 1000x. Pollen identification was made using Kapp's Pollen and Spores (1969), and the comparative collection of Southwestern pollen types in the Ethnobotany Lab. An attempt was made to reach a count of 200 pollen grains for each sample to derive relative pollen frequencies for the interpretation of the pollen record (Barkley 1934).

13. When slide preparations were scanned with the microscope, it was found that the samples were still laden with humic debris and charcoal, making the location and identification of pollen very difficult. As a consequence, the samples were further treated. This was done by "floating" the debris from the samples by use of a dispersant (Calgon, in a 5% aqueous solution) followed by successive rinses with distilled water. As a result, concentrations of pollen two to three times greater were achieved.

14. The pollen was counted and the absolute pollen ratio was computed (Stockmarr 1971). The absolute pollen ratio is a ratio of fossil pollen counted to a known quantity of exotic Eucalyptus control pollen which has been added.

$$\text{Absolute pollen ratio (no. pollen grains per gram sediment)} = \frac{\text{No. fossil grains} \times \text{No. exotics added}}{\text{No. exotics counted} \times \text{No. grams/sample}}$$

FAUNAL REMAINS

Both vertebrate and invertebrate faunal remains were recovered from the WIPP archaeological project. The majority of the materials were recovered from ENM 10418. This is probably due to the amount of subsurface excavation work at the site and the apparently stable nature of the cultural deposits. Faunal materials were also recovered from ENM 10230. The majority of the materials

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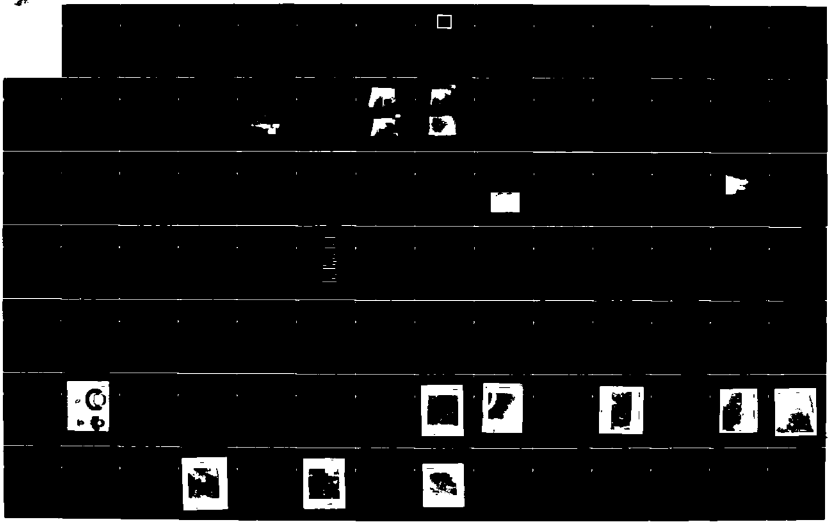

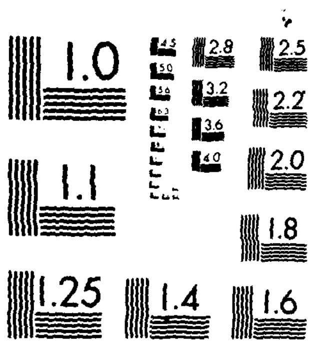

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were from the surface and thus are badly eroded. No faunal remains were recovered from ENM 10222.

The materials recovered from ENM 10230 are discussed below, followed by the more extensive faunal materials from ENM 10418.

Vertebrate faunal remains from ENM 10230 consist of a single carapace fragment of Terrepene sp. This item was found on the surface in Blowout 9 at 55S/66E. It is difficult to determine if this bone is a recent inclusion in the site or represents a food item of the prehistoric occupants. Silverbird (1980:117) states that turtles were probably much more common prehistorically than at present. Jelinek (1967:151) suggests a prehistoric reliance on turtles in the middle Pecos Valley when other animal protein was not readily available.

Invertebrate remains from ENM 10230 consist entirely of unidentifiable fragments of freshwater mussel species. These specimens were probably procured from the Pecos River 25 km west-southwest. These specimens may have functioned as food items or as tools or ornaments. Eight fragments were recovered from the site. Freshwater mussel shell tools used as scrapers or scoops have been found in sites of the general region.

Vertebrate Faunal Remains

Animal remains recovered from ENM 10418 are poorly represented (see Table 7.5). The lack of bones (32) is probably due to poor preservation. Species represented probably include *Sylvilagus* sp., *Odocoileus* sp., and possibly *Bison* sp. A large portion of the bones are too fragmentary to assign even to the genus. These specimens have been placed into size categories: very large mammals are bison size; large mammals are deer or antelope size; medium mammals are coyote size; small mammals are rabbit size. No evidence of rodents was recovered from definite archaeological contexts.

Table 7.5
ENM 10418 Faunal Remains

Excavation Unit	Level	Elevation	Species	Element	No.
97N/118E	4	100.31-100.21	med/lg mammal	long bone frag	1
100N/119E	5	100.47-100.37	med/lg mammal	cranial frag	1
101N/119E	5	100.47-100.37	lg mammal (*Odocoileus*?)	pelvis frag	1
101N/119E	6	100.37-100.27	lg mammal	long bone frag	1
103N/120E	4	100.57-100.47	lg mammal	long bone frag, tooth frag	16
103N/122E	6	100.47-100.37	lg mammal	long bone frag (charred)	1
104N/115E	4	100.26-100.16	lg mammal	long bone frag	1
104N/120E	4	100.57-100.47	lg mammal (*Bison*?)	Petrosal	1
105N/119E	4	100.45-100.35	sm mammal (lagomorph)	femur frag	1

Table 7.5 (continued)
ENM 10418 Faunal Remains

Excavation Unit	Level	Elevation	Species	Element	No.
105N/121E	3	100.66-100.56	lg mammal (*Odocoileus* sp.)	rt. scapula	1
105N/122E	3	100.79-100.69	lg mammal (*Odocoileus*?)	tooth root	1
106N/119E	4	100.45-100.35	small mammal (lagomorph)	long bone frag	1
106N/122E	3	100.79-100.69	med/lg mammal	long bone frag	1
108N/123E	3	100.70-100.60	small mammal (lagomorph)	tooth	1
97N/181E	3	101.50-101.40	small mammal (*Sylvilagus* sp.)	left scapula	1
118N/83E	5	98.01-97.91	small mammal (lagomorph)	long bone frag	1

An interesting distribution pattern of bone does exist at ENM 10418. All of the archaeological bone, with two exceptions, was found in an area bounded by the 97 North line to 108 North, and 115 East and 123 East. Elevations for these bones range between 100.79 and 100.16 meters, a 63 cm range. The mean depth of bone is 100.52 meters with a standard deviation of .16 meters. This 32 cm thick zone contains the vast majority of the bone and may represent a distinct depositional unit which in turn may represent an activity area. This zone of faunal deposition may represent the A.D. 1000 to 1300 time period based on artifact typologies and radiocarbon dates.

With poor preservation and the low numbers of bones recovered from the site due to preservation, it is impossible to state if these bones represent a single occupational episode or a number of very short occupational periods. The faunal remains are badly fragmented and it appears likely that this is the result of post depositional processes. Only one bone had signs of burning, a pelvis fragment from deer, and no bones had any evidence of butchering.

The faunal materials recovered from ENM 10418 indicate that deer, rabbits and possibly bison were hunted and returned to the site. Although faunal remains were poorly represented at ENM 10418, the exploitation pattern seems to be similar to that found at the Duval sites (Silverbird 1980:105-121). Silverbird states that the faunal remains from the Duval sites, although a scant assemblage,

> ...indicate harvesting of jackrabbits, cottontails, deer and possibly bison and small rodents. It is likely that all the animals were utilized as completely as possible, for meat, marrow, and as a raw material (hides, sinews, tools, utensils, and ornaments. While no evidence unequivocally indicates the season of occupation, the faunal resources, specifically rabbits and turtles are optimally harvested spring through fall, especially in midsummer, when they are most abundant (Silverbird 1980:115).

Although data are sparse at ENM 10418, this pattern seems to be repeated, with a spring through fall period of exploitation postulated.

Invertebrate Faunal Remains

Invertebrate faunal remains from ENM 10418 consist mainly of freshwater mussels which were probably collected from the Pecos River. The present-day channel of the Pecos River is approximately 16 km south-southwest of ENM 10418. Species identification is based on characteristics of six whole shells recovered from the site. These valves have been identified as *Lampsilis* sp. In addition to these identified valves, 21 fragments recovered from the site have morphological characteristics which suggest that they are from *Lampsilis* sp. The remaining shell fragments (160) represent pieces which could not be identified to genus but probably represent *Lampsilis* sp.

Table 7.6
ENM 10418 Freshwater Mussel Locations
(* = identifiable)

Provenience	Level	Elevation	Number
80N/129E	2	100.30-100.20	1 frag
80N/131E	2	100.30-100.20	1 frag
* 83N/140E	3	100.68-100.61	1 whole
87N/176E	2	100.95-100.85	1 frag
88N/176E	1	101.09-101.00	10 frag
88N/176E	2	101.00-100.90	1 frag
88N/157E	2	100.84-100.72	1 frag
89N/176E	3	100.90-100.80	1 frag
89N/177E	1	101.12-101.00	1 frag
90N/179E	4	100.93-100.83	1 frag
91N/180E	4	100.93-100.83	1 frag
* 92N/128E	2	no elevation	3 hinges
* 95N/113E	4	100.26-100.16	1 hinge
97N/110E	2	100.29-100.19	1 frag
97N/117E	3	100.41-100.31	2 frag
97N/181E	3	101.50-101.40	1 frag
97N/181E	4	101.40-101.30	1 frag
98N/111E	2	100.29-100.19	1 frag
* 98N/112E	5	100.12-100.02	1 hinge
99N/117E	3	100.41-100.31	5 frag
99N/119E	2	100.51-100.41	1 frag
100N/114E	2, strat 2	100.54-100.49	5 frag
100N/145E	2	100.91-100.81	2 frag
* 101N/115E	7	100.27-100.17	1 hinge
101N/144E	2	100.91-100.81	2 frag
101N/145E	2	100.91-100.81	1 frag
102N/110E	3	100.44-100.34	1 frag
* 102N/110E	4	100.34-100.24	1 whole
* 103N/115E	2	100.46-100.36	1 hinge

Table 7.6 (continued)
ENM 10418 Freshwater Mussel Locations
(* = identifiable)

Provenience	Level	Elevation	Number
103N/115E	3	100.36-100.26	1 frag
103N/120E	3	100.67-100.57	1 frag
103N/120E	6	100.47-100.37	1 frag
103N/120E	7	100.37-100.27	1 frag
103N/121E	3	100.67-100.57	1 frag
103N/122E	3	100.77-100.67	1 frag
103N/122E	5	100.57-100.47	3 frag
104N/121E	3	100.67-100.57	1 frag
104N/121E	7	100.37-100.27	2 frag
104N/122E	2	100.80-100.77	1 frag
104N/123E	6	100.47-100.37	6 frag
* 104N/145E	2	100.99-100.89	1 hinge
105N/115E	1	100.53-100.43	1 frag
105N/117E	4	100.36-100.26	1 frag
105N/120E	5	100.43-100.31	1 frag
105N/121E	5	100.43-100.31	1 frag
105N/122E	4	100.69-100.59	1 frag
105N/123E	3	100.79-100.69	1 frag
105N/123E	4	100.69-100.59	2 frag
105N/123E	5	100.59-100.49	2 frag
105N/123E	6	100.49-100.39	1 frag
105N/124E	4	100.67-100.57	1 frag
* 105N/124E	5	100.57-100.47	1 whole
105N/125E	4	100.67-100.57	8 frag
* 105N/125E	5	100.57-100.47	2 whole
106N/116E	4	100.36-100.26	3 frag
106N/119E	4	100.45-100.35	1 frag
106N/120E	3	100.66-100.56	1 frag
106N/120E	5	100.43-100.31	1 frag
106N/122E	4	100.69-100.59	1 frag
106N/122E	5	100.59-100.49	1 frag
106N/122E	6	100.49-100.39	1 frag
106N/123E	3	100.79-100.69	1 frag
106N/123E	4	100.69-100.59	1 frag
106N/123E	5	100.59-100.49	10 frag
106N/125E	3	100.77-100.67	3 frag
106N/125E	4	100.67-100.57	10 frag
106N/156E	3	101.01-100.91	3 frag
106N/157E	2	101.12-101.02	1 frag
107N/117E	3	100.48-100.43	1 frag
107N/119E	4	100.46-100.36	2 frag
* 107N/122E	3	100.61-100.55	1 whole
107N/122E	5	100.50-100.40	1 frag
107N/123E	2	100.85-100.70	1 frag
107N/123E	4	100.60-100.50	5 frag
107N/126E	3	100.66-100.56	4 frag

Table 7.6 (continued)
ENM 10418 Freshwater Mussel Locations
(* = identifiable)

Provenience	Level	Elevation	Number
107N/127E	2	100.76-100.66	1 frag
108N/120E	5	100.43-100.33	3 frag
108N/122E	5	100.50-100.40	2 frag
108N/125E	3	100.77-100.67	1 frag
108N/125E	4	100.67-100.57	1 frag
108N/126E	3	100.66-100.56	1 frag
* 108N/127E	2	100.76-100.66	4 hinges
108N/127E	3	100.66-100.56	1 frag
108N/127E	4	100.56-100.46	1 frag
111N/244E	surface	102.14	1 frag
111N/244E	5	101.74-101.64	1 frag
114N/117E	1	100.70-100.65	12 frag
115N/103E	surface		1 frag
116N/137E	1	100.99-100.97	1 frag

Mussel shells have a much wider distribution across the site when compared to bone remains. Shell fragments were found across the eastern two-thirds of the site, however, the highest concentrations were found in an area bounded by 97 North and 108 North, and 110 East and 127 East. This is roughly the same area where vertebrate remains were concentrated.

Using the data from Table 7.6 which lists provenience information on the shell remains the mean depth of shell remains for the main concentration was 100.55 m with a standard deviation of .16 m and a range of from 100.85 to 100.12 m. The mean, standard deviation and range for shell recovered from ENM 10418 are virtually identical to the distribution of bones within the main excavation areas of the site. This suggests that the deposition probably occurred concurrently with the bone.

The amount of shell fragments found at the site makes it difficult to interpret their role within the site assemblage. Undoubtedly freshwater mussel shells could indicate consumption of the meat. The fragmentary nature of the shells makes it difficult to determine how heavy this exploitation was. Confusing the issue even more is the presence of a whole valve which has grinding along an entire margin and a shell pendant. The whole shell may have functioned as a scoop of some kind. It is difficult to tell if other pieces of shell were used in a similar manner.

The shell pendant recovered from the site (Figure 7.1) measures 36 mm wide by 35 mm long. The length measurement may be incorrect since the pendant is apparently broken along the side and lower margins. The upper margins have been scored and ground smooth. A small hole, 2 mm across, has been drilled unidirectionally from the interior of the shell. The pendant was found in 105N/114E at a depth of 100.20-100.10 meters.

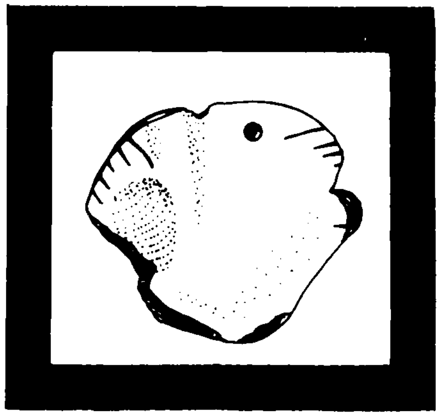


Figure 7.1
Shell Pendant from ENM 10418

The presence of both a shell ornament and a shell tool makes it difficult to interpret the other shell found within the site. The shell may represent portions of additional shell scoops, manufacturing debris from shell ornaments and/or portions of shell used as a food resource.

Chapter 8

SITE INTERPRETATIONS

Kenneth J. Lord and William E. Reynolds

INTRODUCTION

The data recovered from intensive surface collections and limited subsurface testing from the three sites in the WIPP archaeological project have been analyzed in the previous chapters. The results of these analyses have been synthesized and interpreted on a site by site basis. Major problems related to these syntheses include the almost total lack of stratigraphy due to the shifting nature of the dunal deposits. This problem, coupled with intensive collection of artifacts in the region by amateurs over many years, has reduced the amount and types of information available to the professional archaeologist. This potential if not actual loss of information makes it difficult to address questions of cultural affiliation, chronology, and function particularly when discussing the data sets from ENM 10222 and ENM 10230 which received only a limited amount of subsurface testing.

The archaeologists on this project were fortunate to have identified and sampled a number of prehistoric hearths which provided the largest body of radiocarbon dates thus far recovered in the region. These dates have provided valuable information on dating local ceramic sequences and projectile point typologies. Functional categorization of the sites, however, was severely hindered by the lack of formal tool categories beyond projectile points. It was originally assumed that these artifact classes were collected from the sites prior to the archaeological fieldwork. This, however, may not have been the case since intensive excavation work at ENM 10418 also failed to produce a large number of formal tools. The tentative conclusions must therefore be that the prehistoric groups which used these three sites had very few formal tools or rarely discarded formal tools at these types of sites.

The interpretive discussions below will be from the site with the least amount of field work to the most intensively investigated site. Portions of all three sites remain intact and additional work to test some of the conclusions given below is possible.

ENM 10222

This site is located on a low east-west trending ridge which is covered by a semistabilized sand dune field with numerous blowout depressions (Figure 4.3). The dunes range in height from 0.5 to 1.5 m and are sparsely covered with mesquite, shinnery oak, dune yucca, sandweed, sand sage, and small amounts of forbs and grasses. The blowout depressions are usually devoid of vegetation.

ENM 10222 spans an area measuring 150 m east-west by 80 m north-south (1,200 sq m) and consists of a sparse (.019 artifacts/sq m) scatter of lithics, ground stone, and fire-cracked caliche. The majority of the cultural materials recovered from the site was confined to surface materials from an old road bed which parallels the section line fence along the northern margin of ENM 10222 (see Figure 4.3).

Surface collections from the site consist primarily of lithic debitage (158) with one complete projectile point, two projectile point tips, one retouched flake, one hammerstone, two metate fragments, and one mano fragment also recovered.

The original survey report indicated that 66 artifacts were widely scattered throughout the site. The original dimensions for the site were defined as 60 m east-west by 37 m north-south. Artifacts noted at the site included a chipping station of 20 flakes, mano and metate fragments, primary and secondary decortication flakes, a scraper, burned caliche and sandstone, El Paso Brownware sherds, and two Archaic-like projectile points. A single hearth was also found (Schermer 1980:30).

The discrepancy in the artifact inventories and site size between the original survey and the recent work done by CCP in 1983 can be explained by several factors: 1) a portion of the site north of the fenceline had been impacted by the construction of a well pad. The two projectile points noted on the original survey map (Schermer 1980:31) were located north of the fenceline. These points could have been destroyed in the construction of the pad; 2) due to the unstable nature of the dune deposits on the site, the ceramics could have been reburied and additional portions of the site uncovered; and 3) collection of certain portions of the site by unauthorized persons could have removed a number of artifacts from the site.

The hearth noted by Schermer (1980:30) was relocated. After the site had been mapped and totally surface collected, subsurface testing was started originally centering around this hearth. The hearth was subsequently designated Feature 2 and four 1 by 1 m units were excavated. Surface material surrounding this hearth included 24 lithic retouch flakes indicating a probable tool manufacturing area. An additional 31 microflakes, a biface fragment, and a metate fragment were found in the 0-2 cm level surrounding Feature 2.

Upon completion of excavations Feature 2 consisted of a 60 cm in diameter, 50 cm deep pit, filled with charcoal and fire-cracked caliche. Flotation samples were collected from the feature fill. No known food items were noted in the flotation samples (see Chapter 7 for detailed discussion). Feature 2 has been radiocarbon dated to 1140 B.C. ± 190.

The high concentration of lithics recovered from this feature are in a heavily deflated area may be the result of this deflation. No other portion of the site contained high levels of cultural materials, thus making intrasite comparisons difficult.

Feature 1 was a small (10 cm in diameter, 6 cm deep) shallow pit filled with ch[illegible]red sand. It was radiocarbon dated to A.D. 720 ± 590. Since the standard deviation of the radiocarbon sample was so large and the feature was so small it was difficult to determine if it represents a cultural manifestation.

An additional ten 1 by 1 meter units were excavated across the site in order to test the hypothesis that large portions of the site remain intact below the extensive dune deposits (see Figure 4.2). The results of these test excavations indicated that cultural deposits were present in all of these units with the exception of 40N/5E, 50N/56E, and 14N/100E. The seven remaining excavation units contained a low density of lithic debitage and occasional pieces of ground stone. The upper 20 cm of these units contained no evidence of cultural usage with the majority of the lithic debitage found between 20 and 60 cm below the present ground surface. These findings confirm the original ideas of Schermer (1980:30) that intact deposits are present below the extensive dune deposits.

The results of the lithic analysis for ENM 10222 are discussed in detail in Chapter 6. The lithic activities represented at the site indicate a predominance of biface manufacturing through the use of secondary cores (flake blanks). No primary cores or formal tool types exclusive of projectile points were recovered from the site. This, coupled with the paucity of cortex on flakes, suggests that groups using the site did preliminary reduction away from the site, possibly at winter villages or quarries and formal tool categories were considered curated items to be carried from site to site within the seasonal round. Based on the amount of biface manufacturing debris and the lack of biface failures it is doubtful that intensive lithic manufacturing activities were carried out at the site. A small quantity of ground stone was found at the site. Six pieces were recovered, primarily manos, and suggest that some plant processing was undertaken.

Based on the limited amount of cultural debris located at ENM 10222, it may be posited that the site probably functioned as a plant procurement camp which was used intermittently from around 1200 B.C. to approximately A.D. 1200-1300. This date range is based on the single radiocarbon date from Feature 2 and a 1-A or 1-C style projectile point. Activities which probably occurred at the site include hunting, based on the one complete projectile; the two point fragments and the two points noted in the original survey report; plant processing, indicated by the presence of ground stone; tool maintenance and/or tool production, indicated by the lithic debitage and at least one episode of cooking activity possibly indicative of an overnight stay.

ENM 10222 probably represented one stop on a seasonally oriented gathering round which occurred in the Los Medanos region from the Late Archaic period through the Neoarchaic period. Based on the paucity of cultural remains, it is doubtful that this site was used on a regular basis. The results of the flotation analysis for Feature 2 did not produce any commonly known plant foodstuffs; however, plant collection has been postulated as the most likely function for the site. Economically useful plants which occur within the present vegetative community include mesquite, shinnery oak, and various grass seeds. These species generally mature in late summer, thus a late summer occupation is postulated for ENM 10222.

Prehistoric groups which utilized ENM 10222 probably inhabited temporary base camps throughout the region focusing on areas with semi-permanent water supplies, e.g., springs, rain filled playas or small ephemeral streams. Small task groups would radiate out from these base camps into the surrounding area with plant and animal foods gathered and probably returned to the limited base camps. When resources within this limited area were exhausted the base camp would be moved to another area with similar resources. These types of activities probably occurred for several months during the summer over several thousand years resulting in a large number of resource procurement camps throughout the region. It is highly likely that a number of these camps would have left little archaeological evidence and archaeological sites encountered in the region represent sites with multiple occupations spread out over thousands of years. ENM 10222 would have gone undetected if the dune deposits in the region were stabilized. The evidence at the site suggests that the extensive dune deposits now present at the site probably occurred within the last 500 years.

ENM 10230

This site is situated on a southeast trending ridge with a commanding view of the surrounding area. The site is basically oval in shape and follows the contours of the ridge. The ridgetop and the immediate site area is covered with large southeast trending dunes which range in height from one to four meters (see Figure 4.8). These dunes are still active within the site boundaries and on several occasions during fieldwork portions of the site were covered and uncovered. Cultural materials were generally exposed in blowout depressions between the dunes.

The site vegetation consists of mesquite, shinnery oak, dune yucca, snakeweed, sand sage, and small amounts of forbs and grasses. The majority of the vegetation is confined to the semistabilized dunes.

ENM 10230 is a very large site measuring 395 m NW-SE by 205 m SW-NE (81,000 sq m) and consists of a moderately dense (.767 artifacts/sq m) scatter of ceramics, lithics, and ground stone. Cultural materials were generally confined to blowout depressions. The initial phase of work at the site consisted of random samples across the site. Using the methods discussed in Chapter 4, 5,790 sq m of the site were examined.

The next phase of work at the site consisted of biased collection of data within 15 blowout depressions at the site. Densities and artifact type distributions between these blowouts suggest occupations by culturally or temporally distinct groups. These differences can be seen by examining the distribution of ceramics, lithic material types, and a small number of radiocarbon dates (see Figure 4.9).

One of the primary methods used to distinguish blowout temporal affinities was based on the presence or absence of ceramics. Ceramic types recovered from ENM 10230 include Jornada Brownware, El Paso Brownware, Roswell Brownware, Jornada Corrugated, and Jornada Black-on-brown. The original survey report listed

Jornada Brown, Carlsbad Brown, Chupadero Black-on-white, and an unidentified red-on-brown ware (Schermer 1980:60). The differences in ceramic inventories probably results from the shifting nature of the dune deposits and/or collecting by amateurs.

Based on standard time ranges for the ceramic types represented at ENM 10230, the site could have been occupied by Neoarchaic groups between A.D. 400 to 1400. Blowouts at the site containing ceramics include 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, and 15.

Radiocarbon dates have been recovered from a number of these blowouts. Blowout 14 contains two radiocarbon dates: A.D. 570 ± 150 and A.D. 880 ± 140. The blowout has been divided into two subareas. Only the southern portion which has been dated to A.D. 880 contains ceramics. Ceramic types found in this portion of the blowout include Jornada and Roswell Brownware. Blowout 9 has been radiocarbon dated to between A.D. 580 ± 60 and A.D. 670 ± 70 and contains Jornada Brownware and undifferentiated brownware. Blowout 6 has been radiocarbon dated to A.D. 770 ± 360 and contains Jornada Brownware and undifferentiated brownwares. Blowout 12 has been radiocarbon dated to A.D. 1310 ± 40 and contains Jornada Brownware and undifferentiated brownwares.

Based on the radiocarbon chronologies of the blowouts at ENM 10230, ceramics first occurred around A.D. 600 and lasted until A.D. 1300.

Relative dates based on ceramic types in the blowouts lacking radiocarbon dates are given below. Blowout 2 contained no diagnostic ceramics and thus could date within the entire ceramic date range (A.D. 400-1350). Blowout 4 contained a single sherd of Jornada Brownware and could date between A.D. 600 and 1350. Blowout 5 contains Jornada Brownware and undifferentiated brownware and probably dates between A.D. 600 and 1350. Only undifferentiated brownwares were recovered from Blowout 7 and thus could date between A.D. 400 and 1350. Blowout 10 contains Jornada Brown, Roswell Brown, Jornada Corrugated, and undifferentiated brownwares. The date range for Roswell Brownware is A.D. 1100 to 1250+ (Jelinek 1967); however, Roswell Brownware was recovered in Blowout 14 which has been radiocarbon dated to A.D. 880 ± 140. Blowout 10 has been tentatively assigned to the A.D. 900 to 1250 range. Blowout 11 contains Jornada Brownware and undifferentiated brown and has been assigned to the A.D. 600 to 1350 period. Blowout 13 ranges in age from A.D. 400 to 1350. No typed ceramics were recovered. Blowout 15 contains Jornada Brownware and Jornada Black-on-brown and probably dates between A.D. 900 and 1350.

These ceramic date ranges for the blowouts at ENM 10230 coupled with the radiocarbon dates for four blowouts suggest that the ceramic date ranges for the eastern extension of the Jornada Mogollon extend 300 years earlier than previously thought (Leslie 1979). The ceramic date ranges and the radiocarbon dates from the blowouts assume that no previous or later occupations occurred within the blowouts. This assumption will be critical to the analysis of the lithics from the site. The separation of distinct lithic technological attributes with regard to temporal and/or cultural differences has been a primary goal of this report. Distinguishing separate components at this and other sites in the region are necessary in order to understand the prehistoric occupational usage of the region more fully. The comparisons of various lithic components from a known temporal context are crucial for these analyses. The blowout data from ENM 10230 will be used as a first approximation of this study. The results of this lithic attribute analysis are discussed in Chapter 6 and are summarized below.

The lithic activities represented at ENM 10230 indicate a predominance of biface manufacturing through the use of secondary cores or flake blanks. No primary cores were found and only two formal tools were recovered. The lack of cortex on the flakes and flake fragments would indicate that the prehistoric groups who occupied the site were reducing cores elsewhere and only transporting usable lithic materials to the site. Little primary reduction occurred at the site based on the lack of cores and the small number of flakes containing cortex. In addition to biface manufacturing activities a small number of biface retouch flakes were also recovered indicating the resharpening of some tool classes.

Spatial distributions of lithic material types show a tendency to vary within blowouts. Examination of the percentages of the 16 major material types (Table 8.1) reveal differences in material type selection which is probably related to temporal factors. Blowout 1, which is the earliest dated blowout at ENM 10230 (A.D. 260), contains the highest percentage of Material Class B (Ogallala cherts) within the site. It also contains Material Class D in a high percentage. This material class is almost nonexistent in the other blowouts at the site. Material Class I is also well represented with 15.4% of the total for Blowout 1. Only Blowouts 7 and 8 contain this material class in high percentages. Material Classes F and G are poorly represented when compared to the other blowouts at ENM 10230. While the total number of cases for Blowout 1 are small, the percentages would seem to suggest, although they could not be statistically proven, that a different lithic resource procurement pattern was operating during the Late Archaic (see Table 8.2). Examination of blowouts containing ceramics (2, 4, 5, 6, 7, 9, 10, 11 12, 13, 14, and 15) generally indicate a homogeneous lithic resource procurement strategy (see Table 8.2) wider variety of lithic resources were utilized during this time period. Material Classes B, F and G within these blowouts represent between 53 and 7? of the lithics present. Variations from this pattern were noted in Blowout which contains 23.5% of Material Class E and no Class G; Blowout 6 which contains 22.5% of Material Class L and Blowout 7 which contains 13.3% of Material Type I.

The blowouts (3, 8) which have not been assigned a temporal period have characteristics of both the late Archaic and ceramic occupations and may indicate a multicomponent situation (see Table 8.2). This comparison must be examined critically since the number of cases is very small.

Differences in material type selection were apparently in operation, although not statistically validated, in the prehistoric past in the WIPP area between late Archaic populations and Neoarchaic populations. This trend should be monitored at future projects. The differences may represent changes in the seasonal round through time or may indicate shifts in material type selection which is related to changes in tool manufacturing techniques.

Table 8.1
ENM 10230 Material Type Classification

Material Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	-	-	-	-	-	-	1 (6.7%)	-	-	-	-	-	-	-	-
B	7 (53.8)	15 (42.9)	-	36 (36.7)	24 (26.1)	11 (27.5)	6 (40.0)	5 (38.5)	18 (28.1)	67 (37.0)	47 (36.1)	21 (26.2)	26 (23.0)	47 (23.4)	23 (24.5)
C	-	-	-	1 (1.0)	2 (2.2)	-	1 (6.7)	-	2 (3.1)	-	4 (3.1)	3 (3.7)	-	1 (.5)	1 (1.1)
D	2 (15.4)	-	-	-	-	-	-	-	-	-	-	-	1 (.9)	-	3 (3.2)
E	-	-	-	1 (1.0)	-	-	-	-	-	-	1 (.8)	-	-	1 (.5)	-
F	1 (7.7)	4 (11.4)	-	23 (23.5)	29 (31.5)	10 (25.0)	1 (6.7)	3 (23.1)	12 (18.7)	40 (22.1)	31 (23.8)	23 (28.7)	31 (27.4)	59 (29.3)	27 (28.7)
G	1 (7.7)	8 (22.9)	1 (33.3)	16 (16.3)	18 (19.6)	5 (12.5)	2 (13.3)	-	9 (14.1)	25 (13.8)	23 (17.7)	15 (18.7)	20 (17.7)	32 (15.9)	13 (13.8)
H	-	-	-	-	-	-	-	1 (7.7)	3 (4.7)	2 (1.1)	1 (.8)	2 (2.5)	-	1 (.5)	-
I	2 (15.4)	1 (2.9)	-	4 (4.1)	2 (2.2)	1 (2.5)	2 (13.3)	2 (15.4)	3 (4.7)	4 (2.2)	2 (1.5)	1 (1.2)	2 (1.8)	7 (3.5)	1 (1.1)
J	-	1 (2.9)	1 (33.3)	1 (1.0)	2 (2.2)	-	-	-	1 (1.6)	2 (1.1)	1 (.8)	-	-	2 (1.0)	4 (4.2)
K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L	-	1 (2.9)	1 (33.3)	5 (5.1)	5 (5.4)	9 (22.5)	1 (6.7)	1 (7.7)	9 (14.1)	17 (9.4)	9 (6.9)	10 (12.5)	26 (23.0)	28 (13.9)	8 (8.5)
M	-	-	-	2 (2.0)	1 (1.1)	1 (2.5)	-	-	-	1 (.5)	2 (1.5)	-	-	1 (.5)	2 (2.1)
N	-	-	-	-	-	-	-	1 (7.7)	-	-	-	-	-	-	-
O	-	5 (14.3)	-	9 (9.2)	9 (9.8)	2 (5.0)	1 (6.7)	-	7 (10.9)	23 (12.7)	9 (6.9)	5 (6.2)	7 (6.2)	21 (10.4)	12 (12.8)
P	-	-	-	-	-	1 (2.5)	-	-	-	-	-	-	-	1 (.5)	-

Table 8.2
ENM 10230, Late Archaic Versus
Ceramic Occupation Material Selections

Material Types	Blowout 1 (Late Archaic) (%)	Blowouts 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15 (Ceramic) (%)	Blowouts 3, 8 (Unknown) (%)
A	-	.08	-
B	53.8	29.8	31.2
C	-	1.3	-
D	15.4	.3	-
E	-	29.8	31.2
F	7.7	25.4	18.7
G	7.7	16.3	6.2
H	-	.8	6.2
I	15.4	2.6	12.5
J	-	1.2	6.2
K	-	-	-
L	-	11.1	12.5
M	-	.9	-
N	-	.09	6.2
O	-	9.6	-
P	-	.2	-

Six features were identified during the testing phase at ENM 10230. Descriptions of these features are presented in Chapter 4. Features from ENM 10230 can be divided into two categories: charcoal filled pits containing fire-cracked rock and fire-cracked rock concentrations containing little charcoal. Charcoal filled pits are generally smaller than the fire-cracked rock concentrations. The sample size is too small to indicate if these differences are significant. Differences between these hearth types are presently unknown; however, functional differences are suspected. Flotation samples were processed from Features 1, 2, 5, and 6. Detailed discussions of the flotation analyses for ENM 10230 are provided in Chapter 7. The flotation samples contain two seed types which could have been utilized by prehistoric populations. Both mesquite and shinnery oak produce edible seeds which probably formed a significant portion of the diet during certain seasons of the year. The low numbers of seeds recovered may indicate that processing using fires was not necessary.

Although superficial fire-cracked rock concentrations were not considered as features, differences in the densities of fire-cracked rock were noted. These density figures were calculated for each blowout examined during the intensive collection phase at ENM 10230. The mean density and standard deviations of fire-cracked rock were calculation on blowout by blowout basis with density categories plotted in order to examine potential feature locations. This methodology was used for excavated data from Cochiti Lake (Chapman 1980) and suggests the location of fire features. The density maps for the blowouts from

ENM 10230 are contained in Appendix 4. A summary of the results are given below. Only the two highest fire-cracked rock density figures will be listed.

Within Blowout 1, two areas may contain features, 65S/161E and 67-68S/164-165E. Fire-cracked rock (FCR) densities for these areas are between 14.1 and 19.23 rocks/square meter (FCR/sq m). Blowout 2 contains a single high density area (231S/389E). This square has a density of 7.52 FCR/sq m. Blowout 3 also contains a single high density area (209S/365E) with a density of 4.33 FCR/sq m. Blowout 4 has two high density areas: 163S/278E and 165S/282E. The densities for these two areas range between 11.51 and 14.17 FCR/sq m. Blowout 5 contains a single high density area (186S/323E) with a density figure of 20.18 FCR/sq m. Blowout 6 has a single high density area which encompassed three sq m (142-144S/191E). High densities in this blowout range between 16.28 and 20.11 FCR/sq m. Blowout 7 contains two high density regions. One encompasses 169S/180-182E with the second high density area located at 167S/178E. The densities range between 7.91 and 10.29 FCR/sq m. Blowout 8 has a single high density area (33S/185E) with a FCR/sq m figure of 27.13. Blowout 9 contains two high density areas (53S/58E and 55S/60E). These two areas are adjacent to an extremely low density area and may represent discard areas. The density figures range between 13.62 and 18.14 FCR/sq m. Blowout 10 also has two high density areas. A single high density area was calculated for 103S/171E. The second area contains three diagonally adjacent squares (103S/167E, 104S/166E, and 105S/165E). High density variability ranges between 29.29 and 48.33 FCR/sq m. Blowout 11 covers an extensive area and contains four high density areas (149S/248E, 154S/236E, 153S/234E, and 154S/245E). High density values range between 14.44 and 18.2 FCR/sq m. Blowout 12 has a single high density zone separated by a square containing no FCR. This area is centered around 167S/239E and 169S/237E. Density figures range between 18.56 to 24.47 FCR/sq m. Blowout 13 contains a single high density area (155S/209E) with a density figure of 19.04 FCR/sq m. Blowout 14 has two high density areas. One is located at 81-82S/181-182E; the other is at 97-99S/175-178E. Density figures range from 19.37 to 25.67 FCR/sq m. Finally, Blowout 15 contains a single high density area at 84-86S/157-159E. Density figures for this blowout range between 35.12 and 44.35 FCR/sq m.

Using these density figures, 22 probable prehistoric hearth features have been identified. Feature densities per blowout range from one to three. A single high FCR density within a blowout may indicate a single occupation within the blowout. Multiple high FCR density areas may represent multiple occupations. Multiple high FCR density areas were present in Blowouts 1, 4, 7, 10, 11, and 14.

The distance between high FCR densities for Blowout 1 is only two meters, suggesting that these areas are not contemporaneous. Within Blowout 4 the distances between high density areas is less than four meters, again suggesting chronologically distinct occupations. High FCR concentrations within Blowout 7 are less than two meters apart, indicative of multiple occupations. Blowout 10 FCR concentrations are only three meters apart, again suggestive of multiple occupational episodes. Blowout 11 with four high density areas may contain both contemporaneous and noncontemporaneous areas. Two of the concentrations are only three meters apart with the remaining two well over six meters apart. Blowout 14 contains two high density areas which are separated by more than six meters. These two areas of the blowout have been radiocarbon dated to A.D. 570 ± 150 and A.D. 880 ± 140.

Based primarily on surficial evidence, ENM 10230 probably functioned as a plant procurement camp much like ENM 10222. The radiocarbon sequence obtained from the site indicates intermittent occupation between A.D. 260 and 1310 with the heaviest occupational usage occurring between A.D. 490 and 880. Activities which probably occurred at the site include hunting, based on six complete projectile points recovered from the present work and three points from the site but in an amateur's collection. Seven of the points have been classed as Type 6 in the Leslie (1978) typology. Type 6 points probably date between A.D. 600 and 900. Other activities include plant processing indicated by the numerous pieces of ground stone and tool maintenance and/or tool production based on the lithic debitage and cooking activities.

ENM 10230 probably represented one stop on a seasonally oriented gathering round which occurred in the Los Medaños area between the Transitional and Neoarchaic periods. Based on the low density of formal tool types it is doubtful that the site represents a base camp as had previously been postulated (Schermer 1980:60). The large areal expanse of the site is probably the result of numerous non-contemporaneous short occupations over at least a 1,000 year span. The low density of formal tools may be the result of a gathering oriented collection strategy which focused on mesquite and acorns. No tools are necessary for the collection of either of these seed crops.

The differences and similarities between ENM 10222 and ENM 10230 are probably a factor of intensive reuse at ENM 10230. Apparently ENM 10230 was attractive to prehistoric populations. This may have been due to the density of mesquite and oak, therefore assuring a large supply of foodstuffs; the presence of sandstone bedrock on the site would have been important for the manufacture of ground stone implements; and possibly, most importantly, ENM 10230 is situated on a ridge which would have provided excellent visibility for monitoring larger game species such as deer. The only major drawback to the site setting is the present day lack of reliable water supplies. Examination of the Nash Draw 15' USGS map reveals no springs or drainages which could have provided water for the prehistoric inhabitants. This lack of water could be counteracted by the presence of a number of small playa basins which could have supplied limited amounts of water during the summer rainy season. If a reliable water supply were present, it is likely that ENM 10230 would have been the focus of a seasonally occupied base camp.

ENM 10418

ENM 10418 is a large site which is roughly oval in shape and is bisected by an unnamed arroyo which runs into Nash Draw. The site covers a total area of 160,000 sq m (400 m north-south by 400 m east-west); however, only a portion of the site was intensively examined. This portion of the site (see Figure 4.15) is bounded by a road on the west leading to the Duval Mine Nash Draw Property, a railroad spur leading to the mine on the north and a section line fence on the south. The eastern boundary of the site is defined by a lack of cultural materials. This portion of the site measures 100 m north-south by 250 m east-west (25,000 sq m). Cultural items within this portion of the site include a low density scatter (.0176 artifacts/sq m) of lithics, projectile points, ceramics, ground stone, shell, and fire-cracked caliche. Several areas of the site had evidence of charcoal stained soil on the surface indicative of partially deflated hearths. ENM 10418 is located in an area which is, at present, relatively stable with the majority of the cultural materials located subsurface. The original survey report indicated that the site measured 70 by 90 m and consisted of an artifact scatter of extremely low density in association with approximately eight remnant hearth areas. Artifacts noted at the site included a scraper, chopper, core, preform, a mano fragment, and three sherds. The ceramics included Jornada Brownware, Chupadero Black-on-white, and an unidentifiable Black-on-gray type (MacLennan and Schermer 1979:13).

Preliminary examination of ENM 10418 in November of 1983 indicated that the site covered a much larger area and contained a slightly higher density and variety of artifact types. Following the initial reconnaissance of the site, a grid system was established and all surface materials were collected using 1 by 1 m units for provenience. Following the surface collection, subsurface test excavations were initiated focusing on areas with potential subsurface features. Four cultural features were excavated during the initial testing phase. Two of these features contained sufficient charcoal for radiocarbon dating. Feature 9 was radiocarbon dated at A.D. 360 ± 50 (see Plate 8.1) and Feature 10 produced a radiocarbon date of 170 B.C. ± 270. Location of these features during the subsurface testing phase indicated that ENM 10418 had the potential to yield significant information pertinent for reconstructing the cultural sequence in the WIPP area.

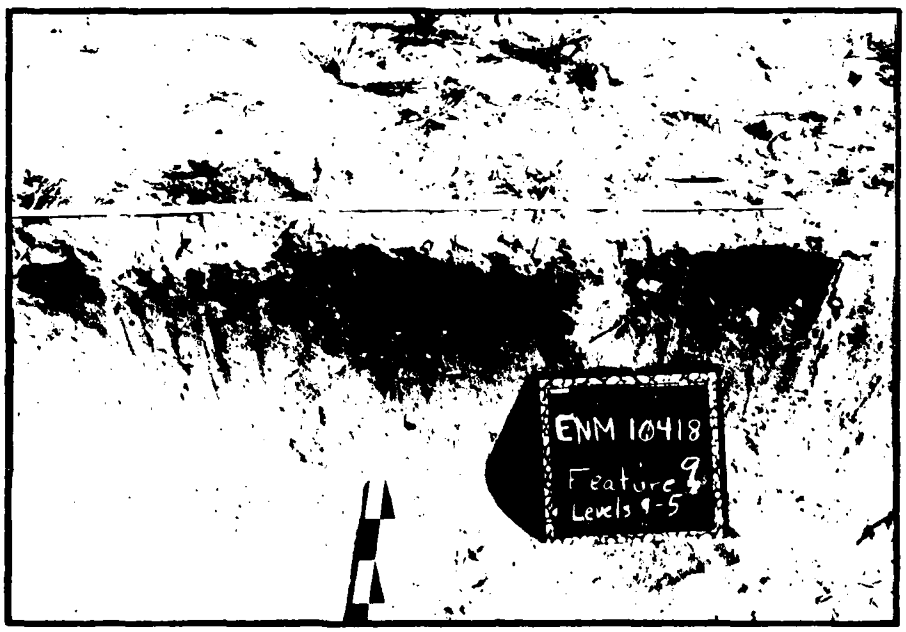


Plate 8.1
ENM 10418 Charcoal in Profile, Feature 9

Augering of the site was then initiated to determine if additional subsurface features were present. The augering program indicated that 11 (40%) of the auger holes contained sufficient evidence to indicate that a large number of features were present at the site. Following the preliminary testing phase, it was determined that additional excavation work was needed to sample the site adequately.

A magnetic survey of the site was undertaken in conjunction with a systematic augering program as an aid in determining the location of subsurface features. Following the evaluation of the preliminary magnetic survey and augering data additional testing was conducted. This second excavation phase located an additional 12 features. Features 15 through 23 were located in four 25 m long machine dug test trenches. Two features were radiocarbon dated. Feature 14, a charcoal and fire-cracked rock filled hearth was dated to A.D. 1270 ± 100 (see Plates 8.2:A,B and 8.3A) and Feature 25 (Plate 8.3B), a charcoal filled pit, has an A.D. 600 ± 60 date. The results of this phase indicated that more work confined to the railroad right-of-way would be necessary to mitigate the site adequately.

This final phase located an additional 14 cultural features which were found during intensive excavations. Charcoal samples from 11 of these features were submitted for radiocarbon dating. These dates are listed below.

Table 8.3
ENM 10418 Radiocarbon Dates

	Source	Date Recovered
Feature 26	FCR and charcoal	A.D. 300 ± 110
Feature 27	charcoal	A.D. 210 ± 210
Feature 30	FCR and charcoal	A.D. 1190 ± 70
Feature 31	FCR and charcoal	A.D. 660 ± 70
Feature 32	FCR and charcoal	A.D. 1450 ± 100
Feature 33	charcoal	A.D. 230 ± 70
Feature 34	FCR and charcoal	A.D. 490 ± 70
Feature 35	charcoal	A.D. 520 ± 80
Feature 36	charcoal	880 B.C. ± 140
Feature 37	FCR and charcoal	A.D. 680 ± 90
Feature 38	charcoal	A.D. 720 ± 80

Following the controlled subsurface excavations, the railroad right-of-way was bladed in order to locate additional subsurface features. Twenty-eight charcoal features were located during the blading. These features were designated by letter suffixes and the cultural designation of these features is not as certain as for the numbered (controlled excavation) features. The locations of all features, descriptions and profile views are discussed in Chapter 4. The spatial distributions of the features are shown in Figure 8.1. A discussion of the spatial distribution of all features using nearest neighbor analyses and clusters analysis follows.

Plate 8.2A
ENM 10418 Feature 14 Detection Level with Fire-Cracked Rock

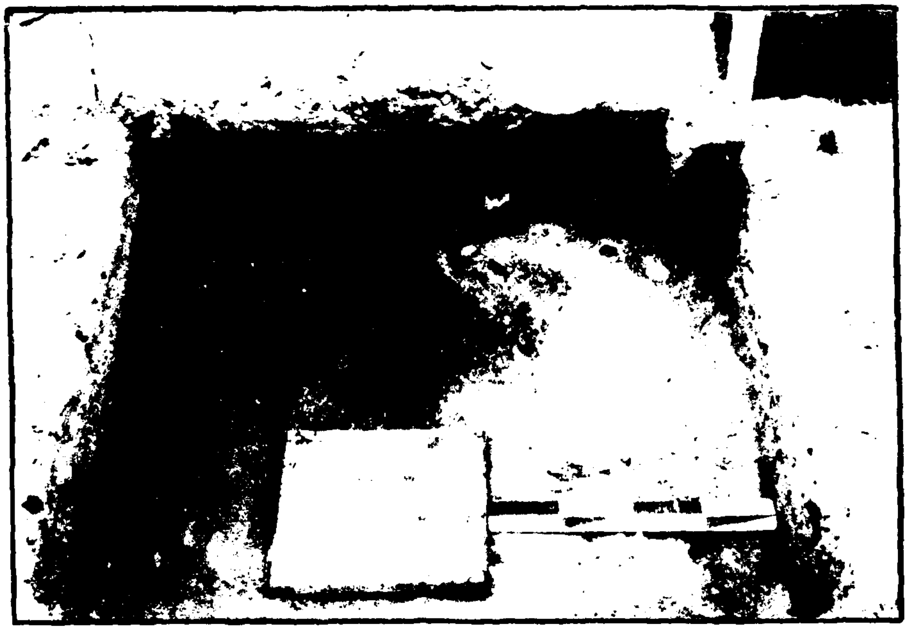


Plate 8.2B
ENM 10418 Feature 14 Charcoal Stain Below Fire-Cracked Rock

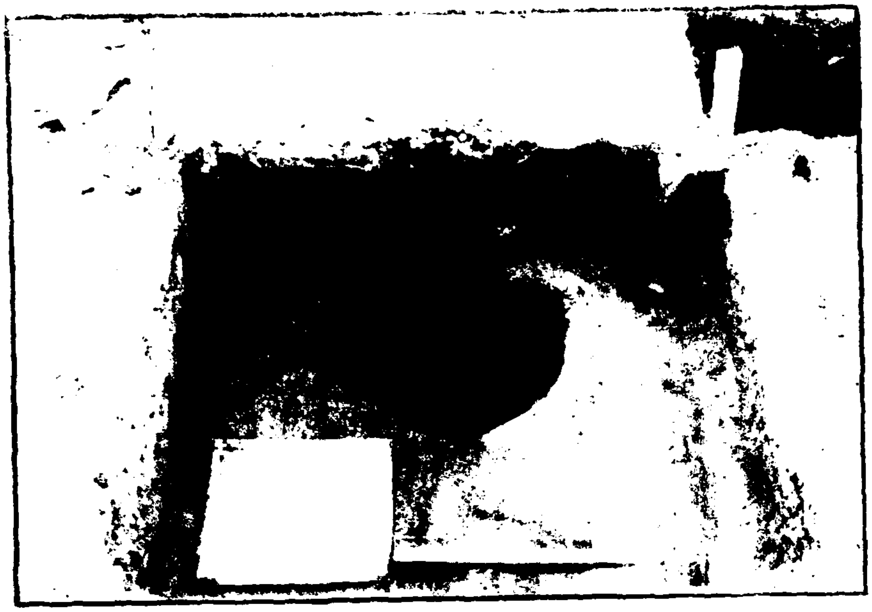


Plate 8.3A
ENM 10418 Feature 14 - Fill Rem[illegible]

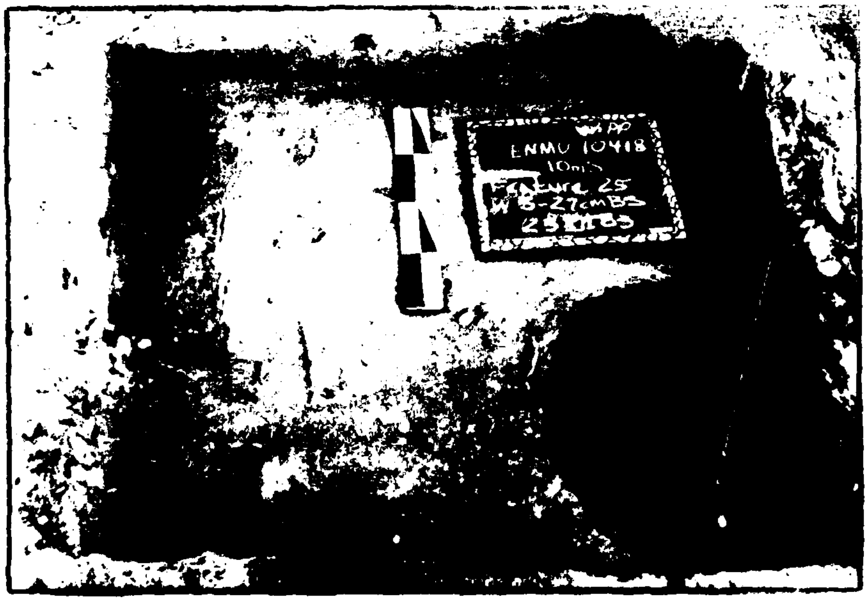


Plate 8.3B
ENM 10418 Feature 2[illegible] - F[illegible]

Spatial Analysis of ENM 10418

One of the major analytical and interpretative problems associated with ENM 10418 was to deal with the spatial configuration of the features. Is there a way to define the various spatial occupation episodes that are indicated in the distribution of radiocarbon dates? Two spatial techniques were applied to the data; nearest neighbor analysis and a heuristic approach using k-means cluster analysis described by Kintigh and Ammerman (1982).

Nearest Neighbor Analysis:

The more easily understood accounts of nearest neighbor analysis are presented in Clark and Evans (1954), Pinder and Witherick (1972, 1974). Nearest Neighbor Analysis is a statistical method by which the spatial distribution of similar items may be quantified and compared. The degree of variation is determined by comparing the mean observed distance between nearest neighboring items to the corresponding theoretically expected value. The nearest neighbor of any item is that item which is closest in proximity to it. In any given population of N items over an area A, each item will at least in principle, have a nearest neighbor. R is the distance from each item to its nearest neighbor. All distances and area must be calculated in the same unit of measurement (Whallon 1974).

The following six steps constitute the process by which one arrives at a nearest neighbor statistic for a two-dimensional area.

1. Calculate site area

2. Measure all nearest neighbor distances

3. Take the average observed distance from each item to its nearest neighbor:

$$\bar{r}_o = \frac{\text{sum of all nearest neighbor distance}}{\text{number of objects}}$$

4. Calculate the density of the population of items over the site area:

$$d = \frac{N}{A}$$

5. Calculate the expected average distance from each item to its nearest neighbor in a random spatial distribution:

$$\bar{r}_e = \frac{1}{2\sqrt{d}}$$

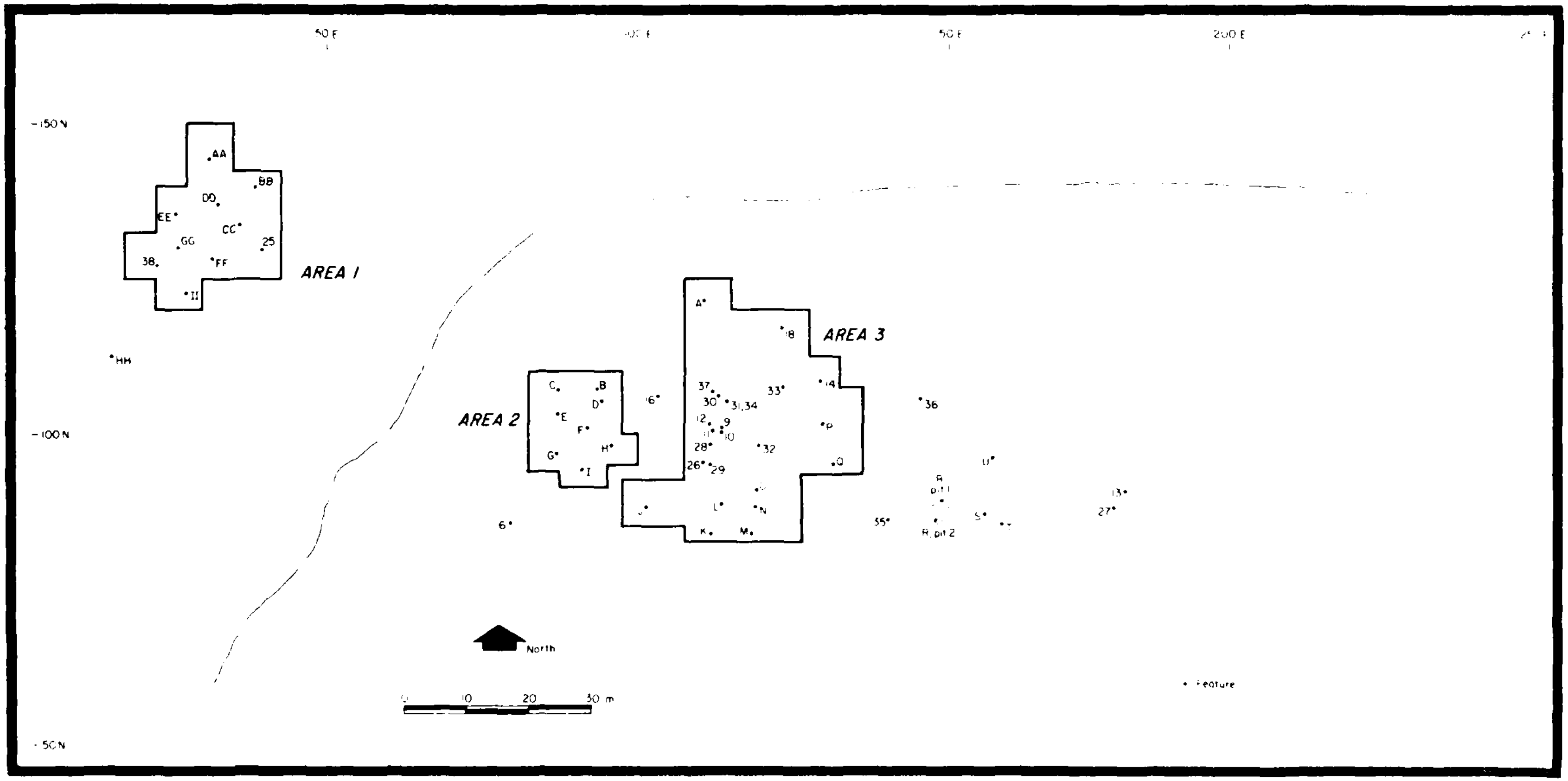


Figure 8.1
ENM 10418 Nearest Neighbor Analysis

6. Calculate the ratio of the observed to the expected average nearest neighbor distance:

$$R = \frac{\bar{r}_o}{\bar{r}_e}$$

The range of the result varies from 0.00 to 2.1491; 0.00 is clustering, 1 approaches random, and 2.1491 is patterning. If the observed mean distance is the same as the expected, then the ratio between these two mean distances is 1, a random distribution. If the observed mean distance is less than the expected, then their ratio would be less than one and these items would tend toward clustering. When the observed mean distance is greatest, the ratio is greater than one and these items tend toward patterning or a homogenous distribution across the surface.

Nearest neighbor analysis was used to test of a proposition put forward by Reynolds (1975) that all social units are either clustered, patterned (including linear patterning), or randomly distributed; however, only contemporaneous social units will show some type of deliberate spatial organization. Reynolds (1975) analyzed the spatial distributions of prehistoric and present village layouts and confirmed the proposition that contemporaneous behavior generated either patterned or clustered R values.

Thus the use of nearest neighbor analysis of the charcoal pits on ENM 10418 should indicate whether the features were all contemporaneously occupied.

The statistics associated with the nearest neighbor analysis are presented in Table 8.4.

Table 8.4
Nearest Neighbor Analysis of ENM 10418

			STATISTICS			
Area No.	N	Area	$\bar{r}_o$	d	$\bar{r}_e$	R
1	10	437.50	5.90	.02	3.57	1.65
2	9	271.25	3.28	.03	2.86	1.15
3	20	873.50	3.13	.02	3.57	.88

The boundary of each area is shown in Figure 8.1. The boundary was determined by plotting the $\bar{r}_e$ distance around the outer perimeter of the different areas. The boundary around Area 1 included all features west of the arroyo through the site. A boundary was established between Areas 2 and 3 because of the empty space and the east boundary of Area 3 was placed at the edge of the feature concentration.

The results of the analysis presented in Table 8.4 indicate that Areas 2 and 3 have a random distribution while Area 1 has a distribution halfway between random and patterning. In terms of the proposition put forward by Reynolds (1974), Areas 2 and 3 represent many noncontemporaneous occupations and Area 1 may represent only one or two noncontemporaneous occupations.

These results conform with other lines of evidence. In Area 1 there are five radiocarbon dates with Features FF and BB overlapping and Features 25, 38, and II overlapping in terms of their respective dates. Also, only lithic material Type B was found in Area 1 while this type and all other material types were found in Areas 2 and 3. Thus it would appear that Area 1 represents only two occupations. Areas 2 and 3 have many nonoverlapping radiocarbon dates and therefore indicate many occupations.

In conclusion, the nearest neighbor analysis technique is useful for defining multiple occupation at sites with features. In the analysis of ENM 10418 the three discrete areas had R values approaching a random distribution and also had nonoverlapping radiocarbon dates. Thus in the absence of radiocarbon dates one may use nearest neighbor analysis as one method to make the distinction between single occupation and multiple occupation sites.

Given that Areas 1, 2, and 3 represent multiple occupations, the question becomes, is there a method to define the individual occupations spatially. The radiocarbon results indicate that there were four time periods during which the site was occupied (see Chapter 9). Within each time period we have dates for specific features at ENM 10418.

One method to define individual occupations spatially is provided by Kintigh and Ammerman (1982) in an article called "Heuristic Approaches to Spatial Analysis in Archaeology." The method employs a <u>k</u>-means nonhierarchical divisive cluster analysis which attempts to minimize the intracluster variances while maximizing the intercluster distances. Data consist of the x and y coordinates of a set of objects, in this case, features on a site. Kintigh and Ammerman (1982:39) write, "the goal is to find (locally) optimal cluster configurations from one to some user-specified maximum number of clusters.... The <u>k</u> cluster configuration (also referred to as the <u>k</u>th clustering stage) is simply a division of all of the objects in the analysis into one of <u>k</u> different clusters." Kintigh and Ammerman (1982) include in their article additional statistics to the <u>k</u>-means cluster program which provide the user with cluster specific statistics which were not available for our analysis.

The program used in this analysis was the SAS FASTCLUS procedure (SAS 1982:433-447). This program allows the user to specify the maximum number of clusters, the radius which establishes a minimum distance criterion for selecting new seeds and replacement which specifies how seed replacement is performed.

The features with radiocarbon dates were broken out by time periods so that the dated features that fell outside a given time period were not considered in that period's cluster analysis. The time periods are listed below:

Time Period 1 = Late Archaic
Time Period 2 = Late Archaic/Transitional
Time Period 3 = Transitional
Time Period 4 = Neoarchaic

For each time period there was a different number of features with the maximum number of clusters (discrete occupations by a given social group) established by dividing the number of features by four, the number of features contemporaneously occupied. This number was based upon ethnographic data presented in Binford's (1983:144-192) discussion of people in their lifespace. The radius was set at 3.5 m which was also based on Binford's discussion. The replacement option requested seed replacement only when the minimum distance between the observation and any current seed is greater than the minimum distance between current seeds. The plots by time period are presented in Figures 8.2 to 8.5.

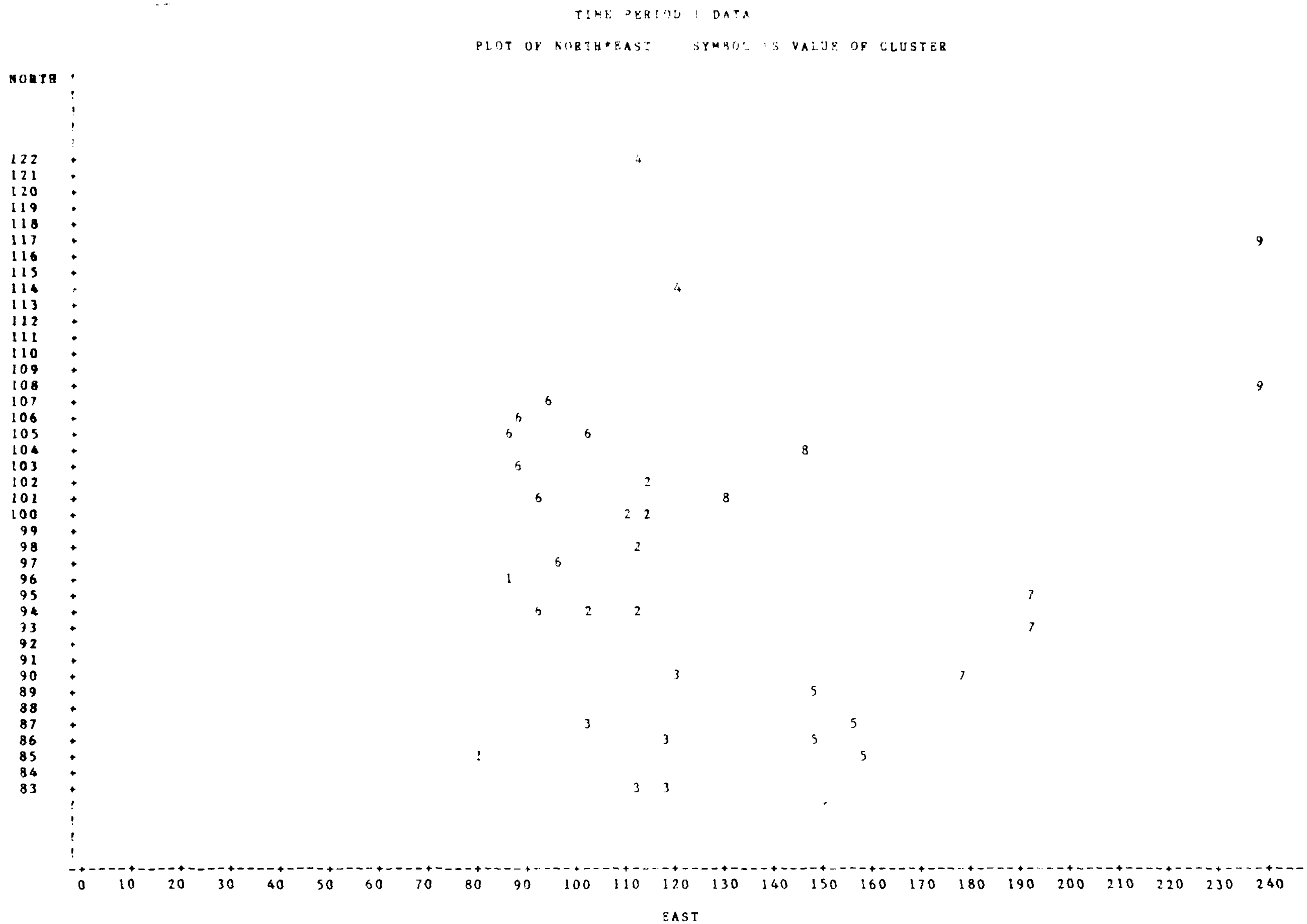
The idea behind these clusters is that they represent areas occupied by different social groups at one time or another during the given time period. The statistics associated with the clusters of each time period are presented in Table 8.5. If the R-SQUARED, coefficient of determination, is high (close to 1.0), it indicates that there is a strong linear trend to the clusters. In the SAS program the R-SQUARED statistic is for all clusters combined; Kintigh and Ammerman (1982) provide this statistic for each cluster.

Table 8.5
Clusters by Time Period

Cluster	Time Period 1 Members	Time Period 2 Members	Time Period 3 Members	Time Period 4 Members
1	2	1	2	1
2	6	10	3	3
3	5	3	9	3
4	2	8	2	3
5	4	5	2	9
6	8	3	6	8
7	3	4	8	2
8	2	2	3	1
9	3	3	1	5
10	-	1	-	-
Overall R-SQUARED	.9739	.9761	.9727	.9742

Interpretation of the Results:

There are two basic interpretations of the cluster results that have behavioral significance. The first is that there is a linear trend to almost all the clusters for each time period. This linear trend is perpendicular to the axis of the stabilized dune which forms the main focus of the site. This linear trend may be the result of two factors. First, the linear north/south axis of

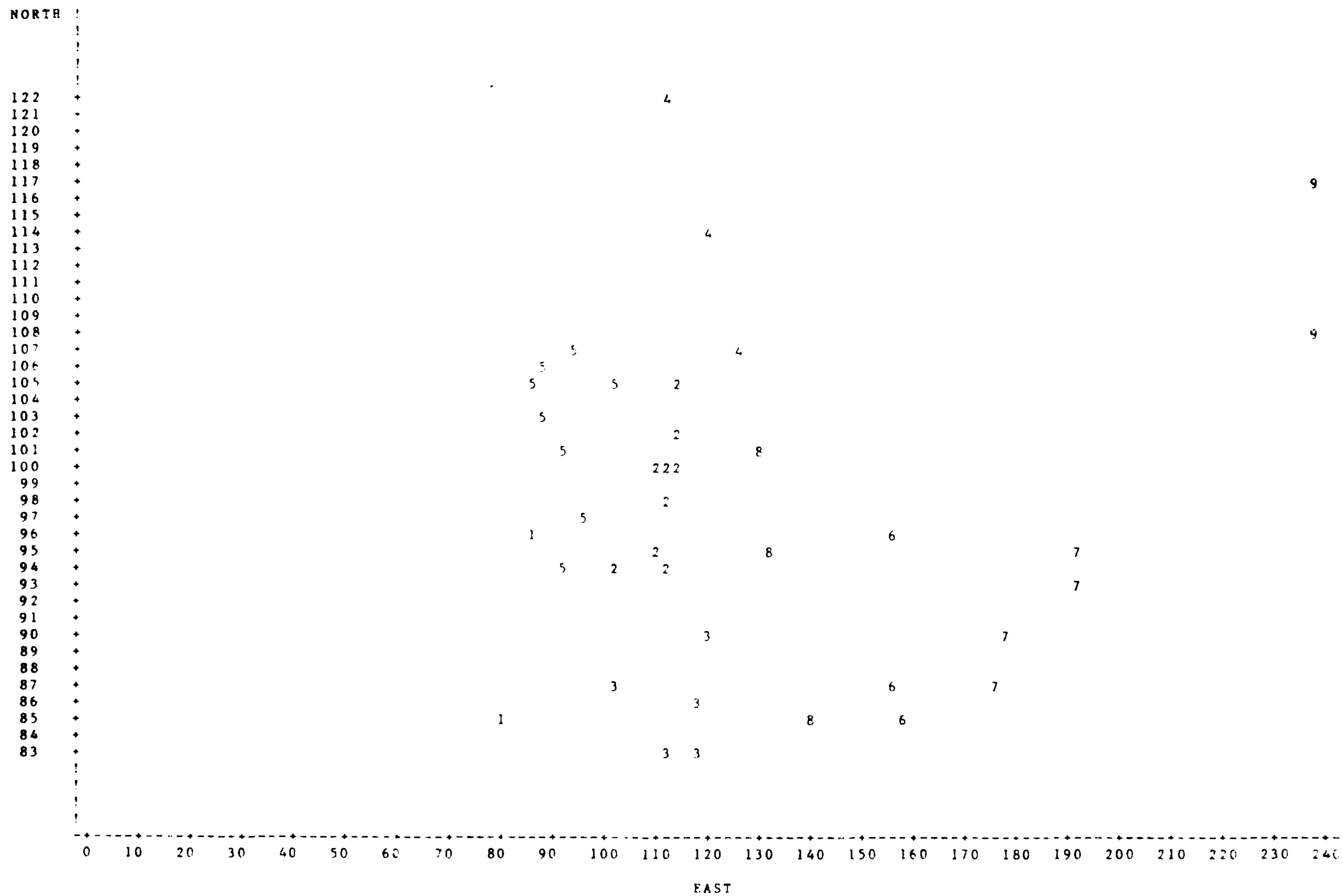


Note: one observation hidden

Figure 8.2

TIME PERIOD 2 DATA

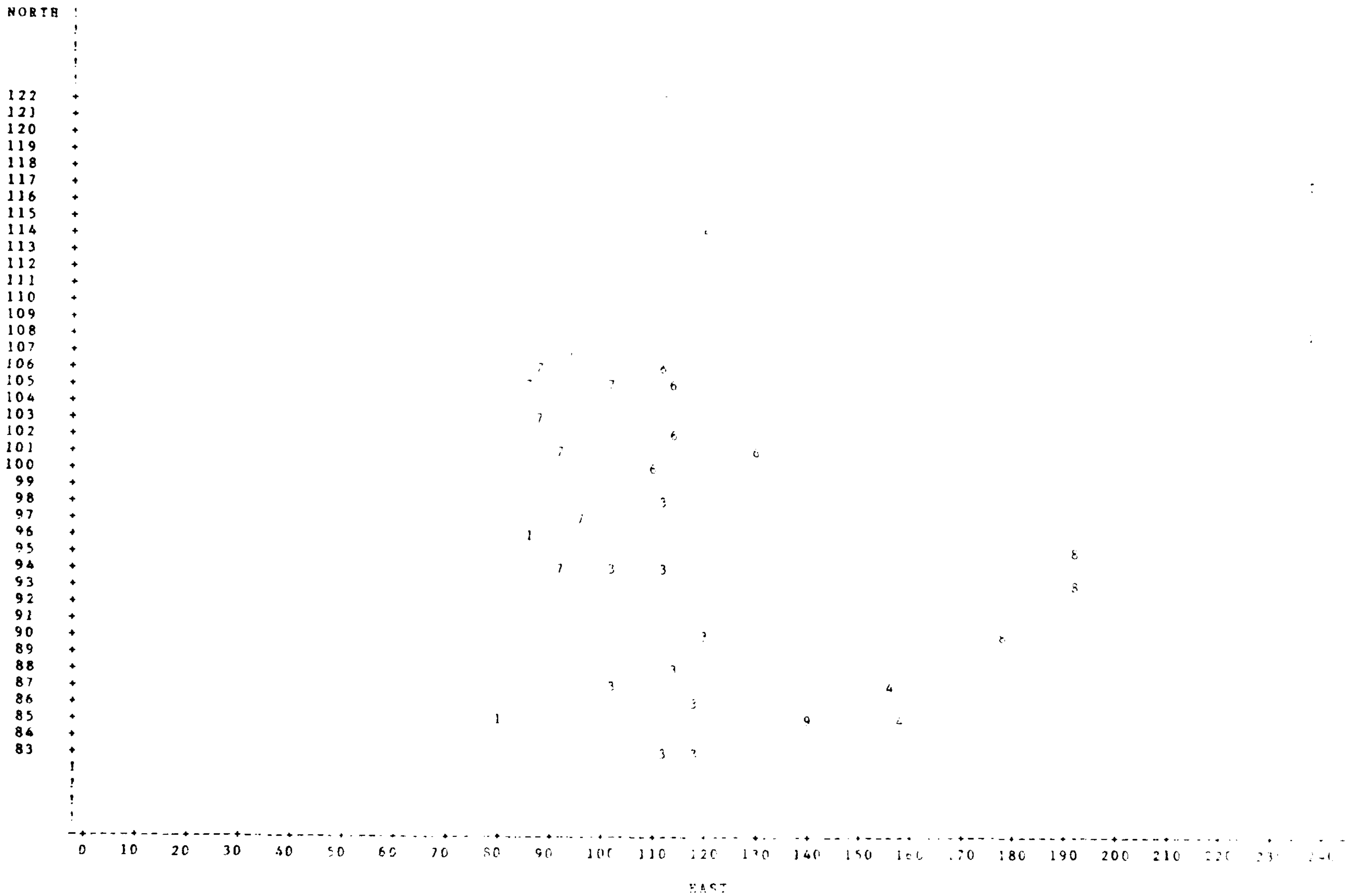
PLOT OF NORTH*EAST SYMBOL IS VALUE OF CLUSTER



Note: one observation hidden

Figure 8.3

PLOT OF NORTH*EAST   SYMBOL IS VALUE OF CLUSTER

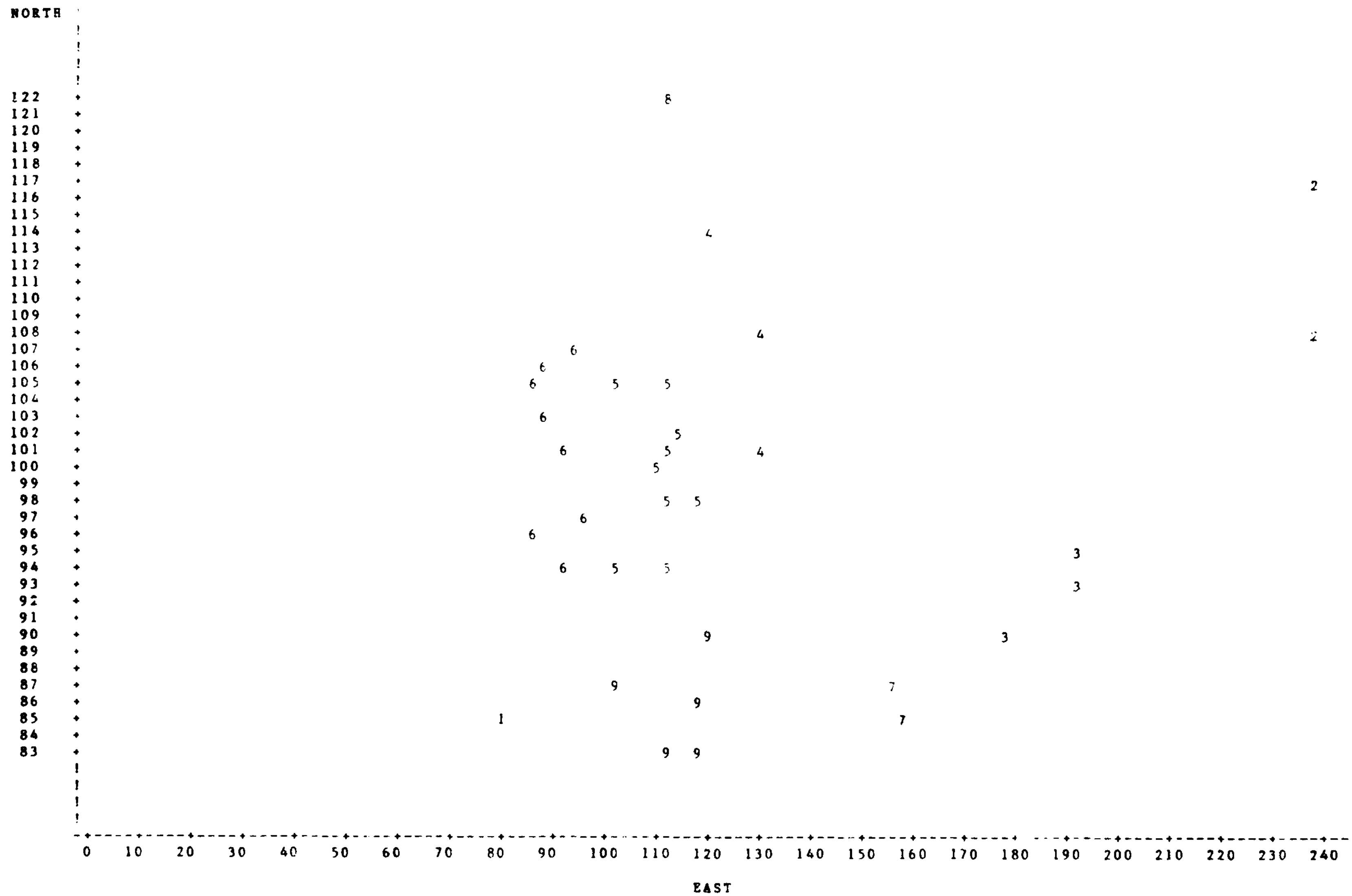


Note: one observation hidden

Figure 8.4

TIME PERIOD 4 DATA

PLOT OF NORTH*EAST   SYMBOL IS VALUE OF CLUSTER



Note: one observation hidden

Figure 8.5

the clusters provides the only view of Nash Draw to the west (see Plate 3.3) as views to the north, east and south are cutoff by other dune fields. Second, the prevailing wind is from the southeast (see Figure 3.5) and the north/south linear trend would organize the social groups such that smoke and/or smells would minimally affect other groups.

The second interpretation is that during any given time period the size of the individual groups (as defined by the number of pits) varied considerably. Although the analysis set the number of features per cluster at four, the clusters near the central and southern portion of the site usually had more than four features. This may mean that larger groups occupied the central portion of the site while smaller groups used the peripheral areas. In addition there is a consistent pattern in that the larger clusters are found in Area 2, the central part of Area 3 and the southern part of Area 3. Due to the fact that the majority of the features in Areas 2 and 3 (south) were discovered during the blading of the site, there were no artifact assemblages associated with these areas. Therefore there is no functional basis to explain these consistent clusters.

Conclusion:

In conclusion, both spatial methods offer means to evaluate spatial distributions; nearest neighbor analysis to establish the contemporaneity or noncontemporaneity of features and k-means cluster analysis to establish patterns of contemporaneous features. The analysis developed is tentative because there is nothing to compare it to in terms of other sites in the area. However it does offer a means to evaluate spatial distributions when one has a limited number of dated features and quite a few undated features.

Artifact Analyses

A limited number of artifact categories were recovered from the site. These consist primarily of ceramics, lithics, shell, ground stone, bone, and a small number of formal tools.

Detailed discussions of the ceramics recovered from ENM 10418 are discussed in Chapter 5. The results are summarized below. A total of 95 sherds was recovered from both surface and subsurface contexts. Roswell Brownware accounted for 31.5% of the ceramic inventory followed by Jornada Brownware with 28.4% of the assemblage. Also represented were El Paso Brownware (12.6%), San Andres Red-on-terracotta (11.5%), Chupadero Black-on-white and Whiteware (14.7%), and a single sherd of South Pecos Brownware (1.05%). These six types represent a potential time span of from A.D. 400 to 1550. Based on the presence of Roswell Brown, San Andres Red-on-terracotta and Chupadero Black-on-white, the best dates for the ceramic occupation of the site range between A.D. 1100 and 1300. The distributions of the ceramics were generally confined to an area bounded between 96-108N/110-120E. Ceramics found on the surface were rare, accounting for only 7.4% of the total. Mean depths and standard deviations of the various ceramic types indicate that the San Andres Red-on-terracotta, South Pecos Brown, and Chupadero Black-on-white and Whiteware sherds have mean elevations of 100.50 ± .042, 100.50 and 100.59 ± .098 respectively. These ceramic types date to A.D. 1100 and 1350 for the San Andres and A.D. 950 and 1100 for the Chupadero Black-on-white. The San Andres Red-on-terracotta and its body sherd type South Pecos Brown range in depth between 100.44 and 100.56 m. Chupadero Black-on-white and Whiteware body sherds range in depth from 100.47 and 100.67 m.

Mean elevational depths and standard deviations for Jornada, Roswell and El Paso Brownwares are also similar. These ceramic types date to A.D. 400 to 1350 for Jornada and El Paso Brownwares and A.D. 1100 to 1250 for Roswell Brownware. Jornada Brownwares range in depth from 100.26 to 100.74 m; Roswell Brownware ranges from 100.26 to 100.74 m and El Paso Brownware ranges from 100.39 to 100.48 m.

Using these rather crude associational measures, the following ceramic sequence for ENM 10418 is suggested. The earliest ceramic occupation probably included Jornada and Roswell Brownwares. This occupation may have occurred as early as A.D. 600 based on the radiocarbon sequence for ENM 10418 and ENM 10230. This early date, however, would require a major revision of the Roswell Brownware chronology. The second ceramic occupation at the site includes Jornada, Roswell, and El Paso Brownwares. The date sequence for this occupation at ENM 10418 is currently unknown. The final ceramic occupational sequence at the site included San Andres Red-on-terracotta, Chupadero Black-on-white, South Pecos Brownware, Jornada Brown, and Roswell Brownware. This occupation would have occurred between A.D. 1000 and 1350 based on ceramic chronologies. This date range is well represented at the site with three radiocarbon dates falling within this date range. Feature 14 has been dated A.D. 1270 ± 100, Feature 30 has been radiocarbon dated to A.D. 1190 ± 70 and Feature 32 has an A.D. 1450 ± 100 date.

Vessel forms represented at ENM 10418 are primarily jar forms (47.3%) with bowl forms representing only 15.8% of the assemblage. Over one-third of the assemblage could not be identified as to form. Bowl forms are represented by Jornada, Roswell and El Paso Brownwares and San Andres Red-on-terracotta. Chupadero Black-on-white is represented completely by jar forms. The low percentage of bowl forms at ENM 10418 are probably indicative of a low incidence of domestic activities while the high percentage of jar forms suggests transport or storage.

Lithic analyses for ENM 10418 are discussed in detail in Chapter 6. A brief summary of these results are given below.

The lithic activities represented in the ENM 10418 assemblage indicate a predominance of biface manufacturing activities. Secondary core flakes and/or flake blanks were transported to the site and were subsequently reduced into usable tool types. The low incidence of primary core flakes and flakes with cortex suggest that the prehistoric populations which utilized the site over nearly 2,000 years were obtaining lithic materials at some distance from the site and were performing primary reduction of cores at these locations. This process would reduce the amount of nonusable lithic material that would have to be carried by highly mobile hunter-gatherer groups. Some primary reduction was carried out at the site and may indicate a relatively nearby lithic source area. The presence of some primary lithic reduction at this site is not surprising since it was probably the focus for a number of the smaller campsites found throughout the region.

In addition to biface manufacturing activities a limited amount of tool resharpening occurred at the site as evidenced by a number of biface retouch flakes.

Analyses of the spatial distributions of the lithic material classes and flake types were accomplished using a complex group of variables; these include the depths of ceramics and features and the presence and types of projectile points. Based on these findings the occupations at ENM 10418 were divided into Archaic and Neoarchaic occupations. The Archaic component at ENM 10418 was spatially defined as the following:

$95 \leq$ N-S ≤ 108 and $110 \leq$ E-W ≤ 123 with vertical provenience ≤ 100.25 m.
$82 \leq$ N-S ≤ 85 and $140 \leq$ E-W ≤ 141 with vertical provenience ≤ 100.60 m.
$86 \leq$ N-S ≤ 96 and $176 \leq$ E-W ≤ 181 with vertical provenience ≤ 100.94 m.
$108 \leq$ N-S ≤ 111 and $243 \leq$ E-W ≤ 248 with vertical provenience ≤ 102.03 m.
$118 \leq$ N-S ≤ 155 and $20 \leq$ E-W ≤ 47 with vertical provenience ≤ 98.90 m.
$116 \leq$ N-S ≤ 117 and $136 \leq$ E-W ≤ 139 with vertical provenience ≤ 101.01 m.
$79 \leq$ N-S ≤ 82 and $128 \leq$ E-W ≤ 131 with vertical provenience ≤ 100.40 m.
$100 \leq$ N-S ≤ 105 and $144 \leq$ E-W ≤ 145 with vertical provenience ≤ 100.85 m.

Using these parameters, flakes which met these criteria were assigned to the Archaic component and were analyzed separately. These parameters were selected based on the lack of ceramics, radiocarbon dated features, and Archaic style projectile points found in association. The characteristics of the Archaic lithic assemblage are discussed in Chapter 6.

The Neoarchaic component at ENM 10418 was spatially defined as:

$95 \leq$ N-S ≤ 108 and $110 \leq$ E-W ≤ 123 with vertical provenience ≤ 100.26 m.
$82 \leq$ N-S ≤ 85 and $140 \leq$ E-W ≤ 141 with vertical provenience ≤ 100.61 m.
$86 \leq$ N-S ≤ 96 and $176 \leq$ E-W ≤ 181 with vertical provenience ≤ 100.95 m.
$108 \leq$ N-S ≤ 111 and $243 \leq$ E-W ≤ 248 with vertical provenience ≤ 102.04 m.
$118 \leq$ N-S ≤ 155 and $20 \leq$ E-W ≤ 47 with vertical provenience ≤ 98.91 m.

Neoarchaic assemblages were isolated using these spatial parameters. These units contained ceramics, had radiocarbon dated features and contained arrow points.

This system of selecting lithic assemblages was used to generate the data sets which were analyzed in Chapter 6. These data were compared on both an intra- and intersite level. The results of the analyses presented in Chapter 6 are briefly summarized below. Lithic source areas remained essentially unchanged throughout the entire occupational sequence at ENM 10418. Within flake types, only the tertiary core flakes were significantly different. Mean widths and thicknesses of tertiary core flakes were significantly larger in the Archaic assemblage. These differences may only be due to small sample sizes; however, changes in flake size attributes should be monitored in future projects in the region to see if this trend can be recognized at other sites.

Distributions of artifacts in an area three meters in diameter surrounding features are shown in Table 8.6.

Table 8.6
ENM 10418 Features and Associated Artifacts

Feature	Provenience	Radiocarbon Dates	Associated Materials
9	100N/112-113E	A.D. 360 ± 50	2 flakes, ground stone
10	110N/113-114E	170 ± 270 B.C.	4 flakes, 5 shell fragments
11	100N/110-111E	-	nothing associated
13	90N/178E	-	6 flakes
14	108N/129E	A.D. 1270 ± 100	2 flakes
25	129N/39E	A.D. 600 ± 60	1 flake
26	95N/110E	A.D. 300 ± 110	15 flakes, 1 ceramic
27	87N/176E	A.D. 210 ± 210	12 flakes, 2 ceramics, 25 shell fragments
28	98N/111E	-	1 shell fragment
29	94-95N/111E	-	1 flake
30	105N/112E	A.D. 1190 ± 70	9 flakes, 2 projectile points, 3 ceramics
31	105N/114E	A.D. 660 ± 70	4 flakes, 1 projectile point, 4 ceramics, 1 shell fragment
32	98N/118E	A.D. 1450 ± 100	3 flakes, 4 ceramics, 5 shell fragments, ground stone
33	107N/125E	A.D. 230 ± 70	1 flake, 1 bone, 10 shell fragments
34	105N/114E	A.D. 490 ± 70	2 flakes
35	85N/140E	A.D. 520 ± 80	25 flakes, 1 projectile point
36	104N/145E	880 ± 140 B.C.	6 flakes, 1 projectile point, 1 shell fragment
37	106N/111-112E	A.D. 680 ± 90	1 flake
38	128N/19E	A.D. 720 ± 80	ground stone

No attempts at distinguishing lithic assemblage variability were attempted due to the small sample sizes for each feature. The low numbers of artifacts spatially associated with the features suggests the utilization of the features was probably of short duration with little tool manufacture or maintenance carried out.

Additional artifact classes represented at ENM 10418 include mussel shell and bone. Whole mussel shells and mussel shell fragments are well represented at the site. Specimens recovered from the site are probably from the genus Lampsilis, a species which probably lived in the Pecos River. Mussel shell has a wide distribution across the site (Figure 8.6) but is generally concentrated in the eastern two-thirds of the site. The highest concentrations of shell are in an area bounded by 97-108N/110-127E. This concentration coincides with the

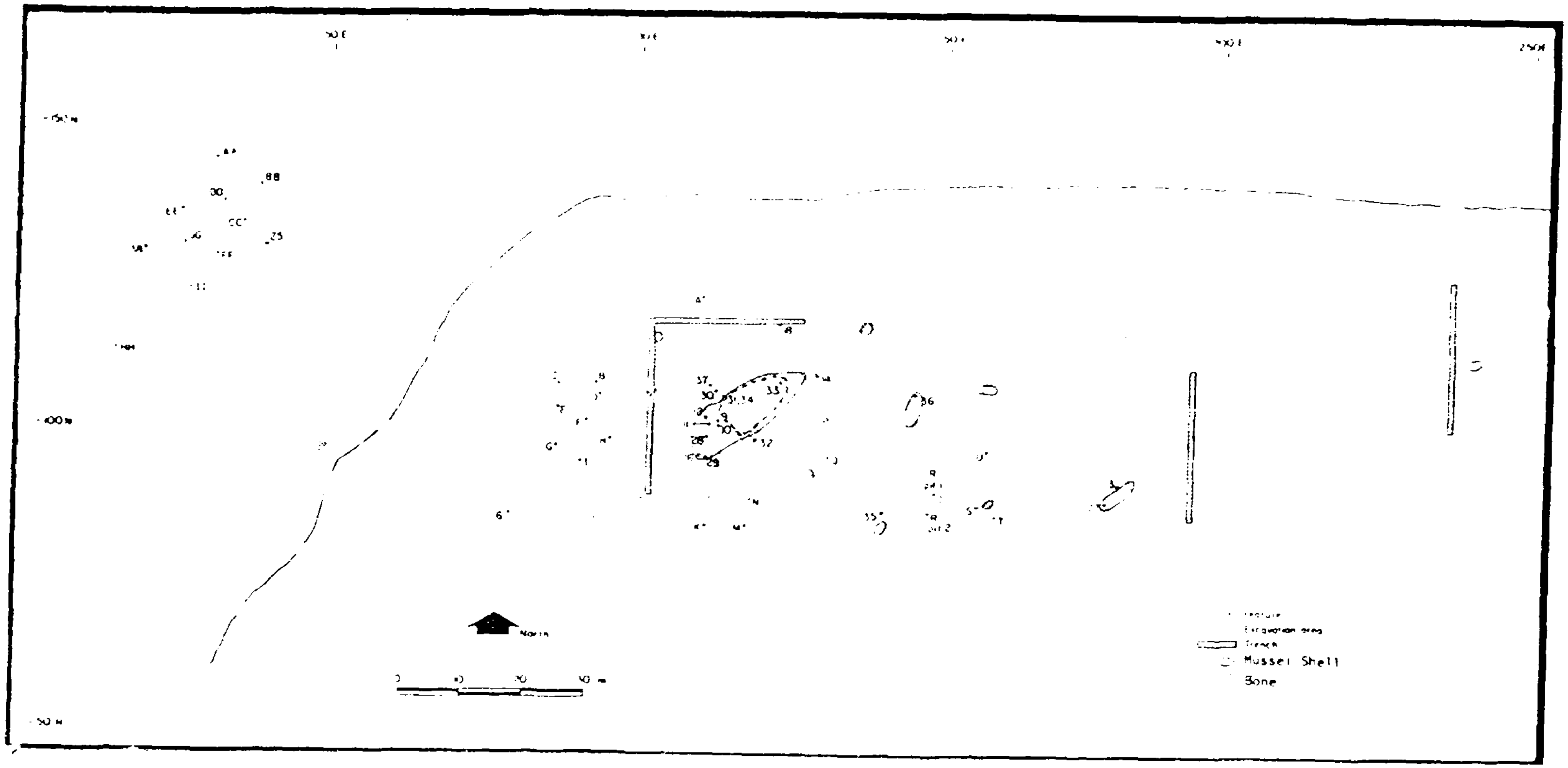


Figure 8.6
ENM 10418 Distribution of Mussel Shell and Bone

distribution of both the faunal remains and ceramics. The shell concentrations also seem to correlate with the spatial distribution of hearth features containing fire-cracked rock.

The shell remains at the site are indicative of consumption of mussels which were probably obtained from the Pecos River. The Pecos River is located 16 km south-southwest of ENM 10418. The association of mussel shell and fire-cracked rock lined hearths suggests that cooking took place at the site. Two different scenarios are given below to account for the presence of shell at ENM 14018: 1) the site was a limited base camp with groups moving to the river to collect mussels and then returning to the site with the mussels for processing for the entire group's consumption; or 2) movement of a group from a gathering area near the Pecos River to a new location. The groups may have collected the shells for a food resource at a new temporary camp location. Based on other findings at the site the first scenario seems to be more likely. The distribution patterns of the shell and bone from ENM 10418 suggests a conscious discard pattern of refuse away from the hearth areas (Figure 8.6).

Two deliberately manufactured shell artifacts were recovered from the site. A shell pendant (see Figure 7.1) was recovered near Feature 30. The pendant measures 36 mm wide and 35 mm long with 2 mm in diameter hole drilled unidirectionally from the interior of the shell. Feature 30 has been radiocarbon dated to A.D. 1190 ± 70 (Plate 8.4). This date indicates that shell exploitation was present during the latest occupational sequence at the site. Also recovered from the site was a whole mussel valve which has grinding along one margin. This shell probably functioned as a scoop of some sort. Based on the grinding patterns, it is likely that the ground edge was a function of usage rather than intentional shaping.

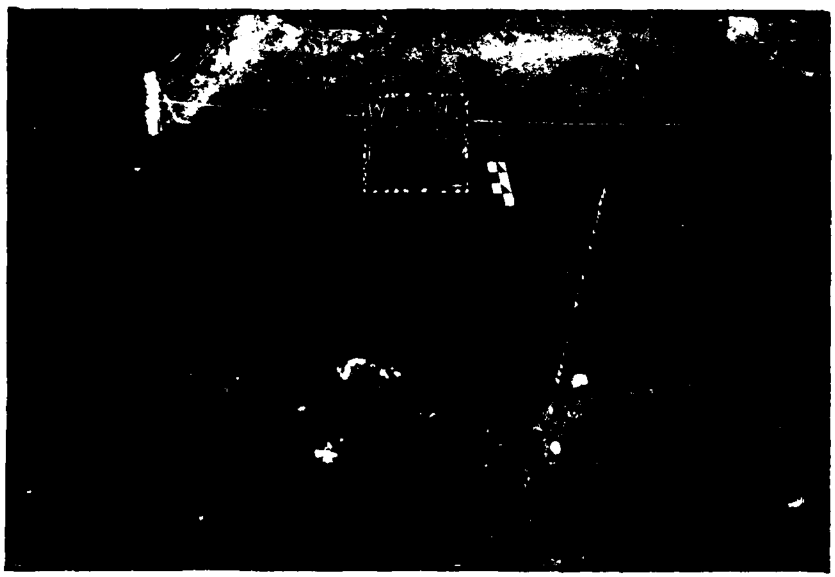


Plate 8.4
ENM 10418 Feature 30 - Fill Removed

Vertebrate faunal remains at the site were meager (see Table 7.6) but seem to include a high number of larger mammal remains. Deer were well represented although rabbits were also present. The distribution of faunal remains were concentrated in a small area bounded by 97-108N/115-123E (Figure 8.6). This concentration correlates very well with the distribution of shell and again indicates a distinct processing area which also seems to correlate with fire-cracked rock hearths. The vertical provenience of bone, shell, and later ceramic types co-occur suggesting that these items may have been deposited contemporaneously. This exploitation pattern is therefore associated with the A.D. 1000 to 1350 time span.

The results of the flotation analysis at ENM 10418 are shown in Table 7.2. Two primary species were recovered from hearth fill. Mesquite was recovered in 54% of the processed samples. Mesquite could have provided a high yield food item to prehistoric inhabitants of the region, and the presence of mesquite stands could have been a primary requisite for the location of campsites. A discussion of the various uses for mesquite can be found in Chapter 7. The low incidence of grinding implements at the site does not preclude mesquite processing at the site.

The other species found in high numbers at ENM 10418 is spurge (see Table 7.2). Spurge seeds were found in almost 46% of the flotation samples but co-occur with mesquite seeds in only 17% of the samples. The distributional characteristics of these two species with relations to the hearths are shown in Figure 8.7. Apparently spurge is a plant species which cannot be used directly as a food resource, but can be used for processing corn meal flour, converting the starches into sugars (Castetter 1935:29). While there is no evidence of corn at ENM 10418, spurge may have been used in a similar manner for the sweetening of mesquite. Spurge also has a number of medicinal values (Kearney and Peebles 1960) and the presence of this species for various types of medicine should not be overlooked.

Hearths containing spurge seeds are generally located on the peripheries of major activity areas of the site. The seeds were found in hearths which date to the early and middle occupational episodes at the site and never contain fire-cracked rock. Three hearths which have been radiocarbon dated contain spurge seeds. These dates range from 880 B.C. to A.D. 660. It is not known if this association is significant or represents a spurious correlation.

Mesquite seeds were found in hearths which contained fire-cracked rock and simple basin-shaped charcoal filled pits. Mesquite was obviously a stable item in the diet as it was found in hearths dating from 880 B.C. to A.D. 1190, thus spanning the entire occupational sequence at the site.

The evidence from ENM 10418 suggests that the site functioned in a different manner than either ENM 10222 and ENM 12030. The location of the site on the Livingstone Ridge with a small arroyo bisecting the site is quite different from either ENM 10222 or ENM 10230. The presence of the arroyo which was in existence since the Pleistocene (Larry Smith, personal communication 1984) probably would have contained water during at least part of the year. This would have allowed more prolonged occupational duration than the other sites in the region. This fact coupled with the large number of fire features and the

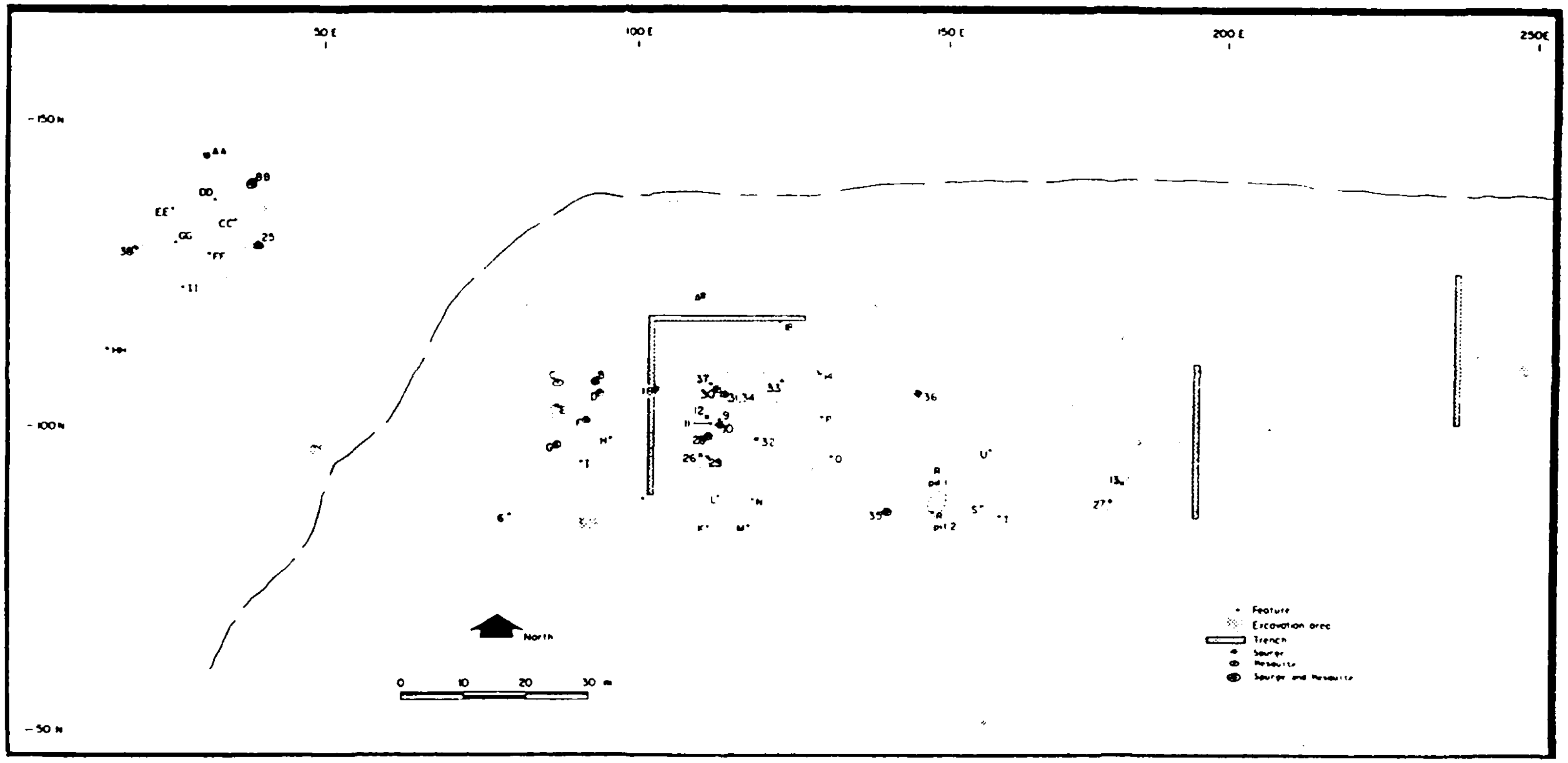


Figure 8.7
ENM 10418 Distribution of Spurge and Mesquite from Flotation Analyses

incidence of shell and bone remains is indicative of limited base camps. The lack of other formal tool categories cannot be explained. Cultural items present at ENM 10418 include ceramics with at least six types represented, shell ornaments and tools, projectile points, a small number of split cobble unifaces, biface fragments, manos and metates, lithic tool manufacturing debris, a variety of plant and animal food remains, and a large number of fire hearths with two distinct types. These lines of evidence indicate a wider variety of activities than were found at ENM 10222 and ENM 10230 and may in fact be representative of a limited base camp locality.

Projectile point styles, ceramic types, and radiocarbon dates suggest that at least four major occupational episodes took place at the site. The earliest occupation was preceramic and is represented by Features 10, 36, R-1, and R-2. The date range for these features extends from approximately 1100 to 250 B.C. Projectile points associated with this occupation include Types 8-D, 9, and Edgewood/Fairland. One Type 8-D point has been dated to 880 B.C. based on its association with Feature 36. The Edgewood/Fairland point can be placed within the 300 B.C. to A.D. 500 range in Central Texas (Prewitt 1981). In general ceramics were not found in association with these features; however, ceramics were found within the area of Feature 10 although these ceramics may represent subsequent occupational debris. No real spatial parameters can be placed on this occupational period due to the patchy nature of the excavation units and the intensive reuse of the site through time. The functional attributes of this occupational phase cannot be adequately addressed due to the low number of artifacts associated.

A second occupation at the site is postulated primarily based on the radiocarbon dating of four or possibly five hearths. Features 9, 26, 27, 33, and possibly Feature 10 span a period between 0 and A.D. 400. The Edgewood/Fairland point may be associated with this occupational episode. These hearths occur primarily in the major occupational focus of the site, thus it is difficult to separate cultural debris into distinct time periods. Functional information is again very sparse and cannot be adequately addressed.

The third occupational phase at the site is again defined primarily by the radiocarbon dating of hearths. Six features (25, 31, 34, 35, 37, and 38) range in age between A.D. 450 and 850. A single untyped projectile point was found in association with Feature 35 (Plate 8.5). Brownware ceramics, particularly Jornada and Roswell Brownwares, may be associated with this occupational phase. In addition some ground stone and possibly some of the mussel shell may be associated with this occupational period. This may have been the first occupational phase at ENM 10418 where a limited base camp designation can be postulated.

The final occupational phase at the site has been dated to between A.D. 1100 and 1450. Three features (14, 30, and 32) have been radiocarbon dated to this period. Decorated ceramics were present with both San Andres Red-on-terracotta and Chupadero Black-on-white represented. Five projectile points have been assigned to this period based primarily on Leslie's (1979) typology. Three of the points were found in the vicinity of Feature 30 which has been radiocarbon dated to A.D. 1190 ± 70. These are a Type 3-C, D or E, a Type 3, and a Cliffton/Perdiz/Livermore style. A single Type 3-C, D, or E was found at the extreme eastern limits of the site suggestive of widespread use of the site area during this time period. Ground stone, biface fragments, and split cobble unifaces have been tentatively assigned to this occupational period. The concentrations of shell and bone, and the shell pendant and mussel shell scoop have also been assigned to this period. Based on the ceramic inventory, the number of projectile points and the distributions of shell and bone suggest that this occupational period represents a limited base camp function for ENM 10418. This occupational period also represents the most intense usage of the site.

Plate 8.5
ENM 10418 Feature 35 - Fill Removed

The long occupational sequence present at ENM 10418 spans almost a 2,000 year period. Obviously the site must have been attractive to prehistoric groups. The primary attraction might have been a reliable water resource such as the arroyo which runs through the site. The site setting overlooks Nash Draw and the numerous playas which are within the Draw system. The range of view focuses toward the west-southwest and the site may have partially functioned as a game monitoring area as well as a processing locality. Another advantage of the site location is the ecotonal situation between the Nash Draw resources to the west and the dunal resources to the east. Prehistoric groups using ENM 10418 thus would have had access to water and two discrete environmental zones. ENM 10418 could have functioned as a temporary base camp with small special task groups radiating out in all directions with groups spending one or two days collecting and hunting and then returning to the base camp primarily to obtain water and to redistribute food items brought back from camps.

Chapter 9

SUMMARY

Kenneth J. Lord

Data collected in the intensive surface collections and test excavations at ENM 10222, ENM 10230, and ENM 10418 have been analyzed and discussed in the preceding chapters. These data suggest that all three sites were occupied over a long period of time and probably represent two functionally discrete site type categories. ENM 10222 and ENM 10230 probably represent plant collection stations with some emphasis on hunting while ENM 10418 probably functioned as a limited base camp.

ENM 10222 was occupied during at least two phases: the first phase represents the Late Archaic period and has been dated to 1140 B.C.; the second phase is represented by a single Fresno style projectile point and was dated to between A.D. 1000 and 1500. This site had a limited amount of data available and probably represents a marginal locale which was not used on a regular basis.

ENM 10230 was probably occupied during three phases: a Late Archaic-Transitional phase which has been radiocarbon dated at A.D. 260; a Transitional phase which as been radiocarbon dated between A.D. 570 and 880; and a Neoarchaic phase which has been radiocarbon dated to A.D. 1310. Artifact densities, the amount of ceramics and ground stone, and the number and variety of projectile points suggest a fairly extensive but focal occupation over a long time span. ENM 10230 is in an ideal location for plant collecting and game monitoring. It is located on a ridge overlooking a wide expanse of the Los Medanos region. This physiographic factor would have made the site a primary area for a variety of activities and relocation of the site by prehistoric groups would have been easy within an area of low topographic relief.

ENM 10418, the third site examined by this project, probably functioned as a limited base camp. A variety of activities are represented with a primary focus on fire features suggesting cooking and camping activities. This site was sporadically occupied during four phases: the Late Archaic phase has been radiocarbon dated between 320 and 880 B.C.; the Late Archaic-Transitional phase has been dated between 170 B.C. and A.D. 360; the Transitional phase has been radiocarbon dated between A.D. 490 and 720; and the Neoarchaic phase has been dated between A.D. 1190 and 1450.

The low densities of lithics, ground stone, and ceramics would seem to argue against a limited base camp designation; however, the large number of projectile points, hearth features, shell, and bone accumulations would seem to indicate functional differences between this site and the two described above.

Comparisons of the radiocarbon dates at the three sites (Figure 9.1) suggest that these three sites might have been occupied during roughly contemporaneous periods. If this were the case, ENM 10418 might have served as the base camp

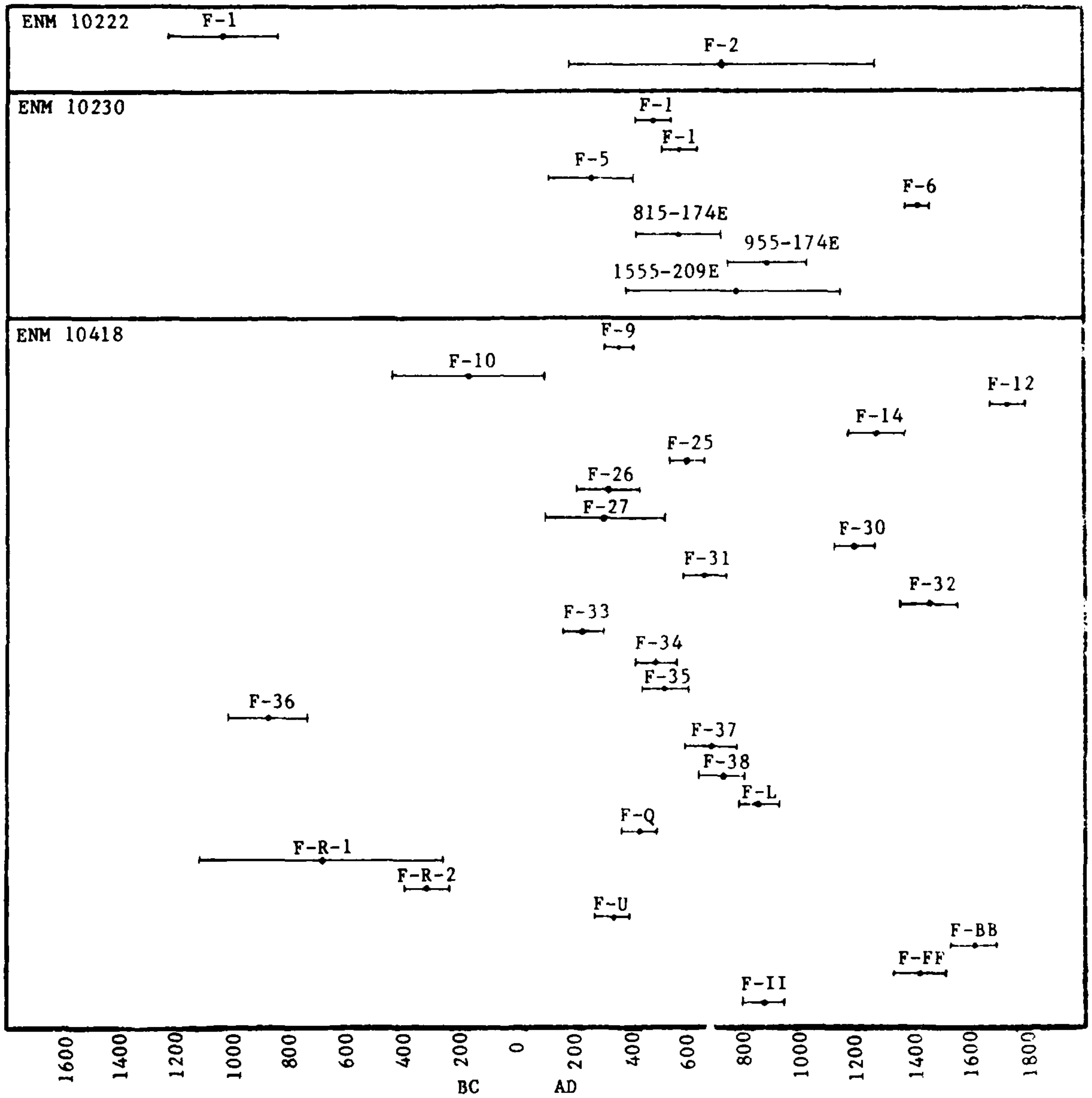


Figure 9.1
Radiocarbon Dates

for the other two sites. ENM 10418 is situated in an ideal location within the region. The arroyo which runs through the site could have easily provided water, particularly during the late summer months (the postulated time of occupation for most of the Los Medaños sites). The site is located in an ecotonal situation between the resources available within Nash Draw and the playas contained within it and the extensive dune fields and their resources, i.e., acorns, mesquite, and grasses. No definitive ties between the sites based on artifact types, however, have been noted.

A number of hypotheses have been generated to characterize the prehistoric utilization of the Los Medanos region (see Chapter 2). Tests of these hypotheses will be discussed below starting with specific research questions and finally moving to generalized research questions. Following these discussions an attempt will be made to place the sites within a generalized year round exploitation pattern.

Research questions and analytical results addressing these questions are examined below.

LITHICS

1) What, if any, lithic reduction activities occurred at the sites?

The lithic reduction strategies at all three sites have been discussed in detail in Chapter 6. Analyses indicate that all sites are characterized by biface manufacturing activities. Reduction activities suggest that groups using the sites collected suitable lithic materials at quarries some distance from the sites and performed preliminary reduction at these locations. Very few core or primary core flakes were recovered. Secondary core flakes and flake blanks were generally brought into the sites and were manufactured into finished items at all three sites. A discrete lithic reduction area was recorded surrounding Feature 2 at ENM 10222. This feature has been radiocarbon dated to 1140 B.C. and this reduction strategy probably represents an Archaic tradition.

In addition to biface manufacturing activities, the sites also contain evidence of a limited amount of tool resharpening, as evidenced by a number of bifacial retouch flakes.

2) Can lithic use activities be formulated based on the presence of formal tools and/or grinding implements?

Formal tool types excluding projectile points were poorly represented at all three sites. ENM 10222 contained four formal tool fragments. A thin biface fragment was recovered. This tool is probably indicative of some type of cutting function. Two flake fragments with unifacial marginal retouch were recovered. These artifacts could have served as cutting or scraping tools. A large secondary flake with steep marginal unifacial retouch possibly functioned as some type of scraper. The formal tools from ENM 10222 therefore probably represent butchering and hide scraping activities. Some of the tools may have been used for woodworking and plant collection activities.

Ground stone items at ENM 10222 were rare, but do include both mano and metate fragments. These items could have been used for processing mesquite, acorns, and possibly grass seeds.

The tool assemblage at ENM 10230 was also poorly represented. Only two formal tools were recovered over a very large site area. The lack of tools at this site may be due in part to intensive collection of the site by amateurs over a number of years. Both tools recovered are large secondary flakes. One tool is a large prismatic flake with marginal retouch on the dorsal surface. Based on morphological characteristics and the edge angle, it probably functioned in some type of cutting function. The second tool is a secondary flake with a hinged termination. One of the lateral margins has been steeply retouched on the dorsal surface. This tool probably functioned in some type of scraping activity. Based on this limited tool group, assignment of function to ENM 10230 is difficult. These tools are basically similar to those recovered from ENM 10222 and are probably indicative of similar functions. Both of these tools were found within Blowout 10, a blowout containing ceramics which has been tentatively assigned to the A.D. 900 to 1250 period.

Ground stone was rather abundant at ENM 10230. Both mano and metate fragments were recovered and a large number of fragments which could not be placed into a functional category were also noted. The abundance of ground stone at the site is indicative of plant processing, with mesquite, acorns, and grass seeds most probably being processed. The large amount of ground stone at this site may be the result of some manufacturing. The ridge on which ENM 10230 is situated contains a sandstone bedrock substrate of Santa Rosa sandstone. This sandstone type is well represented in the ground stone inventories of all three sites.

Two complete tools and two biface failure fragments were recovered from ENM 10418. The complete tools are split cobble unifaces with steep marginal retouch on the dorsal surfaces. Both tools contain large percentages of cortex. They both probably functioned as scrapers on unknown types of materials. Two early stage biface manufacturing failures were also recovered from the site. Both items were transversely snapped during manufacturing and were probably discarded without further use.

A limited amount of ground stone was also found at the site. Both mano and metate fragments were recovered suggesting a certain amount of plant processing. Plant processing, and either hide or woodworking activities, can be postulated as occurring at this site.

The tools from all three sites indicate similar economic activities. The lack of formal tool types is probably a function of a curation ethic in which the mobile groups using the sites carried formal tools throughout this portion of the seasonal round. Some tool manufacturing occurred at the site as evidenced by the lithic debitage and the biface failures. The potential for using simple flakes for a variety of tasks must not be overlooked and this class of artifact may be virtually indistinguishable from lithic debitage considering the environmental constraints discussed in Chapter 6.

3) <u>Do lithic activities correlate with material types and if so, what activities co-occur with material types?</u>

The lack of a large population of stone tools makes it difficult to address this research question. General tendencies seem to indicate that certain tool types were associated with broad material classes. The larger unifaces recovered from the sites were manufactured from medium to coarse grained quartzites. This may be a reflection of the importance of durable edges rather than the ability of the material to hold a sharp edge. Bifaces, biface fragments, and projectile points were made primarily on cherts. In these cases edge sharpness was probably more important than durability.

4) <u>If projectile points are present, will they help date the site?</u>

Nineteen complete or nearly complete projectile points were recovered from the three sites. Analyses described in Chapter 6 indicate that three general point categories were recovered. ENM 10418 had five projectile points which have been classified as dart points. According to the typology developed by Leslie (1978) these points (Type 8 and 9) predate A.D. 950. One projectile point with morphological characteristics similar to Type 8-D was recovered in association with Feature 36 which has been radiocarbon dated to 880 B.C. ± 140. These five points and a similar point style found at ENM 10230 would suggest that they represent the Late Archaic phase. Postulated dates for the Late Archaic phase run to 320 B.C. with no information on the initial date.

Four projectile points from ENM 10230 have been classified as dart points or larger arrow points. Within Leslie's typological classification (1978) these points (Type 6) date between A.D. 800 and 1000. These four points have been radiocarbon dated by blowout association to A.D. 570, A.D. 580, A.D. 670, and A.D. 880. Based on the radiocarbon dates and projectile point characteristics they fall within the Transitional phase which runs from A.D. 400 to 900.

The final projectile point category consists of arrow points. Nine specimens were recovered from the sites. Six were recovered from ENM 10418. These points represent Types 2 and 3 within the typological classifications of Leslie (1978). Two arrow points were recovered from ENM 10230. They represent Types 1 and 2 within Leslie's classification system (1978). All three of these projectile point styles have been dated by Leslie to between A.D. [illegible] and 1300. Data collected from the three sites seem to corroborate these dates. Three projectile points found at ENM 10418 were found in indirect association with Feature 30 which has been radiocarbon dated to A.D. 1190 ± 70. Additional radiocarbon dates at ENM 10418 which fall within this time period include A.D. 1270 and A.D. 1450. A single radiocarbon date from ENM 10230 falls within this period (A.D. 1310). No radiocarbon dates within this period were obtained from ENM 10222.

Based on the morphological characteristics, radiocarbon dates, and associated ceramics, these points represent the Neoarchaic phase which is dated between A.D. 900 and 1500.

5) <u>Can lithic raw materials be identified to specific source area?</u>

Lithic raw materials were identified to source areas whenever possible. Lithic source areas have been classified into letter designations and defined in Chapter 6. Figure 9.2 lists the lithic material classes and the percentages of these classes for the three sites investigated.

Material Class A is basalts. This class is poorly represented in the sample and may have been obtained in the Sierra Blanca Mountains to the west-northwest or in gravels in the Pecos River.

Material Class B is Ogallala gravels. Source areas for this class occur due east of the project area on the Llano Estacado and in the Pecos River drainage and probably represent the nearest lithic source area. This material class dominated all three lithic assemblages.

Material Class C is Ogallala opals and occurs in the same area as the Ogallala gravels. It was, however, a minor type.

Material Class D is obsidians. Source areas for obsidians are unknown in the region. This class is represented only at ENM 10222 and ENM 10230 in very limited quantities.

Material Class E is welded tuffs probably from the Plains of San Augustin which lie several hundred miles to the west of the project area. This class is represented only at ENM 10418 and ENM 10230 and is present in limited numbers.

Material Class F is fossiliferous cherts from the Hueco formation which is located south-southwest of the project area. This is one of the predominant material types at all three sites.

Material Class G is Pecos chalcedonies. This class was probably obtained from gravels associated with the Pecos River and could be found both west and south of the project area. This class is also well represented in all three lithic assemblages.

Material Class H is white cherts which could not be placed within a known source area. This class is present in small percentages at all three sites.

Material Class I is quartzite river cobbles probably obtained from the Pecos River. They were poorly represented at ENM 10418 and ENM 10230.

Material Class J is San Andres cherts found west and northwest of the project area near Roswell. This class was found at all sites but in relatively high percentages only at ENM 10418.

Material Class K is Washington Pass cherts which occur in northwestern New Mexico along the Arizona border. This material class was recovered from ENM 10418 only and probably represents the most distant source area.

Material Class L is purplish cherts which superficially resemble Alibates flint. The source area for this class is postulated to be near Yeso, New

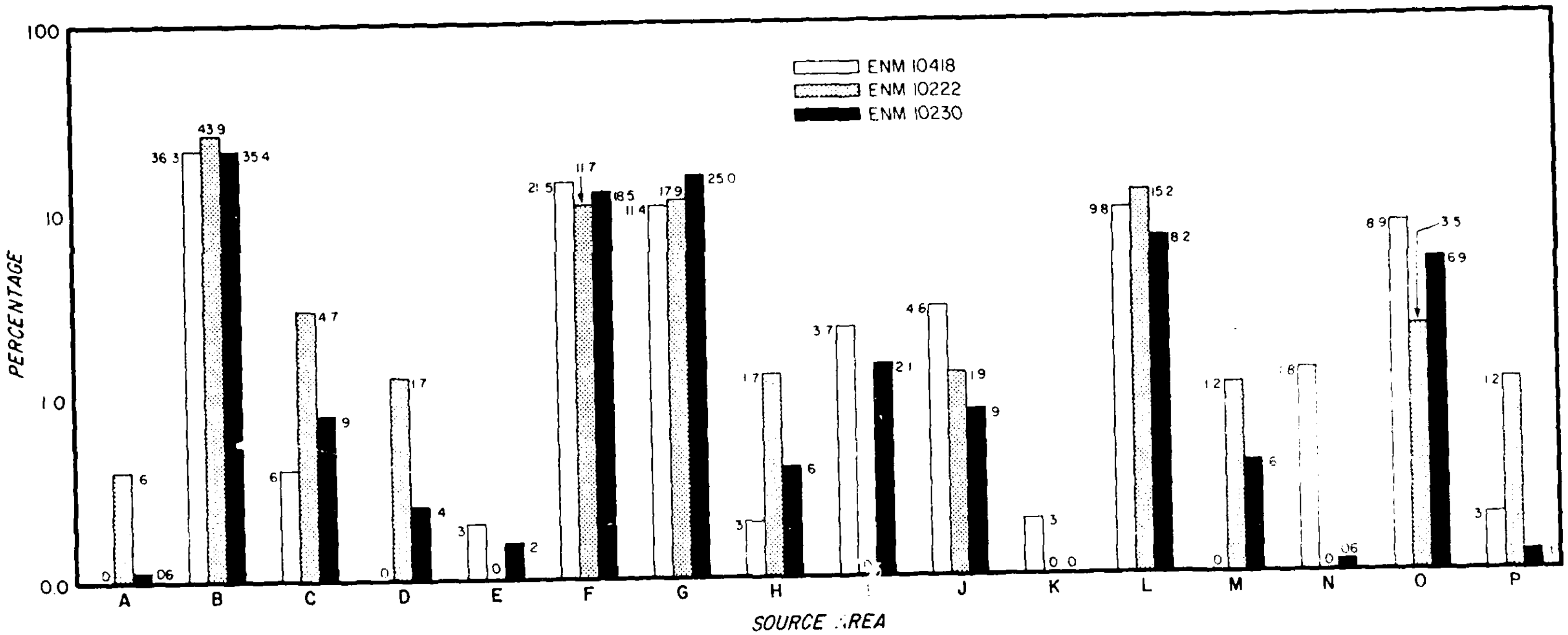


Figure 9.2
Material Class Percentages

Mexico over 200 miles north of the project area. This material type is well represented at all three sites.

Material Class M is brown silicified woods. No known source area could be determined. This class is represented at ENM 10222 and ENM 10230 in low percentages.

Material Class N is hydrous quartzes. Again no source areas have been identified. This class was present in low percentages at ENM 10418 and ENM 10230.

Material Class O is brown siltstones which have been found along the margins of the Guadalupe Mountains and in the Pecos River Valley north of Roswell. This material class is represented in moderate percentages at all three sites.

Material Class P is Ogallala jaspers probably acquired just east of the site area. This class is poorly represented at all three sites.

The material classes indicate that the groups that inhabited ENM 10418, ENM 10222, and ENM 10230 obtained the majority of their lithic resources east and southeast of the project area. Some materials were obtained from the north along the Pecos River, however these types account for a maximum of 17% of the assemblage at ENM 10222 and lesser amounts at ENM 10230 and ENM 10418. ENM 10222 may represent a true Archaic site and different resource utilization strategies were probably used based on percentage differences noted in Figure 9.2. Very few material classes were obtained west of the Pecos River and the Guadalupe Mountains may have been a barrier to group movement to the west. The implications of these findings will be discussed later within the generalized hypotheses.

6) <u>Can lithic manufacturing attributes as delineated by debitage analyses be related to the three governing hypotheses?</u>

The results of the lithic debitage analysis (Chapter 6) indicate that biface manufacturing was the dominant lithic reduction strategy utilized at all three sites. Although only limited data were recovered the attributes would suggest a core/flake reduction trajectory. These data indicate that the populations which inhabited the sites retained this trajectory throughout the entire occupational sequence and suggest that cultural change in the area was limited to the adoption of ceramics and the bow and arrow.

7) <u>Can tool morphology attributes be used to place the sites within a regional context?</u>

Few formal tool types were recovered from the sites excluding projectile points. Analysis of projectile point styles (Chapter 6) suggest that Late Archaic and Transitional projectile points represent a regional expression which developed in the Late Archaic period. The exact range of this distribution is incomplete at present. Similar styles have been found west of the

Pecos River at Three Rivers, New Mexico, (Wimberly and Rogers 1977) and in the Guadalupe Mountain foothills (Mera 1938). On the east side of the river projectile points similar in morphology have been found from Santa Rosa, New Mexico to the north (Schelberg 1984), in the Roswell area (Kemrer and Kearns 1984), and numerous areas around Carlsbad (Leslie 1978; Laumbach 1979; Hurst 1976; Thompson 1980). The eastern and southern limits of this distribution have not yet been defined. These projectile point styles are characterized by expanding stems and convex bases and have not been identified in Texas or to the west. This suggests that the Late Archaic and Transitional populations developed their own style of manufacturing points with little outside influence.

The Neoarchaic period projectile points have a wide distribution and are generally similar to styles in the southwest and across Texas. This wide spread distribution may indicate contact with other ceramic producing groups across a vast expanse of territory. Assignment of cultural affiliation based primarily on projectile points would be difficult. The styles of points seem to have a great many similarities to Central Texas point types; however, no conclusions on affinities can be made.

CERAMICS

A number of generalized research questions were developed to explore the role of ceramics in the history of the three sites. Original data (Schermer 1980) indicated that all three sites contained ceramics; however, when fieldwork began no ceramics were recovered from ENM 10222 and a reduced inventory was noted at ENM 10230. The following research questions and results of the investigations are discussed below.

1) <u>Can a relative date be assigned to each site based on the ceramic assemblages?</u>

Ceramics recovered from ENM 10230 include Jornada Brownware, Roswell Brownware, Jornada Corrugated, Jornada Black-on-brown, and undifferentiated brownwares. Based upon traditional ceramic dating methods (Jelinek 1967; Runyan and Hedrick 1973; Human Systems Research 1973) these ceramic types date between A.D. 900 and 1350. Recently El Paso Brownwares have been extended from A.D. 400 to 1350 by Whalen (1978). Examination of the data from ENM 10230 with regard to radiocarbon dated blowouts suggests that the range for brownware ceramics in the WIPP project area should be extended to A.D. 600.

Ceramics present at ENM 10418 include Jornada Brownware, El Paso Brownware, Roswell Brownware, San Andres Red-on-terracotta, and Chupadero Black-on-white. Ceramic date ranges for these types range from A.D. 400 for the El Paso Brownware (Whalen 1978) to A.D. 1550 for Chupadero Black-on-white (Breternitz 1966). Using radiocarbon dates from both ENM 10230 and ENM 10418 the range of dates for the ceramics at ENM 10418 would indicate a date range between A.D. 600 and 1450.

2) What vessel forms were present and how are they related to subsistence and lithic activities?

Vessel forms represented at both ENM 10230 and ENM 10418 were often difficult to determine due to the small size of the sherds and the surface erosion which occurred at the sites. ENM 10418 was dominated by jar forms (47.3%) with bowl forms accounting for only 15.8% of the ceramic assemblage. The remaining 36.9% could not be identified to vessel type. San Andres Red-on-terracotta was the only ceramic type at ENM 10418 which had a higher percentage of bowl forms to jar forms (see Table 5.2). Chupadero Black-on-white was represented entirely by jar forms.

ENM 10230 has a very high percentage of ceramics which could not be placed in a vessel form category (55.6%). Jar forms account for 37.7% of the total with only 6.7% of the ceramics representing bowl forms. Jornada Brownware has a high bowl to jar ratio (see Table 5.2) while the remaining ceramic types are represented exclusively by jar sherds.

The ratio of jars to bowls indicate that jars predominate; however, the undetermined vessel form category makes it difficult to assess the significance of the ratio. The research question on the ratio of jars to bowls to determine if the sites were occupied on a semipermanent or seasonal basis therefore could not be adequately addressed.

3) Can differences in tempering materials be discerned and can these differences be related to temporal periods at the sites?

A breakdown of ceramic type by tempering material (Table 5.1) indicates that most ceramic types were represented by a single temper material. Exceptions to this include Jornada Brownwares which are represented by temper groups 1, 2, 3, and 7. Interesting differences in dominant temper types between ENM 10230 and ENM 10418 exist. The former is dominated by temper type 1 (57.1%) while the latter is predominately temper type 2 (74.0%). Since both sites date to roughly the same time periods differences in temper types may indicate differences in social group composition. These differences in temper composition may also be related to slight temporal differences since ENM 10418 probably had a more intense occupation in the Neoarchaic period. If this were the case temper type 1 represents the earlier occupation at both ENM 10230 and ENM 10418 while temper type 2 represents the latter, Neoarchaic, occupation.

Temper type differences between Jornada Brownware and El Paso Brownware at ENM 10418 are insignificant and the problems involved with distinguishing these two ceramic types cannot be answered. Additional aralyses will be needed to separate these ubiquitous brownware categories.

FEATURES

Research questions concerning features involve examination of spatial structure and radiometric assignment.

1) <u>If features were present, they would most likely take the form of hearths which could be used for spatial analysis. Can hearths be used to spatially define specific activity areas for discrete periods of occupation at the sites?</u>

Sixty-six cultural features were identified from the three WIPP sites. ENM 10222 contained two features, only one of which can be given a hearth designation (Figure 4.2). This hearth feature has been radiocarbon dated to 1140 B.C. Due to the lack of cultural features and the paucity of culturally produced items no information on the spatial distribution was attempted.

Six cultural features were identified at ENM 10230. Three of the features have been radiocarbon dated. They range in age from A.D. 260 to 1310. Potential features based on fire-cracked rock densities indicate that an additional 22 hearth features may be present within the sampled portions of the site. Although no radiocarbon dates are available, the majority of these potential features may represent similar time periods. Spatial patterning within the blowouts indicate that from one to four features per blowout were present. Detailed spatial analyses of features within ENM 10230 were hindered by the small sample fraction at the site. The data suggest that blowouts or portions of blowouts represent discrete occupational activity areas.

ENM 10418 contained at least 58 cultural features found during intensive excavations, backhoe trenching and grading. Chapter 8 discusses the analysis of spatial patterning in detail. A brief summary of the results indicate that a nonrandom distribution of hearths on the western side of the arroyo was present. This coupled with almost exclusive use of Material Class B suggest that this portion of the site represents a single occupational episode. Data for the eastern side of the arroyo using nearest neighbor analysis suggests a random distribution of hearths. These data are corroborated by the radiocarbon sequence and their spatial distribution (see Figures 9.1 and 8.1). Cluster analysis of the hearths on the eastern side of the site reveal a linear arrangement of hearth groups. These group memberships shift throughout the four major periods of occupation. Repeated reoccupation of the eastern portions of the site has made detailed spatial analysis vis-a-vis lithic reduction strategies and ceramic assemblages impossible to determine with any degree of confidence.

This statement therefore has profound effects on research questions involving the presence of discrete living surfaces and the dating of nondiagnostic lithic scatters.

GOVERNING HYPOTHESES

Three governing hypotheses were developed regarding prehistoric utilization of the WIPP area (see Chapter 2). Using all of the data discussed throughout the report and the specific research questions, these three hypotheses have been evaluated.

Hypothesis 1:

> The WIPP area was seasonally utilized where activities were focused on the gathering of vegetal materials (acorns and mesquite beans) with a lesser emphasis on hunting. Temporary structures were set up at base camps. Procurement groups would range into the surrounding area to hunt and gather as well as perform initial processing. Foodstuffs were stored at the base camp and subsequently removed to permanent villages, probably located near the Pecos River. Tool production and maintenance was performed at the base camps although tool production for immediate needs might occur elsewhere. This hypothesis varies little from that suggested for the preceding Archaic groups.

Based on findings from the three sites investigated portions of this hypothesis can be supported. The WIPP area was seasonally occupied, probably by small groups, with acorns and mesquite forming the major subsistence focus. Some evidence for hunting does exist, however the main focus was probably plant processing based on the presence of ground stone.

No temporary structures were noted at ENM 10418, a postulated base camp. This may be due to the ephemeral nature of structures and/or disturbance caused by deflation and sheet erosion. There was no evidence of storage structures although the high percentage of jars at the sites may indicate transportation and storage facilities. Removal of stored goods to permanent sites along the Pecos River cannot be verified or refuted due to a lack of data. Small village sites have been documented along the Pecos River to the north (Jelinek 1967). However, it is not known whether this patterning can be extended to the south. No evidence of village sites were found in the Brantley Reservoir area along the Pecos River just north of the project area (Gallagher and Bearden 1980).

Tool production and maintenance activities occurred both at base camps and at temporary collection camps, perhaps indicating a wider variety of activities at the temporary camps than had been previously postulated. The hypothesis states that this pattern began in the preceding Archaic period. Evidence from ENM 10222, ENM 10230, and ENM 10418 suggests that this exploitation pattern did occur in the Late Archaic period and remained essentially unchanged through the Neoarchaic period.

Hypothesis 1, therefore, is probably correct. Groups did use the area on a seasonal basis, probably summer, with a focus or plant materials and some emphasis on hunting. The hunting focus was probably centered around the base camps. Plant collection and processing activities were probably carried out at the temporary camps. No evidence for permanent villages have been found in the region during the time periods represented by the three WIPP sites. Using lithic debitage attributes the groups using the sites retained Archaic reduction strategies and it is assumed that other Archaic strategies vis-a-vis procurement and settlement systems were also in effect.

Hypothesis 2:

The WIPP area supported a semi-sedentary population of Mogollon throughout the year. Data from the Merchant site (Leslie 1965) and from the Andrews Lake locality in Texas (Collins 1968) demonstrate the existence of pit structures and surface rooms occupied during the Ochoa phase at playa locations. These populations appear to be almost totally dependent on the hunting of game, especially bison, and the gathering of wild vegetal materials. This situation might have developed earlier in the Mogollon sequence in the WIPP area.

No evidence within the WIPP area in either survey or excavation data indicates the presence of pit structures or surface rooms. ENM 10222, ENM 10230, and ENM 10418 contain little evidence which could be reliably placed within the Ochoan phase. No evidence indicates that this subsistence-settlement strategy occurred prior to A.D. 1300 in the region and therefore, based on the data collected for this project, Hypothesis 2 cannot be addressed.

Hypothesis 3:

The population in the WIPP area was never Mogollon but an indigenous, essentially nomadic hunter-gatherer group that systematically traded for Mogollon ceramics. Puebloan tradewares from the Southwest have been found on Plains Indian sites throughout Texas and Oklahoma (Krieger 1947). An alternative is that "Plains" groups acquired ceramics and architectural technologies from the Mogollon after considerable contact with them.

Data collected from ENM 10222, ENM 10230, and ENM 10418 would seem to support portions of this hypothesis. Examination of lithic source areas for these sites suggest that ties to the west were rare. Western ties could have indicated contact with Jornada Mogollon groups. Mogollon ties at the sites seem to occur within the ceramic assemblage only and may indicate some type of reciprocal trade status. Ceramics coming in from the west could have been traded in, however, no evidence for reciprocal trade items from southeast New Mexico have been recorded. Potential trade items, however, may include acorns, dried bison meat, or salt (Pat Beckett, personal communication 1984).

Analysis of projectile points suggest that Late Archaic and Transitional groups developed unique projectile points which could not be linked to groups to the west. The trend of these point types suggests a linear distribution following the Pecos River at least to Santa Rosa, New Mexico. This Archaic and Transitional group association with the river may be in part related to Taylor's (1961) ideas on tethered nomadism, with groups essentially tied to the reliable water present in the river. Groups therefore would have been spatially associated with the river for at least part of the year.

Difficulties exist in extending this relationship to Neoarchaic groups. Settlement locations and subsistence strategies apparently remained stable. Stability is also indicated in lithic reduction strategies with Archaic-like strategies present throughout the entire occupation sequences at all three sites. This cultural conservatism is also a hallmark of Taylor's (1961) ideas on tethered nomadism. The introduction of ceramics and the bow and arrow, therefore, would have had little effect on the settlement-subsistence-technological or social structures of the indigenous populations.

CONCLUSIONS

In summary, archaeological investigations of the three sites in the WIPP area suggest that the region in general represents one portion of a seasonal round by mobile hunter-gatherer groups. These groups probably developed out of an as yet poorly defined Middle Archaic context. The Late Archaic groups, the first phase represented at ENM 10222, ENM 10230, and ENM 10418, probably represent a regional expression of the general Archaic populations of the Southwest and Texas. These groups may have had a seasonal round which encompassed the Pecos River in areas such as Brantley Reservoir for certain portions of the year (Gallagher and Bearden 1980) and based on similarities to projectile point types into the eastern foothills of the Guadalupe Mountains (Mera 1938). Data are not available on settlement and subsistence information vis-a-vis seasonal usage of these three regions. Based on the presence of mesquite, acorns, and summer maturing grasses, a summer to early fall exploitation season is postulated for the area surrounding WIPP.

This basic exploitation pattern persisted in the region through the Transitional and Neoarchaic periods. During these two periods ceramics were incorporated into the material culture sphere and eventually the bow and arrow replaced the atlatl. Evidence for agriculture during this time period is scant; however, this may be due to a lack of archaeological coverage in areas suitable for supporting agriculture.

The three sites excavated within the WIPP area fall within Periods 3 (Hueco phase), 4 (Querecho phase), and 5 (Maljamar phase) (Leslie 1979). The Hueco phase in the region may represent the Late Archaic, Late Archaic/Transitional, and Transitional phases discussed throughout this report. Leslie (1978) indicated that the Hueco phase pre-dates A.D. 950.

The Querecho (A.D. 950 - 1100) and Maljamar (A.D. 1100 - 1300) phases encompass the Neoarchaic period discussed in this report. These phase designations were not used because, 1) they imply a certain type of adaptation, 2) the mixed nature of the deposits at the site precluded detailed phase assignments based on ceramic typologies and/or projectile point typologies, 3) radiocarbon dates do not corroborate much of the data discussed in Leslie (1979), and 4) demonstrated evidence of pit structures and sedentism have not been adequately documented until post A.D. 1350.

The primary question therefore is, did settled life exist in southeastern New Mexico between A.D. 900 and 1350? Since data are generally lacking to address this question adequately, the more generalized scheme of classification was used. Until additional surveys and excavations in the area have been completed and village sites have been documented, the problems of placing the sites excavated at WIPP within the eastern extension of the Jornada Branch of the

Mogollon as presently defined (Corley 1965; Leslie 1979) will be difficult. The term Neoarchaic fits the data better and implies a continuation of an Archaic adaptation with the addition of ceramics and the bow and arrow.

REFERENCES CITED

Adovasio, J. M., R. L. Andrews, and R. C. Carlisle
1981 Prehistoric Basketry of the Lower and Trans-Pecos Region of Texas. Ethnology Monographs.

Applegarth, Susan M.
1976 Prehistoric Utilization of the Environment of the Eastern Slopes of the Guadalupe Mountains, Southeastern New Mexico. Unpublished Ph.D. dissertation. Department of Anthropology, University of Wisconsin, Madison.

Bachman, G. O.
1974 Geologic Processes and Cenozoic History related to salt dissolution in Southeastern New Mexico. U.S. Geological Survey Open-file report 74-194.

Barkley, Fred A.
1935 The Statistical Theory of Pollen Analysis. Ecology 15:283-289.

Bearden, Susan E.
1979 The EPCC Survey Chipped Stone Analysis. In The Archaeology of Southwest Gallegos Mesa: The EPCC Survey Project, edited by S. E. Sessions, pp. 169-198. Navajo Nation Papers in Anthropology No. 1.

Beckes, M. R., and J. M. Adovasio
1982 Perspectives on the Origins and Affinities of Mogollon on the Eastern Periphery. In Mogollon Archaeology: Proceedings of the 1980 Mogollon Conference, edited by Patrick Beckett and Regge Wiseman, pp. 201-209. Acoma Books, Ramona, California.

Beckett, Patrick H.
1976 Mescalero Sands Archaeological Resources Inventory, Second Season. Cultural Resource Management Division Report No. 45. New Mexico State University, Las Cruces.

1979 Hueco Phase: Fact or Fiction. In Jornada Mogollon Archaeology, edited by Patrick H. Beckett and Regge N. Wiseman, pp. 223-225. Las Cruces.

Binford, Lewis R.
1983 In Pursuit of the Past - Decoding the Archaeological Record. Thames and Hudson Inc. Publishers, New York.

Blalock, Hubert M.
1972 Social Statistics. McGraw-Hill, New York.

Bond, Mark
1979 A Class III Cultural Resources Inventory of Proposed Off Road Vehicle Recreation Areas in the Haystack Mountain, Comanche Hill Mescalero Sands Vicinity near Roswell, New Mexico. Cultural Resources Management Division Report No. 327. New Mexico State University, Las Cruces. Prepared for BLM Roswell District.

Bordes, Francois
1969 Reflections on typology and techniques in the Paleolithic. Arctic Anthropology 6(1):1-29.

Bradley, Bruce A.
1982 Cultural Resource Inventory of a Proposed Water Pipeline, Waste Isolation Plant Project, Eddy County, New Mexico. Complete Archaeological Service Associates, Cortez, Colorado. Prepared for U.S. Army Corps of Engineers, Albuquerque District, New Mexico, Purchase Order Number DACW47-82-M-0377.

Breternitz, David A.
1966 An Appraisal of Tree-Ring Dated Pottery in the Southwest. Anthropological Papers of the University of Arizona No. 10. Tucson.

Broilo, Frank J.
1971 An Investigation of Surface Collected Clovis, Folsom, and Midland Projectile Points from Blackwater Draw and Adjacent Localities. Unpublished Masters thesis, Department of Anthropology, Eastern New Mexico University, Portales.

Bryant, Vaughn M., Jr., and Harry J. Shafer
1977 The Late Quaternary Paleoenvironment of Texas: A Model for the Archeologist. Bulletin of the Texas Archeological Society 48:1-25.

Burns, Barney T.
1967 The Archaeology of the Carlsbad District, Southeastern New Mexico. Unpublished B.A. honors thesis, Department of Anthropology, University of Arizona.

Burns, Bruce A.
1977 Ceramics - ENM 10017. In Caprock Water System Archeological Project, Lea County, New Mexico, edited by J. L. Haskell, pp. 213-302. Agency of Conservation Archaeology, Eastern New Mexico University, Portales.

Camilli, Eileen, and Christina G. Allen (editors)
1979 A Cultural Resources Overview for the Bureau of Land Management Roswell District. Ms. on file with the Office of Contract Archeology, Department of Anthropology, University of New Mexico, Albuquerque.

Castetter, Edward F.
1935 Uncultivated native plants used as sources of food. Ethnobiological Studies of the American Southwest No. 1, University of New Mexico Bulletin Biological Series 4(1).

Chapman, Richard C.
1977 Analysis of the Lithic Assemblages. In Settlement and Subsistence Along the Lower Chaco River: The CGP Survey, edited by C. A. Reher, pp. 371-452. University of New Mexico Press, Albuquerque.

1980 The Archaic Period in the American Southwest: Fact or Fantasy. Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico.

1982 Dating Archaeological Sites with Lithic Manufacturing Debris. In Inventory Survey of the Lower Hidden Mountain Floodpool, Lower Rio Puerco Drainage, Central New Mexico, edited by Peter L. Eidenbach, pp. 235-285. Human Systems Research, Inc., Tularosa, New Mexico. Submitted to the Corps of Engineers, Albuquerque.

Chapman, Richard C., and J. A. Schutt
1977 Methodology of lithic analysis. In Archeological Investigations in Cochiti Reservoir, New Mexico, edited by R. C. Chapman and J. V. Biella. The Office of Contract Archeology, University of New Mexico, Albuquerque.

Chugg, Jack C., George W. Anderson, Donald L. King, and LaVaughan H. Jones
1971 Soil Survey, Eddy Area, New Mexico. Soil Conservation Service, U.S. Department of Agriculture in cooperation with New Mexico Agricultural Experiment Station. U.S. Government Printing Office, Washington, D.C.

Clark, P. J., and F. C. Evans
1954 Distance to Nearest Neighbor as a Measure of Spatial Relationships in Populations. Ecology XXXV:445-453.

Collins, Michael B.
1971 A Review of Llano Estacado Archaeology and Ethnohistory. Plains Anthropologist 16(52):85-104.

Colton, Harold S.
1953 Potsherds. Museum of Northern Arizona Bulletin 25. Flagstaff.

Corley, John A.
1965 Proposed Eastern Extension of the Jornada Branch of the Mogollon Culture. In Southeastern New Mexico and Western Texas Symposium Papers 1:30-36. Lea County Archaeological Society, Hobbs.

Corley, John A., and Robert H. Leslie
1960 The Boot Hill Site. Bulletin of the Lea County Archaeological Society No. 2. Hobbs.

1963 Projectile Point Types of Extreme Southeastern New Mexico, LCAS Site Survey Report. Bulletin of the Lea County Archaeological Society No. 4. Hobbs.

Crabtree, Don E.
1966 A Stoneworkers' Approach to Analyzing and Replicating the Lindenmeir Folsom. Tebiwa 9:3-39.

Department of Energy (DOE)
1980 Final Environmental Impact Statement, Waste Isolation Pilot Plant, 2 vols. DOE/EIS-0026 UC-70. U.S. Government Printing Office, Washington, D.C.

Duran, M., and K. Laumbach
1981 Collection and Testing of a Late Archaic Sites on the Black River for the Washington Ranch Storage Station, Eddy County, New Mexico. Cultural Resources Management Division Report No. 479. New Mexico State University, Las Cruces.

Fenneman, Neville M.
1931 Physiography of the Western United States. McGraw-Hill, New York.

Fry, Gary F.
1970 Preliminary Analysis of the Hogup Cave Coprolites. In Hogup Cave, edited by C. Melvin Aikens, pp. 247-250. University of Utah Anthropological Papers No. 93. University of Utah Press, Salt Lake City.

Gallagher, Joseph G., and Susan E. Bearden
1980 Evaluation of Cultural Resources at Brantley Reservoir, Eddy County, New Mexico. Archeological Research Program, Department of Anthropology. Southern Methodist University, Dallas Texas.

Gomolak, Andrew R., and Lee Heinsch
1982 Lithic Artifact Analysis: Methods, Interpretations, and Conclusions. Ms. in authors' possession.

Gross, Frederick A., and William A. Dick-Peddie
1979 A Map of Primeval Vegetation in New Mexico. The Southeastern Naturalist 24(1):115-122.

Gunnerson, D. A.
1974 The Jicarilla Apaches: A study in survival. Northern Illinois University Press. Dekalb.

Hafsten, Ulf
1961 Pleistocene Development of Vegetation and Climate in the Southern High Plains as Evidenced by Pollen Analysis. In Paleoecology of the Llano Estacado, assembled by Fred Wendorf, pp. 59-91. Publication No. 1 of the Fort Burgwin Research Center. Museum of New Mexico Press, Santa Fe.

Hall, Stephen A.
1981 Deteriorated Pollen Grains and the Interpretation of Quaternary Pollen Diagrams. Review of Paleobotany and Palynology 32:193-206.

Hantman, Jeffrey
1978 An Archaeological Survey of the Chevelon Juniper Push Apache-Sitgreaves National Forests, Chevelon Ranger District, Coconino County, Arizona. Cultural Resources Management Report No. 40. Arizona State University, Tempe, Arizona.

Haskell, J. Loring (editor)
1977 Caprock Water System Archaeological Project, Lea County, New Mexico. Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

Hayes, Alden C.
1977 Chupadero Black-on-white. Prepared as a part of the Gran Quivira Project of the National Park Service.

Henderson, Mark
1976 An Archaeological Inventory of Brantley Reservoir, New Mexico: Models of Regional Culture History. Southern Methodist University Contributions in Anthropology No. 18. Dallas.

Hester, James J.
1972 Blackwater Draw Locality 1. Fort Burgwin Research Center Publication No. 8. Southern Methodist University, Dallas.

Hicks, Patricia A.
1981a Mitigation of Four Archaeological Sites on the Waste Isolation Pilot Project near Carlsbad, New Mexico for Westinghouse, Inc. Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

1981b Mitigative Collection and Testing of Five Archaeological Sites on the Waste Isolation Pilot Project near Carlsbad, New Mexico for Westinghouse, Inc. Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

Howard, E. B.
1935 Evidence of Early Man in North America. University of Pennsylvania Museum Journal 24:53-171.

Huggins, Robert J., and J. W. Weymouth
1981 Magnetic Reconnaissance Program. In Dolores Archaeological Project - Interpretation of Data Collected during Field Year 1979. Department of Physics, University of Nebraska report to the University of Colorado.

Human Systems Research
1973 Survey of the Tularosa Basin: the Research Design. Human Systems Research, Inc., Tularosa, New Mexico.

Hurst, W.
1976 An Archaeological Reconnaissance of the Maroon Cliff, Eddy County, New Mexico. Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

Irwin-Williams, Cynthia
1967 Picosa: The Elementary Southwestern Culture. American Antiquity 32:441-457.

Jelinek, Arthur J.
1967 A Prehistoric Sequence in the Middle Pecos Valley, New Mexico. University of Michigan, Museum of Anthropology, Anthropological Papers No. 31.

Jones, C. L., M. E. Cooley, and G. O. Bachman
1973 Salt Deposits of Los Medaños Area, Eddy and Lea Counties, New Mexico. Open File Report 4339-7, U.S. Geological Survey.

Judge, W. James
n.d. Early Man, Plains and Southwest: An Interpretive Summary of the PaleoIndian Occupation of the Plains and Southwest. Handbook of North American Indians, vol. 3, edited by W. D. Sturtevant. In preparation.

1973 PaleoIndian Occupation of the Central Rio Grande Valley in New Mexico. University of New Mexico Press, Albuquerque.

Kapp, Ronald O.
1969 Pollen and Spores. Wm. C. Brown Company, Dubuque, Iowa.

Kauffman, Barbara
1983 Evidence for Late Hunter-Gatherer Adaptations in Southeastern New Mexico. In Proceedings of New Mexico Archeological Council, Southeastern New Mexico Conference 5(1):23-40. Roswell.

Kearney, T. H., and R. H. Peebles
1960 Arizona Flora. University of California Press, Berkeley.

Kelley, J. C., T. N. Campbell, and D. J. Lehmer
1940 The Association of Archaeological Materials with Geological Deposits in the Big Bend region of Texas. West Texas Historical and Scientific Society Bulletin 21(3).

Kemrer Meade F., and Timothy M. Kearns
1984 An Archaeological Research Design for the Abo Oil and Gas Field, Southeastern New Mexico. Chambers Consultants and Planners, Albuquerque. Submitted to and copies available from the Bureau of Land Management, Roswell District, Contract No. YA-553-CT2-139, Roswell, New Mexico.

Kintigh, Keith W., and Albert J. Ammerman
1982 Heuristic Approaches to Spatial Analysis in Archaeology. American Antiquity 47:31-63.

Knight, Terry
1980 Ceramic Analysis. In Archaeological Reconnaissance in White Sands National Monument, New Mexico, edited by Peter L. Eidenbach and Mark L. Wimberly. Human Systems Research Inc., Tularosa, New Mexico.

Krieger, Alex D.
1947 The eastward extension of Puebloan datings toward cultures of the Mississippi Valley. American Antiquity 7(3).

Laumbach, Karl W.
1979 A Cultural Resource Inventory of the Proposed Laguna Plata Archaeological District. Cultural Resource Management Division Report No. 335, New Mexico State University, Las Cruces.

Lee, Richard B.
1968 What Hunters do for a Living or How to Make out on Scarce Resources. In Man the Hunter, edited by R. B. Lee and I. DeVore, pp. 30-48. Aldine, Chicago.

Lehmer, Donald J.
1948 The Jornada Branch of the Mogollon. University of Arizona Social Science Bulletin No. 17. University of Arizona Bulletin 19(2), Tucson.

Leonard, A. Byron
1950 Handbook of Gastropods in Kansas. University of Kansas Museum of Natural History Miscellaneous Publication No. 20.

Leslie, Robert H.
1965 The Merchant Site (A Mogollon Site). Bulletin of the Lea County Archaeological Society 1:23-29.

1968 The Monument Spring Site, LCAS No. D16. In Transactions: Fourth Regional Archaeological Symposium for Southeastern New Mexico and Western Texas, pp. 79-83. Iraan Archaeological Society, Iraan, Texas.

1978 Projectile Point Types and Sequence of the Eastern Jornada-Mogollon, Extreme Southeastern New Mexico. In Transactions of the 13th Regional Archaeological Symposium for Southeastern New Mexico and Western Texas, pp. 81-157.

1979 The Eastern Jornada Mogollon, Extreme Southeastern New Mexico (A Summary). In Jornada Mogollon Archaeology: Proceedings of the 1st Jornada Conference, edited by P. H. Beckett and R. N. Wiseman, pp. 179-200. Las Cruces.

MacLennan, R. B., and S. C. Schermer
1979 An Archaeological Survey for the Waste Isolation Pilot Project: Access Roads and Railroad Right-of-way. Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

Martin, Alexander C., and William D. Barkley
1961 Seed Identification Manual. University of California Press, Berkeley.

Mehringer, P. J.
1967 Pollen Analysis of the Tule Springs Site, Nevada. In Pleistocene Studies in Southern Nevada, edited by M. H. Wormington and Dorothy Ellis. Nevada State Museum Anthropological Papers No. 13.

Mera, H. P.
1938 Reconnaissance and Excavation in Southeastern New Mexico. American Anthropological Association Memoirs No. 51, Washington D.C.

Mera, H. P., and W. S. Stallings
1931 Lincoln Black-on-red. Technical Series of the Laboratory of Anthropology Bulletin No. 2. Santa Fe.

Muto, Guy R.
1971 A Technological Analysis of the Early Stages in the Manufacture of Lithic Artifacts. Unpublished Masters thesis. Idaho State University.

Nielsen, Jeffrey
1977 An Archaeological Reconnaissance of a Proposed Site for the Waste Isolation Pilot Plant (WIPP). Sandia Laboratories, Albuquerque.

Oldfield, Frank, and James Schoenwetter
1975 Discussion of the Pollen Analytical Evidence. In Late Pleistocene Environments of the Southern High Plains, edited by F. Wendorf and J. J. Hester, pp. 149-177. Fort Burgwin Research Center Publication No. 9, Taos.

Pilles, Peter
1978 The Field House and Sinagua Demography. In Limited Activity and Occupation Sites, edited by A. Ward, pp. 119-133. Center for Anthropological Studies Report No. 1. Albuquerque.

Pinder, P. A., and M. E. Witherick
1972 The Principles, Practice, and Pitfalls of Nearest Neighbor Analysis. Geography 57:277-288.

1974 A Modification of Nearest Neighbor Analysis for use in Linear Situations. Geography 59:16-22.

Plog, Fred
1980 Stylistic Variation in Prehistoric Ceramics. Cambridge University Press, New York.

Powers, D. W., S. J. Lambert, S. E. Shaffer, L. R. Hill, and W. D. Weart (editors)
1978 Geological Characterization Report for the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico, 2 vols., SAND78-1596, Sandia Laboratories, Albuquerque, New Mexico.

Prewitt, Elton R.
1981 Cultural Chronology in Central Texas. Bulletin of the Texas Archeological Society 52:65-89.

Prewitt, Elton R., and Linda A. Nance
1980 Archeological Survey and Assessments on the McBryde Lease, Duval County, Texas, pp. 1-35. Prewitt and Associates, Inc. Reports of Investigations No. 7.

Reynolds, William E.

1974 Archaeological Investigations at Arizona U:9:45 (ASM): A Limited Activity Site. Cultural Resource Management Section, Arizona State Museum, University of Arizona. Submitted to the National Park Service, Purchase Order No. PX810040179.

1975 Boundary Definition in Nearest Neighbor Analysis: An Analysis of the Connie Site. Paper presented at annual meeting of the Society for American Archaeology, Dallas.

1983 Research Design for the Archaeological Investigations of Sites ENM 10418, ENM 10222 and ENM 10230. Chambers Consultants and Planners. Prepared as partial fulfillment of Contract No. DACW47-83-D-0069 DM0001. Ms. on file with Corps of Engineers, Albuquerque.

Roberts, Frank H. H., Jr.

1942 Archaeological And Geological Investigations in the San Jon District, Eastern New Mexico. Smithsonian Miscellaneous Collections 103(4).

Runyan, John, and J. Hedrick

1972 The Laguna Plata Site: LCASC-10-C, LA 5148. Transactions of the Seventh Regional Archeological Symposium for Southeastern New Mexico and West Texas, pp. 101-114.

1973 Pottery Types of the S.W.F.A.S. Area. In Transactions of the 8th Regional Symposium for Southeastern New Mexico and Western Texas, La Mesa, Texas, pp. 19-47. Published by the Lea County Archaeological Society, Hobbs.

SAS

1982 SAS User's Guide: Statistics. SAS Institute Statistical Analysis System.

Sayles, Edwin B., and Ernst Antevs

1941 The Cochise Culture. Medallion Papers 29. Gila Pueblo, Globe, Arizona.

Schander, Mark D.

1983 Environment. In Cultural Resource Study on the White River Oil Shale Lease Lands in the Vernal District, Utah, pp. 37-61. Chambers Consultants and Planners, Albuquerque, New Mexico. Submitted to Bureau of Land Management, Vernal District, Contract No. YA-553-CT1-131, Vernal, Utah.

Schelberg, John D. (editor)

1984 Archaeological Investigations at Los Esteros Reservoir. Contributions to Anthropological Studies No. 4. Center for Anthropological Studies, Albuquerque. In press.

Schermer, Scott C.
1980 A Report on the Archaeological Site Locations in the WIPP Core Area with Mitigation Recommendations for Bechtel National, Inc. Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

1983 Report on Two Radiocarbon Dates Obtained from Feature 2, Site ENM 10233 on the WIPP Project Area near Carlsbad, New Mexico, Supplement to Hicks (1981). Ms. on file with the Agency for Conservation Archaeology, Eastern New Mexico University, Portales.

Schultz, C. B., and L. D. Martin
1970 Quaternary Mammalian Sequence in the Central Great Plains. In Pleistocene and Recent Environments of the Central Great Plains, pp. 341-354. The University of Kansas Press, Lawrence.

Sellards, E. H.
1952 Early Man in America. University of Texas Press, Austin.

Shelley, Phillip H., and Fred L. Nials
1983 A Preliminary Evaluation of Aeolian Processes in Artifact Dislocation and Modification: An Experimental Approach to One Depositional Environment. Proceedings of the New Mexico Archeological Council, Southeast New Mexico Conference 5(1):50-56. Roswell.

Silverbird, Kira
1979 Fauna. In A Cultural Resource Inventory of the Proposed Laguna Plata Archaeological District, by Karl W. Laumbach. Cultural Resources Management Division Report No. 335, New Mexico State University, Las Cruces. Prepared for Bureau of Land Management, Roswell District.

1980 Fauna. In Implications of Archaeological Collections, Tests, and Excavation in the Carlsbad Area, pp. 105-121. Cultural Resources Management Division Report No. 433. New Mexico State University, Las Cruces.

Smiley, T. L., S. A. Stubbs, and B. Bannister
1953 A Foundation for the Dating of Some Late Archaeological Sites in the Rio Grande Area, New Mexico: based on studies in tree-ring methods and pottery analyses. University of Arizona Bulletin 24(3), Laboratory of Tree-Ring Research Bulletin No. 6. Tucson.

Smith, C. B.
1966 The Paleo-Indian in Southeastern New Mexico. In Transactions of the Second Regional Archeological Symposium for Southeastern New Mexico and Western Texas, pp. 3-8.

1972 The Maljamar Point. Llano Estacado Heritage 2(2):33-35.

Stockmarr, Jens
1971 Tablets with spores used in absolute pollen analysis. Pollen et Spores 8(4):615-621.

Stuart, David and Rory Gauthier
1981 Prehistoric New Mexico: Background for Survey. Historic Preservation Bureau, Santa Fe.

Suhm, Dee Ann, and Edward B. Jelks
1962 Handbook of Texas Archeology. Texas Archeological Society Special Publication No. 1 and Texas Memorial Museum Bulletin No. 4. Austin, Texas.

Suhm, Dee Ann, A. D. Krieger, and Edward B. Jelks
1954 An Introductory Handbook of Texas Archeology. Texas Archaeological Society Bulletin No. 25.

Taylor, W. W.
1961 A Study of Archaeology. American Anthropological Association Memoir No. 69, Washington, D.C.

Thomas, David H.
1976 Figuring Anthropology: First Principles of Probability and Statistics. Holt, Rinehart and Winston, New York.

Thompson, Marc
1980 Implications of Archaeological Collections, Tests, and Excavation in the Carlsbad Area. Cultural Resources Management Division Report No. 433. New Mexico State University, Las Cruces.

USGS
1976 Water resources data for New Mexico, water year 1976. U.S. Geological Survey Water-Data report NM-76-1.

1983 Water resources data for New Mexico, water year 1983. U.S. Geological Survey Water-Data report NM-83-1.

Van Devender, Thomas R.
1977 Holocene Woodlands in the Southwestern Deserts. Science 198:182-191.

1980 Holocene Plant Remains from Rocky Arroyo and Last Chance Canyon, Eddy County, New Mexico. The Southwestern Naturalist 25(3):361-372.

Van Devender, Thomas R., and B. L. Everitt
1977 The Latest Pleistocene and Recent Vegetation of Bishop's Cap, South-Central New Mexico. The Southwestern Naturalist 22(1):22-28.

Van Devender, Thomas R., and David H. Riskind
1979 Late Pleistocene and Early Holocene Plant Remains fro Hueco Tanks State Park: The Development of a Refugium. The Southwestern Naturalist 24(1):127-140.

Vine, James D.
1963 Surface Geology of the Nash Draw Quadrangle, Eddy County, New Mexico. Contributions to General Geology, Geological Survey Bulletin 1141-B, U.S. Geological Survey, Department of the Interior. U.S. Government Printing Office, Washington, D.C.

Warnica, J. M.
1961 The Elida Site: Evidence of a Folsom Occupation in Roosevelt County, Eastern New Mexico. Bulletin of the Texas Archeological Society 30:209-215.

1965 Archaic Sites in Eastern New Mexico. Transactions of the First Regional Archeological Symposium for Southeastern New Mexico and Western Texas, pp. 3-8. Lea County Archaeological Society, Hobbs.

Watson, V.
1950 The Optima Focus of the Panhandle Aspect: Description and Analysis. Bulletin of the Texas Archeological and Paleontological Society No. 21.

Wendorf, Fred, and J. J. Hester (editors)
1975 Late Pleistocene Environments of the Southern High Plains. Fort Burgwin Research Center Publication No. 9, Southern Methodist University, Dallas.

West Texas Geological Society
1969 Delaware Basin Exploration. No. 68-55a, West Texas Geological Society, Midland, Texas.

Whalen, Michael E.
1977 Settlement Patterns of the Eastern Hueco Bolson. El Paso Centennial Museum Publications in Anthropology No. 4. The University of Texas at El Paso.

1978 Settlement Patterns of the Western Hueco Bolson. Anthropological Paper No. 6. Centennial Museum, University of Texas at El Paso.

Whallon, Robert Jr.
1974 Spatial Analysis of Occupation Floors 11, the Application of Nearest Neighbor Analysis. American Antiquity 39:16-34.

Wheat, Joe Ben
1955 Mogollon Culture Prior to A.D. 1000. Memoirs of the Society of American Archeology 20:242.

Wimberly, Mark, and Alan Rogers
1977 Archeological Survey Three Rivers Drainage, New Mexico. The Artifact 15.

Appendix 1

FINAL REPORT ON MAGNETIC SURVEYING OF ARCHAEOLOGICAL RESOURCES ASSOCIATED WITH PROPOSED WASTE ISOLATION PILOT PLANT

Site ENM 10418

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May 25, 1984

INTRODUCTION

During the month of December, 1983, Spectrum Geophysics was contracted to conduct magnetometer surveys of selected archaeological sites by Dr. Bill Reynolds, Chambers Consultants and Planners, as a part of the archaeological investigations associated with the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The project is funded by the Department of Energy and administered by the United States Army Corps of Engineers, Albuquerque District.

Magnetic surveying is a method whereby subsurface cultural features may be located and identified prior to archaeological investigation. Features such as house pits, fire hearths and concentrations of refuse, shell or rock can produce detectable changes (referred to as anomalies) in the magnitude of the earth's magnetic field. Based on the results of a magnetic survey, areas of cultural activity may be recognized, and archaeological investigations can then concentrate on areas with the most pertinent cultural information. The magnetic survey program undertaken as part of the WIPP Project was designed with these capabilities in mind.

Provision was made for the collection of ten 20 x 20 m 'blocks' of magnetometer data, sampled at a .5 sq m interval. Data collection commenced on December 3, 1983, and continued until December 8. Two crews were run simultaneously to expedite data collection. The results and interpretations presented in this report represent the compilation of preliminary work generated for the use in the field at the time of excavations, and the findings of a later, more comprehensive rexamination of the data once excavation information became available for correlation.

PRODUCTION OF MAGNETIC ANOMALIES

In brief terms, location of buried archaeological features using magnetic methods depends on the measurement and recognition of anomalies in the earth's magnetic field caused by changes on the concentration, orientation and type of iron oxides in the soil. In culturally sterile alluvial or wind blown sediments, iron oxides are commonly in the form of hematite and are distributed in such a way as to produce a distinctive, often uniform magnetic field at the surface. In the presence of cultural activity, various forms of energy are brought to bear on the soil. This can result in localized changes in the magnetic properties of the oxides which often produce measurable variations or 'anomalies' in the magnetic field over the area of interest. These energy forms include:

Thermal Mechanisms

The firing of the soil in hearths and in burned structures has traditionally produced the largest and most easily recognizable magnetic anomalies associated with prehistoric cultural features. Iron oxides in the soil are magnetically enhanced and may be transformed to more ferromagnetic forms such as magnetite and maghemite. Even if the burned material does not remain in its original position after being fired but is transported to a midden or redeposited by wind or water, the magnetic enhancement is often still measurable.

Detrital and Soil Disturbance Mechanisms

Disturbance of the original sterile sediment by digging or by subsequent geologic processes often leaves measurable magnetic anomalies. The top soil is typically more magnetic than the sediment underlying it, so removal of the A horizon or its redistribution can be reflected in the magnetic record. Unburned habitation structures, borrow areas or other depressions often have anomalies produced in this way.

Chemical Mechanisms

Anaerobic decomposition of organic matter, and also the iron oxide content and distribution in this area.

Inclusions of Magnetic Material

Inclusions of magnetic material, typically mafic river cobbles, gravels, or oxide rich sediments can produce substantial magnetic anomalies. Those which are derived from cultural processes often exhibit distinctive signatures.

Anomalies produced in the above ways can assume a variety of shapes and magnitudes but usually are composites of two basic categories, the monopole and the dipole. The monopole anomaly consists of a group of measurements, one group greater than surrounding values and the other group less, but closely associated with the first group. Figure A1.1 shows several dipole anomalies typical of archaeological features. These anomalies are typically less distinct and slightly distorted by contributions from noncultural sources. Note that the 'low' or blue area associated with each dipole anomaly is located to the north of the 'high' or red area. This orientation helps to distinguish cultural from noncultural anomalies.

There are several techniques and instruments for measuring the earth's field but the most practical in an archaeological context employs proton precession magnetometers measuring spatial variations in the magnetic field on a grid of points at some fixed distance above the surface. The unit commonly used for measurement is gamma (.00001 gauss) which is approximately 1/50,000 of the earth's total field. Display of the data is usually in the form of contour maps or x-y profiles. Once anomalies with suspected cultural features are isolated, reasonable predictions can often be made about their location, geometry, and occasionally their composition.

Several additional 'noise' producing agents affect the ease with which cultural features can be detected. 'Noise', as used in the following discussions, can be considered as extraneous contributions to the earth's field made by objects which tend to obscure archaeologically interesting anomalies. Underlying geology with any appreciable iron content produces strong magnetic fields which

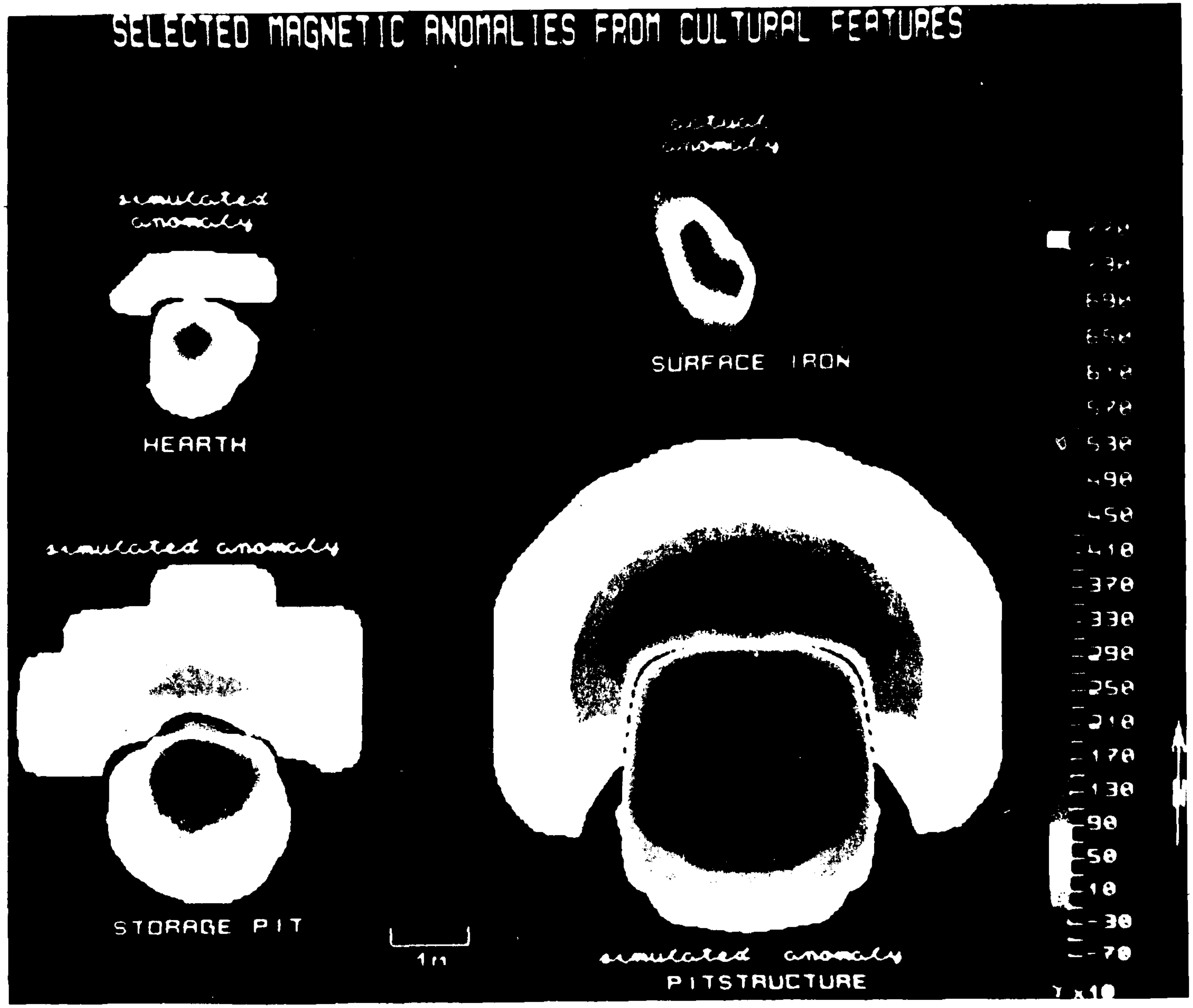

Figure A1.1
Computer Generated Anomalies from Archaeological Features

mask the typically weak archaeological fields. Soil disturbance caused by site vandals or heavy equipment can also cause difficulties. Magnetic fields from recent iron trash such as tin (iron) cans or bits of farm machinery will often obliterate cultural anomalies. Surface topography, especially if it is the size of the archaeological features being sought, can be particularly problematic. These confusing effects can usually be minimized by appropriate computer image enhancement (filtering) but in some instances the magnetic archaeological record is not detectable above the surrounding noise.

SURVEY PROCEDURES

Measurements of the magnetic field over site ENM 10418 was accomplished using 3 Geometrics proton precession magnetometers (model G856) in the difference mode capable of an accuracy of 1 part in 500,000. One magnetometer remained stationary on the site to monitor the time fluctuations in the earth's field (diurnal drift) while the other two instruments measured the field over the area of interest at a 0.5 sq m sample interval. This interval was chosen to detect low magnitude magnetic anomalies caused by archaeological features with diameters as small as .2 m. Areal coverage during the survey averaged approximately 600 sq m per day per crew. To establish an optimum sensor height for the detection of weakly magnetized cultural features, several test lines were initially run over a selected portion of the site, varying the ground-sensor distance for each run. The best compromise between decaying signal to noise ratio and response from features was found by maintaining the sensor height at .4 m above the ground surface.

Two people were used on each crew for the survey: one person, wearing nonmagnetic clothing carried the sensor; another carried the instrument pack for the moving sensor. The stationary magnetometer was automated and internally stored the collected diurnal data; the moving instrument had the capacity to internally store half a survey block of information. When the magnetometers were full with data, the information was dumped into a field computer and retained on computer tapes for eventual retrieval for final analysis.

Although care was taken to ensure accurate positioning of the sensor during the survey, it is reasonable to assume a positional error of $\pm$10 cm for any given reading due to terrain irregularities. In addition, the height of the sensor varied over the course of a survey although efforts were taken to account for small scale topographic changes. The magnetometers are factory calibrated to produce combined errors of approximately .1 gamma, but once positional errors are taken into effect, the repeatability of any one reading might be more conservatively estimated at $\pm$0.3 gamma.

The magnetometer survey grids were located along established archaeological grid systems and used the corresponding archaeological coordinate system to locate the magnetic measurements.

PROCESSING

Data collected during the survey were first computer corrected for diurnal drift each evening then run through error checking routines. Preliminary contour maps then produced at scales to best enhance the magnetic fields caused by archaeological features. When necessary, convolution filtering was performed on the data to reduce contributions from the geology, large features or recent iron trash. Convolution filtering is a similar procedure to removing general trends from data by polynomial regression. However convolution filtering, which replaces each data value by a weighted sum of the surrounding data, allows more control over the size of the remaining residuals. As a result anomalies from specific features of interest can remain (e.g., hearths) while anomalies which are smaller or larger than those features are diminished or removed.

After preliminary processing, color density contour maps were produced on the computer graphics screen with the magnitude of the readings keyed to a color scale. The computer used in the processing allowed interactive alteration of color scales to best enhance features of interest and the magnification of smaller anomalies which may be indistinct.

The excavation of magnetic anomalies selected after preliminary analysis revealed that many of the magnetic sources must have natural origins. Consequently, the data were refiltered using different algorithms in an attempt to isolate magnetic anomalies associated with the cultural features found after the site was mechanically stripped. It was hoped to isolate some magnetic characteristics of the cultural features found from the stripping operations that might be used in more successfully using magnetic surveying on other similar sites in the area.

INTERPRETATION

The interpretation of magnetic survey data from an archaeological site requires the assimilation of a variety of information to isolate anomalies caused by cultural features and to provide a result which is useful and workable for the archaeologist. Initially, either by independent research or through interaction with the project archaeologists, pertinent information must be gathered about the characteristics of features present on the sites. Next, the interpreter must then estimate the types of anomalies that these features might create. This requires additional information about the magnetic environment caused by the soils and underlying geology where the site is located. The magnetic survey data is then searched for the presence of likely anomalies and if necessary, filtered to reduce unwanted contributions. Finally, anomalies suspected of having cultural affiliations are chosen, usually with comments which infer the degree of confidence of the interpreter in their selection.

As no published magnetic surveys have been previously undertaken in the area, the correlation of the excavations with the magnetic survey data should provide valuable information about the utility and methodology of using magnetic survey on similar sites in similar environments. Although the selection of a likely magnetic anomaly often relies on its similarity to the magnetic field generated

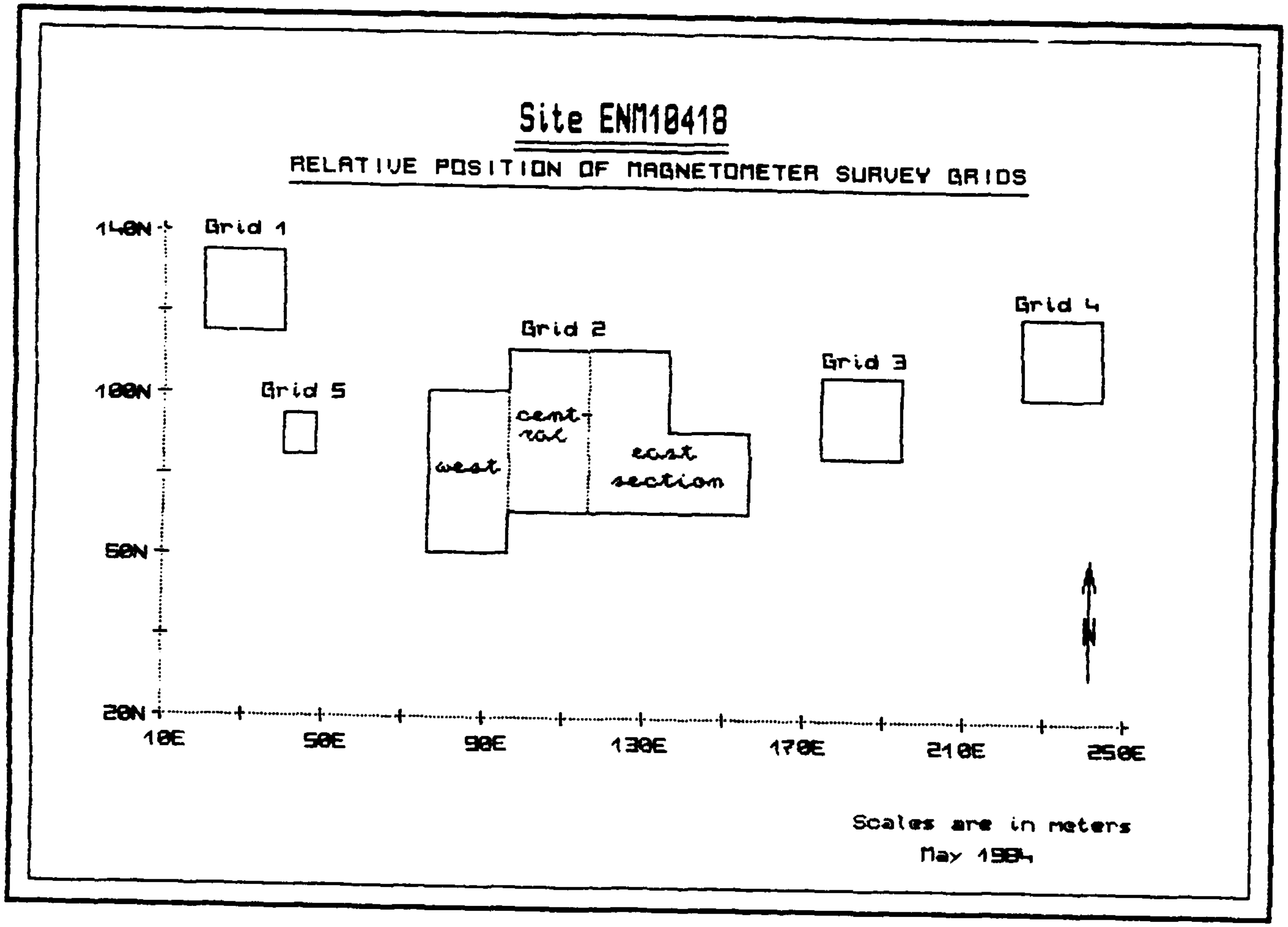

Figure A1.2
Relative Location of Magnetometer Survey Grids on Site ENM 10418

by a computer simulated model, an empirical database of anomalies with corresponding excavated features is extremely useful for interpretive purposes.

One of the more crucial points in making this process a success is interaction with the project archaeologists. When noncultural magnetic sources mask archaeological anomalies, interpretation of the magnetic field must rely more heavily upon combined opinion whether the selection of a given anomaly is reasonable.

STRUCTURE OF MAGNETIC SURVEY REPORTS

The information on magnetic anomalies with potential cultural affiliations is organized on an areal basis, with all anomalies from a given grid presented in tabular form. Each table contains a brief description of the site surface pertinent to the magnetic environment; note any special processing or image enhancement involved; provides the figure designation of associated contour maps; and gives the assigned probability number, center coordinates, possible source and comments associated with each anomaly. A separate section describes any archaeological features found in the grid by excavation, and compares them with the local magnetic field. Finally, a brief section summarizes the survey and any anomalies which have corresponding cultural features. Figure A1.2 shows the location of magnetometer grids 1 through 5, located by Chambers personnel to best cover areas of archaeological interest.

The probability number assigned to each anomaly is an attempt to convey to the archaeological staff the likelihood of a given anomaly having a cultural source. The scale used involves a number between 1 through 5. A probability number of 1 definitely identified an anomaly as caused by specific cultural feature and a description of the causative feature is usually possible. A probability number of 5 indicates that the signature of the anomaly has some elements that are typical of cultural features but the anomaly is too indistinct or distorted to allow any description.

MAGNETIC SURVEY REPORTS AND EXCAVATION CORRELATION

Tables describing the magnetic surveys and corresponding excavation of the surveyed areas follow.

Table A1.1
Magnetometer Report Grid 1

SITE: ENM 10418 Grid 1
AREA OF COVERAGE: 400 sq m
PRELIM. REPORT SENT: 12-16-83
SURVEY DATE(S): 12-8-83
SAMPLE INTERVAL: .5 sq m
OTHER INFORMATION: Grids 2 through 5

GRID DESCRIPTION:
Grid 1 is located on the easternmost edge of the site on a gentle southern facing slope. There are few topographic irregularities so localized unwanted contributions to the magnetic field should be minimal. A railway line to the

Table.A1.1 (continued)
Magnetometer Report Grid 1

north of the grid is expected to contribute strongly to the field but should be removeable using image enhancement.

SPECIAL DATA TREATMENT:
Data were convolution filtered to reduce contributions from the nearby railway tracks.

ASSOCIATED FIGURES:
Figure A1.3 shows the unfiltered magnetic field over grid 1, and Figure A1.4 shows the data after image enhancement (filtering).

MAGNETIC ANOMALIES WITH POSSIBLE ARCHAEOLOGICAL AFFILIATIONS:

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
3g	37.1E,131.1N	indeterminate	symmetrical anomaly, may have burned source
3h	26.7E,128.3N	indeterminate	symmetrical anomaly, may have burned source
4p	32.9E,119.9N	indeterminate	
4q	33.2E,131.3N	indeterminate	
4r	27.3E,118.7N	indeterminate	
5l	37.3E,119.5N	indeterminate	
5k	23.2E,126.6N	indeterminate	

ADDITIONAL COMMENTS:
Some of the anomalies on this site (3g, 3h, 4r, 5k), have signatures which are similar to those caused by surface hummocks. If these anomalies coincide with hummocks, they should be disregarded.

CULTURAL FEATURES LOCATED ON GRID 1 AND DESCRIPTION OF CORRESPONDING LOCAL MAGNETIC FIELD

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
CC	charcoal stain	133N, 35E	no associated anomaly
FF	charcoal stain	128N, 31E	no associated anomaly
GG	no description	130N, 26E	may be associated with anomaly 3h.
II	charcoal pit	122N, 27E	associated with weak local anomaly
F25	charcoal pit 1 flake, 1 slab	129N, 39E	no associated anomaly
F38	charcoal pit with ash burned soil	128N, 19E	no associated anomaly

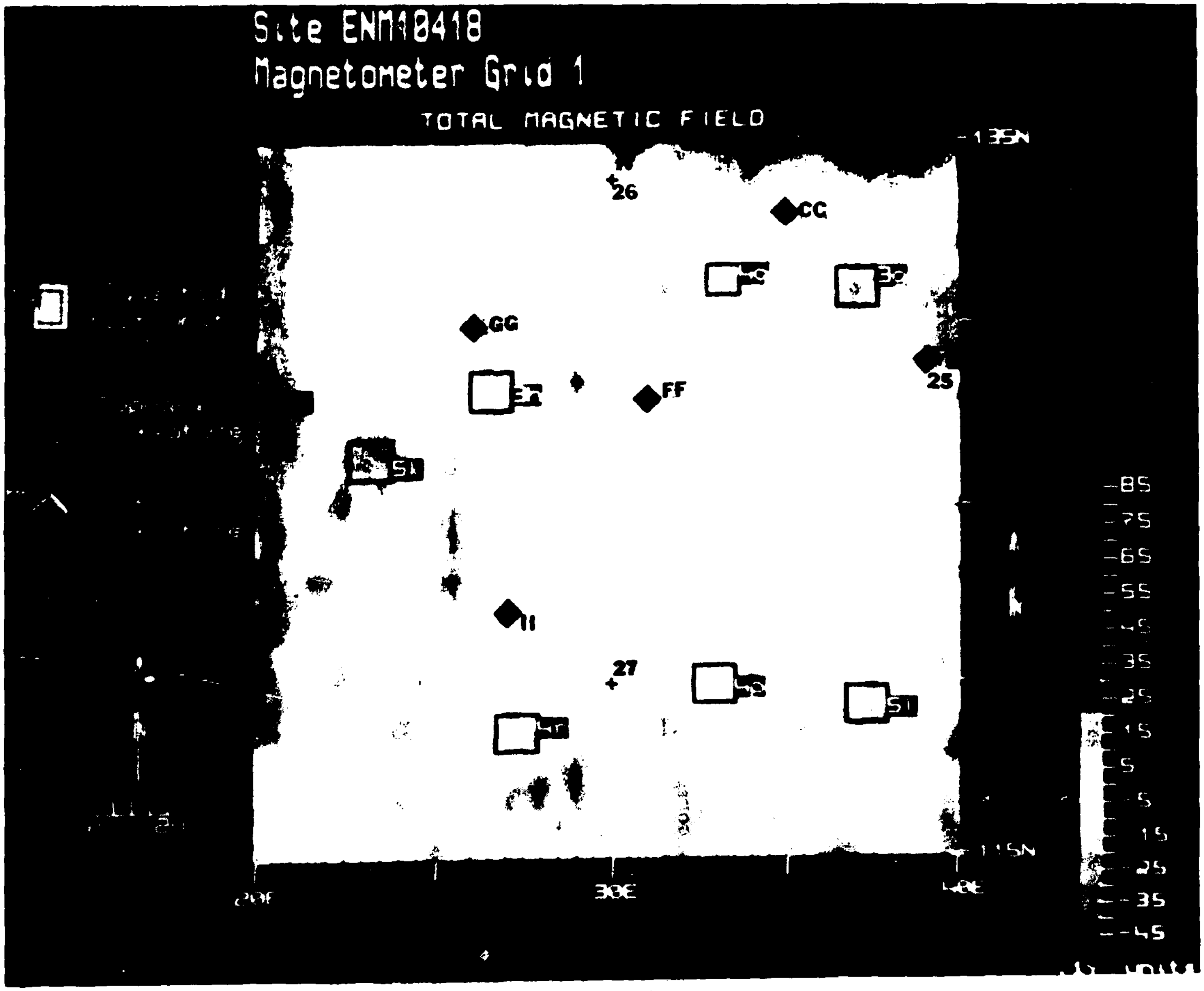

Figure A1.3
Total Magnetic Field Over Site ENM 10418 Grid 1

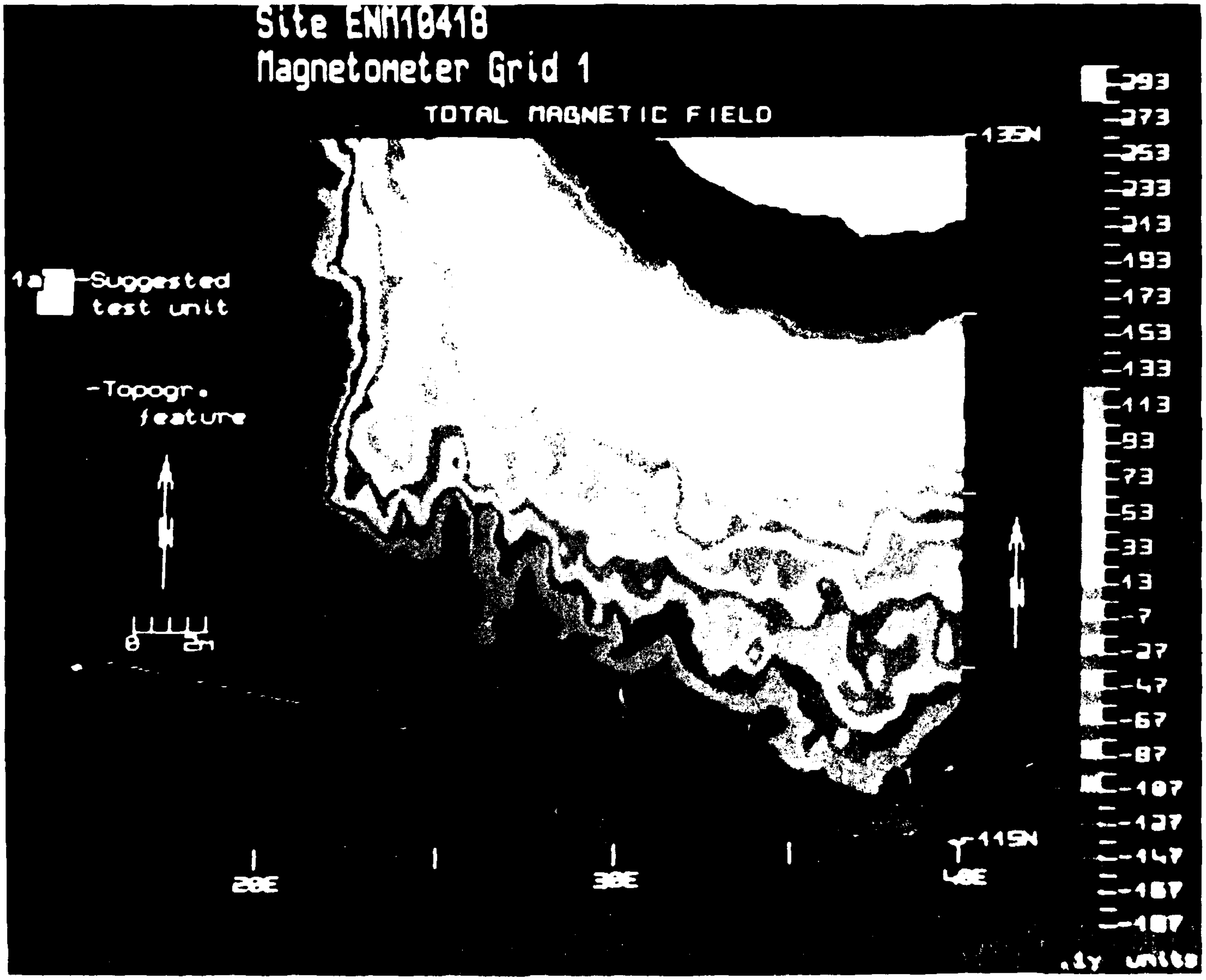

Figure A1.4
Image Enhanced (Fitered) Magnetic Field Over Site ENM 10418, Grid 1

SUMMARY OF MAGNETIC SURVEY:
The magnetic survey of grid 1 located 7 anomalies with potential archaeological sources. Most were assigned lower probability numbers although anomalies 3g and 3h appear to have more promising signatures.

Excavation revealed that one cultural features was associated with a magnetic anomaly. Feature GG occurs on the edge of anomaly 3h. It is possible that this is coincidental and the source of the anomaly is not anthropic.

Table A1.2
Magnetometer Report Grid 2

SITE: ENM 10418 Grid 2
AREA OF COVERAGE: 2800 sq m
PRELIM. REPORT SENT: 12-12-83
SURVEY DATE(S): 12-4-83
SAMPLE INTERVAL: .5 sq m
OTHER INFORMATION: Grids 1,3,4 and 5

GRID DESCRIPTION: The soil covering the caliche layer on grid 2 pinches out toward the east in the presence of erosional effects from the nearby arroyo. To the west the soil increases gradually in thickness to an estimated depth of about 1 m. A barbed wire fence was present on the southern portion of the grid but was relocated while the magnetic surveys were undertaken. Fewer localized topographic features are present on grid 2 than on grids 3 and 4, but their effects caused by concentration of organics are expected to be present.

SPECIAL DATA TREATMENT:
High pass convolution filtering was used on this data set to isolate small anomalies from very weak archaeological sources.

ASSOCIATED FIGURES:
To facilitate display of the magnetic field, the data from grid 2 was broken up into 3 maps. Figure A1.5 shows the magnetic field over the western most portion of grid 2, Figure A1.6 the central portion and Figure A1.7 the east portion.

MAGNETIC ANOMALIES WITH POSSIBLE ARCHAEOLOGICAL AFFILIATIONS:

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
The following anomalies are shown on Figure A1.5:			
2a	93.5E,92.0N	burned feature	This anomaly exhibits good symmetry and is also polarized in a northerly direction.
4e	79.3E,96.3N	indeterminate	
4f	83.9E,91.3E	indeterminate	

Figure A1.5
Total Magnetic Field Over Site ENM 10418, Grid 2
(Western Section)

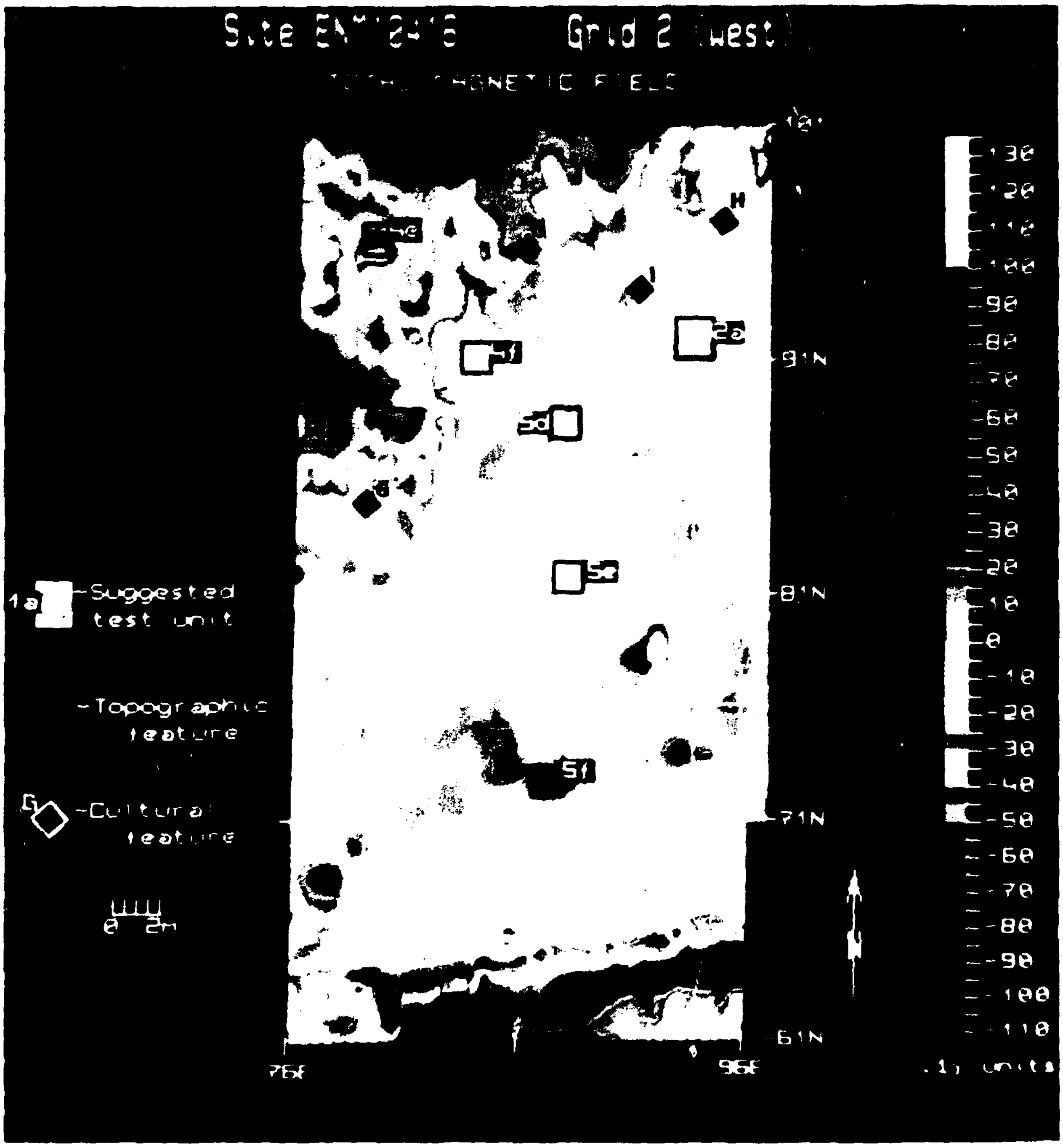

Table A1.2 (continued)
Magnetometer Report Grid 2

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
The following anomalies are shown on Figure A1.5: (continued)			
5d	87.9E,88.5N	indeterminate	located in the center of a larger area of increased magnetization. If cultural, examine vicinity.
5e	87.9E,81.9E	indeterminate	
5f	87.3E,72.9N	indeterminate	local extrema in a large anomaly-probably geological in origin.
The following anomalies are shown on Figure A1.6:			
3b	109.5E,103.5N	small local source	possible hearth
3c	113.1E,104.5N	small local source	possible hearth
3d	115.1E,104.3N	indeterminate	off edge of map
4g	103.9E,104.7N	indeterminate	
4h	107.5E,96.9N	indeterminate	
5g	103.5E,93.5N	indeterminate	
5h	111.7E,72.8N	indeterminate	
The following anomalies are shown on Figure A1.7:			
3e	128.1E,93.9N	small source	
3f	128.7E,107.0N	small source	
4i	125.4E,105.3N	indeterminate	
4j	133.5E,105.7N	indeterminate	
4k	124.3E,94.9N	indeterminate	signature similar to areas of ash and organics
5i	122.7E,79.9N	indeterminate	

CULTURAL FEATURES LOCATED ON GRID 2 AND DESCRIPTION OF CORRESPONDING LOCAL MAGNETIC FIELD

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
The location of the following features are shown on Figure A1.5:			
F6	burned caliche with ash stain	85N,79E	small anomaly to south of feature
G	charcoal pit	96N,86E	on small anomaly
H	charcoal pit burned caliche	97N,95E	on small anomaly

Figure A1.6
Total Magnetic Field Over Site ENM 10418, Grid 2
(Central Section)

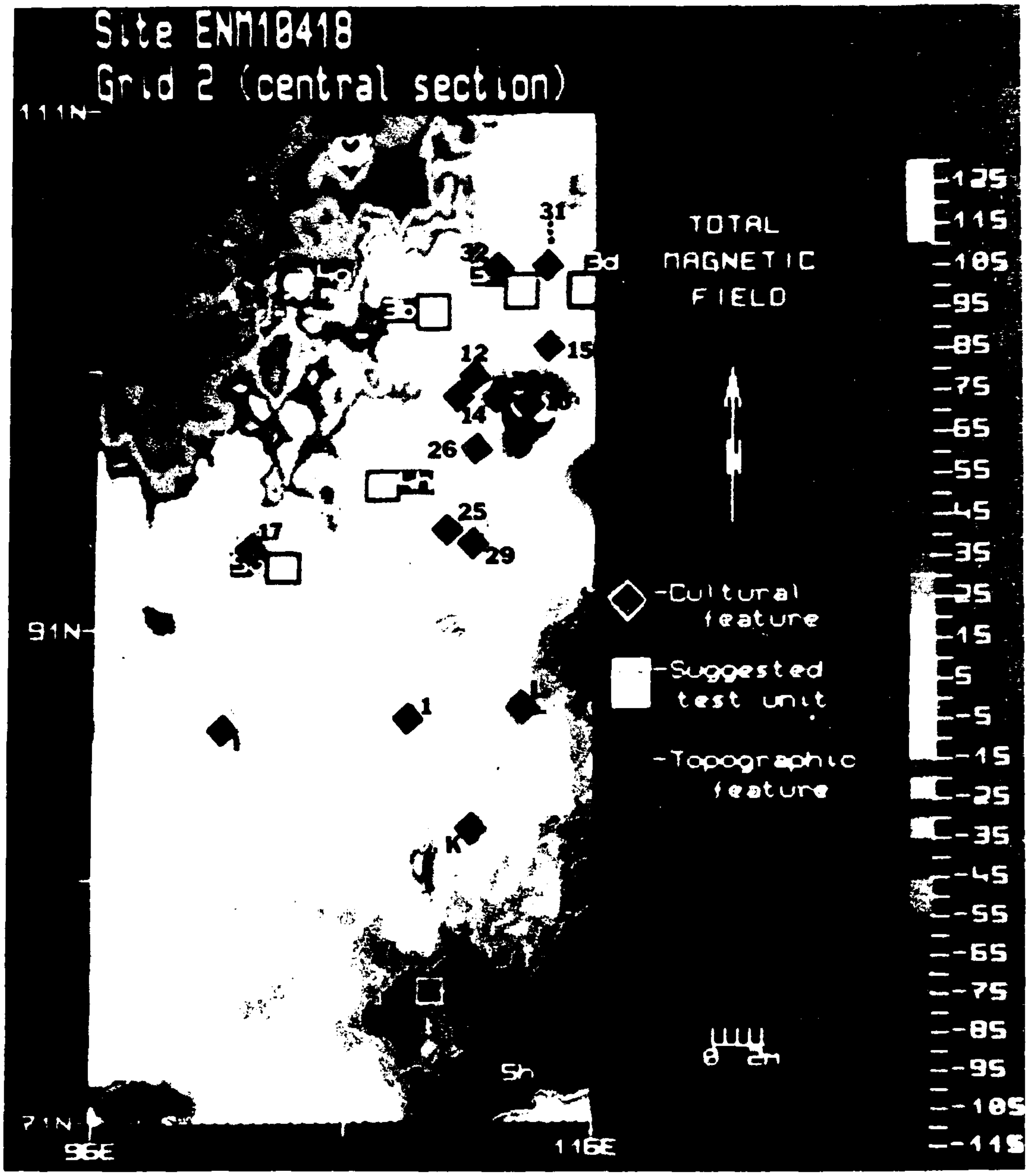

Figure A1.7
Total Magnetic Field Over Site ENM 10418, Grid 2
(Eastern Section)

Table A1.2 (continued)
Magnetometer Report Grid 2

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
The location of the following features are shown on Figure A1.5: (continued)			
I	charcoal pit	94N,91E	no associated anomaly
The location of the following features are shown on Figure A1.6:			
F1	dispersed burned caliche	87.5N,108.5E	no associated anomaly
F2	dispersed burned caliche	100.5N,113E	masked by backdirt pile
F9	charcoal pit, burned caliche, mano	100N,112.5E	masked by backdirt pile
F10	charcoal pit	100N,113.5E	masked by backdirt
F11	charcoal pit	100N,110.5E	no associated anomaly
F12	charcoal pit, ash burned caliche	101N,111E	possible anomaly
F16	charcoal pit	105N,102E	associated with small anomaly
F17	charcoal pit	94N,102E	no associated anomaly
F26	charcoal and ash stain, burned caliche	95N,110E	no associated anomaly
F28	charcoal pit, shell fragments	98N,111E	close to small anomaly
F29	charcoal pit, ash burned caliche	94.5N,111E	no associated anomaly
F37	charcoal pit, ash burned caliche	106N,11.5E	no associated anomaly
J	charcoal pit	87N,101E	associated with small anomaly
K	charcoal pit	83N,111E	no associated anomaly
L	charcoal pit	88N,113E	no associated anomaly
The location of the following features are shown on Figure A1.7:			
F3	dispersed surface scatter of burned caliche	80.5N,141.5E	no associated anomaly
F4	dispersed burned caliche	111N,117E	no associated anomaly
F5	dispersed burned caliche	73N,131.5E	masked by fence anomaly

Table A1.2 (continued)
Magnetometer Report Grid 2

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
The location of the following features are shown on Figure A1.7: (continued)			
F14	burned caliche, lithic flakes	108N,129E	close to anomaly 3f
F32	charcoal pit, burned caliche	98N,188E	no associated anomaly
F35	charcoal pit	85N,140E	no associated anomaly
M	charcoal pit	83N,118E	no associated anomaly
N	charcoal stain	88N,118E	no associated anomaly
O	charcoal pit	90N,119E	no associated anomaly
P	charcoal stain	101N,129E	no associated anomaly
R	charcoal stain	87.5N,148E	no associated anomaly
S	charcoal stain	87N,155E	no associated anomaly
T	charcoal stain	85N,158E	no associated anomaly

SUMMARY OF MAGNETIC SURVEY:
The magnetic survey of site ENM 10418 grid 2 located 18 anomalies with possible archaeological affiliations. The majority of the anomalies on this grid have been assigned lower probability numbers and consequently have little description of causative source.

Subsequent excavations revealed an abundance of charcoal filled pits within the boundaries of grid 2. Of the anomalies suggested for excavation, only anomaly 3f appears to be directly associated with a cultural feature. However, there does appear to be a significantly greater number of magnetic anomalies previously selected for investigation in the vicinity of features F10, F11, F12, F15, F30, F31.

In addition, several other features appear to exhibit magnetic anomalies. Weak anomalies are present on or near features F6, G, H, F12, F14, F16, F28, and J. Most of these anomalies are very weak and might not have been isolated without the excavation information. The extremely low magnitude of these features appears to be linked to the very low iron oxide content present in the soil on this site.

Table A1.3
Magnetometer Report Grid 3

SITE: ENM 10418 Grid 3
AREA OF COVERAGE: 400 sq m
PRELIM. REPORT SENT: 12-12-83

SURVEY DATE(S): 12-3-83
SAMPLE INTERVAL: .5 sq m
OTHER INFORMATION: Grids 1, 2, 4 and 5

GRID DESCRIPTION:
This area has greater than a meter of soil over the caliche layer. Hummocks of vegetation and soil are present which may produce detectable magnetic anomalies.

SPECIAL DATA TREATMENT:
Data were high pass convolution filtered to isolated small, weak magnetic anomalies.

ASSOCIATED FIGURES:
Figure A1.8 shows the total magnetic field measured over the grid.

MAGNETIC ANOMALIES WITH POSSIBLE ARCHAEOLOGICAL AFFILIATIONS

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
4d	193.3E,91.8N	indeterminate	
5b	178.0E,100.3N	indeterminate	weak positive anomaly- possibly caused by organics.
5c	185.8E,94.8N	indeterminate	weak negative anomaly-may be caused by geologic feature.

CULTURAL FEATURES LOCATED ON GRID 3 AND DESCRIPTION OF CORRESPONDING LOCAL MAGNETIC FIELD

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
F13	charcoal pit	90N,178E	small, weak anomaly
F19	charcoal stain	95.5N,191E	no associated anomaly
F20	charcoal filled pit	93N,191E	no associated anomaly
F27	charcoal pit	87N,176E	no associated anomaly

SUMMARY OF MAGNETIC SURVEY:
The magnetic survey over grid 3 located 3 anomalies of interest, all which were assigned low probability numbers. None of these anomalies exhibit the degree of symmetry or the magnitude typical of cultural features in other areas. Hummocks caused by localized deposits of loess in surface vegetation coincide with many of the more distinct anomalies on this grid. Excavation revealed that none of the anomalies suggested for investigation were caused by cultural features. However, a weak anomaly is present over feature F13.

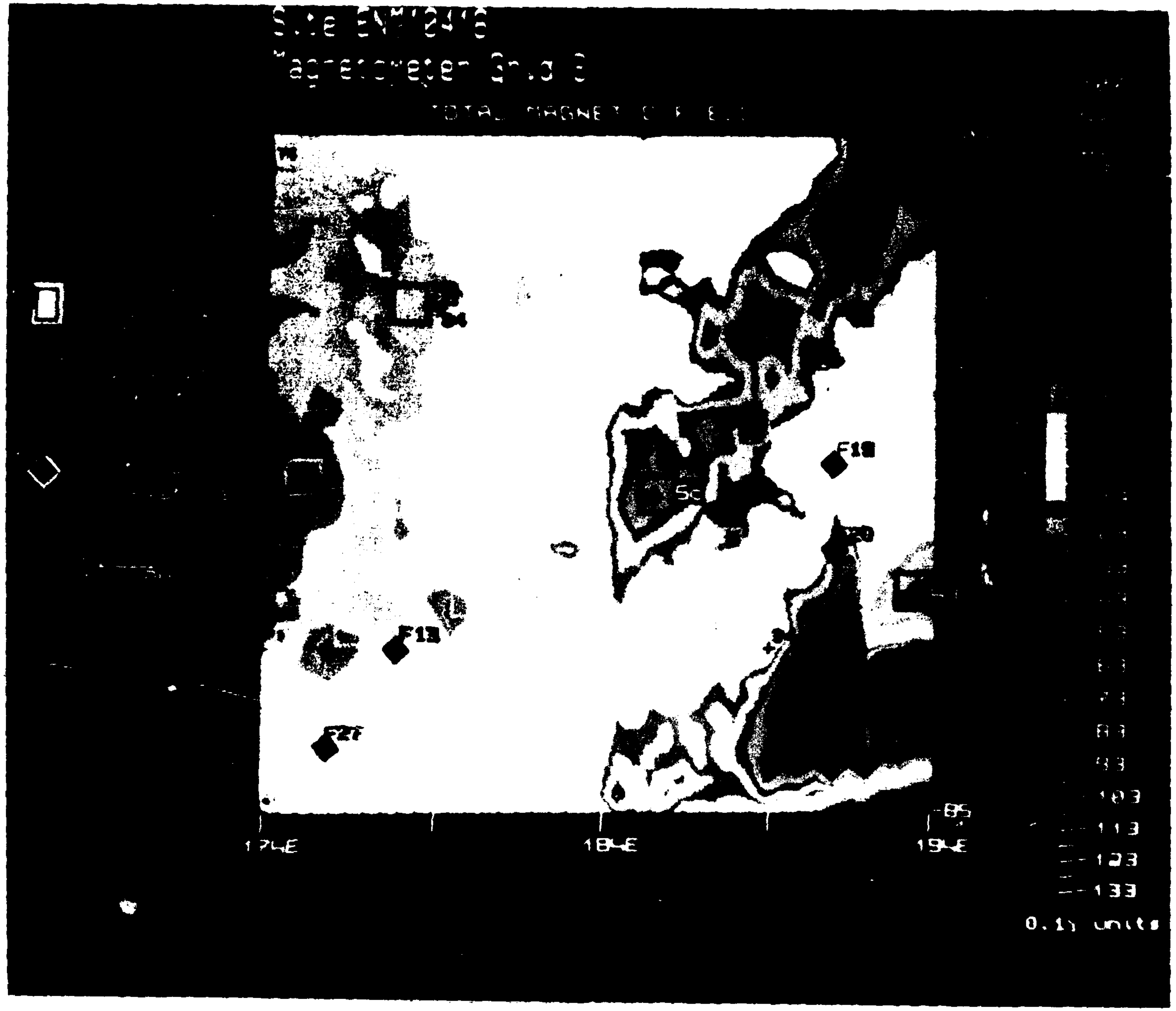

Figure A1.8
Total Magnetic Field Over Site ENM 10418, Grid 3

Table A1.4
Magnetometer Report Grid 4

SITE: ENM 10418 Grid 4
AREA OF COVERAGE: 400 sq m
PRELIM. REPORT SENT: 12-12-83

SURVEY DATE(S): 12-3-83
SAMPLE INTERVAL: .5 sq m
OTHER INFORMATION: Grids 1 through 3, 5

GRID DESCRIPTION:
Grid 4 is located on the easternmost edge of the site. The depth to the caliche layer is felt to be the greatest in this area. The A horizon is poorly developed due to aeolian activity but surface vegetation has trapped some of the more organic soil and produced mounds of enriched loess. This is anticipated to be a source of surface noise.

SPECIAL DATA TREATMENT:
Computer image enhancement was unnecessary on this site.

ASSOCIATED FIGURES:
Figure A1.9 shows the magnetic field data collected over the site.

MAGNETIC ANOMALIES WITH POSSIBLE ARCHAEOLOGICAL AFFILIATIONS

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
3a	228.5E,109.4N	indeterminate	symmetrical anomaly
4a	237.0E,119.3N	indeterminate	large plateau high-may be an area of ash and/or organics
4b	2[illegible]9.0E,105.0N	small source	localized anomaly
4c	226.3E,114.8N	indeterminate	
5a	234.3E,107.5N	indeterminate	

CULTURAL FEATURES ON GRID 4 AND DESCRIPTION OF CORRESPONDING LOCAL MAGNETIC FIELD

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
F21	charcoal pit	108N,238E	no associated anomaly
F23	charcoal, ash pit	117N,238E	no associated anomaly
F24	charcoal pit	110N,238E	no associated anomaly

SUMMARY OF MAGNETIC SURVEY:
Several strong symmetrical anomalies occur on this site but all coincide with hummocks of soil caused by surface vegetation. As a result, none of these anomalies were recommended for excavation. One anomaly, labeled 3a, exhibits moderate symmetry and is the most likely on this grid to be caused by an archaeological feature. Four other anomalies, all assigned low probability numbers, were selected for investigation. Except for magnetic contributions associated with vegetation, noise levels on this grid are low. Subsequent excavation revealed that none of the anomalies suggested for investigation were caused by cultural features.

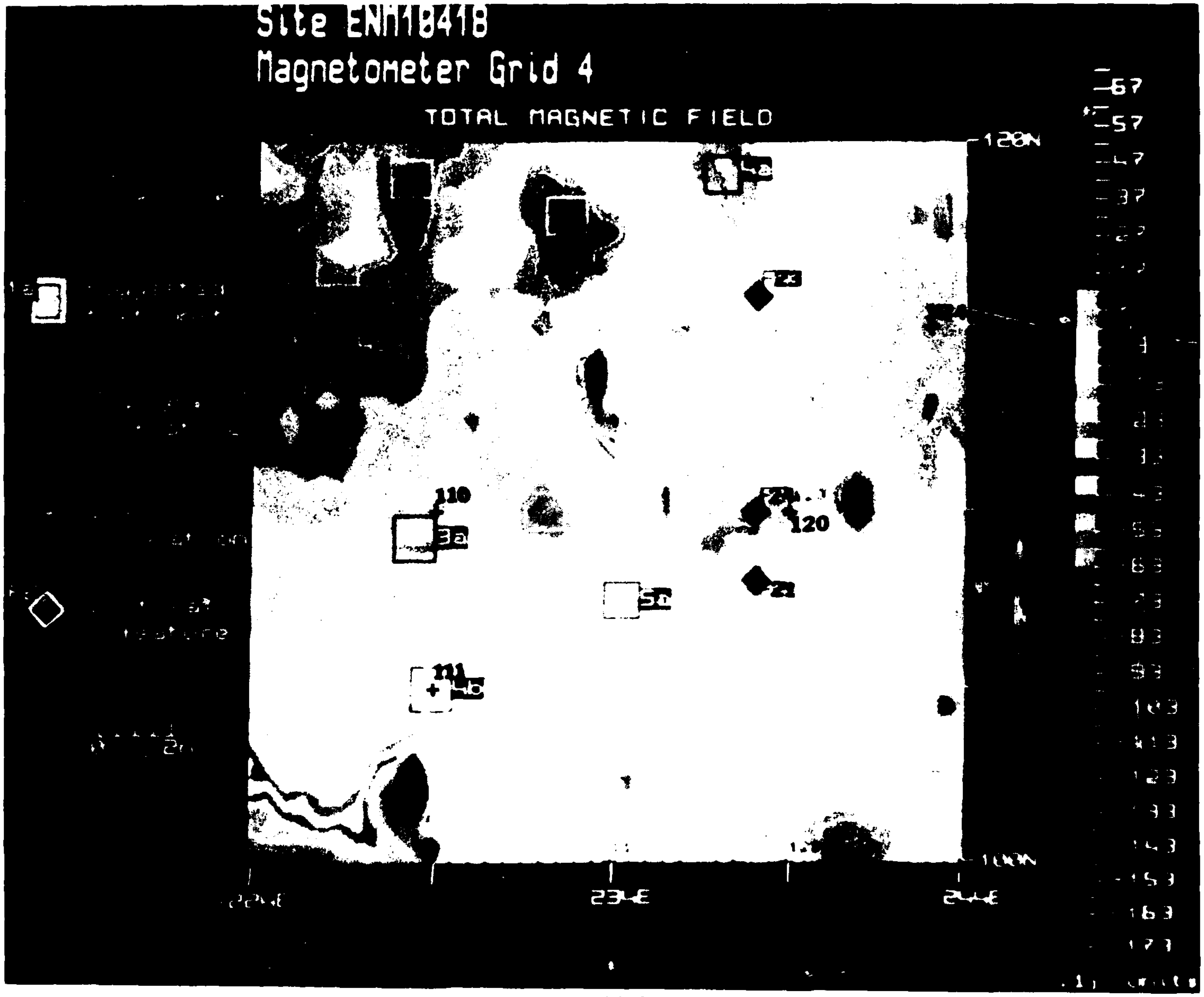

Figure A1.9
Total Magnetic Field Over Site ENM 10418, Grid 4

Table A1.5
Magnetometer Report Grid 5

SITE: ENM 10418 Grid 5
AREA OF COVERAGE: approx. 400 sq m
PRELIM. REPORT SENT: 12-16-83
SURVEY DATE(S): 12-8-83
SAMPLE INTERVAL: .5 sq m
OTHER INFORMATION: Grids 1 through 4

GRID DESCRIPTION:
This grid is located on the east side of the arroyo which truncates the site. Topography is very irregular and is anticipated to adversely affect the magnetic field. Several measurements were not possible on the site (shown in Figure A1.10 as ragged edges) due to terrain difficulties.

SPECIAL DATA TREATMENT:
Image enhancement was not felt to be useful for this data set.

ASSOCIATED FIGURES:
Figure A1.10 shows the unfiltered magnetic field data over the site.

MAGNETIC ANOMALIES WITH POSSIBLE ARCHAEOLOGICAL AFFILIATIONS:

ANOMALY+ PROB.	CENTER COORDINATES	POSSIBLE SOURCE	COMMENTS
4l	46.9E,92.9N	local source	
4m	47.0E,91.6N	local source	
4n	46.0E,92.1N	local source	
4o	43.5E,91.1N	indeterminate	
5j	46.0E,88.1N	indeterminate	

CULTURAL FEATURES ON GRID 5 AND DESCRIPTION OF CORRESPONDING LOCAL MAGNETIC FIELD

FEATURE ANNOTATION	FEATURE DESCRIPTION	COORDINATES	CORRESPONDING MAGNETIC FIELD
F7	lenses of charcoal ash stain	95N,48E	off edge of grid

SUMMARY OF MAGNETIC SURVEY:
The magnetic survey undertaken on site ENM 10418 grid 5 located anomalies with potential archaeological sources. All have been assigned low probability numbers.

Excavation of the area covered by grid 5 found no cultural features associated with anomalies selected for investigation. In addition, no additional cultural features were located which exhibited magnetic anomalies.

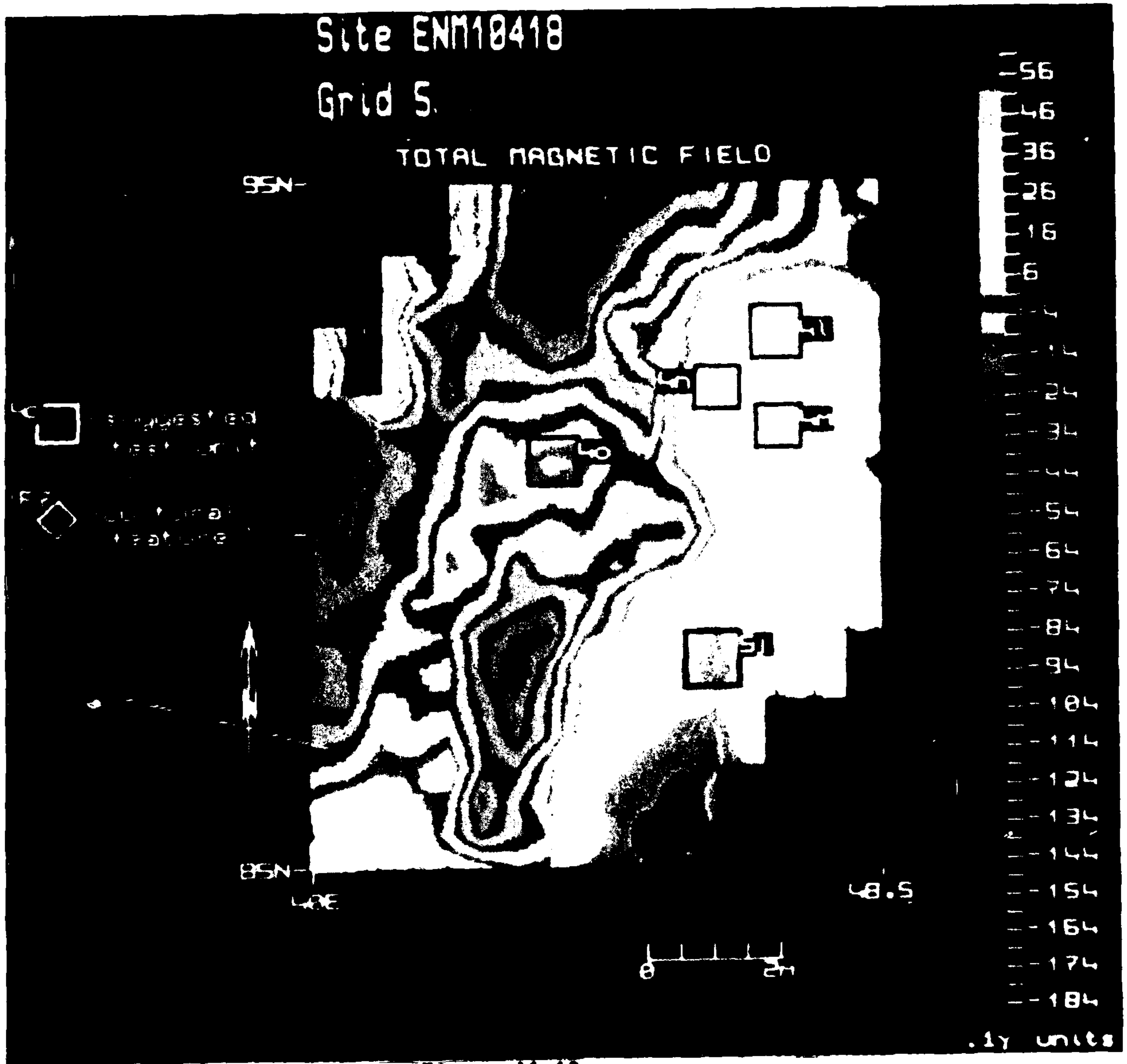

Figure A1.10
Total Magnetic Field Over Site ENM 10418, Grid 5

DISCUSSION

The final analysis of the magnetometer survey data indicates that there are no substantial contributions to the local magnetic field by sources that might obscure weak archaeological anomalies. Strong magnetic contributions from natural inhomogeneities in the soil were absent, save for concentrations of organic soil trapped by some types of surface vegetation. Underlying bedrock contributes little variation to the local magnetic field and tests conducted on the caliche layer (exposed in the arroyo which truncates the site) failed to locate any significant naturally occurring magnetic anomalies. A nearby railway masks the nearby small anomalies from cultural features, but computer image enhancement procedures were successful in removing these effects. A barbed wire fence which crosses the southern portions of the surveyed grids was temporarily removed to improve data quality. Its former position is still noticeable on the maps from grid 2; rust flakes from the fence are sufficient to produce a strong linear magnetic anomaly.

The selection of magnetic anomalies with potential cultural sources involves the isolation of those magnetic responses which exhibit:

1. symmetry

2. a suitable magnitude

3. correct size

4. if a dipole, the correct orientation and high/low pole magnitude ratio

5. proximity to other promising anomalies

6. signatures which are similar to magnetic anomalies generate from computer models of archaeological features

7. similarity to anomalies with ground truthing from similar sites in a similar magnetic environment

Of the above criterion, the last two are relied on the most heavily.

The complicating factors introduced by magnetic fields from geologic, pedologic and recent sources occasionally necessitate that the selection of magnetic anomalies with potential cultural sources can become somewhat ambiguous. To relay to the archaeological staff the likelihood of a given magnetic anomaly having a significant cultural source, a ranking system is utilized. Anomalies are annotated on the maps with a number (known as the probability number) and a letter, the number ranging between 1 and 5. An anomaly assigned the number 1 usually has a signature which allows a definitive suggestion about the anomaly's origin, size and occasionally, its composition. An anomaly assigned a probability number of 5 usually has some characteristics which suggest it is cultural but is too indistinct or distorted to allow much comment. Anomalies with probability numbers between these two extremes are accompanied by as much information about the causative source as possible. The letter attached to each probability number is used only to distinguish between anomalies of like probability (i.e., 2a, 2b, etc.).

The noise level (noncultural variations in the magnetic field) on site ENM 10418 is abnormally low suggesting that either the iron oxides which produce magnetic anomalies are distributed in an unusually uniform fashion or that iron oxide content is extremely low, making the production of detectable magnetic anomalies by cultural processes a difficult procedure. The latter phenomenon appears to be most likely; excavation revealed that only a few magnetic anomalies selected for investigation were caused by cultural features and that only 12 features exhibited any anomaly at all. Of the 12 anomalies which occurred above excavated features, only five might have been detectable without prior knowledge of the features which caused them.

SUMMARY

A series of magnetometer surveys were undertaken on site ENM 10418 near Carlsbad, New Mexico as part of archaeological investigations by Chambers Consultants and Planners on the Waste Isolation Pilot Plant, under construction by the U.S. Army Corps of Engineers. Magnetic surveying, a geophysical remote sensing technique, is used to locate subtle 'anomalies' in the earth's magnetic field that reflect changes in the iron oxide content of soils that might be caused by human activities. The information provided by these surveys is often useful in reducing the time spent in the excavation phases of archaeological investigation by pinpointing areas of cultural interest.

One of the factors determining a successful magnetic survey requires that the iron oxides in the soil be, 1) present in sufficient quantity to allow the production of detectable magnetic fields from cultural activity, and 2) have a sufficiently uniform distribution so as not to mask or obscure the typically weak archaeological anomalies with background noise. The iron oxide distribution on site ENM 10418 appears to be uniform as background variation in that the measured magnetic field is small but the percentage of iron oxides present in the soil is very low.

A preliminary analysis of the magnetic surveys on site ENM 10418, undertaken prior to excavation, selected 38 magnetic anomalies for investigation in the field. The average probability number of these anomalies is four, which although representative of sites with smaller features, is lower than most sites. The anomalies selected lacked the magnitude and symmetry of magnetic anomalies found on other sites (Huggins and Weymouth 1981), partially due to the types of features constructed by the prehistoric inhabitants but also due to the low iron oxide content of the soil.

Excavation of the suggested anomalies revealed that only two were affiliated with cultural features. However, reexamination of the magnetic survey data showed that 12 features did exhibit associated anomalies, albeit small and subtle ones. Five of these anomalies might have been isolated without the excavation data, but the remainder show little to distinguish them from small anomalies occurring naturally at the site.

Due to the apparently low iron oxide content of the soils in this area, it is recommended that future magnetic surveys employ soil susceptibility testing before any data collection is undertaken. Susceptibility measurements can provide a rule of thumb estimate of the suitability of the soil to produce detectable magnetic anomalies from cultural features. This process involves the measurement of the magnetic properties of about 10 small cores within and outside the area of cultural activity. These samples are heated in an oxygen poor environment (to simulate firing) and remeasured to estimate the magnitude of change of iron oxide components. This process provides data for computer modeling of anticipated magnetic anomalies. Unfortunately, this complete process was not available in the U.S. at the time of the surveys on site ENM 10418, but we are working to acquire facilities in the near future.

Appendix 2

CERAMICS

Table A2.1
Ceramic Analysis Format

Column Number	Attribute	
1	Item	
2-6	Site Number	
7-9	North/South grid coordinates	
10-12	East/West grid coordinates	
13-14	Level	
15-19	Vertical provenience top of level	
20-24	Vertical provenience base of level	
25-27	Sequential artifact number	
28-30	Length in millimeters	
31-33	Width in millimeters	
34-36	Thickness in tenths of millimeters	
37	Vessel type	
	0	Undetermined
	1	Jar
	2	Bowl
38	Rim form	
	0	Not a rim
	1	Direct
	2	Direct thinned
	3	Continuous Curve
	4	Mild flare
	5	Strong flare
	6	Everted
	7	Ground rim
39	Exterior surface description	
	0	Eroded
	1	Plainware rough surface
	2	Plainware smoothed surface
	3	Incised plainware
	4	Corrugated
	5	Slip only
	6	Slip and paint
	7	Paint on plain surface
	8	Obliterated coil plainware
	9	Scraped surface

Table A2.1 (continued)
Ceramic Analysis Format

Column Number	Attribute	
40	Corrugated surface - exterior	
	0	Not corrugated
	1	Neck banded
	2	Clapboard
	3	Incised
	4	Incised indented
	5	Indented
41	Slip - exterior	
	0	absent
	1	thin white/gray
42	Paint color - exterior	
	0	Absent
	1	Black
	2	Brown
	3	Reddish oxidized iron
	4	White
	5	Red-Orange
	6	Polychrome
43	Paint location - exterior	
	0	Absent
	1	Interior
	2	Exterior
	3	Both interior and exterior
44	Paint Type - exterior	
	0	Absent
	1	Mineral
	2	Carbon
	3	Even mix
	4	Mostly mineral, some carbon
	5	Mostly carbon, some mineral
45	Polish - exterior	
	0	Absent
	1	Plain surface streaky
	2	Plain surface glossy
	3	Over slip only streaky
	4	Over slip only glossy
	5	Over paint only streaky
	6	Over paint only glossy
	7	Over paint and slip streaky
	8	Over paint and slip glossy
46-47	Munsell color exterior	
	0	Eroded
	1	5YR 5/6 yellowish-red
	2	5YR 6/6 reddish-yellow
	3	7.5YR N4 dark gray
	4	7.5YR 5/2 brown
	5	10YR 5/4 yellowish-brown

Table A2.1 (continued)
Ceramic Analysis Format

Column Number	Attribute
46-47	Munsell color exterior (continued)
	6 7.5YR 6/4 light brown
	7 7.5YR N/5 gray
	8 7.5YR N/6 gray
	9 7.5YR 7/2 pinkish gray
	10 7.5YR N25 black
	11 7.5YR 4/2 dark brown
	12 10YR 6/6 brownish-yellow
	13 10R 4/4 weak red
	14 2.5YR 4/4 reddish brown
	15 7.5YR 4/4 dark brown
	16 5 YR 5/3 reddish brown
48	Interior surface description
	0 Eroded
	1 Plainware rough surface
	2 Plainware smoothed surface
	3 Incised plainware
	4 Corrugated
	5 Slip only
	6 Slip and plain
	7 Slip and paint
	8 Obliterated coil plainware
	9 Scraped surface
49	Corrugated surface - interior
	0 Not corrugated
	1 Neckbanded
	2 Clapboard
	3 Incised
	4 Incised indented
	5 Indented
50	Slip - interior
	0 Absent
	1 thin white/grey
51	Paint color - interior
	0 Absent
	1 Black
	2 Brown
	3 Reddish oxidized iron
	4 White
	5 Red orange
	6 Polychrome
52	Paint Location - interior
	0 Absent
	1 Interior
	2 Exterior
	3 Both interior and exterior

AD-A173 934 ARCHAEOLOGICAL INVESTIGATIONS OF THREE SITES WITHIN THE WIPP CORE AREA ED..(U) CHAMBERS CONSULTANTS AND PLANNERS ALBUQUERQUE NM K J LORD ET AL. JUN 85 4/4

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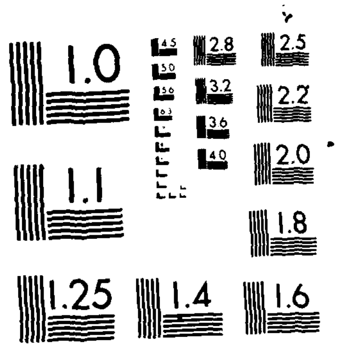


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table A2.1 (continued)
Ceramic Analysis Format

Column Number	Attribute	
53	Paint type - interior	
	0	Absent
	1	Mineral
	2	Carbon
	3	Even Mix
	4	Mostly mineral some carbon
	5	Mostly carbon some mineral
54	Polish - interior	
	0	Absent
	1	Plain surface streaky
	2	Plain surface glossy
	3	Over slip only streaky
	4	Over slip only glossy
	5	Over paint only streaky
	6	Over paint only glossy
	7	Over paint and slip streaky
	8	Over paint and slip glossy
55-56	Munsell color - interior	
	0	Eroded
	1	5YR 5/6 yellowish-red
	2	5YR 6/6 reddish-yellow
	3	7.5YR N4 dark gray
	4	7.5YR 5/2 brown
	5	10YR 5/4 yellowish-brown
	6	7.5YR 6/4 light brown
	7	7.5YR N/5 gray
	8	7.5YR N/6 gray
	9	7.5YR 7/2 pinkish gray
	10	7.5YR N25 black
	11	7.5YR 4/2 dark brown
	12	10YR 6/6 brownish-yellow
	13	10R 4/4 weak red
	14	2.5YR 4/4 reddish brown
	15	7.5YR 4/4 dark brown
	16	5 YR 5/3 reddish brown
57	Munsell color Paste	
	0	Not observed
	1	Gray white
	2	Gray
	3	Dark gray
	4	Black
	5	Brown
	6	Pinkish brown
	7	Brown exterior, gray center, brown interior
	8	Brown exterior, gray interior
	9	Gray exterior, pink interior

Table A2.1 (continued)
Ceramic Analysis Format

Column Number	Attribute	
58	Temper	
	0	Not observed
	1	Large blocky quartz crystals, smokey gray rounded crystals, possibly Feldspar, small black crystals
	2	Large blocky white quartz crystals, small black crystals
	3	Large blocky white crystals, blocky reddish inclusions, small black crystals
	4	Small blocky white quartz crystals, numerous small black inclusions
	5	Small blocky white quartz crystals, large semi-rounded gray rock
	6	Large blocky white quartz crystals, small metallic particles
	7	Excessive amounts of large blocky quartz crystals, small black inclusions
	8	Numerous small grey/black semi-rounded rock particles, occasional small white quartz crystals
59	Type	
	0	
	1	Jornada Brown
	2	Roswell Brown
	3	San Andres Red-on-terra cotta
	4	Chupadero Black-on-white
	5	South Pecos Brown
	6	Chupadero Whiteware
	7	Corrugated Jornada
	8	Jornada Black-on-brown
	9	El Paso Brown

Table A2.2
Temper Groupings

TEMPER GROUP 1	Jornada - El Paso Brown (A.D. 900-1350) (Jelinek 1967; Runyan and Hedrick 1973; Human Systems Research 1973)
Paste Characteristics:	Soft granular and friable. Usually chocolate brown with a dark core frequently occurring.
Rock Type:	Granitic
Rock Composition:	Variant 1 temper consists predominately of white quartz occurring in large blocky crystals, semi-rounded smokey gray particles, possibly Feldspars, and small black biotite or hornblend crystals occurring in lesser amounts.
	Variant 2 temper consists predominately of white quartz occurring in large blocky crystals, and small black biotite or hornblend crystals occurring in lesser amounts.
	Variant 6 temper consists predominately of white quartz occurring in large blocky crystals, small black biotite or hornblend crystals occurring in lesser amounts, occasional unidentified metallic particles.
	Variant 7 temper consists almost entirely of blocky white quartz crystals occurring in excessive amounts, and small black biotite or hornblend occurring in lesser amounts.

Varieties of El Paso and Jornada Brown were included in the total sample.

1. Jornada Brown (A.D. 900-1350) represented by 22.6% of the combined sample. Type is characterized by one or more polished surfaces. This class was limited to undecorated and untextured sherds.

2. Jornada Brown - Incised (no date) represented by .54% of the combined sample. Type is basically Jornada Brown with decorative incising.

3. Jornada Black-on-brown (no date) represented by .54% of the combined sample. Distinguished by the presence of black mineral paint on a polished brownware surface.

4. El Paso Brown (A.D. 900-1350) represented by 5.4% of the combined sample. Distinguished from Jornada Brown by the absence of surface polish.

Table A2.2 (continued)
Temper Groupings

5. Jornada Brown Corrugated (no date) occurring in the total collection only one time making up .54% of the combined collection.

6. San Andres Red-on-terra cotta (A.D. 1100-1350) represented by 3.8% of the combined sample. Characterized by a red pigment wash painted in broad red lines over a terra cotta surface.

TEMPER GROUP 2 — South Pecos Brown (A.D. 900-1350)
(Jelinek 1967; Runyan and Hedrick 1973; Human Systems Research 1973; Mera and Stallings 1931).

Paste Characteristics: Ranges from soft, granular, and friable to fairly hard and homogenous. South Pecos Brown is characterized by a tan paste and surface color but may occasionally range to dark brown. Dark or light gray cores are frequent in South Pecos Brown.

Rock Type: The tempering material used in South Pecos Brown was first described by (Jelinek 1967:53). Petrographic analysis conducted by Burns indicates it is probably an andesite porphyry.

Rock Composition: Variant 5 temper is predominately white quartz occurring in large blocky crystals. Semi-rounded gray particles occur in slightly lower frequencies. Occasional small black biotite or hornblend crystals are intermixed.

Variant 8 temper consists predominately of semi-rounded gray particles with large blocky white quartz crystals occurring in slightly lower frequencies. Occasional small black biotite or hornblend crystals are intermixed. Burns 1977 indicates the gray particles are largely pragioclase feldspars (either oligoclase or andesine) with microcline, perthite, and orthoclase occurring in minor qualities.

Two ceramic types were present which exhibited tempering material characteristic of Temper Group 2.

1. South Pecos Brown (most abundant between A.D. 900-1350) made up 3.2% of the combined collection. Distinguished by a tan surface color and paste. South Pecos Brown may grade into Three Rivers Red-on-terracotta making them hard to distinguish.

2. San Andres Red-on-terracotta (A.D. 1100-1350) represented by 3.8% of the combined sample. Characterized by a red pigment wash painted in broad red lines over a Terra cotta surface.

Table A2.2 (continued)
Temper Groupings

TEMPER GROUP 3	Roswell Brownware (A.D. 1100-1250+) (Jelinek 1967)
Paste Characteristics:	Soft granular and friable usually chocolate brown with dark colors frequently occurring. Most distinctive of Roswell Brown paste is the distribution of temper particles which are characterized by a high percentage of exceptionally fine particles with a few larger fragments distributed through the paste.
Rock Composition:	Variant 3 temper consists predominately of white quartz occurring in large blocky crystals. Feldspars are secondary to quartz in dominance. Burns (1977) identified these particles as potassium feldspars which are characteristically orange-red. A mixture of microcline, perthite and orthoclase is common. No plagioclase particles occur. Small black biotite or hornblend crystals are also present in small quantities.

Two ceramic types exhibiting temper characteristic of Temper Group 3 were present in the combined sample.

1. Roswell Brown (A.D. 1100-1250+) represented by 16.7% of the combined sample. Characterized by generally well smoothed or polished surfaces.

2. Jornada Brown (A.D. 900-1350) represented by 22% of the combined sample. Type is characterized by one or more polished surfaces. This class is limited to undecorated and untextured sherds.

TEMPER GROUP 4	Chupadero Black-on-white (A.D. 950-1550) (Breternitz 1966:72; Hayes n.d.:16; Corley 1965:36; Mera 1935:29)
Paste Characteristics:	Very fine grained hard paste characteristically light gray in color. Tempering particles are generally small and uniform in size.
Rock Type:	Andesitic
Rock Composition:	Variant 4 temper is characterized by fine grained white quartz crystals and black biotite or hornblend crystals occurring in relatively equal proportions.
	Variant 9 temper is characterized by black biotite or hornblend crystals occurring in a slightly higher frequency than the fine-grained white quartz crystals.

Two ceramic types exhibiting temper characteristics of Temper Group 4 were present in the combined sample.

1. Chupadero Black-on-white (A.D. 950-1550) represented by 4.3% of the combined sample. Characterized by scoring or scraping of undecorated surfaces and designs which are largely opposed hatching and solid motifs.

2. Chupadero Whiteware (A.D. 950-1550) represented by 3.2% of the combined sample. Characterized by scoring or scraping of undecorated surfaces and the presence of a thin white slip. These sherds probably represent the unpainted portions of Chupadero Black-on-white vessels.

Table A2.3
Ceramic Attributes for the WIPP Sites

SITE	NS	EW	LEVEL	VTOP	VBOT	TYPE	THICK	VTYPE	RIM	EXSUR	POLEX	MUNSEX	INSUR	POLIN	MUNSIN	PASTE	TEMPER
230	.	.	0	0	0	1	4.9	1	0	2	1	14	1	.	5	5	7
230	45	66	0	0	0	0	4.0	0	0	2	.	3	2	.	4	2	7
230	45	66	0	0	0	0	4.3	0	0	2	.	3	1	.	4	2	7
230	51	56	0	0	0	0	4.8	1	0	2	.	2	1	.	2	5	7
230	51	56	0	0	0	0	4.9	1	0	2	.	2	1	.	2	5	7
230	51	58	0	0	0	0	5.0	0	0	1	.	5	1	.	5	7	7
230	52	63	0	0	0	0	4.2	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.2	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.3	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.3	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.3	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.4	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.4	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.5	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.6	1	0	2	.	1	1	.	1	8	7
230	52	63	0	0	0	0	4.7	1	0	2	.	1	1	.	1	5	7
230	52	63	0	0	0	0	4.8	0	0	2	.	1	2	.	1	7	7
230	52	63	0	0	0	0	4.9	0	0	2	.	1	2	.	1	7	7
230	52	63	0	0	0	0	5.6	0	0	2	.	1	2	.	1	7	7
230	53	62	0	0	0	0	5.4	0	0	1	.	1	1	.	1	5	7
230	54	55	0	0	0	1	4.1	1	0	2	1	1	0	.	1	5	7
230	54	59	0	0	0	0	5.2	0	0	1	.	1	1	.	1	7	7
230	54	61	0	0	0	0	4.1	0	0	1	.	1	1	.	2	3	7
230	54	63	0	0	0	0	3.9	0	0	1	.	1	1	.	2	3	7
230	54	63	0	0	0	0	4.9	0	0	1	.	1	1	.	2	3	7
230	55	60	0	0	0	0	3.6	0	0	1	.	1	1	.	1	5	7
230	55	62	0	0	0	0	4.8	0	0	1	.	5	1	.	5	7	7
230	83	57	0	0	0	0	5.0	1	0	2	.	1	1	.	1	3	2
230	83	57	0	0	0	0	6.1	1	0	2	.	1	1	.	1	3	2
230	83	57	0	0	0	0	6.3	1	0	2	.	1	1	.	1	3	7
230	83	57	0	0	0	0	6.5	1	0	2	.	1	1	.	1	3	7
230	87	153	0	0	0	1	4.9	2	0	1	.	1	2	1	1	3	3
230	87	159	0	0	0	0	3.9	0	0	1	.	6	1	.	6	3	1
230	87	225	0	0	0	0	6.8	2	0	1	.	11	2	0	5	4	1
230	88	160	0	0	0	8	4.0	1	0	1	0	14	1	.	3	3	1
230	90	158	0	0	0	0	4.2	0	0	1	.	1	1	.	1	3	1
230	97	177	0	0	0	1	4.2	0	0	2	1	13	2	1	13	3	1
230	97	179	0	0	0	2	3.2	1	0	3	.	1	2	.	1	3	3
230	-97	179	0	0	0	2	4.0	0	0	2	.	16	2	.	16	3	3
230	98	178	0	0	0	1	5.2	2	0	1	.	4	2	1	16	3	1
230	103	169	0	0	0	1	5.5	0	0	1	.	3	1	.	3	2	1
230	103	171	0	0	0	7	6.4	1	0	4	.	16	1	.	1	6	5
230	103	173	0	0	0	0	3.7	1	0	2	.	1	1	.	1	3	2
230	103	175	0	0	0	0	4.6	0	0	1	.	4	1	.	4	3	2
230	105	173	0	0	0	0	4.9	1	0	2	.	1	1	.	1	3	2
230	105	173	0	0	0	2	5.0	1	0	2	.	16	1	.	16	5	3
230	105	173	0	0	0	1	6.1	1	0	2	1	4	1	.	5	5	3
230	118	173	0	0	0	0	5.5	1	0	2	.	7	0	.	0	3	1
230	139	237	0	0	0	0	4.2	0	0	1	.	1	1	.	1	3	2
230	140	238	0	0	0	0	3.1	0	0	0	.	5	0	.	5	3	1
230	140	238	0	0	0	0	3.1	0	0	1	.	5	1	.	5	3	1
230	142	238	0	0	0	0	3.2	0	0	2	.	15	2	.	1	3	1
230	143	192	0	0	0	0	6.3	1	0	2	.	5	0	.	5	5	1
230	144	187	0	0	0	0	6.3	1	0	2	.	1	1	.	1	7	2
230	144	191	0	0	0	0	4.4	1	0	2	.	1	0	.	0	2	1
230	145	188	0	0	0	0	3.2	0	0	2	.	1	2	.	1	3	1

Table A2.3 (continued)
Ceramic Attributes for the WIFP Sites

SITE	NS	EW	LEVEL	VTOP	VBOT	TYPE	THICK	VTYPE	RIM	EXSUR	POLEX	MUNSEX	INSUR	POLIN	MUNSIN	PASTE	TEMPER
230	146	187	0	0.00	0.00	1	4.9	2	0	2	.	5	2	1	5	3	2
230	146	256	0	0.00	0.00	0	4.0	0	0	1	.	13	1	.	13	3	1
230	149	257	0	0.00	0.00	1	4.4	0	0	2	.	13	2	1	13	3	2
230	150	208	0	0.00	0.00	0	4.0	0	0	2	.	1	2	.	1	3	2
230	151	233	0	0.00	0.00	0	5.2	0	0	1	.	5	1	.	5	7	1
230	151	253	0	0.00	0.00	0	4.3	0	0	2	.	5	2	.	5	6	1
230	152	189	0	0.00	0.00	1	5.0	0	0	2	1	11	2	1	14	3	1
230	152	208	0	0.00	0.00	0	4.0	0	0	0	.	1	0	.	1	3	1
230	152	208	0	0.00	0.00	0	4.4	0	0	1	.	1	1	.	1	5	7
230	154	110	0	0.00	0.00	0	5.0	0	0	2	.	1	2	.	1	6	2
230	154	208	0	0.00	0.00	0	4.8	0	0	1	.	4	1	.	4	3	1
230	157	111	0	0.00	0.00	0	3.6	1	0	2	.	1	2	.	1	3	1
230	160	66	0	0.00	0.00	0	5.1	0	0	1	.	14	1	.	14	3	2
230	160	163	0	0.00	0.00	0	3.2	0	0	0	.	1	0	.	0	6	6
230	160	187	0	0.00	0.00	0	6.3	1	0	2	.	6	1	.	6	2	1
230	163	110	0	0.00	0.00	1	4.5	2	0	1	.	.	3	1	1	2	1
230	166	183	0	0.00	0.00	0	5.5	0	0	1	.	1	1	.	1	5	7
230	166	281	0	0.00	0.00	1	5.1	2	0	1	.	14	2	1	14	3	1
230	167	182	0	0.00	0.00	0	4.8	1	0	2	.	2	1	.	2	3	2
230	167	243	0	0.00	0.00	0	4.5	0	0	0	.	0	1	.	0	3	1
230	168	246	0	0.00	0.00	0	4.8	0	0	0	.	11	0	.	11	3	7
230	168	246	0	0.00	0.00	0	5.0	0	0	2	.	1	2	.	1	6	1
230	168	246	0	0.00	0.00	0	5.4	0	0	0	.	0	2	.	1	6	1
230	169	245	0	0.00	0.00	0	7.5	0	0	1	.	13	1	.	13	3	7
230	170	242	0	0.00	0.00	0	3.5	1	0	2	.	16	1	.	16	3	2
230	171	243	0	0.00	0.00	0	4.9	0	0	1	.	1	1	.	1	3	1
230	171	245	0	0.00	0.00	1	5.2	0	0	2	1	1	2	1	1	7	1
230	173	245	0	0.00	0.00	0	3.5	0	0	1	.	11	1	.	1	3	1
230	184	321	0	0.00	0.00	0	5.0	0	0	2	.	14	0	.	14	3	7
230	184	321	0	0.00	0.00	0	5.0	0	0	2	.	14	1	.	0	3	7
230	190	320	0	0.00	0.00	1	5.8	1	0	2	1	4	1	1	1	9	1
230	227	389	0	0.00	0.00	0	2.2	0	0	1	.	6	1	.	14	2	2
230	229	383	0	0.00	0.00	0	5.8	0	0	1	.	14	1	.	14	3	2
230	231	[illegible]	0	0.00	0.00	0	4.2	0	0	2	.	5	2	.	3	3	2
418	87	177	1	101.00	100.95	9	4.2	0	0	1	.	1	1	.	2	3	2
418	88	177	1	101.01	100.95	9	4.6	0	0	1	.	1	1	.	2	3	2
418	95	49	99	0.00	95.96	6	7.8	0	0	1	1	3	2	.	4	2	4
418	95	111	0	0.00	0.00	9	5.2	0	0	2	.	2	2	.	5	3	2
418	97	119	1	100.56	100.44	3	5.1	1	0	8	.	2	2	.	3	3	5
418	97	119	1	100.56	100.44	3	5.2	1	0	8	.	2	2	.	3	3	5
418	97	119	3	100.34	100.24	1	5.1	0	0	2	1	2	2	.	3	3	2
418	98	118	2	100.51	100.41	3	5.5	1	0	8	1	2	2	.	3	3	5
418	98	118	2	100.51	100.41	3	6.9	1	0	8	.	2	2	1	3	3	5
418	98	119	1	100.61	100.51	6	6.9	0	0	2	.	3	2	.	6	2	4
418	98	119	2	100.51	100.41	3	5.1	1	0	8	1	2	2	1	3	3	5
418	102	110	1	100.65	100.54	1	5.4	0	1	2	1	6	2	1	6	2	3
418	103	86	2	99.58	99.44	1	5.2	1	0	2	1	3	2	.	7	4	1
418	103	110	2	100.39	100.33	2	5.7	1	0	2	.	6	1	.	6	4	3
418	103	110	2	100.39	100.33	2	6.2	0	1	2	2	6	2	.	4	4	3
418	103	110	2	100.65	100.47	2	5.0	1	0	2	2	6	2	.	6	4	3
418	103	112	2	100.39	100.33	2	5.0	0	0	2	1	6	2	.	7	4	3
418	103	112	2	100.39	100.33	9	5.5	0	0	2	.	8	2	.	9	2	1
418	103	112	2	100.39	100.33	2	6.0	0	0	2	1	5	2	.	5	4	3
418	103	112	2	100.39	100.33	1	6.0	0	1	2	1	5	2	.	7	2	1
418	103	112	2	100.39	100.33	1	6.0	1	0	5	1	3	3	.	7	2	7
418	103	114	2	100.46	100.36	9	4.8	0	0	2	.	6	0	.	0	3	1

Table A2.3 (continued)
Ceramic Attributes for the WIPP Sites

SITE	NS	EW	LEVEL	VTOP	VBOT	TYPE	THICK	VTYPE	RIM	EXSUR	POLEX	MUNSEX	INSUR	POLIN	MUNSIN	PASTE	TEMPER
418	103	114	2	100.46	100.36	1	5.0	2	0	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	1	5.0	2	1	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	9	5.5	2	1	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	1	5.8	2	0	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	1	6.0	2	0	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	1	6.0	2	0	2	.	3	2	1	2	3	2
418	103	114	2	100.46	100.36	1	6.1	2	0	2	.	3	2	1	2	3	2
418	103	115	2	100.46	100.36	2	6.0	1	0	2	.	3	2	.	3	5	3
418	103	115	2	100.46	100.36	2	6.0	1	0	2	.	3	5	1	3	5	3
418	104	112	3	100.32	100.27	2	6.0	0	1	2	1	3	2	1	7	5	3
418	104	113	2	100.39	100.32	1	5.8	0	1	2	1	6	2	1	7	2	2
418	104	113	2	100.39	100.32	2	5.9	0	0	2	1	6	2	1	7	5	3
418	104	113	2	100.39	100.33	9	5.0	0	0	1	.	6	1	.	6	5	2
418	104	113	2	100.39	100.33	1	5.6	0	1	2	1	8	2	.	8	2	2
418	104	113	4	100.27	100.20	1	5.6	1	0	2	1	3	2	.	3	3	1
418	104	113	4	100.27	100.20	1	5.9	0	0	2	1	3	2	1	3	3	1
418	104	115	3	100.36	100.26	1	6.0	1	0	2	1	3	2	.	3	4	2
418	104	115	3	100.36	100.26	1	6.0	1	0	2	1	3	2	.	3	4	2
418	104	115	4	100.26	100.22	2	6.4	0	0	2	.	3	2	.	3	3	3
418	104	115	4	100.26	100.22	2	6.4	0	0	2	.	3	2	.	3	3	3
418	104	115	4	100.26	100.22	2	6.4	0	0	2	.	3	2	.	3	3	3
418	104	120	3	100.67	100.57	4	5.5	1	0	6	5	8	9	.	9	2	9
418	104	120	3	100.67	100.57	6	7.4	1	0	2	.	10	9	.	4	3	4
418	104	120	6	100.47	100.37	6	6.4	0	0	1	.	3	9	.	3	3	4
418	104	123	6	100.47	100.37	6	5.2	0	0	1	.	11	1	.	11	3	4
418	105	112	6	100.09	99.99	2	5.4	1	0	2	1	10	2	.	10	3	3
418	105	112	6	100.09	99.99	2	6.5	1	0	2	1	10	2	.	10	3	3
418	105	112	6	100.09	99.99	2	6.8	1	0	2	1	10	2	.	10	3	3
418	105	113	2	100.48	100.38	9	5.5	1	1	2	.	3	1	.	3	3	1
418	105	113	2	100.48	100.38	3	5.5	2	0	2	.	12	7	5	12	3	7
418	105	113	2	100.48	100.38	3	6.4	2	0	2	.	10	2	.	10	3	7
418	105	115	1	100.43	100.33	9	5.5	0	0	2	.	6	2	.	3	3	2
418	105	115	1	100.43	100.33	9	5.8	0	0	2	.	6	2	.	3	5	2
418	105	115	1	100.43	100.33	9	6.3	0	0	2	.	7	2	.	7	3	2
418	106	113	3	100.38	100.28	2	6.0	2	0	2	.	6	2	.	7	4	3
418	106	115	1	100.44	100.30	3	6.1	2	0	2	.	6	7	8	6	3	8
418	106	116	3	100.46	100.36	1	6.1	1	0	2	1	3	1	.	6	7	2
418	106	116	3	100.46	100.36	1	6.1	1	0	2	1	3	1	.	6	7	2
418	106	116	3	100.46	100.36	1	6.7	1	0	2	1	3	1	.	6	7	2
418	106	116	3	100.46	100.36	1	6.7	1	0	2	1	3	1	.	6	7	2
418	106	116	3	100.46	100.36	1	6.7	1	0	2	1	3	1	.	6	7	2
418	106	117	5	100.26	100.16	1	4.8	0	0	2	.	6	2	.	6	6	2
418	106	118	4	100.45	100.35	3	6.2	2	0	2	.	6	7	8	6	3	8
418	107	113	3	100.33	100.25	1	5.3	0	0	2	1	3	2	1	3	5	2
418	107	115	2	100.50	100.40	5	5.0	0	0	2	.	6	2	.	6	3	3
418	107	115	4	100.30	100.18	2	6.0	0	0	2	.	3	2	.	3	3	3
418	107	116	3	100.48	100.43	2	6.7	0	0	2	1	7	2	1	7	5	3
418	107	119	1	100.74	100.66	2	5.5	1	0	2	1	1	1	.	1	6	3
418	107	119	1	100.74	100.66	1	6.3	1	0	2	1	1	1	.	1	5	1
418	108	114	1	100.50	100.47	2	6.2	1	0	2	1	1	1	.	2	6	3
418	108	115	1	100.61	100.51	2	5.0	2	0	2	.	6	7	8	6	6	3
418	108	115	1	100.61	100.51	2	5.5	1	0	2	1	1	1	.	2	6	3
418	108	115	1	100.61	100.51	2	5.6	1	0	2	.	1	1	.	2	6	3
418	108	115	1	100.61	100.51	2	5.8	1	0	2	.	1	1	.	2	6	3
418	108	115	1	100.61	100.51	1	5.9	1	0	2	1	1	1	.	2	3	2
418	108	115	1	100.61	100.51	2	6.2	1	0	2	1	1	1	.	2	6	3

Table A2.3 (continued)
Ceramic Attributes for the WIPP Sites

SITE	NS	EW	LEVEL	VTOP	VBOT	TYPE	THICK	VTYPE	RIM	EXSUR	POLEX	MUNSEX	INSUR	POLIN	MUNSIN	PASTE	TEMPER
418	108	115	3	100.41	100.31	2	6.6	1	0	2	1	1	1	.	2	6	3
418	108	116	.	100.56	100.46	2	5.9	1	0	2	1	1	1	.	2	6	3
418	108	117	3	100.49	100.43	2	6.0	0	0	2	.	6	2	.	6	6	3
418	108	119	2	100.56	100.46	2	4.9	0	0	2	.	6	2	.	6	5	3
418	115	100	3	100.67	100.57	4	7.1	1	0	2	.	3	9	.	6	2	4
418	118	44	4	99.11	99.01	3	5.4	2	0	2	.	6	7	7	6	3	2
418	118	47	0	0.00	0.00	9	9.1	1	0	2	.	2	1	.	2	7	2
418	119	44	4	99.11	99.01	3	5.2	2	1	2	.	6	7	7	6	7	2
418	126	27	1	99.61	99.53	6	5.5	1	0	2	.	8	9	.	6	2	4
418	134	31	0	0.00	0.00	4	4.4	1	0	6	8	8	9	.	.	2	4
418	134	31	0	0.00	0.00	4	5.0	1	0	6	8	8	9	.	.	2	4
418	135	23	0	0.00	0.00	1	6.9	1	5	2	1	1	2	.	2	7	2
418	135	29	0	0.00	0.00	4	4.6	1	0	6	8	8	9	.	.	2	4
418	148	31	2	100.19	100.09	4	4.8	1	0	6	8	8	9	.	6	2	4
418	148	32	1	100.26	100.19	4	5.0	1	0	6	8	8	9	.	6	2	4
418	149	32	1	100.26	100.19	2	6.0	0	0	2	.	1	2	1	1	6	3
418	155	20	0	0.00	0.00	4	5.6	1	0	6	8	8	9	.	.	2	4

Appendix 3

LITHICS ANALYTICAL FORMAT AND GLOSSARY OF TERMS

The following variables have been used to discern differences and similarities in lithic reduction strategies (Tables A3.1, A3.2, and A3.3).

Provenience

All artifacts were located horizontally by one meter grid units and vertically by 10 cm levels.

Dimensions

Artifact length was measured in millimeters along the proximal/distal axis. Width was recorded in millimeters at the widest distance between both lateral margins along an axis perpendicular to the proximal/distal axis. Thickness was recorded as the maximum distance between the dorsal and ventral surface.

Material Type (see Table A3.1)

Table A3.1
Material Types

Material Class	Material Type	Description
		Cherts
B	1	Gray-brown chert - sometimes banded orange - red cortex
B	2	Red chert
B	2	Butterscotch chert
B	11	White chert
B	17	White chert with purple to red inclusions - macro crystalline
B	21	Gray chert - pebble or cobble
B	26	Black chert - pebble
B	38	Olive-brown chert
B	42	Oolitic chert - pink to purple spotted
F	8	Fossiliferous white chert
F	12	Fossiliferous gray chert
H	4	White chert - waxy luster
H	5	Rose-red chert - macro crystalline grading to fine grained
J	9	Gray banded chert
J	20	Slate gray chert

Table A3.1 (continued)
Material Types

Material Class	Material Type	Description
		<u>Cherts</u> (continued)
J	27	Gray chert - grading to rusty chalk metamorphic limestone
J	29	White-tan banded chert
J	37	Gray chert - agatized limestone
L	15	Variegated chert - purple, gray, blue, white, red
P	24	Jasper
Q	35	Butterscotch - purple banded chert
		<u>Chalcedonies</u>
G	14	White chalcedony
G	28	White Chalcedony - tan to yellow inclusions
G	30	White chalcedony - rust inclusions - rust cortex
G	40	Brown chalcedony
G	41	Orange-red chalcedony
		<u>Quartzites</u>
B	10	Red quartzite sandstone
B	13	Red quartzite - cobble
B	23	White quartzite - cobble
B	31	Purple quartzite - cobble
B	46	Red quartzite - white to yellow banding
G	39	Off-white micro crystalline quartzite with dark inclusions
G	43	White quartzite - purple inclusions
I	32	Yellow quartzite
I	33	Gray quartzite
I	34	Green quartzite
N	45	Hydrous quartz
		<u>Obsidian</u>
D	3	Smokey gray obsidian - translucent
		<u>Miscellaneous</u>
A	18	Fine-grained black basalt
C	19	Ogallala opal
E	7	Welded tuff
M	16	Brown silicified wood
M	44	Red silicified wood - Oolitic inclusions
O	22	Red-brown mudstone

Table A3.2
Whole Flake Coding Format

1	Item	
2-6	Site number	
7-12	Horizontal provenience	
13-14	Level	
15-24	Vertical provenience - top and bottom	
25-28	Artifact number	
29-30	Material type	
31	Flake condition	
32-34	Length	
35-37	Width	
38-40	Thickness	
41	Flake type:	1 = core flake, 2 = biface flake, 3 = blade
42	Core stage:	1 = primary, 2 = secondary, 3 = tertiary
43	Biface:	1 = biface thinning, 2 = retouch
44-46	Platform angle	
47	Platform type:	1 = cortical, 2 = cortical ground, 3 = facet, 4 = facet ground, 5 = multifacet, 6 = multifacet ground, 7 = crushed
48	Edge condition:	1 = non-specific, 2 = use/wear, 3 = none present
49	Heat treatment:	1 = present, 2 = absent
50	Termination:	1 = feather, 2 = hinge, 3 = outrepasse'

Table A3.3
Flake Fragment Coding Format

1	Item	
2-6	Site number	
7-12	Horizontal provenience	
13-14	Level	
15-24	Vertical provenience - top and bottom	
29-30	Material type	
49	Heat treatment:	1 = present, 2 = absent
51	Cortex:	1 = present, 2 = absent

Cortex

"Parent material prior to its use or preparation as a core exhibit a cortex on its out surface. This cortex is often a different color and texture than the underlying material composing the interior of the parent material and is produced as a function of weathering through geological time process" (Chapman 1973:3). Accepted convention in the archaeological literature is to use cortex as the mitigating factor for selecting flake types - primary, secondary, and tertiary.

Flake and Flake Types

A flake is defined as a piece of lithic material removed from a larger mass of a parent material by application of human force and retains certain characteristics. The minimum qualifiers for flake status are the presence of a platform or platform remnant and/or a bulb of force at one end and the presence of a dorsal and ventral surface with a distal termination. The ventral surface is a result of a fracture that is created by oscillation in the internal structure of the parent material through the application of force to the striking platform. The analysis was set up to discriminate between flake types on the basis of attributes that each individual flake displayed.

Core stage flakes were differentiated by the amount of cortex that the dorsal and platform surfaces displayed. Primary flakes displayed up to 100% of cortex on the dorsal and platform surface. Secondary flakes were differentiated on the basis of size coupled with cortex on the platform. Tertiary flakes will display no cortex on either the platform or dorsal surface.

Blades are specialized flakes with parallel or subparallel lateral edges, the length being more than twice the width. Cross sections include plano-convex, triangulate, sub-triangulate, rectangular, and trapezoidal. Some have more than two dorsal crests or ridges. They are usually associated with a prepared core and blade reduction technique, not a random flake (Crabtree 1966).

The bulb of force is located directly below the striking platform and can be identified as a semi-spherical bump. The bulb of force is created by the largest oscillation resulting from the application of force to striking platform.

The bulb of force may or may not be accompanied by ripples that radiate outward from the bulb across the ventral surface. These ripples are created when the shock waves travel through the material in successively smaller oscillations similar to water ripples. The presence or absence of these ripples are dictated in part by the internal morphology of the parent material and the amount and angle of force applied to the striking platform.

Cores:

The first stage of lithic manufacture is the selection of a piece of raw material for modification. In the case of knapped stone artifacts, this piece of raw material is termed a primary core. A core will display a minimum number of attributes such as negative scars where flakes were removed and edges or projections that have been battered. These edges would serve as a striking platform for removal of another flake. Cores are differentiated from angular debris by the presence of a minimum of two complete negative scars.

The attributes measured on cores included: total number of platforms, count of platform types (cortical, cortical ground, facet, facet ground, multifacet, multifacet ground, and crushed [for definition of types see Figure A3.1]) percentage of cortex, presence or absence of wear, material type, dimensions, and weight. No primary cores were recovered from any of the three sites.

For the purpose of our analysis a secondary core was defined as a large secondary flake that displayed the minimum number of attributes of any whole flake. A secondary core would be utilized as a tool blank that has the same general outline as a finished tool.

Biface thinning flakes are characterized by bidirectional flake scars on the dorsal surface. Platform preparation is usually present on biface thinning flakes, however, much of the time the platform type has usually been obscured by crushing during the manufacturing procedure.

Biface retouch flakes are characterized by the attributes monitored on the platform area and the presence of dorsal flake scars. This flake type is difficult to recognize since the platform is usually crushed when the flake is removed. Retouch flakes are concentrated on the edge margin and never carry more than one-third across the face of an artifact as opposed to biface face thinning flakes that carry more than one-third across the width of the face of the artifact.

Flake Fragment

A flake fragment is a piece of chipped stone material lacking a platform and/or bulb of force and/or a normal distal termination.

Angular debris is defined as a piece of lithic material that can exhibit rings of force, portions of a bulb and a smooth ventral surface. Angular debris may exhibit either one or more fragmented scars, shatter cones, or stray lines of force which are indicative of intentional human alteration of a lithic material (Gomalak and Heinsch 1982). Angular debris lack flake morphology and are presumed associated with primary stages of reduction.

Flake fragments and angular debris were only monitored for provenience, material type, presence or absence of cortex and presence of absence of heat treatment. It was felt that with only part of the flake present that we could not show exactly which variables were missing. Therefore we could not place them into a particular stage of manufacture without uncertainty. Information can still be derived concerning material type source location, preference of material selection by density ratios and information concerning the distance decay model by the presence of cortex.

Platform angles were taken by measuring the perpendicular angles between the platform and the dorsal surface. These angles were taken in order to find any patterns that may exist when comparing core reduction flakes with biface flakes. Observations of such technological attributes may provide valuable insight into which reduction technology was being utilized and its possible trajectory. If our hypothesis that these cultures were using a core/flake technology is correct there should be a discernible difference in platform angles of core flakes and biface thinning flakes. The measurements were taken to the nearest degree.

Platform Types

A platform is defined as any surface area receiving the force necessary to remove flakes from a core. It must be pointed out that there is an inherent bias in dealing with platform characteristics since only a remnant of the platform usually remains intact on the flake. A platform can either be natural or prepared.

Platform attributes may be used to infer differing levels of energy input invested in the process of producing lithic artifacts. A natural platform refers to the natural state of the parent material surface and represents the lowest level of energy input. A prepared platform is created when the striking surface has been altered by human activity, e.g., grinding, faceting, or flaking; and represents the highest level of energy investment.

Platform preparation is usually performed to increase control over the size and shape of the prospective flake. Patterning in platform preparation should be a direct reflection of conscious behavior on the part of the knapper in order to produce flakes of a preconceived shape.

For the purposes of this analysis platform types were classified by the type of preparation present.

1. Striking platform - The flake platform is a remnant of the original surface of the core. Several platform attributes will be monitored in order to provide nominal data concerning the stage in the reduction sequence that a flake was produced. If the flake has been detached from a platform that had not been prepared in any manner and is covered with cortex the platform will be termed cortical.

2. A cortical platform that is ground will be termed a ground cortical platform.

3. Facet platforms are defined as natural or artificial single plane surface.

4. Facet ground - same as above only ground.

5. Multifacet platforms are defined as above except there is more than one plane, multiplane surfaces can be flaked or stepped.

6. Multifacet ground - see above.

7. <u>Crushed platforms</u> - This platform type was established to categorize all pieces of debitage classified as whole flakes but which lack platform attributes. In many cases the platform is almost completely obliterated due to crushing when the flake is detached from the core.

Edge condition refers to damage along the lateral margins of a whole flake. The categories monitored were:

1. Non-specific damage refers to that which could have been caused by environmental processes or use wear but which cannot be quantified.

2. Use wear refers to damage that was created through use of the flake or tool. No attempt was made to distinguish different types of use wear.

All lateral margins were examined under a 10X - 40X stereoscope for traces of use wear. However every flake examined had extensive edge damage and could not be quantified as to whether it was use wear or non-specific damage. Therefore interpretation of activities and use wear are virtually impossible for sites in the regions because of the variety of uncontrolled, interrelated, deviation amplifying process present in this environment, i.e., sand blasting and tumbling (Shelley and Nials 1983).

Heat treatment was monitored in order to see if there was any differential treatment in material type preparation. The attribute was measured on the basis of presence of absence.

<u>Termination</u>

Flake termination was recorded in order to establish a ratio of mistakes that can happen within any given assemblage. A <u>feathered termination</u> is a proper end to a flake. A <u>hinge</u> (an abrupt termination) or an outrepasse' (an over shot) are mistakes.

Table A3.4

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10222

NS	EW	LEVEL	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
21	60	0	24	P	1	27	11	5	.	1	68	3	2	2
22	175	4	35		1	19	16	9	3	.	63	3	2	1
24	83	0	12	F	1	12	10	5	2	.	99	1	2	2
26	70	0	8	F	1	36	24	9	2	.	62	1	2	1
26	76	0	.		1	11	13	6	3	.	56	3	2	1
32	124	0	1	B	1	12	13	4	.	1	48	5	2	1
32	124	0	14	G	1	10	9	3	.	1	55	5	2	1
35	90	0	19	C	1	15	8	2	.	1	65	3	2	1
39	108	3	22	O	1	9	20	4	.	2	49	4	1	2
40	122	0	12	F	1	21	17	7	2	.	56	5	2	1
41	108	0	2	B	1	20	16	4	2	.	55	1	2	1
42	102	0	.		1	13	16	3	.	1	49	3	2	1
42	108	0	1	B	1	9	10	2	.	2	0	3	2	1
56	100	0	8	F	1	14	9	3	.	2	0	.	2	1
63	120	0	19	C	1	19	19	3	.	1	61	3	1	2
65	86	0	14	G	1	25	10	3	.	1	.	.	2	2
65	96	0	8	F	1	18	12	1	.	2	.	.	2	3
67	100	0	12	F	1	21	13	3	.	1	68	3	2	1
70	100	0	.		1	22	14	8	2	.	73	1	1	1
70	103	0	23	B	1	28	20	9	1	.	0	1	2	2
71	100	0	14	G	1	20	13	18	.	1	95	3	2	2
71	111	0	6	B	1	19	17	7	.	1	59	3	2	1
72	111	0	12	F	1	19	12	4	.	1	56	3	2	1
73	91	0	6	B	1	33	30	13	2	.	80	1	2	1
74	93	0	12	F	15	13	13	3	.	1	72	5	1	1
76	94	0	16	M	1	35	13	5	2	.	82	3	2	1
76	130	0	25	K	1	15	14	3	.	1	.	.	1	2
77	87	0	8	F	1	22	18	3	.	1	61	3	2	1
80	88	0	13	B	1	12	9	2	.	1	61	3	2	1
80	170	0	8	F	1	13	18	4	.	1	91	3	2	3
81	88	0	7	E	1	18	17	4	.	1	83	4	2	2
83	74	0	8	F	1	9	10	2	.	1	83	4	2	1
84	70	0	1	B	1	16	17	6	3	.	60	3	2	1
84	105	0	19	C	1	11	7	1	.	2	63	3	2	1
85	75	0	8	F	1	19	12	2	.	1	78	4	1	2
85	105	0	11	B	1	10	7	2	.	1	67	5	2	1
85	125	6	5	H	1	18	18	5	2	.	83	3	2	1
86	125	3	31	B	1	47	30	11	1	.	89	5	2	1

Table A3.4 (continued)

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10222

NS	EW	LEVEL	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
86	125	4	13	B	1	28	22	10	1	.	70	3	2	1
86	125	5	15	L	1	12	10	2	.	1	31	4	1	1
86	125	6	22	O	1	25	27	4	.	1	70	4	2	1
86	125	6	22	O	1	9	11	2	.	2	55	3	2	1
86	125	7	7	E	1	59	26	10	1	.	93	1	2	1
87	111	0	26	B	1	6	4	1	.	2	0	.	2	1
87	112	0	15	L	1	8	8	1	.	2	0	.	2	1
88	106	0	17	B	1	27	40	12	2	.	77	5	2	1
88	111	0	12	F	1	8	7	2	.	2	55	.	2	1
88	163	0	12	F	1	13	17	4	.	2	0	.	1	1
89	108	0	13	B	1	30	23	10	1	.	93	1	2	1
89	108	0	16	M	1	30	16	5	2	.	76	5	2	2
89	111	1	15	L	1	18	14	7	3	.	50	4	2	1
89	111	1	17	B	1	9	9	1	.	2	0	.	2	1
89	112	0	3	D	1	5	4	1	.	2	0	4	2	1
89	112	1	16	M	1	13	10	3	.	2	59	4	2	1
89	112	1	30	G	1	22	15	3	.	1	63	3	2	1
89	112	1	8	F	1	16	8	2	.	1	84	4	2	2
89	113	0	8	F	1	14	24	5	.	1	0	5	2	2
89	123	0	6	B	1	27	28	10	1	.	0	1	2	1
89	123	0	11	B	1	18	15	4	2	.	61	3	2	2
90	106	0	14	G	1	17	8	1	.	1	61	3	2	1
92	103	0	18	A	1	23	11	2	.	1	73	4	2	1
93	104	0	8	F	1	19	18	3	.	1	0	.	2	1

Table A3.5

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
46	66	.	.	.	8	F	1	26	16	5	.	1	80	5	2	1
52	63	.	.	.	19	C	1	6	14	2	.	2	92	5	1	1
53	60	.	.	.	22	O	1	15	14	3	1	.	73	3	2	1
55	64	.	.	.	21	B	1	39	27	9	1	.	89	3	2	2
55	64	.	.	.	22	O	1	18	20	5	2	.	71	3	1	2
55	66	.	.	.	8	F	1	13	6	2	.	1	70	3	1	1
62	162	.	.	.	8	F	1	11	22	3	3	.	75	5	2	2
62	164	.	.	.	15	L	1	28	13	4	3	.	68	3	2	1
75	174	.	.	.	15	L	1	8	14	2	.	1	85	5	2	1
75	177	.	.	.	22	O	1	30	25	12	2	.	73	3	2	2
75	177	.	.	.	33	I	1	10	13	3	.	1	68	4	2	1
78	151	.	.	.	22	O	1	15	14	5	.	1	.	7	1	2
78	186	.	.	.	8	F	1	20	7	3	3	.	75	5	1	1
81	174	.	.	.	.		1	10	13	3	.	1	99	5	2	2
81	174	.	.	.	.		1	12	17	3	.	1	68	5	2	1
83	57	.	.	.	21	B	1	12	9	2	.	1	92	3	2	1
84	179	.	.	.	8	F	1	23	34	9	2	.	69	3	2	1
84	184	.	.	.	15	L	1	20	6	3	.	1	82	1	2	1
86	158	.	.	.	1	B	1	30	16	4	2	.	70	4	2	2
95	177	.	.	.	8	F	1	6	8	1	.	1	65	4	2	1
95	177	.	.	.	12	F	1	21	14	6	2	.	58	3	2	1
95	177	.	.	.	12	F	1	28	7	2	.	1	56	5	2	2
95	177	.	.	.	15	L	1	9	10	1	.	1	.	7	1	1
95	177	.	.	.	15	L	1	23	14	7	1	.	63	1	2	1
95	177	.	.	.	16	M	1	5	11	2	.	1	65	3	2	1
95	177	.	.	.	16	M	1	10	7	2	.	1	.	7	2	1
95	177	.	.	.	30	G	1	24	19	11	1	.	.	.	2	1
96	180	.	.	.	8	F	1	7	7	3	.	1	74	5	2	1
96	180	.	.	.	12	F	1	9	6	3	.	1	74	4	2	1
96	180	.	.	.	14	G	1	8	5	1	.	1	.	7	2	1
96	180	.	.	.	47	I	1	19	5	3	.	1	77	3	2	2
97	175	.	.	.	.		1	10	10	2	.	1	76	4	2	1
97	175	.	.	.	28	G	1	11	5	1	.	2	76	4	2	1
97	175	.	.	.	40	G	1	15	14	4	3	.	78	2	2	1
97	179	.	.	.	8	F	1	22	23	6	1	.	85	4	2	2
98	176	.	.	.	5	H	1	18	14	3	.	1	82	3	2	1
98	176	.	.	.	8	F	1	4	7	1	.	2	.	7	2	1
98	176	.	.	.	12	F	1	16	13	3	.	1	64	4	2	1
98	176	.	.	.	29	J	1	10	6	1	.	1	50	4	2	1
98	176	.	.	.	43	G	1	19	9	4	2	.	65	3	1	2
98	178	.	.	.	2	B	1	1	14	14	2	.	1	45	1	2
99	163	.	.	.	15	L	.	36	21	5	1	.	90	1	2	1
99	172	.	.	.	14	G	1	28	15	4	2	.	87	5	2	1
99	172	.	.	.	28	G	1	8	7	2	.	1	85	5	2	1
99	175	.	.	.	8	F	1	12	13	2	.	1	.	7	2	1
99	175	.	.	.	8	F	1	13	14	5	.	1	71	5	2	2
99	175	.	.	.	8	F	1	14	10	2	.	1	69	4	1	1
99	175	.	.	.	8	F	1	23	15	4	1	.	86	4	2	1
99	175	.	.	.	15	L	1	12	14	8	.	2	79	5	2	2
99	177	.	.	.	8	F	1	8	7	2	.	2	66	5	2	1
99	177	.	.	.	30	G	1	4	2	1	.	2	.	7	2	1
101	171	.	.	.	8	F	1	16	10	3	3	.	67	4	2	1
101	171	.	.	.	40	G	1	10	7	2	.	2	.	.	1	1
101	175	.	.	.	12	F	1	12	12	4	.	1	67	3	2	1
102	168	.	.	.	22	O	1	10	17	3	.	3	74	5	2	2
102	170	.	.	.	11	B	1	18	16	4	.	1	58	4	2	1

Table A3.5 (continued)

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
102	170	.	.	.	29	J	.	9	7	1	.	1	65	4	2	1
102	174	.	.	.	30	G	.	10	10	3	3	.	89	5	2	1
102	174	.	.	.	35		1	8	8	4	3	.	90	1	2	1
102	176	.	.	.	15	L	1	18	10	2	.	1	67	4	1	1
103	167	.	.	.	22	O	1	26	16	4	.	1	.	7	2	1
103	169	.	.	.	12	F	1	11	4	2	.	1	59	4	2	1
103	169	.	.	.	22	O	1	23	14	7	2	.	95	1	2	1
103	169	.	.	.	32	I	1	11	10	2	.	1	.	7	2	1
103	171	.	.	.	33	I	.	24	33	8	2	.	80	5	2	1
103	175	.	.	.	8	F	1	40	23	3	.	1	73	4	1	1
103	175	.	.	.	15	L	1	10	6	1	.	2	58	7	2	1
103	175	.	.	.	15	L	1	11	8	2	.	2	77	6	2	2
104	164	.	.	.	2	B	2	1	8	14	2	.	1	74	1	2
104	174	.	.	.	36	O	1	15	20	3	.	1	70	4	2	1
104	176	.	.	.	12	F	1	10	9	3	.	1	69	3	2	1
104	176	.	.	.	28	G	1	18	14	6	2	.	60	1	2	1
105	161	.	.	.	12	F	1	15	24	4	.	1	72	3	2	1
105	163	.	.	.	8	F	1	8	16	3	.	1	77	6	1	1
105	165	.	.	.	8	F	1	7	5	1	.	1	60	5	2	1
105	165	.	.	.	8	F	1	11	8	2	.	1	70	4	2	1
105	165	.	.	.	8	F	1	24	12	3	.	1	83	5	2	1
105	165	.	.	.	15	L	1	9	9	1	.	2	80	7	2	1
105	167	.	.	.	6	B	1	24	12	6	3	.	.	7	2	1
106	166	.	.	.	14	G	1	12	10	2	1	.	63	5	2	1
106	172	.	.	.	15	L	1	15	7	2	.	1	62	5	2	1
106	176	.	.	.	22	O	1	14	9	1	.	1	71	3	2	3
107	165	.	.	.	22	O	1	62	50	13	1	.	75	4	2	3
118	161	.	.	.	8	F	1	18	10	2	.	1	61	4	2	1
132	195	.	.	.	8	F	1	15	20	4	.	1	.	7	2	1
134	236	.	.	.	19	C	1	13	18	14	2	.	.	.	2	2
135	235	.	.	.	6	B	1	19	26	5	.	1	.	7	2	1
137	241	.	.	.	8	F	1	7	5	1	.	1	.	7	2	1
138	234	.	.	.	30	G	1	21	18	3	.	1	.	7	2	1
138	236	.	.	.	8	F	1	6	13	4	.	1	75	4	2	1
138	238	.	.	.	28	G	1	9	7	2	.	1	.	.	2	1
138	238	.	.	.	28	G	1	12	7	2	.	1	60	3	2	1
139	237	.	.	.	17	B	.	17	22	8	2	.	83	4	2	2
139	237	.	.	.	22	O	.	11	5	2	.	1	63	3	2	1
139	239	.	.	.	15	L	.	22	20	5	3	.	71	6	2	1
139	239	.	.	.	15	L	1	13	12	5	.	1	70	5	1	2
139	239	.	.	.	31	B	1	29	13	4	.	.	84	3	2	1
139	239	.	.	.	37	J	1	39	35	8	2	.	65	5	2	1
142	191	.	.	.	46	B	1	20	14	4	2	.	70	4	2	1
146	187	.	.	.	8	F	1	8	13	2	.	1	68	4	2	1
148	212	.	.	.	13	B	1	19	11	4	.	1	8	3	2	1
148	214	.	.	.	30	G	1	18	10	6	.	1	.	7	2	1
150	210	.	.	.	12	F	1	7	10	2	.	1	66	4	2	2
150	212	.	.	.	8	F	1	11	6	4	3	.	70	4	1	2
150	212	.	.	.	30	G	1	10	13	4	2	.	67	1	2	2
150	214	.	.	.	19	C	1	6	4	1	.	1	68	6	2	2
151	190	.	.	.	2	B	1	7	5	1	.	1	65	3	1	1
151	190	.	.	.	12	F	1	7	8	1	.	1	64	5	2	1
151	209	.	.	.	12	F	1	12	17	2	.	1	78	5	2	1
152	191	.	.	.	8	F	1	11	7	1	.	1	.	7	2	1
152	206	.	.	.	12	F	1	6	4	1	.	2	.	7	2	1
152	210	.	.	.	30	G	1	29	25	11	1	.	102	5	2	1

Table A3.5 (continued)

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
152	210	.	.	.	40	G	1	7	9	1	.	1	83	5	2	2
152	212	.	.	.	30	G	1	11	12	3	.	1	70	4	2	1
152	214	.	.	.	30	G	1	30	13	6	1	.	.	7	2	2
153	207	.	.	.	8	F	1	13	19	3	.	1	69	5	2	1
153	207	.	.	.	30	G	1	14	10	5	0	1	59	5	2	1
153	209	.	.	.	12	F	1	7	6	1	.	1	73	3	2	1
153	209	.	.	.	12	F	1	8	4	1	.	1	69	5	2	1
153	211	.	.	.	8	F	1	7	8	2	.	1	73	5	2	1
153	213	.	.	.	31	B	1	21	21	7	1	.	62	4	2	2
154	210	.	.	.	8	F	1	12	13	5	3	.	75	4	2	3
154	212	.	.	.	8	F	1	19	12	2	.	1	80	5	2	2
154	212	.	.	.	16	M	1	12	17	3	.	1	80	4	2	1
154	212	.	.	.	26	B	1	5	8	2	2	.	71	3	2	1
154	212	.	.	.	30	G	1	15	11	3	2	.	.	7	2	1
154	214	.	.	.	15	L	1	15	15	8	.	1	60	5	2	2
154	214	.	.	.	16	M	1	5	4	1	.	1	75	4	2	1
154	214	.	.	.	41	G	1	13	13	3	2	.	70	4	1	2
154	214	.	.	.	43	G	1	14	16	3	.	1	46	3	2	1
155	136	.	.	.	8	F	1	15	20	3	.	1	78	4	2	2
155	136	.	.	.	30	G	1	20	10	4	1	.	.	7	2	1
155	207	.	.	.	31	B	1	3	2	1	.	1	.	7	2	2
155	213	.	.	.	8	F	1	20	13	5	.	2	.	7	1	2
155	227	.	.	.	5	H	1	10	6	2	3	.	66	4	2	1
155	227	.	.	.	28	G	1	37	11	1	.	1	68	4	2	1
160	270	.	.	.	28	G	.	8	20	3	.	1	58	5	1	2
161	284	.	.	.	29	J	1	24	15	7	1	.	87	3	2	1
162	183	.	.	.	31	B	.	16	21	6	2	.	80	1	2	1
162	279	.	.	.	4	H	1	9	9	2	.	1	63	5	2	1
162	279	.	.	.	22	O	1	16	11	3	.	1	67	3	2	1
163	273	.	.	.	19	C	1	6	4	1	.	2	.	.	2	1
164	179	.	.	.	28	G	1	15	10	2	.	1	75	3	2	1
164	179	.	.	.	46	B	1	16	19	3	2	.	80	3	2	1
165	178	.	.	.	1	B	1	8	5	1	.	2	.	.	1	1
165	178	.	.	.	28	G	1	10	10	1	.	2	62	3	2	1
165	242	.	.	.	15	L	1	15	7	2	.	2	56	1	1	1
165	242	.	.	.	23	B	1	10	8	1	.	1	54	3	1	1
165	248	.	.	.	8	F	1	13	9	2	.	1	86	7	2	1
165	293	.	.	.	8	F	.	23	21	4	2	.	78	2	2	1
166	246	.	.	.	1	B	1	3	4	1	.	2	53	4	2	2
166	246	.	.	.	1	B	1	6	4	1	.	1	51	4	2	1
166	248	.	.	.	8	F	1	8	6	1	.	2	64	4	2	1
166	248	.	.	.	8	F	1	14	13	1	.	2	73	4	2	1
166	248	.	.	.	16	M	1	6	4	1	.	2	.	7	1	1
166	248	.	.	.	23	B	1	12	5	2	.	1	70	7	2	1
166	285	.	.	.	12	F	1	19	14	8	2	.	.	.	2	2
166	330	.	.	.	28	G	1	18	9	1	.	1	70	3	2	1
167	294	.	.	.	19	C	1	12	9	2	.	2	62	4	2	2
167	329	.	.	.	8	F	1	15	14	5	3	.	83	5	2	1
168	238	.	.	.	31	B	1	7	9	2	.	2	.	7	2	1
168	246	.	.	.	30	G	1	10	14	2	.	1	.	7	2	1
169	243	.	.	.	31	B	1	10	14	3	1	.	90	1	2	2
170	168	.	.	.	31	B	1	10	8	2	.	1	.	7	2	1
170	238	.	.	.	21	B	1	11	14	6	.	1	65	4	2	2
170	238	.	.	.	30	G	1	37	20	6	1	.	90	1	2	1
170	240	.	.	.	8	F	1	6	7	2	.	1	.	7	2	1
170	240	.	.	.	33	I	1	7	4	1	.	2	80	5	2	1

Table A3.5 (continued)

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BI¨ACE	PANGLE	PTYPE	HEAT	TERM
170	242	.	.	.	30	G	1	10	9	2	.	1	.	.	2	1
171	238	.	.	.	5	H	1	34	20	9	1	.	46	4	2	1
171	243	.	.	.	22	O	1	10	21	3	.	1	69	3	2	1
171	247	.	.	.	12	F	.	16	22	8	2	.	69	3	2	2
171	247	.	.	.	30	G	.	9	4	3	.	1	.	.	2	1
171	247	.	.	.	30	G	.	11	18	3	.	1	92	3	2	1
171	294	.	.	.	6	B	1	12	10	4	2	.	.	3	2	1
171	294	.	.	.	30	G	1	11	9	3	2	.	62	1	2	1
172	284	.	.	.	33	I	1	7	6	2	.	1	80	3	2	1
172	747	.	.	.	.		1	14	14	3	.	1	71	2	2	1
172	747	.	.	.	12	F	1	8	7	1	.	1	59	6	2	1
173	239	.	.	.	2	B	1	6	4	1	.	2	61	4	2	1
173	239	.	.	.	8	F	1	5	4	1	.	2	57	4	2	1
173	239	.	.	.	8	F	1	6	4	1	.	2	59	4	2	1
173	247	.	.	.	4	H	1	7	8	2	.	2	74	.	1	1
182	325	.	.	.	44	M	.	23	17	3	2	.	99	1	2	1
195	325	.	.	.	17	B	1	19	8	2	1	.	.	.	2	1
195	325	.	.	.	31	B	1	1	10	2	.	1	69	3	2	1
217	281	.	.	.	45	N	.	40	38	11	1	.	64	1	2	1
227	383	.	.	.	26	B	1	11	9	3	3	.	91	4	2	1
270	309	.	.	.	8	F	1	20	19	8	1	.	84	3	2	2

Table A3.6

[illegible] OF WHOLE FLAKE ATTRIB[illegible] ENM 1041

NS	EW	LEVEL	[illegible]OP	[illegible]	MATTYPE	CLASS	COND	LENGTH	[illegible]	THICK	CORE	BIFACE	PANGLE	FTYPE	HEA	TERM
79	123	2	10030	[illegible]	[illegible]7	I	1	[illegible]5	[illegible]	7	.	2	77	4	1	2
80	129	2	10030	10020	1	B	1	9	11	2	2	.	.	7	2	[illegible]
80	131	2	10030	10020	12	F	1	.	.	.	.		.	.	.	.
82	141	5	10051	10041	45	N	1	[illegible]8	23	11	3	.	73	4	2	2
84	141	2	10074	10071	14	G	1	22	17	.	[illegible]	.	5[illegible]	1	2	1
85	141	3	10071	10061	30	G	1	11	9	2	.	[illegible]	71	2	2	[illegible]
85	141	4	10061	10051	.		1	.	.	.	.	.	.	.	.	
85	141	4	10061	10051	24	F	1	18	13	5	[illegible]	.	8[illegible]	6	2	.
85	139	.	.	.	.		1	.	.	.	.	.	.	.	.	.
8[illegible]	1[illegible]	5	10051	10041	28	D	1	12	11	4	1	.	53	1	[illegible]	
87	1[illegible]	4	10061	[illegible]		D	1	15		[illegible]	2		7[illegible]	[illegible]	[illegible]	
87	1[illegible]	3	10071	[illegible]	[illegible]	C	1	11	[illegible]	7	.		6[illegible]	4		
[illegible]	[illegible]	2	10095		[illegible]	[illegible]	1	13	[illegible]	4	2		6[illegible]	.		
[illegible]3	132	.	.	.	20	J	1	34	6		.	2	87	7	.	
[illegible]	[illegible]	.	.	.	.		1	16	21	8	[illegible]	.	64	.	2	
[illegible]	[illegible]	.	.	.	7	E	1	9	.	3	1	.	94	[illegible]		
[illegible]	[illegible]	2	10111	10101	6	D	1	[illegible]3	21	6	2		66	.	2	[illegible]
	1[illegible]	4	10091	[illegible]		.	1	[illegible]	[illegible]	3	.	.	77	5	2	
9[illegible]	112	3	10021	10011	20	J	1	12	[illegible]	4	3	.	.	7	2	2
[illegible]	[illegible]	2	.	.	15	[illegible]	1	[illegible]3	4	3	.	1	[illegible]	[illegible]	2	2
94	110	2	10024	10014	6	D	1	[illegible]	[illegible]	4	[illegible]	.	59	1	2	1
94	111	1	10034	10024	20	J	1	[illegible]0	[illegible]	[illegible]	[illegible]	.	110	1	2	3
95	49	4	9587	9577	33	I	1	30	16	6	.	1	80	4	2	2
95	111	3	10017	10007	14	G	1	7	10	3	.	2	.	7	2	2
95	111	3	10017	10007	40	G	1	10	6	2	.	1	77	4	2	1
95	112	6	10082	10072	20	J	1	11	13	3	2	.	18	2	2	1
96	111	3	10017	10007	2	B	1	9	14	2	.	[illegible]	.	7	2	2
97	113	4	10022	10012	.		1	.	.	.	.	.	.	.	.	.
97	117	3	10041	10031	14	G	1	19	9	3	2	.	.	7	2	2
97	117	3	10041	10031	31	B	1	39	13	7	2	.	73	4	2	2
97	119	3	10034	10024	26	D	1	29	17	4	3	.	76	3	2	1
97	181	7	10110	10100	15	L	1	10	10	2	.	[illegible]	66	4	2	2
98	112	2	10042	10032	15	L	1	11	10	2	.	2	.	.	.	.
98	112	4	10022	10012	13	B	1	14	25	5	1	.	.	.	.	.
99	118	3	10041	10031	14	G	1	19	13	3	.	1	66	3	1	2
99	119	2	10051	10041	15	L	1	16	12	5	.	1	63	4	2	2
100	87	1	9962	9955	20	J	1	13	11	3	.	2	.	7	2	1
100	87	2	9952	9944	.		1	.	.	.	.	.	.	.	.	.
100	119	3	10067	10057	33	I	1	41	20	9	2	.	80	3	2	2
100	124	.	.	.	.		1	.	.	.	.	.	.	.	.	.
101	87	2	9954	9944	14	G	1	9	8	2	.	1	69	3	2	1
102	86	2	9950	9940	.		1	.	.	.	.	.	.	.	.	.
103	121	4	10057	10047	11	B	1	8	10	1	.	1	.	7	2	1
103	123	4	10067	10057	15	L	1	11	11	2	.	1	71	3	2	1
103	144	.	.	.	40	G	1	13	11	2	.	1	.	7	2	1
104	93	.	.	.	.		1	.	.	.	.	.	.	.	.	.
104	112	3	10033	10030	14	G	1	12	17	5	2	.	77	2	2	1
104	113	2	10042	10031	21	B	1	20	14	4	3	.	78	3	2	2
104	113	2	10042	10031	23	B	1	23	17	7	3	.	66	3	2	2
104	114	2	10046	10036	14	C	1	39	17	4	1	.	66	4	2	3
104	145	2	10089	10079	15	L	1	10	8	1	.	2	.	7	2	1
104	145	4	10069	10059	.		1	.	.	.	.	.	.	.	.	.
104	198	.	.	.	.		1	.	.	.	.	.	.	.	.	.
105	112	5	10019	10009	49	B	1	20	11	8	3	.	.	7	2	1
105	113	2	10037	10027	30	G	1	10	13	4	3	.	109	6	2	1
105	113	3	10037	10027	28	G	1	10	11	2	.	1	70	3	2	1

Table A3.6 (continued)

LIST OF WHOLE FLAKE ATTRIBUTES FOR ENM 10418

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	LENGTH	WIDTH	THICK	CORE	BIFACE	PANGLE	PTYPE	HEAT	TERM
105	114	1	10048	10040	.		1	.	.	.	.	.	.	.	.	.
105	117	6	10015	10006	15	L	1	8	7	1	.	1	73	4	2	1
105	122	3	10039	10029	8	F	1	13	15	4	.	2	58	4	2	1
105	144	1	10094	10089	40	G	1	15	12	3	.	2	.	7	2	1
105	144	2	10089	10079	37	J	1	14	15	4	.	1	.	7	2	2
105	144	3	10079	10069	37	J	1	20	19	3	.	1	68	4	2	2
105	167	1	10125	10119	48	B	1	30	11	5	1	.	70	1	2	2
106	113	3	10038	10028	15	L	1	25	23	9	3	.	62	4	1	1
106	115	4	10030	10020	28	G	1	20	12	4	3	.	108	3	2	1
106	116	6	10016	10006	6	B	1	22	14	6	2	.	61	4	2	2
106	119	4	10045	10035	1	B	1	.	.	.	.	.	.	.	.	.
106	119	4	10045	10035	22	O	1	34	14	6	1	.	.	7	2	2
106	122	3	76054	10049	1	B	1	10	9	2	.	1	60	5	2	1
106	122	6	10052	10042	8	F	1	21	15	3	.	1	81	1	2	1
107	117	3	10049	10043	4	H	1	11	10	2	.	1	80	3	2	1
107	117	3	10049	10043	19	C	1	14	9	4	.	1	61	3	2	1
107	117	3	10049	10043	31	B	1	12	12	2	.	1	59	4	2	1
107	121	2	.	.	30	G	1	27	13	5	2	.	70	1	2	1
107	157	1	10018	10108	12	F	1	13	24	6	.	1	83	4	2	2
107	157	3	10101	10091	35		1	27	16	7	1	.	84	3	2	1
107	225	1	10184	10174	12	F	1	.	.	.	.	.	.	.	.	.
107	225	1	10184	10174	20	J	1	17	13	2	.	1	66	4	2	1
107	225	1	10184	10174	32	I	1	21	30	5	2	.	86	3	2	1
107	225	2	10174	10164	8	F	1	17	15	4	2	.	.	7	2	1
107	226	1	10184	10174	.		1	.	.	.	.	.	.	.	.	.
107	226	1	10184	10174	12	F	1	23	12	10	2	.	89	4	2	2
107	226	2	10175	10165	.		1	.	.	.	.	.	.	.	.	.
108	116	2	10056	10048	37	J	1	21	20	2	.	1	.	7	2	1
108	117	4	10043	10033	47	I	1	10	9	3	2	.	.	7	2	2
108	119	4	10049	10043	21	B	1	21	16	6	2	.	78	3	2	2
108	123	4	10060	10050	22	O	1	.	.	.	.	.	.	.	.	.
108	125	4	10048	10038	37	J	1	27	15	5	2	.	90	5	2	2
108	126	3	10066	10056	40	G	1	8	8	2	.	2	73	4	2	1
108	127	2	10076	10066	.		1	.	.	.	.	.	.	.	.	.
108	157	2	.	.	15	L	1	7	11	7	.	1	71	5	2	1
108	227	1	10185	10175	12	F	1	12	14	2	.	2	.	7	1	2
109	247	2	10226	10217	11	B	1	14	10	2	.	2	.	7	2	1
110	215	.	.	.	31	B	1	38	28	7	2	.	76	3	2	2
111	217	.	.	.	1	B	1	22	20	5	2	.	83	5	2	1
118	138	3	9987	9970	.		1	.	.	.	.	.	.	.	.	.
127	26	1	9961	9954	.		1	.	.	.	.	.	.	.	.	.
127	26	1	9961	9954	1	B	1	16	13	3	2	.	69	2	1	2
127	26	1	9961	9954	33	I	1	35	30	5	1	.	.	7	2	1
136	105	3	10084	10074	20	J	1	14	13	3	3	.	63	3	2	2
136	106	5	10064	10054	31	B	1	12	10	2	.	1	77	5	2	1

Table A3.7

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10222

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
10	100	.	.	.	15	L	2	2	2
22	170	1	9973	9963	30	G	2	2	2
32	75	.	9862	9852	1	B	2	2	1
32	75	.	9862	9882	1	B	2	2	1
39	108	2	9938	9928	1	B	2	2	1
40	122	.	.	.	21	B	2	2	1
42	102	.	.	.	15	L	2	2	1
42	108	.	.	.	8	F	2	2	2
43	98	.	.	.	22	O	2	2	2
56	100	.	.	.	10	B	2	2	2
58	100	1	9930	9920	6	B	2	2	1
62	99	.	.	.	15	L	2	2	1
62	99	.	.	.	15	L	2	2	1
62	99	.	.	.	15	L	2	2	2
62	99	.	.	.	15	L	2	2	2
62	99	.	.	.	28	G	2	2	2
63	120	.	.	.	21	B	2	2	2
65	86	.	.	.	15	L	2	2	2
65	86	.	.	.	19	C	2	2	2
65	86	.	.	.	21	B	2	2	1
65	94	.	.	.	17	B	2	2	2
65	120	.	.	.	15	L	2	2	2
66	120	.	.	.	8	F	2	2	2
67	100	.	.	.	15	L	2	2	1
68	100	.	.	.	4	H	2	2	2
68	100	.	.	.	8	F	2	2	2
68	100	.	.	.	10	B	2	2	1
68	100	.	.	.	18	A	2	2	2
68	100	.	.	.	21	B	2	2	1
58	100	.	.	.	28	G	2	2	2
68	120	.	.	.	1	B	2	2	1
68	120	.	.	.	3	D	2	2	2
68	120	.	.	.	15	L	2	2	1
69	103	.	.	.	6	B	2	2	2
69	103	.	.	.	13	B	2	2	2
69	103	.	.	.	14	G	2	2	2
69	103	.	.	.	22	O	2	2	2
69	103	.	.	.	30	G	2	2	2
70	100	.	.	.	4	H	2	2	2
70	100	.	.	.	12	F	2	2	1
70	100	.	.	.	15	L	2	2	2
70	100	.	.	.	21	B	2	2	2
70	103	.	.	.	8	F	2	2	2
70	103	.	.	.	12	F	2	2	2
70	103	.	.	.	21	B	2	2	1
70	103	.	.	.	28	G	2	2	2
71	111	.	.	.	2	B	2	2	2
71	111	.	.	.	29	J	2	2	1
73	93	.	.	.	30	G	2	2	2
74	93	.	.	.	14	G	2	2	1
74	93	.	.	.	30	G	2	2	2
74	130	.	.	.	8	F	2	2	2
76	130	.	.	.	19	C	2	2	2
80	87	.	.	.	12	F	2	2	1
80	88	.	.	.	22	O	2	2	2
80	88	.	.	.	28	G	2	1	2

Table A3.7 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10222

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
81	88	.	.	.	3	D	2	2	2
81	88	.	.	.	15	L	2	2	2
81	89	.	.	.	13	B	2	2	2
83	74	.	.	.	19	C	2	2	1
84	70	.	.	.	8	F	2	2	2
84	88	.	.	.	12	F	2	2	2
84	105	.	.	.	6	B	2	2	2
84	105	.	.	.	8	F	2	2	2
84	137	.	.	.	22	O	2	2	1
85	59	.	.	.	27	J	2	2	1
85	75	.	.	.	12	F	2	2	2
85	108	.	.	.	21	B	2	2	1
85	125	.	.	.	2	B	2	2	2
85	125	.	.	.	14	G	2	2	2
85	125	.	.	.	15	L	2	2	2
85	125	3	9895	9885	2	B	2	1	2
85	125	3	9895	9885	15	L	2	2	2
85	125	3	9895	9885	16	M	2	2	2
85	125	3	9895	9885	19	C	2	2	2
85	125	4	9985	9975	15	L	2	2	1
85	138	.	.	.	15	L	2	2	2
86	125	2	9898	9888	30	G	2	2	.
86	125	5	9868	9858	30	G	2	2	2
86	125	8	.	.	15	L	2	2	2
86	140	.	.	.	14	G	2	2	2
87	111	.	.	.	8	F	2	2	2
87	111	.	.	.	11	B	2	2	2
87	111	.	.	.	12	F	2	2	2
87	111	.	.	.	14	G	2	2	2
87	111	.	.	.	22	O	2	2	2
87	111	.	.	.	24	P	2	2	2
87	111	.	.	.	30	G	2	2	2
87	111	.	.	.	31	B	2	2	2
87	111	1	9952	9942	15	L	2	2	2
87	111	1	9952	9950	1	B	2	2	1
87	111	1	9952	9950	10	B	2	2	2
87	111	1	9952	9950	13	B	2	2	2
87	111	1	9952	9950	15	L	2	2	2
87	111	1	9952	9950	19	C	2	2	2
87	112	.	.	.	1	B	2	2	2
87	112	.	.	.	15	L	2	2	2
87	112	.	.	.	21	B	2	2	2
88	105	.	.	.	2	B	2	2	2
88	105	.	.	.	8	F	2	2	2
88	105	.	.	.	19	C	2	2	2
88	110	.	.	.	6	B	2	1	1
88	111	.	.	.	15	L	2	2	2
88	111	.	.	.	31	B	2	2	2
88	111	.	9947	9945	14	G	2	2	2
88	111	.	9947	9945	19	C	2	2	2
88	111	1	9947	9945	2	B	2	2	2
88	111	1	9947	9945	2	B	2	2	2
88	111	1	9947	9945	6	B	2	2	2
88	111	1	9947	9945	8	F	2	2	2
88	111	1	9947	9945	11	B	2	2	2
88	111	1	9947	9945	13	B	2	2	2

Table A3.7 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR SNM [illegible]

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
88	111	1	9947	9945	14	G	2	2	2
88	111	1	9947	9945	15	L	2	2	2
88	111	1	9947	9945	30	G	2	2	2
88	111	1	9947	9945	31	B	2	2	2
88	112	.	.	.	4	H	2	2	2
88	112	.	.	.	6	B	2	2	2
88	113	.	.	.	19	C	2	2	2
89	103	.	.	.	6	B	2	2	1
89	103	.	.	.	11	B	2	2	
89	107	.	.	.	29	J	2	2	2
89	107	.	.	.	30	G	2	2	1
89	108	.	.	.	15	L	2	1	2
89	111	.	.	.	14	G	2	2	2
89	111	1	9942	9932	6	B	2	1	2
89	111	1	9947	9945	8	F	2	2	2
89	111	1	9947	9945	22	O	2	2	1
89	111	1	9947	9945	26	B	2	2	1
89	112	.	.	.	3	D	2	2	2
89	112	1	9939	9929	8	F	2	2	1
89	112	1	9939	9929	15	L	2	2	2
89	112	1	9939	9929	15	L	2	2	2
89	114	.	.	.	1	B	2	2	2
89	114	.	.	.	24	P	2	2	2
89	123	.	.	.	6	B	2	2	1
89	123	.	.	.	8	F	2	2	2
92	103	.	.	.	8	F	2	2	
92	103	.	.	.	16	M	2	2	1
93	98	.	.	.	28	G	2	2	2

Table A3.6

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
52	65	.	.	.	6	B	2	2	1
52	65	.	.	.	35		2	1	1
90	160	.	.	.	15	L	2	2	2
90	188	.	.	.	8	F	2	2	2
90	188	.	.	.	38	B	2	2	2
228	386	.	.	.	8	F	2	2	2
228	386	.	.	.	12	F	2	2	1
228	386	.	.	.	21	B	2	2	1
228	386	.	.	.	26	B	2	2	1
49	66	.	.	.	15	L	2	2	2
84	152	.	.	.	31	B	2	2	2
84	154	.	.	.	8	F	2	2	2
84	156	.	.	.	30	G	2	2	2
84	158	.	.	.	8	F	2	2	1
84	158	.	.	.	30	G	2	2	2
85	151	.	.	.	3	D	2	2	2
85	163	.	.	.	8	F	2	2	1
88	158	.	.	.	14	G	2	2	2
88	158	.	.	.	15	L	2	2	1
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	31	B	2	2	2
88	158	.	.	.	37	J	2	2	2
89	159	.	.	.	8	F	2	2	1
89	159	.	.	.	21	B	2	2	1
89	159	.	.	.	22	O	2	2	2
89	159	.	.	.	22	O	2	2	2
91	157	.	.	.	6	B	2	2	2
91	157	.	.	.	8	F	2	2	2
96	176	.	.	.	15	L	2	2	2
96	176	.	.	.	22	O	2	2	2
96	180	.	.	.	2	B	2	2	2
96	180	.	.	.	6	B	2	2	2
96	180	.	.	.	22	O	2	2	2
96	180	.	.	.	33	I	2	2	2
98	178	.	.	.	40	G	2	2	1
99	175	.	.	.	2	B	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	15	L	2	2	1
99	175	.	.	.	15	L	2	2	2
99	175	.	.	.	22	O	2	2	2
99	175	.	.	.	30	G	2	2	2
99	175	.	.	.	33	I	2	2	1
142	189	.	.	.	8	F	2	2	2
142	189	.	.	.	31	B	2	2	2
144	191	.	.	.	2	B	2	2	2
144	191	.	.	.	8	F	2	2	2
144	191	.	.	.	12	F	2	2	2
146	256	.	.	.	15	L	2	2	1
148	210	.	.	.	2	B	2	2	2
148	212	.	.	.	12	F	2	2	2
149	209	.	.	.	30	G	2	2	2
149	211	.	.	.	15	L	2	2	2
149	211	.	.	.	39	G	2	2	2
149	213	.	.	.	15	L	2	2	1
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	15	L	2	2	1
150	208	.	.	.	15	L	2	2	2
150	210	.	.	.	12	F	2	2	2
150	210	.	.	.	22	O	2	2	2
147	253	.	.	.	31	B	2	2	1
148	208	.	.	.	6	B	2	2	2
149	239	.	.	.	8	F	2	2	2
150	212	.	.	.	15	L	2	2	2
152	236	.	.	.	31	B	2	2	1
152	254	.	.	.	8	F	2	2	2
153	211	.	.	.	12	F	2	2	1
154	206	.	.	.	34	I	2	2	1
154	256	.	.	.	1	B	2	2	1
154	256	.	.	.	31	B	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
155	213	.	.	.	15	L	2	2	2
156	238	.	.	.	31	B	2	2	1
162	281	.	.	.	12	F	2	2	2
163	278	.	.	.	31	B	2	2	1
165	180	.	.	.	19	C	2	2	2
172	240	.	.	.	22	O	2	2	2
172	240	.	.	.	30	G	2	2	1
172	242	.	.	.	2	B	2	2	2
172	242	.	.	.	8	F	2	2	2
172	242	.	.	.	10	B	2	2	1
172	242	.	.	.	26	B	2	2	2
173	249	.	.	.	17	B	2	2	2
182	325	.	.	.	12	F	2	2	2
186	320	.	.	.	22	O	2	2	2
208	362	.	.	.	28	G	2	2	2
208	366	.	.	.	27	J	2	2	1
226	384	.	.	.	1	B	2	2	1
226	384	.	.	.	8	F	2	2	2
226	384	.	.	.	22	O	2	2	1
226	386	.	.	.	30	G	2	2	2
227	385	.	.	.	1	B	2	2	2
227	385	.	.	.	12	F	2	2	2
227	385	.	.	.	30	G	2	2	2
227	387	.	.	.	26	B	2	2	1
227	387	.	.	.	30	G	2	2	1
227	387	.	.	.	30	G	2	2	2
228	386	.	.	.	8	F	2	2	2
228	386	.	.	.	12	F	2	2	1
228	386	.	.	.	21	B	2	2	1
228	386	.	.	.	26	B	2	2	1
229	387	.	.	.	30	G	2	2	2
231	385	.	.	.	26	B	2	2	1
232	386	.	.	.	1	B	2	2	2
232	386	.	.	.	13	B	2	2	2
232	386	.	.	.	30	G	2	2	2
232	390	.	.	.	2	B	2	2	2
232	390	.	.	.	15	L	2	2	1
232	390	.	.	.	23	B	2	2	2
49	66	.	.	.	15	L	2	2	2
84	152	.	.	.	31	B	2	2	2
84	154	.	.	.	8	F	2	2	2
84	156	.	.	.	30	G	2	2	2
84	158	.	.	.	8	F	2	2	1
84	158	.	.	.	30	G	2	2	2
85	151	.	.	.	3	D	2	2	2
85	163	.	.	.	8	F	2	2	1
88	158	.	.	.	14	G	2	2	2
88	158	.	.	.	15	L	2	2	1
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	31	B	2	2	2
88	158	.	.	.	37	J	2	2	2
89	159	.	.	.	8	F	2	2	1
89	159	.	.	.	21	B	2	2	1
89	159	.	.	.	22	O	2	2	2
89	159	.	.	.	22	O	2	2	2
91	157	.	.	.	6	B	2	2	2
91	157	.	.	.	8	F	2	2	2
96	176	.	.	.	15	L	2	2	2
96	176	.	.	.	22	O	2	2	2
96	180	.	.	.	2	B	2	2	2
96	180	.	.	.	6	B	2	2	2
96	180	.	.	.	22	O	2	2	2
96	180	.	.	.	33	I	2	2	2
98	178	.	.	.	40	G	2	2	1
99	175	.	.	.	2	B	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	15	L	2	2	1
99	175	.	.	.	15	L	2	2	2
99	175	.	.	.	22	O	2	2	2
99	175	.	.	.	30	G	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
99	175	.	.	.	33	I	2	2	1
142	189	.	.	.	8	F	2	2	2
142	189	.	.	.	31	B	2	2	2
144	191	.	.	.	2	B	2	2	2
144	191	.	.	.	8	F	2	2	2
144	191	.	.	.	12	F	2	2	2
146	256	.	.	.	15	L	2	2	1
148	210	.	.	.	2	B	2	2	2
148	212	.	.	.	12	F	2	2	2
149	209	.	.	.	30	G	2	2	2
149	211	.	.	.	15	L	2	2	2
149	211	.	.	.	39	G	2	2	2
149	213	.	.	.	15	L	2	2	1
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	15	L	2	2	1
150	208	.	.	.	15	L	2	2	2
150	210	.	.	.	12	F	2	2	2
150	210	.	.	.	22	O	2	2	2
49	66	.	.	.	15	L	2	2	2
84	152	.	.	.	31	B	2	2	2
84	154	.	.	.	8	F	2	2	2
84	156	.	.	.	30	G	2	2	2
84	158	.	.	.	8	F	2	2	1
84	158	.	.	.	30	G	2	2	2
85	151	.	.	.	3	D	2	2	2
85	163	.	.	.	8	F	2	2	1
88	158	.	.	.	14	G	2	2	2
88	158	.	.	.	15	L	2	2	1
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	22	O	2	2	2
88	158	.	.	.	31	B	2	2	2
88	158	.	.	.	37	J	2	2	2
89	159	.	.	.	8	F	2	2	1
89	159	.	.	.	21	B	2	2	1
89	159	.	.	.	22	O	2	2	2
89	159	.	.	.	22	O	2	2	2
91	157	.	.	.	6	B	2	2	2
91	157	.	.	.	8	F	2	2	2
96	176	.	.	.	15	L	2	2	2
96	176	.	.	.	22	O	2	2	2
96	180	.	.	.	2	B	2	2	2
96	180	.	.	.	6	B	2	2	2
96	180	.	.	.	22	O	2	2	2
96	180	.	.	.	33	I	2	2	2
98	178	.	.	.	40	G	2	2	1
99	175	.	.	.	2	B	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	12	F	2	2	2
99	175	.	.	.	15	L	2	2	1
99	175	.	.	.	15	L	2	2	2
99	175	.	.	.	22	O	2	2	2
99	175	.	.	.	30	G	2	2	2
99	175	.	.	.	33	I	2	2	1
142	189	.	.	.	8	F	2	2	2
142	189	.	.	.	31	B	2	2	2
144	191	.	.	.	2	B	2	2	2
144	191	.	.	.	8	F	2	2	2
144	191	.	.	.	12	F	2	2	2
146	256	.	.	.	15	L	2	2	1
148	210	.	.	.	2	B	2	2	2
148	212	.	.	.	12	F	2	2	2
149	209	.	.	.	30	G	2	2	2
149	211	.	.	.	15	L	2	2	2
149	211	.	.	.	39	G	2	2	2
149	213	.	.	.	15	L	2	2	1
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	8	F	2	2	2
149	257	.	.	.	15	L	2	2	1
150	208	.	.	.	15	L	2	2	2
150	210	.	.	.	12	F	2	2	2
150	210	.	.	.	22	O	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
189	324	.	.	.	6	B	2	2	2
189	324	.	.	.	28	G	2	2	1
215	287	.	.	.	8	F	2	2	2
215	290	.	.	.	30	G	2	2	1
150	212	.	.	.	30	G	2	2	2
151	233	.	.	.	30	G	2	2	2
151	233	.	.	.	31	B	2	2	2
152	210	.	.	.	8	F	2	2	1
152	214	.	.	.	12	F	2	2	2
153	207	.	.	.	2	B	2	2	1
153	207	.	.	.	2	B	2	2	2
153	207	.	.	.	15	L	2	2	1
153	209	.	.	.	8	F	2	2	2
153	209	.	.	.	8	F	2	2	2
153	209	.	.	.	12	F	2	2	2
153	211	.	.	.	12	F	2	2	2
153	211	.	.	.	12	F	2	2	2
153	213	.	.	.	15	L	2	2	1
153	215	.	.	.	1	B	2	2	1
153	215	.	.	.	15	L	2	2	2
154	204	.	.	.	31	B	2	2	2
154	206	.	.	.	30	G	2	2	2
154	208	.	.	.	12	F	2	2	2
154	208	.	.	.	13	B	2	2	2
154	210	.	.	.	3	D	2	2	2
154	210	.	.	.	15	L	2	2	2
154	210	.	.	.	22	O	2	2	2
154	210	.	.	.	30	G	2	2	2
154	214	.	.	.	2	B	2	2	2
154	214	.	.	.	26	B	2	2	1
154	214	.	.	.	28	G	2	2	2
154	216	.	.	.	17	B	2	2	1
155	207	.	.	.	15	L	2	2	2
155	210	.	.	.	26	B	2	2	2
155	211	.	.	.	34	I	2	2	2
155	211	.	.	.	38	B	2	2	2
155	213	.	.	.	1	B	2	2	1
155	213	.	.	.	15	L	2	2	1
155	213	.	.	.	31	B	2	2	2
155	215	.	.	.	15	L	2	2	2
155	215	.	.	.	39	G	2	2	1
156	287	1	.	.	15	L	2	2	2
161	284	.	.	.	14	G	2	2	2
161	288	.	.	.	1	B	2	2	1
161	288	.	.	.	8	F	2	2	1
161	288	.	.	.	12	F	2	2	2
165	284	.	.	.	8	F	2	2	1
165	284	.	.	.	13	B	2	2	2
166	281	.	.	.	8	F	2	2	2
166	281	.	.	.	10	B	2	2	2
167	243	.	.	.	15	L	2	2	2
167	243	.	.	.	23	B	2	2	2
167	243	.	.	.	30	G	2	2	2
167	243	.	.	.	30	G	2	2	2
167	249	.	.	.	22	O	2	2	2
167	282	.	.	.	12	F	2	2	2
167	282	.	.	.	30	G	2	2	2
167	284	.	.	.	8	F	2	2	2
168	181	.	.	.	15	L	2	2	2
168	248	.	.	.	8	F	2	2	1
208	376	.	.	.	15	L	2	2	2
225	381	.	.	.	2	B	2	2	2
225	381	.	.	.	22	O	2	2	1
225	381	.	.	.	22	O	2	2	2
225	381	.	.	.	22	O	2	2	2
225	385	.	.	.	13	B	2	2	2
228	384	.	.	.	2	B	2	2	1
228	384	.	.	.	13	B	2	2	1
228	384	.	.	.	21	B	2	2	1
228	384	.	.	.	26	B	2	2	1
228	384	.	.	.	27	J	2	2	1
231	385	.	.	.	22	O	2	2	2
231	385	.	.	.	30	G	2	2	2
231	385	.	.	.	30	G	2	2	2
231	385	.	.	.	34	I	2	2	2
232	385	.	.	.	30	G	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
31	183	.	.	.	45	N	2	2	2
53	68	.	.	.	8	F	2	2	2
55	60	.	.	.	12	F	2	2	2
55	60	.	.	.	14	G	2	2	2
55	60	.	.	.	15	L	2	2	2
55	60	.	.	.	30	G	2	2	2
60	147	.	.	.	37	J	2	2	2
80	176	.	.	.	8	F	2	2	1
80	176	.	.	.	15	L	2	2	2
80	178	.	.	.	30	G	2	2	1
80	182	.	.	.	21	B	2	2	1
80	182	.	.	.	23	B	2	2	2
80	190	.	.	.	12	F	2	2	1
81	177	.	.	.	30	G	2	2	2
81	181	.	.	.	31	B	2	2	2
82	180	.	.	.	12	F	2	2	2
82	183	.	.	.	7	E	2	2	2
82	183	.	.	.	17	B	2	2	2
82	183	.	.	.	28	G	2	2	1
83	183	.	.	.	10	B	2	2	2
83	187	.	.	.	8	F	2	2	2
83	187	.	.	.	22	O	2	2	1
83	187	.	.	.	22	O	2	2	2
84	157	.	.	.	12	F	2	1	1
84	186	.	.	.	30	G	2	2	1
84	186	.	.	.	36	O	2	2	2
84	188	.	.	.	2	B	2	2	2
84	188	.		.	2	B	2	2	2
84	188	.	.	.	2	B	2	2	2
84	188	.	.	.	8	F	2	2	2
84	188	.	.	.	8	F	2	2	2
84	188	.	.	.	8	F	2	2	2
84	188	.	.	.	11	B	2	2	2
84	188	.	.	.	15	L	2	2	2
86	186	.	.	.	2	B	2	2	2
86	186	.	.	.	8	F	2	2	2
86	186	.	.	.	22	O	2	2	2
86	186	.	.	.	33	I	2	2	2
87	185	.	.	.	15	L	2	2	2
87	185	.	.	.	23	B	2	2	2
87	187	.	.	.	8	F	2	2	2
87	187	.	.	.	12	F	2	2	1
87	187	.	.	.	15	L	2	2	2
87	187	.	.	.	21	B	2	2	2
87	187	.	.	.	30	G	2	2	2
87	189	.	.	.	6	B	2	2	2
87	189	.	.	.	33	I	2	2	1
88	186	.	.	.	12	F	2	2	2
88	186	.	.	.	19	C	2	2	2
88	186	.	.	.	30	G	2	2	2
88	186	.	.	.	30	G	2	2	2
89	185	.	.	.	12	F	2	2	2
89	185	.	.	.	15	L	2	2	2
89	185	.	.	.	30	G	2	2	2
89	185	.	.	.	40	G	2	2	2
89	187	.	.	.	6	B	2	2	2
89	187	.	.	.	11	B	2	2	2
89	187	.	.	.	12	F	2	2	2
89	187	.	.	.	12	F	2	2	2
89	187	.	.	.	21	B	2	2	2
89	187	.	.	.	33	[illegible]	2	2	2
99	177	.	.	.	1	B	2	2	1
99	177	.	.	.	2	B	2	2	1
99	177	.	.	.	5	[illegible]	2	2	2
99	177	.	.	.	8	F	2	2	2
99	177	.	.	.	8	F	2	2	2
99	177	.	.	.	8	F	2	2	2
99	177	.	.	.	8	F	2	2	2
99	177	.	.	.	14	G	2	2	2
99	177	.	.	.	15	L	2	2	1
99	177	.	.	.	15	L	2	2	2
99	177	.	.	.	15	L	2	2	2
99	177	.	.	.	15	L	2	2	2
99	177	.	.	.	22	O	2	2	2
99	177	.	.	.	22	O	2	2	2
99	177	.	.	.	22	O	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
99	177	.	.	.	22	O	2	2	2
99	177	.	.	.	22	O	2	2	2
99	177	.	.	.	22	O	2	2	2
99	177	.	.	.	23	B	2	2	2
99	177	.	.	.	28	G	2	2	2
99	177	.	.	.	28	G	2	2	2
99	177	.	.	.	31	B	2	2	1
101	175	.	.	.	21	B	2	2	2
101	175	.	.	.	22	O	2	2	2
101	175	.	.	.	30	G	2	2	2
102	160	.	.	.	13	B	2	2	2
102	160	.	.	.	22	O	2	2	1
102	164	.	.	.	38	B	2	2	2
102	170	.	.	.	5	H	2	2	1
102	172	.	.	.	12	F	2	2	2
102	172	.	.	.	12	F	2	2	2
102	172	.	.	.	12	F	2	2	2
102	172	.	.	.	13	B	2	2	2
102	172	.	.	.	22	O	2	2	2
102	172	.	.	.	30	G	2	2	2
102	174	.	.	.	6	B	2	2	2
102	174	.	.	.	8	F	2	2	2
102	174	.	.	.	8	F	2	2	2
102	174	.	.	.	15	L	2	1	2
102	174	.	.	.	15	L	2	2	2
102	174	.	.	.	15	L	2	2	2
102	174	.	.	.	22	O	2	2	2
102	174	.	.	.	22	O	2	2	2
102	174	.	.	.	23	B	2	2	1
102	174	.	.	.	23	B	2	2	1
102	174	.	.	.	30	G	2	2	2
102	174	.	.	.	30	G	2	2	2
102	174	.	.	.	31	B	2	2	2
102	176	.	.	.	17	B	2	2	2
102	176	.	.	.	22	O	2	2	1
102	176	.	.	.	22	O	2	2	2
102	176	.	.	.	22	O	2	2	2
102	176	.	.	.	22	O	2	2	2
102	176	.	.	.	28	G	2	2	2
102	176	.	.	.	28	G	2	2	2
104	166	.	.	.	2	B	2	2	1
104	166	.	.	.	15	L	2	2	2
104	166	.	.	.	22	O	2	2	2
104	166	.	.	.	31	B	2	2	1
104	166	.	.	.	35		2	2	1
106	172	.	.	.	15	L	2	2	1
106	172	.	.	.	15	L	2	2	2
106	172	.	.	.	22	O	2	2	2
106	174	.	.	.	5	H	2	2	1
106	176	.	.	.	16	M	2	2	1
106	178	.	.	.	31	B	2	2	2
106	178	.	.	.	31	B	2	2	2
107	163	.	.	.	6	B	2	2	2
107	163	.	.	.	8	F	2	2	2
107	163	.	.	.	23	B	2	2	2
107	163	.	.	.	30	G	2	2	2
107	171	.	.	.	23	B	2	2	2
107	242	.	.	.	8	F	2	2	2
108	164	.	.	.	13	B	2	2	2
108	164	.	.	.	21	B	2	2	1
108	164	.	.	.	39	G	2	2	2
109	161	.	.	.	13	B	2	2	2
110	164	.	.	.	30	G	2	2	2
111	167	.	.	.	6	B	2	2	1
111	167	.	.	.	22	O	2	2	2
111	167	.	.	.	22	O	2	2	2
147	192	.	.	.	31	B	2	2	2
147	233	.	.	.	23	B	2	2	2
147	233	.	.	.	31	B	2	2	2
147	243	.	.	.	12	F	2	2	2
147	243	.	.	.	30	G	2	2	2
149	211	.	.	.	8	F	2	2	1
149	237	.	.	.	31	B	2	2	1
149	251	.	.	.	13	B	2	2	2
149	251	.	.	.	23	B	2	2	2
150	232	.	.	.	8	F	2	2	1
150	232	.	.	.	8	F	2	2	1
150	232	.	.	.	30	G	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
150	248	.	.	.	30	G	2	2	2
150	248	.	.	.	30	G	2	2	2
150	252	.	.	.	2	B	2	2	1
151	211	.	.	.	30	G	2	2	2
151	211	.	.	.	30	G	2	2	2
151	211	.	.	.	31	B	2	2	2
151	237	.	.	.	15	L	2	2	2
151	253	.	.	.	16	M	2	2	2
151	253	.	.	.	21	B	2	2	1
151	255	.	.	.	8	F	2	2	2
151	255	.	.	.	12	F	2	2	2
152	210	.	.	.	2	B	2	2	2
152	210	.	.	.	12	F	2	2	2
152	210	.	.	.	15	L	2	2	2
152	210	.	.	.	31	B	2	2	2
152	232	.	.	.	30	G	2	2	2
152	254	.	.	.	31	B	2	2	2
153	213	.	.	.	2	B	2	2	2
153	213	.	.	.	15	L	2	2	2
153	213	.	.	.	22	O	2	2	2
153	233	.	.	.	30	G	2	2	2
153	251	.	.	.	6	B	2	2	2
153	251	.	.	.	8	F	2	2	1
153	255	.	.	.	31	B	2	2	2
153	338	.	.	.	30	G	2	2	2
154	210	.	.	.	8	F	2	2	1
154	210	.	.	.	12	F	2	2	2
154	210	.	.	.	15	L	2	2	2
154	212	.	.	.	8	F	2	2	1
154	212	.	.	.	15	L	2	2	2
154	214	.	.	.	8	F	2	2	2
154	214	.	.	.	8	F	2	2	2
154	214	.	.	.	8	F	2	2	2
154	214	.	.	.	15	L	2	2	2
154	214	.	.	.	34	I	2	2	2
154	254	.	.	.	30	G	2	2	2
155	210	.	.	.	15	L	2	2	2
155	211	.	.	.	12	F	2	2	2
155	211	.	.	.	14	G	2	2	2
155	211	.	.	.	22	O	2	2	2
155	215	.	.	.	8	F	2	2	2
155	215	.	.	.	15	L	2	2	2
155	215	.	.	.	30	G	2	2	2
155	215	.	.	.	30	G	2	2	2
155	215	.	.	.	30	G	2	2	2
155	215	.	.	.	30	G	2	2	2
155	215	.	.	.	30	G	2	2	2
155	215	.	.	.	31	B	2	2	2
156	234	.	.	.	12	F	2	2	2
156	234	.	.	.	12	F	2	2	2
157	227	.	.	.	21	B	2	2	1
159	281	.	.	.	2	B	2	2	2
159	281	.	.	.	5	H	2	2	2
159	281	.	.	.	22	O	2	2	2
159	284	.	.	.	15	L	2	2	2
159	284	.	.	.	22	O	2	2	2
159	284	.	.	.	22	O	2	2	2
173	249	.	.	.	12	F	2	2	2
173	249	.	.	.	22	O	2	2	2
180	117	.	.	.	29	J	2	1	1
180	332	.	.	.	12	F	2	2	2
180	332	.	.	.	33	I	2	2	2
181	322	.	.	.	12	F	2	2	1
181	322	.	.	.	30	G	2	2	1
183	322	.	.	.	22	O	2	2	2
184	323	.	.	.	.		2	2	1
184	323	.	.	.	12	F	2	2	2
186	320	.	.	.	19	C	2	2	2
191	322	.	.	.	22	O	2	2	2
191	322	.	.	.	22	O	2	2	2
195	322	.	.	.	12	F	2	2	2
195	322	.	.	.	14	G	2	2	2
195	322	.	.	.	21	B	2	2	1
195	322	.	.	.	21	B	2	2	1
195	322	.	.	.	28	G	2	2	2
207	328	.	.	.	12	F	2	2	2
207	331	.	.	.	12	F	2	2	2
207	331	.	.	.	14	G	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NO	FW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
[illegible]	189	.	.	.	8	F	2	2	2
81	189	.	.	.	30	G	2	2	2
82	184	.	.	.	15	L	2	2	2
[illegible]	188	.	.	.	8	F	2	2	2
83	185	.	.	.	12	F	2	2	2
83	185	.	.	.	12	F	2	2	2
83	185	.	.	.	14	G	2	2	1
[illegible]	185	.	.	.	30	G	2	2	2
84	184	.	.	.	8	F	2	2	2
84	184	.	.	.	30	G	2	2	2
85	185	.	.	.	8	F	2	2	2
[illegible]	185	.	.	.	8	F	2	2	2
85	185	.	.	.	12	F	2	2	2
85	[illegible]	.	.	.	12	F	2	2	2
[illegible]	188	.	.	.	2	B	2	2	2
[illegible]	188	.	.	.	22	O	2	2	2
[illegible]	[illegible]	.	.	.	40	G	2	2	2
88	[illegible]	.	.	.	40	G	2	2	2
[illegible]	[illegible]	.	.	.	32	I	2	2	2
[illegible]	[illegible]	.	.	.	12	F	2	2	2
[illegible]	[illegible]	.	.	.	12	F	2	2	2
[illegible]	[illegible]	.	.	.	12	F	2	2	2
[illegible]	[illegible]	.	.	.	15	L	2	2	2
[illegible]	[illegible]	.	.	.	15	L	2	2	2
[illegible]	[illegible]	.	.	.	3	F	2	2	2
[illegible]	[illegible]	.	.	.	31	B	2	2	2
[illegible]	173	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	8	F	2	2	2
105	173	.	.	.	12	F	2	2	2
105	[illegible]	.	.	.	15	L	2	2	2
[illegible]	[illegible]	.	.	.	21	B	2	2	1
[illegible]	164	.	.	.	12	F	2	2	1
143	141	.	.	.	8	F	2	2	2
143	239	.	.	.	6	B	2	2	2
143	239	.	.	.	21	B	2	2	2
145	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	19	C	2	2	2
[illegible]	236	.	.	.	19	C	2	2	2
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	31	B	2	2	1
[illegible]	[illegible]	.	.	.	23	B	2	2	2
[illegible]	[illegible]	.	.	.	43	G	2	2	2
[illegible]	[illegible]	.	.	.	30	G	2	2	2
[illegible]	[illegible]	.	.	.	38	B	2	2	2
[illegible]	[illegible]	.	.	.	1	B	2	2	1
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	2	B	2	2	2
152	236	.	.	.	30	G	2	2	1
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	1	B	2	2	1
[illegible]	[illegible]	.	.	.	2	B	2	2	2
[illegible]	[illegible]	.	.	.	12	F	2	2	1
[illegible]	[illegible]	.	.	.	23	B	2	2	2
[illegible]	[illegible]	.	.	.	10	B	2	2	2
[illegible]	[illegible]	.	.	.	31	B	2	2	2
[illegible]	[illegible]	.	.	.	22	O	2	2	1
[illegible]	253	.	.	.	33	I	2	2	1
[illegible]	[illegible]	.	.	.	19	C	2	2	2
183	321	.	.	.	30	G	2	2	2
[illegible]	321	.	.	.	31	B	2	2	1
[illegible]	324	.	.	.	8	F	2	2	2
184	[illegible]	.	.	.	2	B	2	2	2
184	325	.	.	.	10	B	2	2	2
186	[illegible]	.	.	.	6	F	2	2	2
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	15	L	2	2	2
[illegible]	[illegible]	.	.	.	21	B	2	2	2
[illegible]	320	.	.	.	30	G	2	2	2
[illegible]	[illegible]	.	.	.	30	G	2	2	2
190	[illegible]	.	.	.	21	B	2	2	2
190	323	.	.	.	41	G	2	2	2
190	325	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	8	F	2	2	2
[illegible]	[illegible]	.	.	.	10	B	2	2	2
[illegible]	[illegible]	.	.	.	22	O	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
190	325	.	.	.	40	G	2	2	2
190	327	.	.	.	8	F	2	2	2
191	321	.	.	.	22	O	2	2	2
191	324	.	.	.	2	B	2	2	1
191	324	.	.	.	8	F	2	2	2
191	326	.	.	.	30	G	2	2	2
192	327	.	.	.	30	G	2	2	2
193	321	.	.	.	22	O	2	2	2
193	321	.	.	.	41	G	2	2	2
194	320	.	.	.	26	B	2	2	1
194	325	.	.	.	6	B	2	2	2
194	325	.	.	.	8	F	2	2	1
194	325	.	.	.	8	F	2	2	1
195	322	.	.	.	1	B	2	2	1
195	322	.	.	.	41	G	2	2	2
196	327	.	.	.	8	F	2	2	2
196	327	.	.	.	8	F	2	2	2
.	.	.	.	.	22	O	2	2	2
46	66	1	9549	9539	8	F	2	2	2
46	66	1	9549	9539	30	G	2	2	2
46	66	4	9519	9509	8	F	2	2	1
59	159	.	.	.	28	G	2	2	2
63	161	.	.	.	31	B	2	2	2
81	174	2	.	.	9	J	2	1	1
81	174	2	.	.	17	B	2	2	2
81	174	2	.	.	40	G	2	2	2
81	174	4	.	.	8	F	2	2	2
81	174	4	.	.	8	F	2	2	2
82	174	6	.	.	5	H	2	2	2
82	174	6	.	.	12	F	2	2	2
82	174	10	.	.	10	B	2	2	2
82	174	12	.	.	22	O	2	2	2
96	174	4	.	.	1	B	2	2	2
96	174	4	.	.	8	F	2	2	2
96	178	.	.	.	2	B	2	2	2
96	178	.	.	.	9	J	2	2	1
96	178	.	.	.	12	F	2	2	2
96	178	.	.	.	12	F	2	2	2
96	178	.	.	.	13	B	2	2	2
96	178	.	.	.	15	L	2	2	2
96	178	.	.	.	15	L	2	2	2
96	178	.	.	.	26	B	2	2	2
96	178	.	.	.	30	G	2	2	2
97	175	.	.	.	1	B	2	2	2
97	175	.	.	.	8	F	2	2	2
97	175	.	.	.	8	F	2	2	2
97	175	.	.	.	9	J	2	2	2
97	175	.	.	.	15	L	2	2	2
97	175	.	.	.	30	G	2	2	2
97	175	.	.	.	30	G	2	2	2
97	177	.	.	.	2	B	2	2	2
97	177	.	.	.	6	B	2	2	2
97	177	.	.	.	8	F	2	2	2
97	177	.	.	.	8	F	2	2	2
97	177	.	.	.	8	F	2	2	2
97	177	.	.	.	8	F	2	2	2
97	177	.	.	.	8	F	2	2	2
97	177	.	.	.	12	F	2	2	1
97	177	.	.	.	12	F	2	2	2
97	177	.	.	.	12	F	2	2	2
97	177	.	.	.	12	F	2	2	2
97	177	.	.	.	12	F	2	2	2
97	177	.	.	.	12	F	2	2	2
97	177	.	.	.	15	L	2	2	1
97	177	.	.	.	15	L	2	2	2
97	177	.	.	.	15	L	2	2	2
97	177	.	.	.	22	O	2	2	1
97	177	.	.	.	23	B	2	2	2
97	177	.	.	.	23	B	2	2	2
97	177	.	.	.	28	G	2	2	2
97	177	.	.	.	28	G	2	2	2
97	177	.	.	.	30	G	2	2	2
97	177	.	.	.	30	G	2	2	2
97	177	.	.	.	31	B	2	2	2
97	177	.	.	.	38	B	2	2	2
98	176	.	.	.	8	F	2	2	1
98	176	.	.	.	8	F	2	2	2
98	176	.	.	.	12	F	2	2	2
98	176	.	.	.	15	L	2	2	2
98	176	.	.	.	31	B	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR [illegible]

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
99	177	.	.	.	2	B	2	[illegible]	2
99	177	.	.	.	8	F	2	2	2
99	177	.	.	.	14	G	2	2	2
99	177	.	.	.	28	G	[illegible]	2	[illegible]
99	177	.	.	.	33	I	2	2	2
101	171	.	.	.	22	O	2	2	.
101	171	.	.	.	31	B	2	2	.
102	168	.	.	.	10	B	2	2	1
102	168	.	.	.	12	F	2	2	2
102	168	.	.	.	13	B	2	2	2
102	168	.	.	.	13	B	2	2	2
102	168	.	.	.	15	L	2	[illegible]	2
102	168	.	.	.	15	L	2	2	2
102	168	.	.	.	31	B	2	2	2
102	170	.	.	.	13	B	2	2	1
102	170	.	.	.	22	O	2	2	2
102	170	.	.	.	22	O	2	2	2
102	170	.	.	.	28	G	2	2	2
102	170	.	.	.	30	G	2	[illegible]	[illegible]
103	165	.	.	.	2	B	2	2	2
103	165	.	.	.	12	F	2	.	2
103	165	.	.	.	23	B	2	2	2
103	171	.	.	.	1	B	2	2	1
106	160	.	.	.	30	G	2	2	2
107	165	.	.	.	1	L	2	.	.
107	165	.	.	.	8	F	2	2	
107	165	.	.	.	8	F	2	2	2
107	175	.	.	.	28	G	2	2	2
107	175	.	.	.	30	G	2	2	2
109	165	.	.	.	12	F	2	2	2
109	165	.	.	.	15	L	2	2	2
109	165	.	.	.	15	L	2	2	2
109	165	.	.	.	21	B	2	2	1
109	165	.	.	.	23	B	2	2	[illegible]
109	165	.	.	.	33	I	2	2	2
110	139	.	.	.	15	L	2	2	[illegible]
110	139	.	.	.	31	B	2	2	[illegible]
110	142	.	.	.	31	B	2	2	1
110	163	.	.	.	23	B	2	[illegible]	2
110	163	.	.	.	30	G	2	[illegible]	
110	163	.	.	.	30	G	2	2	
118	176	.	.	.	8	F	2	2	[illegible]
131	236	.	.	.	8	F	2	2	.
142	191	.	.	.	8	F	2	2	[illegible]
142	191	.	.	.	15	L	2	2	[illegible]
142	191	.	.	.	28	G	2	2	2
148	252	.	.	.	8	F	2	2	2
148	252	.	.	.	31	B	2	2	2
151	213	.	.	.	14	G	2	2	1
151	213	.	.	.	15	L	2	2	1
151	213	.	.	.	28	G	2	2	.
152	212	.	.	.	12	F	2	2	.
152	212	.	.	.	15	L	2	2	
152	212	.	.	.	15	L	2	2	2
152	212	.	.	.	15	L	2	[illegible]	2
152	212	.	.	.	22	O	2	.	.
152	212	.	.	.	30	G	2	2	
153	205	.	.	.	15	L	2	[illegible]	.
153	213	.	.	.	8	F	2	[illegible]	2
154	212	.	.	.	2	B	2	2	[illegible]
154	212	.	.	.	8	F	2	2	
154	212	.	.	.	30	G	2	2	2
156	257	1	.	.	8	F	2	2	[illegible]
156	287	1	.	.	30	G	2	2	2
160	163	.	.	.	[illegible]	F	2	2	
160	163	.	.	.	[illegible]	O	2	[illegible]	
161	284	.	.	.	1	B	2	[illegible]	.
161	284	.	.	.	1	B	2	[illegible]	.
161	284	.	.	.	8	F	[illegible]	[illegible]	[illegible]
161	284	.	.	.	9	J	[illegible]	2	[illegible]
161	284	.	.	.	15	L	2	2	.
166	230	.	.	.	30	G	2		2
166	232	.	.	.	14	G	2	.	.
166	240	.	.	.	[illegible]	[illegible]	[illegible]	[illegible]	
166	242	.	.	.	8	F	2	[illegible]	
166	242	.	.	.	[illegible]	[illegible]	[illegible]		
166	244	.	.	.	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	.							
[illegible]	[illegible]	.	.						
166	[illegible]	.	.	.					

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 102[illegible]

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	CONT	HEAT	CORTEX
166	248	.	.	.	8	F	2	2	1
166	248	.	.	.	31	B	2	2	2
167	239	.	.	.	30	G	2	2	2
167	245	.	.	.	8	F	2	2	2
167	247	.	.	.	12	F	2	2	2
167	247	.	.	.	15	L	2	2	2
168	244	.	.	.	22	O	2	2	2
168	244	.	.	.	28	G	2	2	2
168	250	.	.	.	8	F	2	2	2
173	247	.	.	.	15	L	2	2	1
181	324	.	.	.	2	B	2	2	2
181	324	.	.	.	41	G	2	2	2
182	323	.	.	.	12	F	2	2	2
182	323	.	.	.	16	M	2	2	2
182	323	.	.	.	21	B	2	2	1
189	326	.	.	.	2	B	2	2	2
189	326	.	.	.	8	F	2	2	1
193	326	.	.	.	6	F	2	2	2
193	326	.	.	.	8	F	2	2	2
207	314	.	.	.	15	L	2	2	2
12	183	.	.	.	15	L	2	2	1
34	166	.	.	.	15	L	2	2	2
34	166	.	.	.	22	O	2	2	2
49	70	.	.	.	8	F	2	2	2
54	55	.	.	.	2	B	2	1	1
59	165	.	.	.	3	D	2	2	2
59	165	.	.	.	3	D	2	2	2
59	165	.	.	.	12	F	2	2	1
59	165	.	.	.	13	B	2	2	2
59	165	.	.	.	32	I	2	2	2
81	184	.	.	.	1	B	2	2	2
81	184	.	.	.	12	F	2	2	1
81	184	.	.	.	31	B	2	2	2
84	157	.	.	.	12	F	2	2	2
84	157	.	.	.	28	G	2	2	2
84	179	.	.	.	12	F	2	2	1
84	179	.	.	.	12	F	2	2	1
84	179	.	.	.	12	F	2	2	2
84	179	.	.	.	15	L	2	2	2
84	179	.	.	.	21	B	2	2	2
84	179	.	.	.	22	O	2	2	2
84	179	.	.	.	22	O	2	2	2
84	179	.	.	.	28	G	2	2	2
84	179	.	.	.	28	G	2	2	2
84	179	.	.	.	33	I	2	2	2
86	158	.	.	.	15	L	2	2	2
87	156	.	.	.	16	M	2	2	1
87	156	.	.	.	33	I	2	2	1
87	159	.	.	.	6	B	2	2	2
87	159	.	.	.	12	F	2	2	1
87	159	.	.	.	12	F	2	2	2
87	159	.	.	.	12	F	2	2	2
87	159	.	.	.	12	F	2	2	2
87	159	.	.	.	28	G	2	2	2
87	159	.	.	.	28	G	2	2	2
87	159	.	.	.	30	G	2	2	2
87	159	.	.	.	31	B	2	2	2
87	162	.	.	.	8	F	2	2	2
87	162	.	.	.	22	O	2	2	2
87	162	.	.	.	22	O	2	2	2
92	82	.	.	.	21	B	2	1	1
92	158	.	.	.	12	F	2	2	2
92	158	.	.	.	22	O	2	2	2
101	171	.	.	.	8	F	2	2	2
101	171	.	.	.	11	B	2	2	2
101	171	.	.	.	12	F	2	2	1
101	171	.	.	.	12	F	2	2	2
101	171	.	.	.	14	G	2	2	2
101	171	.	.	.	22	O	2	2	2
102	162	.	.	.	11	B	2	2	1
103	161	.	.	.	8	F	2	2	2
103	161	.	.	.	30	G	2	2	2
103	163	.	.	.	8	F	2	2	2
103	163	.	.	.	13	B	2	2	2
103	163	.	.	.	22	O	2	2	2
103	163	.	.	.	31	B	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
147	253	.	.	.	31	B	2	2	1
148	208	.	.	.	6	B	2	2	2
149	239	.	.	.	8	F	2	2	2
150	212	.	.	.	15	L	2	2	2
152	236	.	.	.	31	B	2	2	1
152	254	.	.	.	8	F	2	2	2
153	211	.	.	.	12	F	2	2	1
154	206	.	.	.	34	I	2	2	1
154	256	.	.	.	1	B	2	2	1
154	256	.	.	.	31	B	2	2	1
155	213	.	.	.	15	L	2	2	2
156	238	.	.	.	31	B	2	2	1
162	281	.	.	.	12	F	2	2	2
163	278	.	.	.	31	B	2	2	1
165	180	.	.	.	19	C	2	2	2
172	240	.	.	.	22	O	2	2	2
172	240	.	.	.	30	G	2	2	1
172	242	.	.	.	2	B	2	2	2
172	242	.	.	.	8	F	2	2	2
172	242	.	.	.	10	B	2	2	1
172	242	.	.	.	26	B	2	2	2
173	249	.	.	.	17	B	2	2	2
182	325	.	.	.	12	F	2	2	2
186	320	.	.	.	22	O	2	2	2
208	362	.	.	.	28	G	2	2	2
208	366	.	.	.	27	J	2	2	1
226	384	.	.	.	1	B	2	2	1
225	384	.	.	.	8	F	2	2	2
226	384	.	.	.	22	O	2	2	1
226	386	.	.	.	30	G	2	2	2
227	385	.	.	.	1	B	2	2	2
227	385	.	.	.	12	F	2	2	2
227	385	.	.	.	30	G	2	2	2
227	387	.	.	.	26	B	2	2	1
227	387	.	.	.	30	G	2	2	1
227	387	.	.	.	30	G	2	2	2
228	386	.	.	.	8	F	2	2	2
228	386	.	.	.	12	F	2	2	1
228	386	.	.	.	21	B	2	2	1
228	386	.	.	.	26	B	2	2	1
229	387	.	.	.	30	G	2	2	2
231	385	.	.	.	26	B	2	2	1
232	386	.	.	.	1	B	2	2	2
232	386	.	.	.	13	B	2	2	2
232	386	.	.	.	30	G	2	2	2
232	390	.	.	.	2	B	2	2	2
232	390	.	.	.	15	L	2	2	1
232	390	.	.	.	23	B	2	2	2
107	161	.	.	.	8	F	2	2	2
110	130	.	.	.	22	O	2	2	2
110	136	.	.	.	15	L	2	2	1
110	136	.	.	.	32	I	2	2	2
110	154	.	.	.	12	F	2	2	2
110	154	.	.	.	12	F	2	2	2
110	154	.	.	.	15	L	2	2	2
110	154	.	.	.	24	P	2	2	2
110	154	.	.	.	30	G	2	2	2
110	154	.	.	.	31	B	2	2	2
110	157	.	.	.	31	B	2	2	2
110	160	.	.	.	12	F	2	2	2
110	160	.	.	.	13	B	2	2	2
110	160	.	.	.	15	L	2	2	2
110	165	.	.	.	12	F	2	2	2
110	172	.	.	.	10	B	2	2	1
110	172	.	.	.	17	B	2	2	2
110	172	.	.	.	30	G	2	2	2
110	200	.	.	.	8	F	2	2	1
110	200	.	.	.	12	F	2	2	1
118	152	.	.	.	31	B	2	2	1
118	161	.	.	.	33	I	2	2	2
118	182	.	.		28	G	2	2	2
124	160	.	.	.	12	F	2	2	2
124	163	.	.	.	12	F	2	2	1
124	163	.	.	.	31	B	2	2	2
124	183	.	.	.	2	B	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
130	240	.	.	.	1	B	2	2	2
130	246	.	.	.	8	F	2	2	2
130	246	.	.	.	22	O	2	2	2
131	239	.	.	.	22	O	2	2	2
131	246	.	.	.	8	F	2	2	1
131	246	.	.	.	13	B	2	2	1
131	246	.	.	.	15	L	2	2	2
132	246	.	.	.	6	B	2	2	2
132	246	.	.	.	11	B	2	2	2
132	246	.	.	.	23	B	2	2	2
132	246	.	.	.	30	G	2	2	2
132	247	.	.	.	1	B	2	2	1
132	247	.	.	.	8	F	2	2	2
132	247	.	.	.	26	B	2	2	2
133	243	.	.	.	22	O	2	2	2
133	243	.	.	.	32	I	2	2	1
133	245	.	.	.	8	F	2	2	2
133	245	.	.	.	8	F	2	2	2
133	245	.	.	.	22	O	2	2	2
135	237	.	.	.	5	H	2	2	2
135	237	.	.	.	15	L	2	2	1
135	237	.	.	.	15	L	2	2	1
135	237	.	.	.	21	B	2	2	1
135	237	.	.	.	30	G	2	2	1
135	245	.	.	.	6	B	2	1	2
135	245	.	.	.	28	G	2	2	2
135	245	.	.	.	30	G	2	2	1
137	247	.	.	.	13	B	2	2	2
137	247	.	.	.	22	O	2	2	1
137	247	.	.	.	30	G	2	2	2
138	238	.	.	.	1	B	2	2	2
138	238	.	.	.	22	O	2	2	2
139	235	.	.	.	30	G	2	2	2
139	239	.	.	.	8	F	2	2	1
139	239	.	.	.	12	F	2	2	2
139	239	.	.	.	13	B	2	2	1
139	239	.	.	.	22	O	2	2	2
143	237	.	.	.	30	G	2	2	1
146	234	.	.	.	17	B	2	2	1
146	234	.	.	.	31	B	2	2	2
147	188	.	.	.	12	F	2	2	2
147	188	.	.	.	22	O	2	2	2
153	207	.	.	.	31	B	2	2	2
153	210	.	.	.	8	F	2	2	1
153	210	.	.	.	15	L	2	2	1
153	216	.	.	.	8	F	2	2	2
153	216	.	.	.	8	F	2	2	2
153	216	.	.	.	15	L	2	2	2
153	216	.	.	.	26	B	2	2	1
155	209	1	.	.	15	L	2	2	2
160	216	.	.	.	30	G	2	2	2
164	330	.	.	.	8	F	2	2	1
165	242	.	.	.	2	B	2	2	2
165	242	.	.	.	6	B	2	2	2
166	330	.	.	.	8	F	2	2	2
168	246	.	.	.	12	F	2	2	2
168	246	.	.	.	13	B	2	2	1
168	328	.	.	.	22	O	2	2	2
168	328	.	.	.	22	O	2	2	2
168	328	.	.	.	23	B	2	2	1
170	238	.	.	.	13	B	2	2	2
170	248	.	.	.	12	F	2	2	2
170	328	.	.	.	28	G	2	2	2
170	330	.	.	.	1	B	2	2	1
170	330	.	.	.	8	F	2	2	2
170	330	.	.	.	28	G	2	2	2
170	332	.	.	.	27	J	2	2	1
171	239	.	.	.	12	F	2	2	2
171	239	.	.	.	15	L	2	2	1
171	239	.	.	.	28	G	2	2	2
171	329	.	.	.	12	F	2	2	1
171	329	.	.	.	15	L	2	2	1
172	246	.	.	.	8	F	2	2	2
172	246	.	.	.	8	F	2	2	2
172	246	.	.	.	13	B	2	2	1
172	246	.	.	.	28	G	2	2	2
172	246	.	.	.	31	B	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
172	330	.	.	.	2	B	2	2	1
172	330	.	.	.	23	B	2	2	2
172	330	.	.	.	28	C		2	2
172	330	.	.	.		B	2	2	2
175	329	.	.	.	26	B	2	2	2
195	325	.	.	.	15	L	2	2	2
195	325	.	.	.	17	B	2	2	.
195	325	.	.	.	27	J	2	2	.
32	186	.	.	.	5	H	2	.	.
32	186	.	.	.	8	F	2	2	2
32	186	.	.	.	31	B	2	2	1
33	177	.	.	.	6	B	2	2	.
51	66	.	.	.	8	F	2	2	2
51	66	.	.	.	10	B	2	2	2
51	66	.	.	.	14	G	2	2	2
51	66	.	.	.	15	L	2	2	2
51	66	.	.	.	28	G	2	2	1
54	57	.	.	.	22	O	2	.	2
54	57	.	.	.	22	O	2	2	2
54	63	.	.	.	2	B	2	2	1
54	63	.		.	9	J	2	2	2
54	63	.	.	.	12	F	2	2	2
54	63	.	.	.	15	L	2	2	2
55	64	.	.	.	8	F	2	2	2
55	64	.	.	.	15	L	2	2	2
55	64	.	.	.	31	B	2	2	2
55	64	.	.	.	31	B	2	2	2
56	65	.	.	.	22	O	2	2	1
56	65	.	.	.	22	O	2	2	2
56	65	.	.	.	22	O	2	2	2
56	65	.	.	.	31	B	2	2	2
56	65	.	.	.	32	I	2	2	2
61	163	.	.	.	23	B	2	2	1
61	163	.	.	.	28	G	2	2	2
69	163	.	.	.	1	B	2	2	1
75	174	.	.	.	2	B	2	2	2
75	174	.	.	.	8	F	2	2	2
75	177	.	.	.	1	B	2	2	
75	177	.	.	.	10	B	2	2	2
75	177	.	.	.	33	I	2	2	2
78	180	.	.	.	8	F	2	2	2
78	183	.	.	.	10	B	2	2	2
78	183	.	.	.	22	O	2	2	2
78	186	.	.	.	31	B	2	2	1
82	174	7	.	.	15	L	2	2	1
82	174	8	.	.	14	G	2	2	1
82	174	8	.	.	14	G	2	2	2
82	174	8	.	.	35		2	2	1
83	57	.	.	.	6	B	2	2	2
83	57	.	.	.	11	B	2	2	2
83	57	.	.	.	15	L	2	2	2
83	57	.	.	.	22	O	2	2	2
86	160	.	.	.	1	B	2	2	1
86	160	.	.	.	1	B	2	2	1
86	160	.	.	.	2	B	2	2	2
86	160	.	.	.	3	D	2	2	2
86	160	.	.	.	3	D	2	2	2
86	160	.	.	.	12	F	2	2	2
86	160	.	.	.	12	F	2	2	2
86	160	.	.	.	12	F	2	2	2
86	160	.	.	.	15	L	2	2	2
86	160	.	.	.	15	L	2	2	2
86	160	.	.	.	19	C	2	2	2
86	160	.	.	.	28	G	2	2	1
88	154	.	.	.	8	F	2	2	2
88	154	.	.	.	27	J	2	2	.
88	160	.	.	.	12	F	2	2	2
88	160	.	.	.	13	B	2	2	2
88	160	.	.	.	14	G	2	2	1
88	160	.	.	.	21	B	2	2	1
88	160	.	.	.	21	B	2	2	1
88	160	.	.	.	22	O	2	2	2
88	160	.	.	.	22	O	2	2	2
90	158	.	.	.	6	B	2	2	2
90	158	.	.	.	8	F	2	2	.
90	158	.	.	.	8	F	2	2	2
90	158	.	.	.	8	F	2	2	
[illegible]	[illegible]	.			[illegible]	F			

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
90	158	.	.	.	11	B	2	2	1
90	158	.	.	.	13	B	2	2	2
90	158	.	.	.	15	L	2	2	2
90	158	.	.	.	21	B	2	2	2
90	158	.	.	.	22	O	2	2	2
95	174	7	.	.	16	M	2	2	2
97	179	.	.	.	1	B	2	2	2
97	179	.	.	.	15	L	2	2	2
97	179	.	.	.	15	L	2	2	2
97	179	.	.	.	16	M	2	2	2
97	179	.	.	.	17	B	2	2	2
99	172	.	.	.	6	B	2	2	1
99	172	.	.	.	8	F	2	2	2
99	172	.	.	.	9	J	2	2	1
99	172	.	.	.	9	J	2	2	2
99	172	.	.	.	12	F	2	2	2
99	172	.	.	.	15	L	2	2	2
99	172	.	.	.	21	B	2	2	2
99	172	.	.	.	23	B	2	2	2
99	172	.	.	.	23	B	2	2	2
99	172	.	.	.	30	G	2	2	1
99	172	.	.	.	31	B	2	2	1
99	172	.	.	.	34	I	2	2	2
99	175	.	.	.	2	B	2	2	2
99	175	.	.	.	8	F	2	2	2
99	175	.	.	.	15	L	2	2	2
99	175	.	.	.	22	O	2	2	2
99	175	.	.	.	22	O	2	2	2
99	175	.	.	.	23	B	2	2	1
99	175	.	.	.	24	P	2	2	2
103	173	.	.	.	1	B	2	2	1
103	173	.	.	.	1	B	2	2	1
103	173	.	.	.	1	B	2	2	1
103	173	.	.	.	14	G	2	2	2
103	173	.	.	.	21	B	2	2	1
103	173	.	.	.	22	O	2	2	1
103	173	.	.	.	29	J	2	2	2
103	173	.	.	.	31	B	2	2	2
103	173	.	.	.	31	B	2	2	2
103	175	.	.	.	1	B	2	2	1
103	175	.	.	.	1	B	2	2	2
103	175	.	.	.	1	B	2	2	2
103	175	.	.	.	8	F	2	2	2
103	175	.	.	.	8	F	2	2	2
103	175	.	.	.	9	J	2	2	2
103	175	.	.	.	12	F	2	2	2
103	175	.	.	.	12	F	2	2	2
103	175	.	.	.	13	B	2	2	2
104	162	.	.	.	1	B	2	2	1
104	162	.	.	.	31	B	2	2	1
104	164	.	.	.	2	B	2	2	2
104	164	.	.	.	10	B	2	2	2
104	164	.	.	.	15	L	2	2	2
104	174	.	.	.	22	O	2	2	2
104	176	.	.	.	8	F	2	2	2
104	176	.	.	.	11	B	2	2	2
104	176	.	.	.	31	B	2	2	1
104	176	.	.	.	31	B	2	2	2
105	161	.	.	.	8	F	2	2	2
105	161	.	.	.	15	L	2	1	1
105	163	.	.	.	6	B	2	2	2
105	163	.	.	.	13	B	2	2	1
105	163	.	.	.	26	B	2	2	1
105	163	.	.	.	33	I	2	2	2
105	165	.	.	.	2	B	2	2	2
105	165	.	.	.	8	F	2	2	2
105	165	.	.	.	22	O	2	2	2
105	165	.	.	.	30	G	2	2	2
105	165	.	.	.	33	I	2	2	2
105	165	.	.	.	40	G	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
105	169	.	.	.	8	F	2	2	2
105	169	.	.	.	15	L	2	2	2
130	238	.	.	.	8	F	2	2	2
130	245	.	.	.	9	J	2	2	2
130	245	.	.	.	11	B	2	2	2
130	245	.	.	.	13	B	2	2	2
130	245	.	.	.	15	L	2	2	2
132	238	.	.	.	7	E	2	2	1
132	244	.	.	.	8	F	2	2	2
132	244	.	.	.	15	L	2	2	2
133	237	.	.	.	28	G	2	2	2
136	246	.	.	.	8	F	2	2	2
136	246	.	.	.	11	B	2	2	2
136	246	.	.	.	15	L	2	2	2
138	236	.	.	.	1	B	2	2	1
138	236	.	.	.	28	G	2	2	2
138	240	.	.	.	12	F	2	2	1
138	240	.	.	.	12	F	2	2	2
138	240	.	.	.	12	F	2	2	2
138	240	.	.	.	19	C	2	2	2
139	237	.	.	.	19	C	2	2	1
139	237	.	.	.	22	O	2	2	2
140	236	.	.	.	12	F	2	2	2
140	236	.	.	.	16	M	2	2	1
144	187	.	.	.	2	B	2	2	2
144	187	.	.	.	6	B	2	2	1
144	187	.	.	.	41	G	2	1	1
145	186	.	.	.	8	F	2	2	2
145	186	.	.	.	30	G	2	2	2
145	188	.	.	.	12	F	2	2	2
145	188	.	.	.	15	L	2	2	2
145	188	.	.	.	16	M	2	2	2
146	187	.	.	.	15	L	2	2	1
146	187	.	.	.	15	L	2	2	1
152	208	.	.	.	6	B	2	2	1
152	208	.	.	.	22	O	2	2	2
154	228	.	.	.	[illegible]	B	2	2	2
154	228	.	.	.	30	G	2	2	2
155	227	.	.	.	31	B	2	2	2
155	287	4	.	.	42	B	2	2	1
162	279	.	.	.	31	B	2	2	2
164	183	.	.	.	31	B	2	2	2
165	281	.	.	.	8	F	2	2	1
165	281	.	.	.	28	G	2	2	2
165	329	.	.	.	33	I	2	2	2
166	175	.	.	.	18	A	2	2	1
166	175	.	.	.	23	B	2	2	1
167	176	.	.	.	32	I	2	2	2
168	326	.	.	.	30	G	2	2	2
169	239	.	.	.	8	F	2	2	2
169	239	.	.	.	30	G	2	2	2
169	241	.	.	.	12	F	2	2	1
169	241	.	.	.	15	L	2	2	2
169	241	.	.	.	30	G	2	2	2
169	241	.	.	.	30	G	2	2	2
169	243	.	.	.	28	G	2	2	2
169	247	.	.	.	5	H	2	2	2
169	247	.	.	.	5	H	2	2	2
169	329	.	.	.	8	F	2	2	2
169	329	.	.	.	8	F	2	2	2
170	240	.	.	.	10	B	2	2	2
170	240	.	.	.	22	O	2	2	2
170	240	.	.	.	31	B	2	2	2
171	241	.	.	.	30	G	2	2	1
171	243	.	.	.	6	B	2	2	2
171	243	.	.	.	11	B	2	2	2
171	243	.	.	.	15	L	2	2	1
171	243	.	.	.	15	L	2	2	2
171	243	.	.	.	30	G	2	2	1
171	243	.	.	.	30	G	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
171	247	.	.	.	2	B	2	2	1
171	247	.	.	.	2	B	2	2	1
171	247	.	.	.	8	F	2	2	2
171	247	.	.	.	15	L	2	2	1
171	247	.	.	.	19	C	2	2	1
171	247	.	.	.	33	I	2	2	2
171	249	.	.	.	6	B	2	2	2
171	249	.	.	.	12	F	2	2	2
171	249	.	.	.	30	G	2	2	2
171	331	.	.	.	12	F	2	2	2
172	332	.	.	.	12	F	2	2	2
172	332	.	.	.	15	L	2	2	2
172	332	.	.	.	31	B	2	2	2
192	323	.	.	.	8	F	2	2	2
.	.	.	.	.	22	O	2	2	2
.	.	.	.	.	33	I	2	2	1
.	.	4	.	.	22	O	2	2	1
.	.	6	.	.	30	G	2	2	2
31	181	.	.	.	8	F	2	2	2
31	181	.	.	.	33	I	2	2	2
31	189	.	.	.	15	L	2	2	1
31	189	.	.	.	31	B	2	2	2
33	183	.	.	.	12	F	2	2	2
33	191	.	.	.	1	B	2	2	2
33	191	.	.	.	1	B	2	2	2
45	66	.	.	.	1	B	2	2	2
45	66	.	.	.	8	F	2	2	1
45	66	.	.	.	15	L	2	2	2
45	66	2	9539	9529	30	G	2	2	2
45	66	4	9509	9499	9	J	2	2	1
45	66	4	9549	9539	14	G	2	2	1
46	66	3	9529	9519	15	L	2	2	2
46	66	4	9509	9499	12	F	2	2	2
49	68	.	.	.	8	F	2	2	1
51	68	.	.	.	11	B	2	2	2
51	68	.	.	.	30	G	2	2	2
52	59	.	.	.	2	B	2	1	1
52	59	.	.	.	8	F	2	2	2
52	59	.	.	.	14	G	2	2	2
52	59	.	.	.	19	C	2	2	2
52	59	.	.	.	19	C	2	2	2
52	63	.	.	.	6	B	2	2	2
52	63	.	.	.	8	F	2	2	2
52	63	.	.	.	10	B	2	2	2
52	63	.	.	.	15	L	2	2	1
53	58	.	.	.	1	B	2	2	1
53	58	.	.	.	5	H	2	2	2
53	58	.	.	.	8	F	2	2	1
53	58	.	.	.	13	B	2	2	2
53	60	.	.	.	5	H	2	2	2
53	60	.	.	.	12	F	2	2	1
53	60	.	.	.	15	L	2	2	2
53	60	.	.	.	21	B	2	2	2
53	60	.	.	.	30	G	2	2	2
53	60	.	.	.	30	G	2	2	2
53	64	.	.	.	10	B	2	2	2
53	64	.	.	.	22	O	2	2	2
54	61	.	.	.	12	F	2	2	2
55	56	.	.	.	2	B	2	2	2
55	56	.	.	.	5	H	2	2	2
55	58	.	.	.	8	F	2	2	2
55	58	.	.	.	15	L	2	2	2
55	58	.	.	.	15	L	2	2	2
55	58	.	.	.	32	I	2	2	2
55	58	.	.	.	33	I	2	2	1
56	59	.	.	.	22	O	2	2	2
59	169	.	.	.	11	B	2	2	2
64	162	.	.	.	2	B	2	2	1
64	162	.	.	.	33	I	2	2	2
71	163	.	.	.	23	B	2	2	2

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
192	323	.	.	.	15	L	2	2	2
192	323	.	.	.	22	O	2	2	2
229	383	.	.	.	21	B	2	2	1
85	153	.	.	.	16	M	2	2	2
86	154	.	.	.	15	L	2	2	1
86	154	.	.	.	21	B	2	2	1
88	158	.	.	.	2	B	2	2	1
88	158	.	.	.	8	F	2	2	2
88	158	.	.	.	9	J	2	2	2
88	158	.	.	.	22	O	2	2	1
88	158	.	.	.	23	B	2	2	1
98	176	.	.	.	1	B	2	2	1
98	176	.	.	.	8	F	2	2	2
98	176	.	.	.	15	L	2	2	2
98	176	.	.	.	15	L	2	2	2
98	176	.	.	.	15	L	2	2	2
98	176	.	.	.	15	L	2	2	2
98	176	.	.	.	17	B	2	2	2
98	176	.	.	.	22	O	2	2	2
98	176	.	.	.	22	O	2	2	2
98	178	.	.	.	8	F	2	2	2
98	178	.	.	.	21	B	2	2	2
101	163	.	.	.	14	G	2	2	2
103	167	.	.	.	2	B	2	2	1
103	167	.	.	.	8	F	2	2	1
103	167	.	.	.	41	G	2	2	2
105	197	.	.	.	8	F	2	2	1
105	197	.	.	.	15	L	2	2	2
106	162	.	.	.	8	F	2	2	2
106	162	.	.	.	17	B	2	2	2
106	162	.	.	.	22	O	2	2	2
106	166	.	.	.	33	I	2	2	1
109	163	.	.	.	28	G	2	2	2
109	163	.	.	.	31	B	2	2	1
143	192	.	.	.	2	B	2	2	1
143	192	.	.	.	15	L	2	2	1
143	192	.	.	.	15	L	2	2	2
144	189	.	.	.	8	F	2	2	2
144	189	.	.	.	24	P	2	2	2
144	189	.	.	.	30	G	2	2	2
146	189	.	.	.	15	L	2	2	1
146	189	.	.	.	21	B	2	2	2
146	191	.	.	.	8	F	2	2	1
146	191	.	.	.	15	L	2	2	2
148	189	.	.	.	11	B	2	2	2
148	189	.	.	.	21	B	2	2	2
148	189	.	.	.	22	O	2	2	2
148	191	.	.	.	30	G	2	2	1
150	189	.	.	.	2	B	2	2	2
151	190	.	.	.	15	L	2	2	1
151	211	.	.	.	2	B	2	2	1
151	211	.	.	.	21	B	2	1	1
151	211	.	.	.	21	B	2	2	2
151	211	.	.	.	30	G	2	2	2
152	212	.	.	.	8	F	2	2	2
152	212	.	.	.	8	F	2	2	2
152	212	.	.	.	8	F	2	2	2
152	232	.	.	.	14	G	2	2	2
152	232	.	.	.	30	G	2	2	1
153	190	.	.	.	2	B	2	2	2
153	190	.	.	.	8	F	2	2	2
153	190	.	.	.	33	I	2	2	2
153	211	.	.	.	17	B	2	2	2
154	295	.	.	.	14	G	2	2	1
155	209	.	.	.	22	O	2	2	2
155	209	2	.	.	15	L	2	2	2
155	209	4	.	.	8	F	2	2	1
155	209	4	.	.	12	F	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	FW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
155	287	1	.	.	1	B	2	2	1
155	287	1	.	.	8	F	2	2	2
155	287	1	.	.	8	F	2	.	2
156	236	2	.	.	1	B	2	2	1
159	287	.	.	.	8	F	2	2	1
159	287	.	.	.	14	G	2	2	1
159	287	.	.	.	21	B	2	2	1
160	281	.	.	.	28	G	2	2	2
160	283	.	.	.	17	B	2	2	2
160	283	.	.	.	22	O	2	2	2
160	283	.	.	.	30	G	2	2	2
160	285	.	.	.	17	B	2	2	2
160	285	.	.	.	33	I	2	2	2
160	289	.	.	.	2	B	2	2	1
161	280	.	.	.	22	O	2	2	2
161	280	.	.	.	32	I	2	2	2
161	286	.	.	.	2	B	2	2	1
161	286	.	.	.	8	F	2	2	2
161	286	.	.	.	10	B	2	2	2
161	286	.	.	.	21	B	2	2	1
161	286	.	.	.	21	B	2	2	1
162	275	.	.	.	31	B	2	2	1
162	279	.	.	.	8	F	2	2	2
162	279	.	.	.	11	B	2	2	1
162	279	.	.	.	22	O	2	2	2
162	279	.	.	.	28	G	2	2	2
162	281	.	.	.	30	G	2	2	2
162	283	.	.	.	14	G	2	2	2
162	285	.	.	.	15	L	2	2	2
162	287	.	.	.	31	B	2	2	2
162	381	.	.	.	8	F	2	2	2
162	381	.	.	.	30	G	2	2	2
163	184	.	.	.	14	G	2	2	2
163	280	.	.	.	7	E	2	2	1
163	280	.	.	.	8	F	2	2	2
163	280	.	.	.	12	F	2	2	2
163	282	.	.	.	32	I	2	2	2
163	284	.	.	.	21	B	2	2	1
163	286	.	.	.	1	B	2	2	1
163	286	.	.	.	8	F	2	2	2
163	288	.	.	.	22	O	2	2	2
163	288	.	.	.	30	G	2	2	2
163	290	.	.	.	2	B	2	2	1
163	290	.	.	.	8	F	2	2	2
163	290	.	.	.	30	G	2	2	2
164	181	.	.	.	22	O	2	2	2
164	277	.	.	.	21	B	2	2	1
166	295	.	.	.	22	O	2	2	1
166	297	.	.	.	15	L	2	2	2
166	297	.	.	.	16	M	2	2	2
167	182	.	.	.	8	F	2	2	2
167	182	.	.	.	11	B	2	2	2
167	182	.	.	.	30	G	2	2	2
167	245	.	.	.	8	F	2	2	1
167	247	.	.	.	8	F	2	2	2
167	247	.	.	.	15	L	2	2	1
167	247	.	.	.	31	B	2	2	2
167	292	.	.	.	21	B	2	2	2
167	292	.	.	.	30	G	2	2	1
167	294	.	.	.	13	B	2	2	2
168	183	.	.	.	33	I	2	2	2
169	182	.	.	.	1	B	2	2	1
169	182	.	.	.	10	B	2	2	2
169	182	.	.	.	23	B	2	2	2
169	247	.	.	.	31	B	2	2	2
169	294	.	.	.	11	B	2	2	2
171	245	.	.	.	1	B	2	2	1
172	242	.	.	.	2	B	2	2	1
172	242	.	.	.	15	L	2	2	2
172	242	.	.	.	19	C	2	2	2
188	247	.	.	.	32	I	2	2	1

Table A3.8 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10230

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
164	279	.	.	.	28	G	2	2	2
164	279	.	.	.	31	B	2	2	2
164	281	.	.	.	31	B	2	2	2
164	283	.	.	.	8	F	2	2	1
164	283	.	.	.	12	F	2	2	2
164	283	.	.	.	22	O	2	2	2
164	287	.	.	.	12	F	2	2	2
164	287	.	.	.	30	G	2	2	2
164	289	.	.	.	1	B	2	2	1
164	289	.	.	.	21	B	2	2	1
164	295	.	.	.	6	B	2	2	1
164	295	.	.	.	8	F	2	2	2
164	295	.	.	.	14	G	2	2	1
165	245	.	.	.	8	F	2	2	2
165	280	.	.	.	11	B	2	2	2
165	282	.	.	.	15	L	2	2	1
165	282	.	.	.	15	L	2	2	2
165	282	.	.	.	16	M	2	2	2
165	286	.	.	.	12	F	2	2	2
165	290	.	.	.	22	O	2	2	2
165	290	.	.	.	23	B	2	2	1
165	292	.	.	.	13	B	2	2	2
165	292	.	.	.	22	O	2	2	2
165	294	.	.	.	6	B	2	2	2
165	294	.	.	.	19	C	2	2	1
165	296	.	.	.	26	B	2	2	1
165	296	.	.	.	30	G	2	2	2
165	354	.	.	.	21	B	2	2	1
166	283	.	.	.	22	O	2	2	2
166	293	.	.	.	6	B	2	2	2
166	293	.	.	.	10	B	2	2	1
166	295	.	.	.	8	F	2	2	1

Table A3.9

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10418

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
29	39	2	.	.	11	B	3	2	1
80	131	2	10030	10020	41	G	2	2	2
82	126	0	0	0	19	C	2	2	1
83	141	3	10071	10061	35		2	2	2
83	141	4	10061	10051	29	J	2	2	1
85	128	0	0	0	22	O	2	2	2
85	140	3	10071	10061	2	B	2	2	1
85	140	3	10071	10061	8	F	3	2	1
85	140	5	10051	10041	31	B	2	2	1
85	141	2	10076	10071	35		2	2	2
85	141	3	10071	10061	2	B	2	2	1
85	141	3	10071	10061	8	F	2	2	2
86	140	4	10041	10031	14	G	2	2	1
86	140	4	10041	10031	14	G	2	2	2
86	140	4	10041	10031	25	K	2	2	1
86	141	3	10071	10061	21	B	2	2	1
86	141	3	10071	10061	26	B	3	2	1
86	141	4	10061	10051	2	B	2	2	2
86	141	5	10051	10041	2	B	2	2	1
86	141	5	10051	10041	2	B	2	2	1
86	141	5	10051	10041	2	B	3	2	2
86	176	2	10095	10085	1	B	2	2	1
87	140	4	10061	10051	35		2	2	1
87	141	4	10061	10051	35		2	2	2
87	141	4	10061	10051	35		2	2	2
87	176	2	10095	10085	15	L	2	2	2
87	176	2	10095	10085	26	B	3	2	2
87	177	1	10100	10095	2	B	2	2	2
87	177	1	10100	10095	21	B	3	2	1
88	18	0	0	0	31	B	3	2	2
88	173	0	0	0	22	O	2	2	2
88	176	2	10100	10090	31	B	2	2	2
88	176	3	10090	10080	30	G	2	2	1
89	173	1	10112	10100	9	J	3	2	1
89	173	1	10112	10100	12	F	2	2	2
89	173	1	10112	10100	12	F	2	2	2
89	176	1	10114	10100	8	F	2	2	2
89	176	1	10114	10100	8	F	3	2	1
89	176	1	10114	10100	12	F	2	2	1
89	177	2	10100	10092	12	F	3	2	2
89	177	3	10090	10080	22	O	2	2	2
90	179	1	10123	10013	12	F	2	2	1
90	179	4	10093	10083	15	L	2	2	2
90	179	4	10093	10083	38	B	3	2	2
91	176	2	10103	10093	11	B	3	2	1
91	176	4	10093	10083	22	O	3	2	2
91	180	3	10103	10093	38	B	3	2	2
93	112	3	.	.	8	F	2	2	2
93	112	3	.	.	38	B	2	2	1
93	113	3	10021	10011	13	B	3	2	1
93	113	3	10021	10011	14	G	2	2	1
95	110	3	10017	10007	8	F	2	2	2
95	112	6	.	.	30	G	2	2	2
96	86	1	9934	9930	2	B	2	2	2
96	110	1	10029	10027	15	L	2	2	2
96	110	1	10029	10027	15	L	3	2	2

Table A3.9 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10418

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
96	110	1	10029	10027	31	B	2	2	2
96	110	1	10029	10027	31	B	2	2	2
96	110	2	10027	10017	14	G	2	2	2
96	110	2	10027	10017	30	G	2	2	2
96	110	4	10007	9997	22	O	2	2	1
96	111	2	10027	10017	21	B	2	2	2
96	111	2	10027	10017	21	B	2	2	2
96	111	2	10027	10017	31	B	2	2	2
96	111	2	10027	10017	31	B	3	2	1
96	113	4	10026	10016	2	B	3	2	2
96	113	4	10026	10016	30	G	2	2	2
96	113	4	10026	10016	31	B	2	2	2
97	113	4	10022	10012	22	O	3	2	2
97	117	2	10051	10041	13	B		2	1
98	112	2	10042	10032	8	F	.	2	1
98	113	3	10032	10022	2	B	3	2	1
98	113	3	10032	10022	45	N	3	2	2
99	117	1	10062	10051	15	L	2	2	1
100	86	1	9950	9949	8	F	2	2	1
100	86	1	9950	9949	28	G	2	2	1
100	87	1	9955	9952	12	F	3	2	2
100	87	1	9955	9952	15	L	3	2	1
100	87	1	9955	9952	33	I	2	2	2
100	87	2	9952	9944	8	F	3	2	1
100	87	2	9952	9944	12	F	3	2	2
100	87	4	9934	9924	38	B	2	2	2
100	113	1	.	.	10	B	2	2	2
100	113	1	.	.	15	L	2	2	2
100	114	2	.	.	8	F	3	2	1
100	115	5	10020	10010	15	L	2	2	2
100	115	6	10037	10027	22	O	2	2	2
100	115	6	10037	10027	22	O	2	2	2
100	119	6	10037	10027	8	F	2	2	2
100	144	2	.	.	8	F	2	2	2
100	145	1	10098	10091	8	F	2	2	2
100	145	1	10098	10091	8	F	3	2	2
100	145	1	10098	10091	26	B	2	2	2
101	51	0	0	0	8	F	3	2	1
101	86	1	9952	9942	12	F	2	2	2
101	86	3	9944	9934	22	O	3	2	1
101	87	1	9956	9954	15	L	2	2	2
101	87	2	9954	9944	15	L	3	2	1
101	87	2	9954	9944	32	I	2	2	1
101	87	3	9944	9932	11	B	3	2	2
101	144	1	10103	10091	22	O	3	2	2
101	145	1	10103	10091	21	B	3	2	1
101	145	2	9991	9979	8	F	2	2	2
102	86	2	9950	9940	31	B	2	2	2
102	86	2	9950	9940	31	B	3	2	2
102	86	2	9950	9940	31	B	3	2	2
102	86	2	9950	9940	33	I	2	2	1
102	87	2	9953	9943	12	F	2	2	1
103	86	2	9958	9944	22	O	3	2	1
103	86	2	9958	9944	22	O	3	2	2
103	86	2	9958	9944	31	B	3	2	1
103	86	2	9958	9944	31	B	3	2	2

Table A3.9 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10418

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
103	87	2	9947	9914	31	B	3	2	2
103	112	1	10059	10039	8	F	2	2	2
103	112	2	10039	10033	22	O	2	2	2
103	114	2	10046	10036	30	G	2	2	2
103	114	2	10046	10036	45	N	2	2	2
103	115	4	10026	10016	36	O	2	2	2
103	120	1	10080	10076	26	B	2	2	1
103	120	1	10080	10076	31	B	2	2	2
103	120	2	10076	10067	15	L	3	2	2
103	120	7	10026	10016	2	B	2	2	2
103	121	1	10086	10078	22	O	3	2	2
103	122	6	10047	10037	22	O	2	2	2
103	123	1	10082	10072	12	F	3	2	1
103	123	3	10077	10067	31	B	3	2	1
103	123	5	10057	10047	8	F	3	2	2
103	123	5	10057	10047	22	O	3	2	2
103	170	3	10115	10105	30	G	2	2	2
104	86	0	0	0	31	B	3	2	1
104	88	0	0	0	15	L	3	2	2
104	112	3	10053	10043	12	F	2	2	2
104	113	6	10010	10000	11	B	2	2	2
104	114	3	10036	10026	8	F	3	2	1
104	114	3	10036	10026	12	F	2	2	2
104	114	3	10036	10026	26	B	3	2	1
104	114	5	10016	10006	38	B	3	2	1
104	115	1	.	.	15	L	3	2	1
104	115	3	10036	10026	12	F	3	2	2
104	120	3	10067	10057	21	B	2	2	1
104	120	7	10026	10016	26	B	3	2	1
104	121	1	10087	10079	45	N	3	2	2
104	121	2	10079	10067	10	B	3	2	2
104	121	6	10037	10027	8	F	2	2	2
104	145	3	10079	10069	8	F	2	2	2
105	112	0	0	0	33	I	2	2	2
105	112	2	10039	10029	30	G	2	2	2
105	113	3	10037	10027	6	B	2	2	2
105	114	4	10030	10020	1	B	3	2	2
105	115	0	0	0	17	B	3	2	2
105	115	1	10010	10000	32	I	3	2	2
105	117	7	10006	9996	22	O	2	2	2
105	119	4	10045	10035	22	O	2	2	2
105	122	6	10052	10042	15	L	2	2	2
105	122	6	10052	10042	31	B	2	2	2
105	122	7	10032	10022	13	B	2	2	2
105	122	7	10032	10022	15	L	2	2	2
105	122	7	10032	10022	15	L	3	2	1
105	122	7	10032	10022	26	B	2	2	1
105	123	7	10039	10029	8	F	2	2	2
105	124	3	10077	10067	8	F	2	2	2
105	124	3	10077	10067	8	F	3	2	1
105	124	3	10077	10067	22	O	2	2	2
105	125	4	10057	10047	13	B	2	2	2
105	125	4	10057	10047	15	L	3	2	2
105	167	2	10119	10114	38	B	2	2	2
106	113	1	10058	10048	8	F	2	2	2
106	113	3	10039	10029	11	B	3	2	2

Table A3.9 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10418

NS	FW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
106	117	6	10016	10006	30	G	3	2	2
106	119	4	10045	10035	22	O	3	2	2
106	119	4	10045	10035	33	I	2	2	2
106	120	5	10030	10020	8	F	2	2	2
106	122	4	10072	10062	23	B	2	2	2
106	122	5	10059	10049	17	B	3	2	1
106	122	5	10059	10049	23	B	3	2	1
106	122	5	10059	10049	31	B	2	2	1
106	123	4	10062	10052	11	B	2	2	1
106	123	5	10052	10042	8	F	2	2	2
106	123	5	10052	10042	22	O	2	2	2
106	123	5	10052	10042	22	O	3	2	2
106	125	2	10087	10077	35		2	2	2
106	125	5	10057	10047	8	F	2	2	1
106	125	5	10057	10047	38	B	2	2	2
106	125	7	10032	10022	30	G	2	2	1
106	156	3	10101	10091	37	J	2	2	1
106	158	2	10124	10114	17	B	2	2	2
106	168	3	.	.	15	L	3	2	1
106	169	4	10104	10094	15	L	2	2	2
106	226	1	10185	10175	1	B	3	2	1
106	226	1	10185	10175	21	B	2	2	2
107	113	3	10042	10032	8	F	2	2	1
107	116	2	10057	10048	8	F	2	2	1
107	116	2	10057	10048	31	B	2	2	1
107	118	3	10056	10046	22	O	3	2	1
107	120	2	10079	10066	23	B	3	2	1
107	120	2	10079	10066	26	B	3	2	1
107	121	0	0	0	11	B	3	2	1
107	127	2	10076	10066	14	G	2	2	2
107	226	2	10175	10165	30	G	2	2	2
108	121	3	.	.	8	F	2	2	2
108	124	3	10077	10067	8	F	2	2	2
108	124	3	10077	10067	8	F	2	2	2
108	124	3	10077	10067	45	N	2	2	2
108	125	3	10077	10067	8	F	2	2	2
108	125	3	10077	10067	45	N	3	2	1
108	126	3	10066	10056	22	O	3	2	1
108	127	2	10076	10066	21	B	2	2	2
108	129	5	10038	10028	12	F	2	2	2
108	226	1	10185	10175	8	F	2	2	2
108	226	1	10185	10175	12	F	2	2	1
108	226	1	10185	10175	12	F	2	2	2
108	226	1	10185	10175	30	G	2	2	2
108	247	0	0	0	8	F	2	2	2
108	247	4	10206	10197	8	F	3	2	1
108	247	4	10206	10197	8	F	3	2	1
108	248	1	10220	10217	11	B	2	2	2
109	128	2	10068	10058	8	F	2	2	2
110	201	0	0	0	8	F	2	2	1
112	25	0	0	0	31	B	3	2	1
112	32	0	0	0	38	B	2	2	2
114	179	3	10145	10135	8	F	2	2	2
115	32	0	0	0	22	O	2	2	2
117	139	1	10089	10086	8	F	2	2	2
117	139	1	10089	10086	15	L	2	2	1

Table A3.9 (continued)

LIST OF FLAKE FRAGMENT ATTRIBUTES FOR ENM 10418

NS	EW	LEVEL	VTOP	VBOT	MATTYPE	CLASS	COND	HEAT	CORTEX
118	134	0	0	0	12	F	3	2	2
118	134	0	0	0	31	B	3	2	1
118	139	1	9985	9982	15	L	2	2	2
118	139	1	9985	9982	31	B	3	2	2
118	139	3	9982	9971	8	F	2	2	2
118	139	3	9982	9971	9	J	2	2	2
118	228	0	0	0	30	G	2	2	2
118	228	0	0	0	31	B	2	2	1
119	138	3	9980	9970	31	B	3	2	2
119	139	1	9998	9988	15	L	3	2	2
120	152	0	0	0	1	B	2	2	1
124	35	1	9967	9961	17	B	3	2	2
124	222	0	0	0	13	B	2	2	2
125	34	1	9970	9964	2	B	2	2	2
125	34	1	9970	9964	31	B	3	2	2
125	139	0	0	0	8	F	2	2	1
125	139	0	0	0	22	O	3	2	2
126	26	2	9953	9941	1	B	2	2	2
127	27	1	9961	9955	2	B	2	2	2
134	146	0	0	0	12	F	3	2	2
136	106	4	10074	10064	30	G	2	2	2
148	32	1	10026	10019	2	B	3	2	1
148	131	2	10019	10009	11	B	3	2	1

Table A3.10
Ground Stone Coding Format

Artifact Type
1) One-hand mano
2) Two-hand mano
3) Slab metate
4) Basin metate
5) Limestone knife
6) Pestle
7) Polishing stone
8) Basin-slab metate

Dimensions
1) Length: measured parallel to the long axis
2) Width: measured perpendicular to long axis
3) Thickness: measured at maximum thickness
4) Weight: measured to nearest gram

Condition
1) Whole
2) Fragment

Cross Section
0) Undetermined
1) Convex-convex
2) Convex-plano
3) Plano-plano tabular
4) Concave-plano
5) Concave-concave
6) Concave-irregular
7) Plano-plano wedge

Shape
0) Undetermined
1) Nodular
2) Oval
3) Circular
4) Rectangular
5) Crescent
6) Conical

Grinding Surface
0) Undetermined
1) One grinding surface
2) Two opposed grinding surfaces
3) Two grinding surfaces on the same side
4) Two grinding surfaces on one side and one on the opposite side

Table A3.10 (continued)
Ground Stone Coding Format

<u>Manufacture</u>

0) Undetermined
1) No evidence of manufacture
2) Pecking
3) Grinding
4) Pecking and grinding

<u>Utilization</u>

0) Undetermined
1) Latitudinal striations
2) Longitudinal striations
3) Rotary striations
4) Pecking

Table A3.11

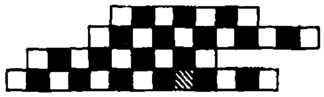
GROUNDSTONE ATTRIBUTES FOR WIPP SITES

SITENO	NS	EW	LEVEL	VTOP	VBOT	TOOLTYP	LENGTH	WIDTH	THICK	WEIGHT	CONDT	SHAPE	XSEC	GSURF	MANU	UT
222	22	175	99	0	9966	1	50	72	50	184	2	1	2	1	2	1
222	46	45	0	0	0	1	65	105	34	200	2	2	7	2	4	1
222	78	182	0	0	0	0	70	45	34	130	2	0	0	0	0	0
222	86	125	99	0	9851	0	95	70	17	145	2	0	2	1	0	0
222	88	111	1	9947	9945	0	75	31	40	120	2	0	0	0	0	0
222	90	58	0	0	0	0	41	50	29	80	2	0	0	0	0	0
230	32	178	0	0	0	4	85	35	25	134	2	0	6	1	0	0
230	51	66	0	0	0	0	50	35	20	34	2	0	0	1	0	0
230	54	57	0	0	0	0	92	45	20	110	2	0	0	2	0	0
230	55	60	0	0	0	3	60	60	25	76	2	0	3	2	2	0
230	55	62	0	0	0	3	110	90	23	299	2	0	3	2	0	0
230	69	167	3	9760	9750	1	65	70	25	180	2	2	7	2	4	1
230	70	167	2	9770	9764	1	60	50	25	92	2	2	7	2	4	0
230	70	167	2	9770	9764	1	60	75	29	226	2	3	7	4	4	0
230	86	158	0	0	0	1	55	40	25	72	2	2	3	2	4	1
230	87	153	0	0	0	0	80	40	55	223	2	0	0	1	0	0
230	88	160	0	0	0	0	30	20	8	7	2	0	0	1	0	0
230	97	181	0	0	0	4	70	30	20	108	2	0	0	1	0	0
230	101	173	0	0	0	0	82	50	25	112	2	0	3	1	2	0
230	101	177	0	0	0	1	105	85	35	371	1	2	7	2	4	1
230	103	173	0	0	0	0	60	45	32	112	2	0	3	2	2	0
230	106	170	0	0	0	0	32	25	15	22	2	0	3	1	0	0
230	107	161	0	0	0	0	60	55	42	188	2	0	3	1	0	2
230	110	120	0	0	0	4	195	160	25	1300	2	0	1	2	0	4
230	110	203	0	0	0	1	70	40	10	52	2	0	0	0	0	0
230	132	238	0	0	0	3	132	120	54	1100	2	0	3	1	2	2
230	134	238	0	0	0	1	63	100	33	196	2	2	7	1	4	1
230	[illegible]	239	0	0	0	1	48	81	42	184	2	2	7	1	4	1
230	143	237	0	0	0	4	128	139	46	1300	2	2	3	1	4	0
230	146	232	0	0	0	0	49	47	20	44	2	0	0	1	0	0
230	148	236	0	0	0	1	80	82	30	249	2	2	2	1	4	1
230	150	234	0	0	0	0	40	20	19	29	2	0	0	0	0	0
230	153	125	0	0	0	8	122	145	44	887	2	2	5	2	4	4
230	153	235	0	0	0	1	72	72	36	210	2	2	7	1	4	1
230	154	226	0	0	0	1	82	61	35	175	2	3	7	2	4	1
230	154	236	0	0	0	0	79	82	34	231	2	0	0	1	2	0
230	155	209	1	10190	10180	0	35	30	15	25	2	0	0	0	0	0
230	156	287	.	.	.	4	95	90	32	344	2	0	0	1	0	0
230	157	237	0	0	0	0	90	72	21	161	2	0	3	1	0	0
230	166	281	0	0	0	0	40	30	15	32	2	0	0	0	0	0
230	168	246	0	0	0	3	125	90	25	294	2	0	3	1	0	0
230	180	317	0	0	0	4	60	65	24	120	2	0	4	1	2	0
230	180	332	0	0	0	0	65	50	30	92	2	0	0	1	0	0
230	188	320	0	0	0	4	100	55	26	170	2	0	4	1	4	0
230	189	324	0	0	0	1	30	64	30	88	2	4	3	1	4	0
230	192	323	0	0	0	4	100	90	37	321	2	0	2	1	2	2
230	198	323	0	0	0	0	52	50	20	49	2	0	0	1	0	0
230	210	373	0	0	0	1	115	80	25	228	2	2	7	2	4	1
418	95	113	3	10044	10026	1	83	35	22	86	2	2	0	0	2	1
418	96	111	3	10017	10007	0	110	70	50	450	2	7	2	2	0	1
418	96	132	0	0	0	7	68	52	44	206	1	1	1	0	1	5
418	98	119	3	10041	10031	4	77	51	26	113	2	0	6	1	0	0
418	99	110	0	0	0	7	63	58	59	226	1	1	1	0	6	5
418	100	113	1	10042	10037	1	80	125	25	405	2	3	3	1	4	1
418	101	119	6	10037	10027	1	40	80	50	120	2	0	7	2	4	1
418	103	171	2	10121	10115	1	61	49	12	53	2	0	0	1	0	0
418	104	115	2	10046	10030	7	66	58	48	226	1	1	1	0	1	5
418	104	120	1	10081	10076	1	88	56	26	164	2	3	3	1	2	0
418	104	170	3	10115	10105	0	28	15	16	9	2	0	0	2	0	0
418	104	171	2	10124	10115	0	43	26	11	16	2	0	5	2	0	0
418	105	112	99	0	10018	5	45	25	14	20	1	2	2	4	1	0
418	105	118	4	10045	10035	0	85	85	30	310	2	0	4	1	4	0
418	106	112	2	10038	10028	.	120	95	40	867	1	2	.	.	.	.
418	106	122	99	0	10029	6	170	105	80	2500	2	6	1	0	4	3
418	107	112	99	0	10013	1	115	105	43	540	2	2	7	2	4	1
418	107	117	4	10043	10033	1	38	36	16	19	2	0	2	2	2	0
418	107	123	4	10060	10050	0	19	14	8	3	2	0	0	0	0	0
418	128	23	0	0	0	1	59	59	41	152	2	3	7	2	4	1
418	129	39	99	0	9945	3	85	80	16	195	2	0	3	2	2	0

Appendix 4

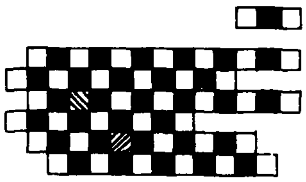
ENM 10230 FIRE-CRACKED ROCK DENSITIES

Figures A4.1 through A4.7 in this section represent the fire-cracked rock densities by blowout (see also Figures 4.8 and 4.9 for spatial distributions of the blowouts). Only the two highest densities have been plotted: ▨ = highest density per 1 m square; ▧ = next highest density per square. Densities were figured using the mean of fire-cracked rock per square with increments based on standard deviations. The highest densities are usually three standard deviations from the mean.



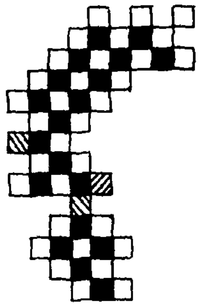
ENM 10230
Blowout 8
30S to 33S
177E to 191E
Fire cracked rock density

Figure A4.1



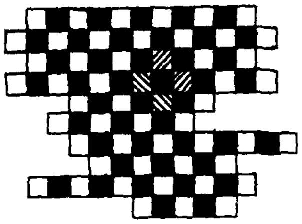
ENM 10230
Blowout 9
49S to 56S
55E to 68E
Fire cracked rock density

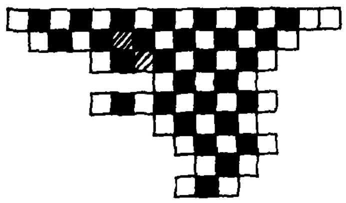
Figure A4.2



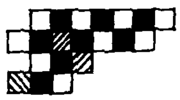
ENM 10230
Blowout 1
59S to 72S
161E to 169E
Fire cracked rock density

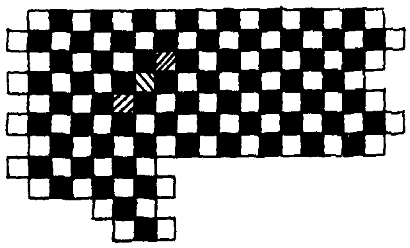
ENM 10230
Blowout 15
82S to 91S
151E to 164E
Fire cracked rock density





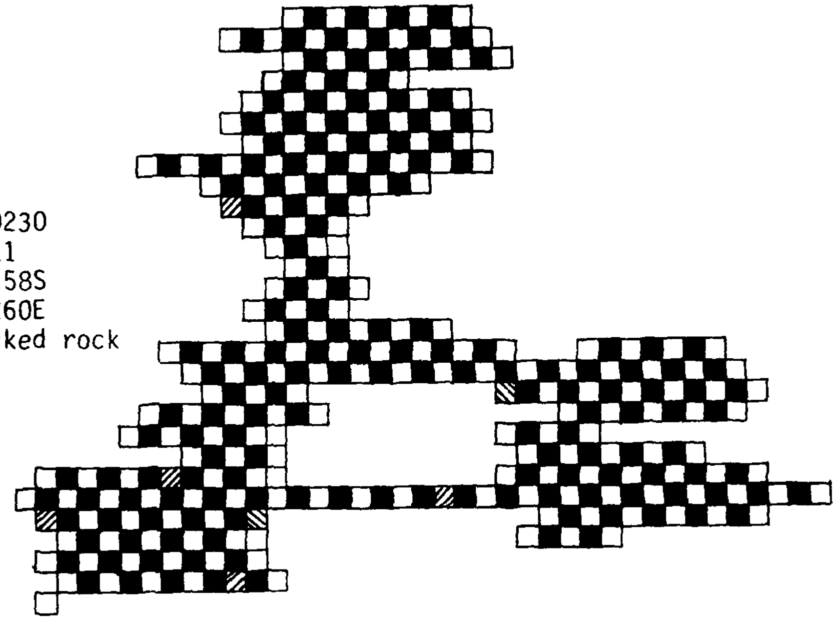
ENM 10230
Blowout 14
80S to 99S
175E to 190E
Fire cracked rock density



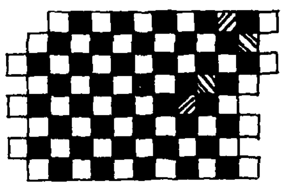


ENM 10230
Blowout 10
101S to 111S
160E to 178E
Fire cracked rock density

Figure A4.3

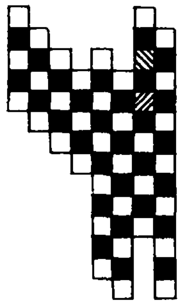


ENM 10230
Blowout 11
130S to 158S
225E to 260E
Fire cracked rock density

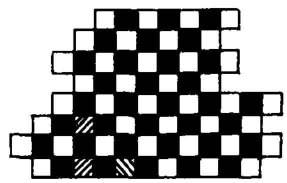


ENM 10230
Blowout 12
166S to 173S
238E to 250E
Fire cracked rock density

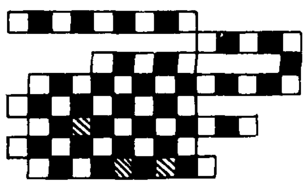
Figure A4.4



ENM 10230
Blowout 6
140S to 153S
185E to 192E
Fire cracked rock density

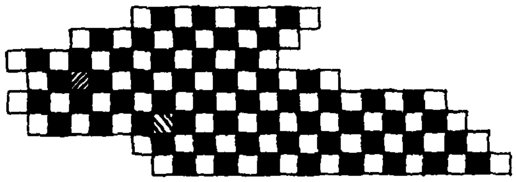


ENM 10230
Blowout 13
148S to 155S
204E to216E
Fire cracked rock density

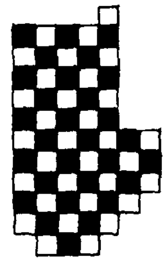


ENM 10230
Blowout 7
162S to 169S
175E to 188E
Fire cracked rock density

Figure A4.5



ENM 10230
Blowout 4
160S to 167S
275E to 298E
Fire cracked rock density



ENM 10230
Blowout 5
164S to 199S
320E to 332E
Fire cracked rock density

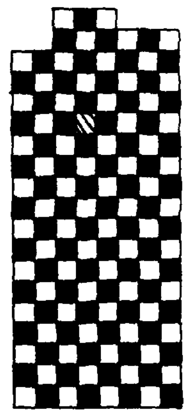
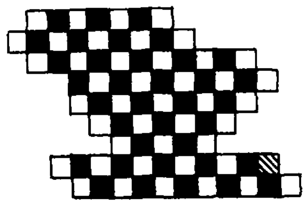


Figure A4.6

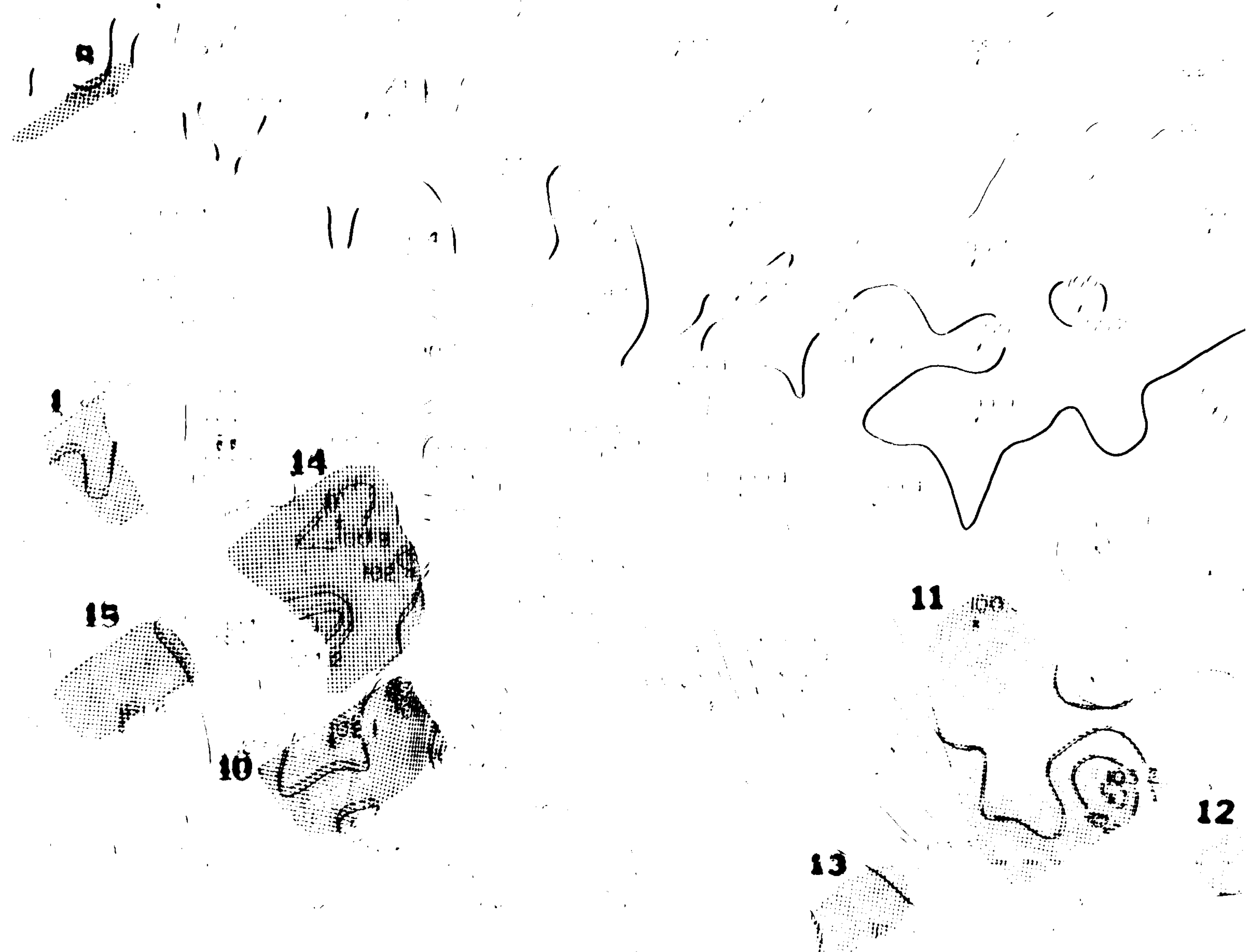
ENM 10230
Blowout 3
218S to 210S
351E to 376E
Fire cracked rock density



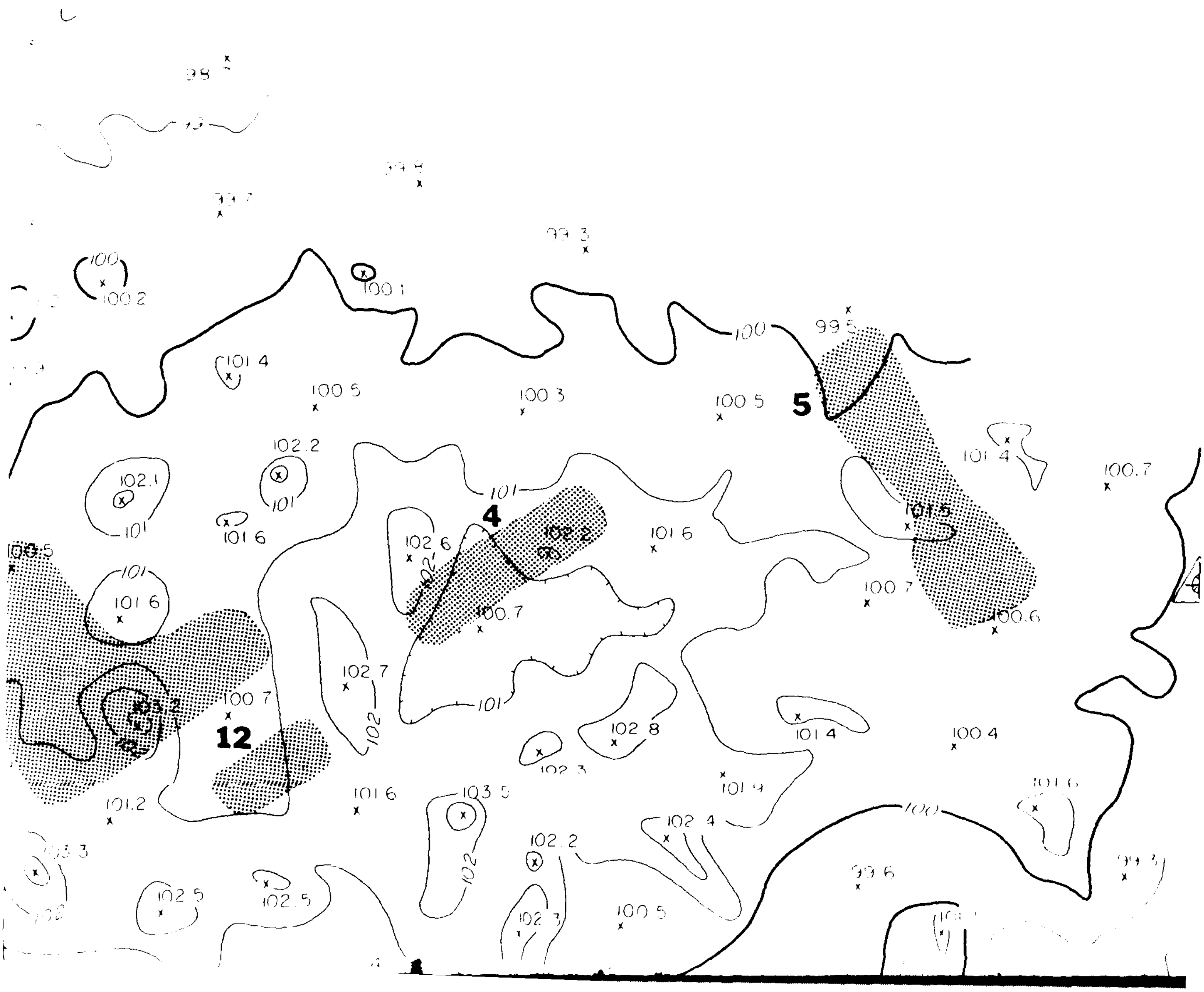
ENM 10230
Blowout 2
224S to 232S
377N to 390N
Fire cracked rock density

Figure A4.7

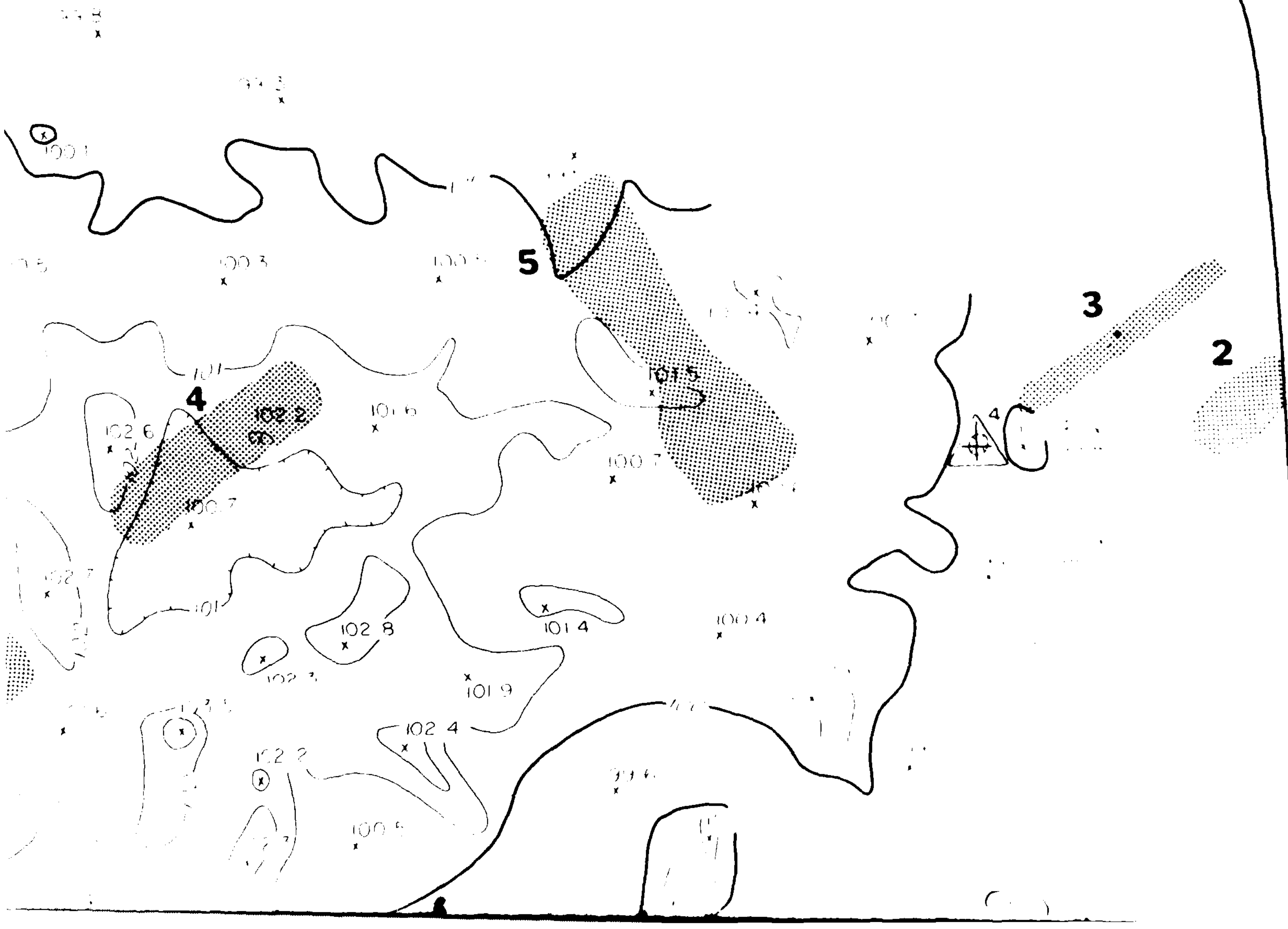

30E
60E
90E
120E
150E
99.4
97.8
99.8
98.1
98
99
99.1
98.4
99.1
99.1
98.6
99.3
99.4
100.2
99.8
100
102.1
101.2
100.6
99.5
99.9
100
102.5
101
102
102.6
99.6
100
101
101
102.2
9
100.6
102.6
99.9
100.9
100.8
101.8

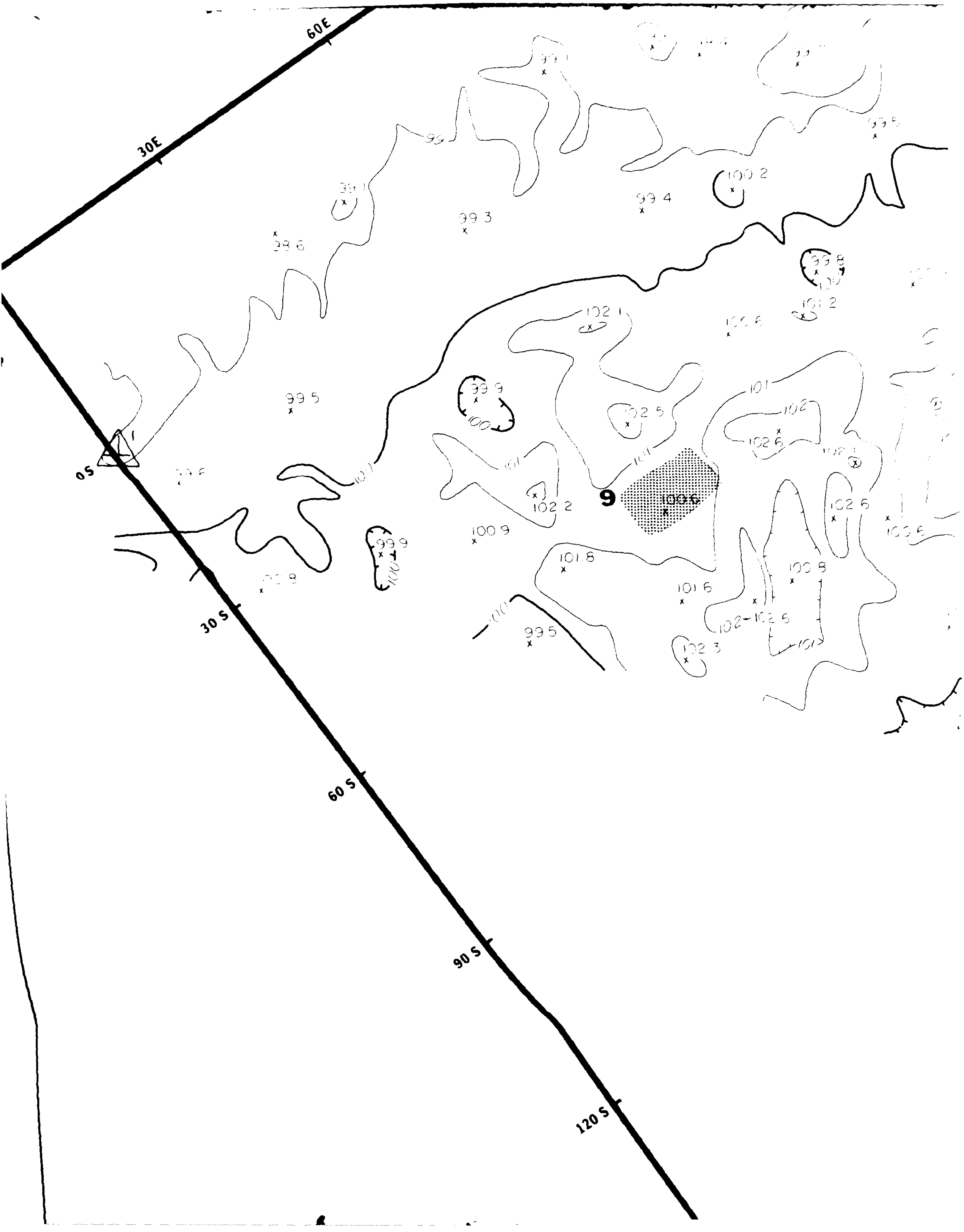

8
1
14
15
10
11
12
13

3



100
100.2
100.1
99.3
99.5
101.4
100.5
100.3
100.5
5
102.2
102.1
101
101.6
100.5
4
102.6
102.2
101.6
101.5
101.4
100.7
100.7
100.7
100.6
101.6
102.7
103.2
100.7
12
102
102.8
101.4
100.4
102.3
101.2
101.6
103.5
101.9
102.4
101.6
103.3
102.2
99.6
102.5
102.5
102.3
100.5


5
3
2
4
100.3
101.6
102.2
102.6
100.7
101.5
100.7
102.8
101.4
100.4
101.9
102.4
102.2
101


60E
30E
0 S
30 S
60 S
90 S
120 S
9
99 3
99 4
99 5
100 2
102 1
102 5
102 2
100 9
101 8
101 6
99 5
102 6
100 8
102 3
101 2

11
12
13
4
6
7
100.1
101.4
100.5
100.3
100
99.9
100.4
100.4
102.2
102.1
101
101.6
102.6
102.2
101.6
100.5
101.6
100.3
100.7
102.7
103.2
103.2
100.7
102.8
102.3
101.9
103.3
101.2
101.6
103.5
102.4
101.8
103.3
102.2
102.5
102.5
102.3
100.5
100.4
103.3
103.5
101.7
100.5
100.4
100.2
100.3
100.4
102.2
99.5
100.6
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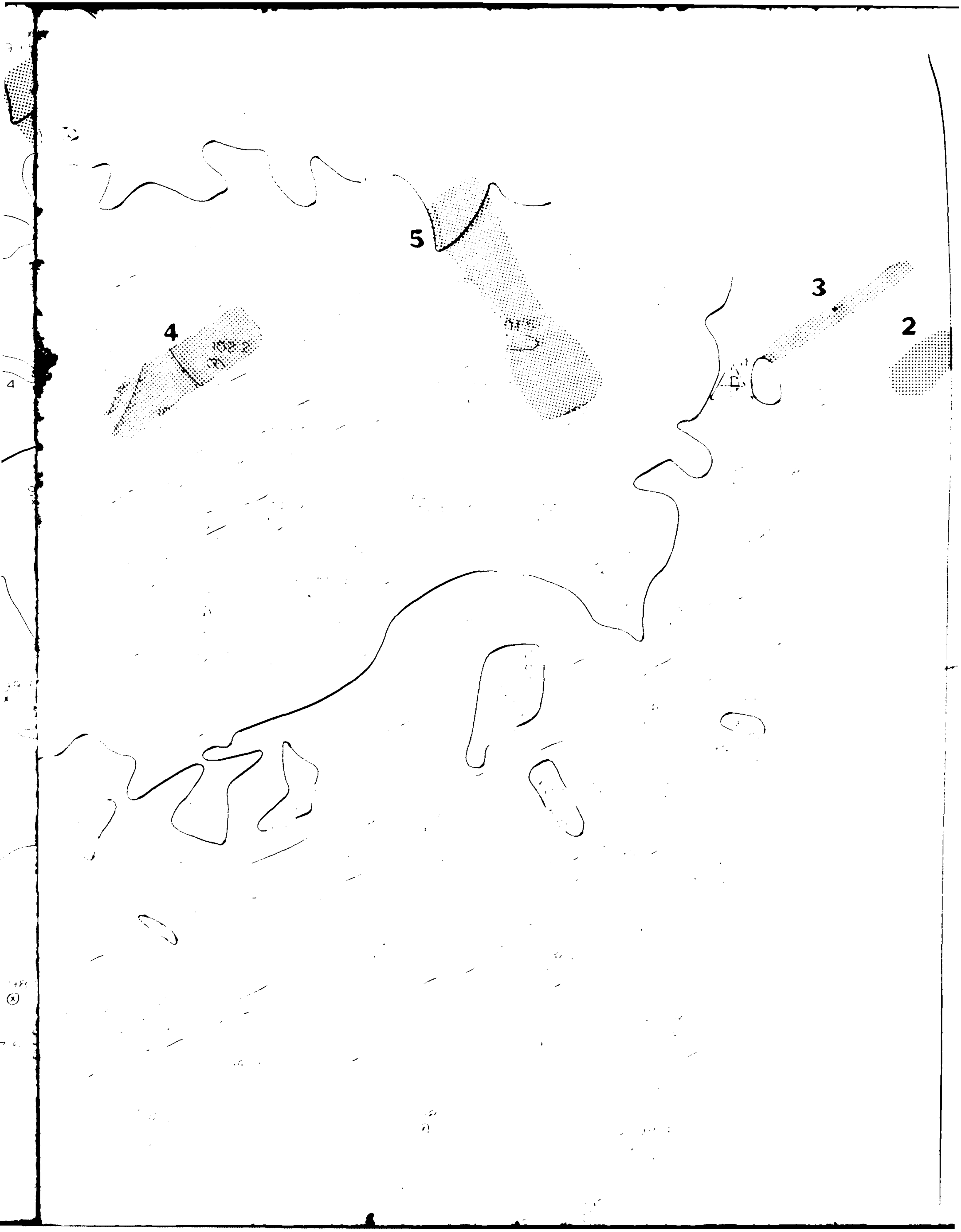
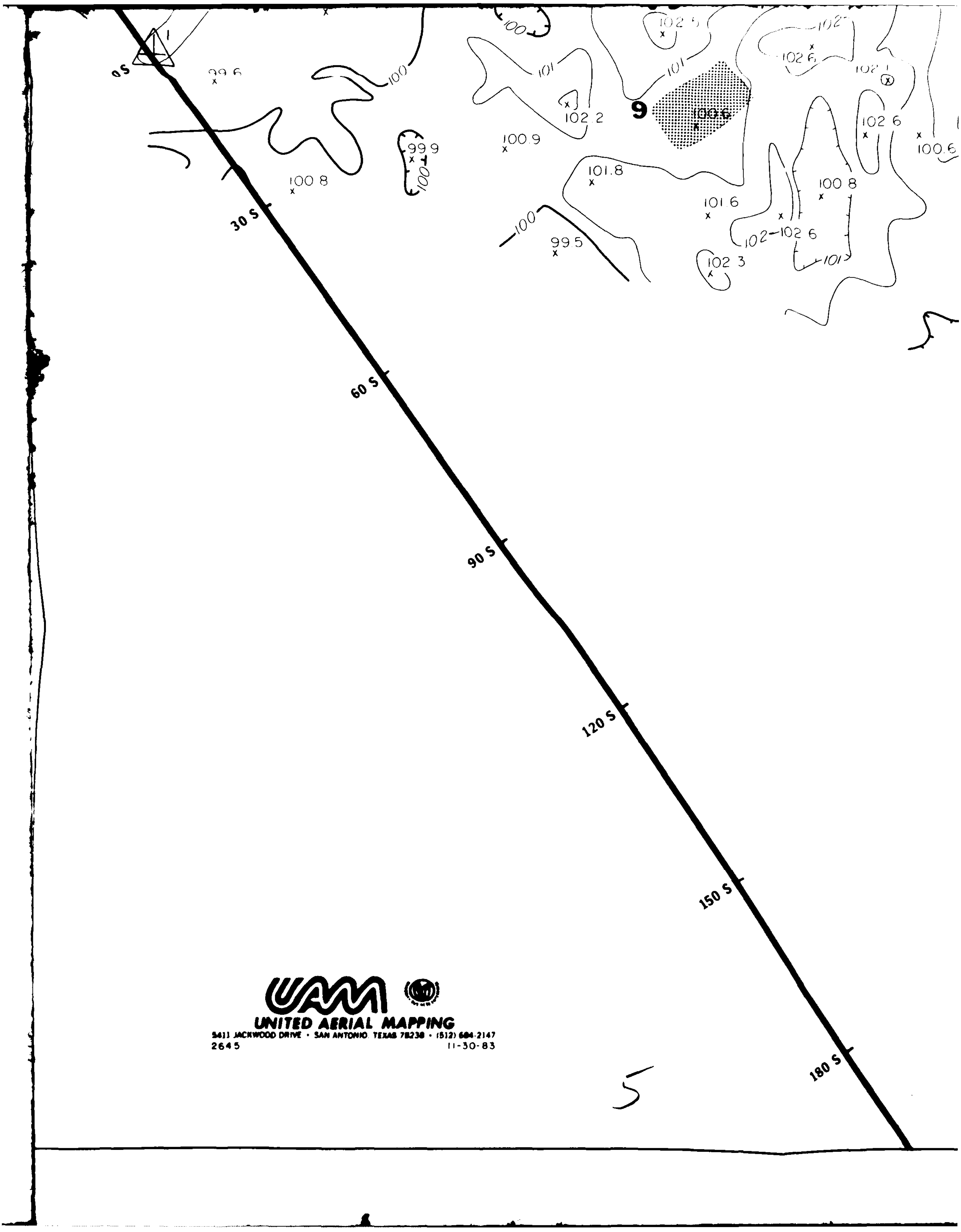
98.4
98.4
97.6


5
4
3
2



0 S
30 S
60 S
90 S
120 S
150 S
180 S
9
99.6
100
101
102.5
102.6
102.2
100.6
102.6
100.6
99.9
100.9
100.8
101.8
100.8
101.6
102
102.6
99.5
102.3
101
5
UNITED AERIAL MAPPING
5411 JACKWOOD DRIVE · SAN ANTONIO, TEXAS 78238 · (512) 684-2147
2645
11-30-83

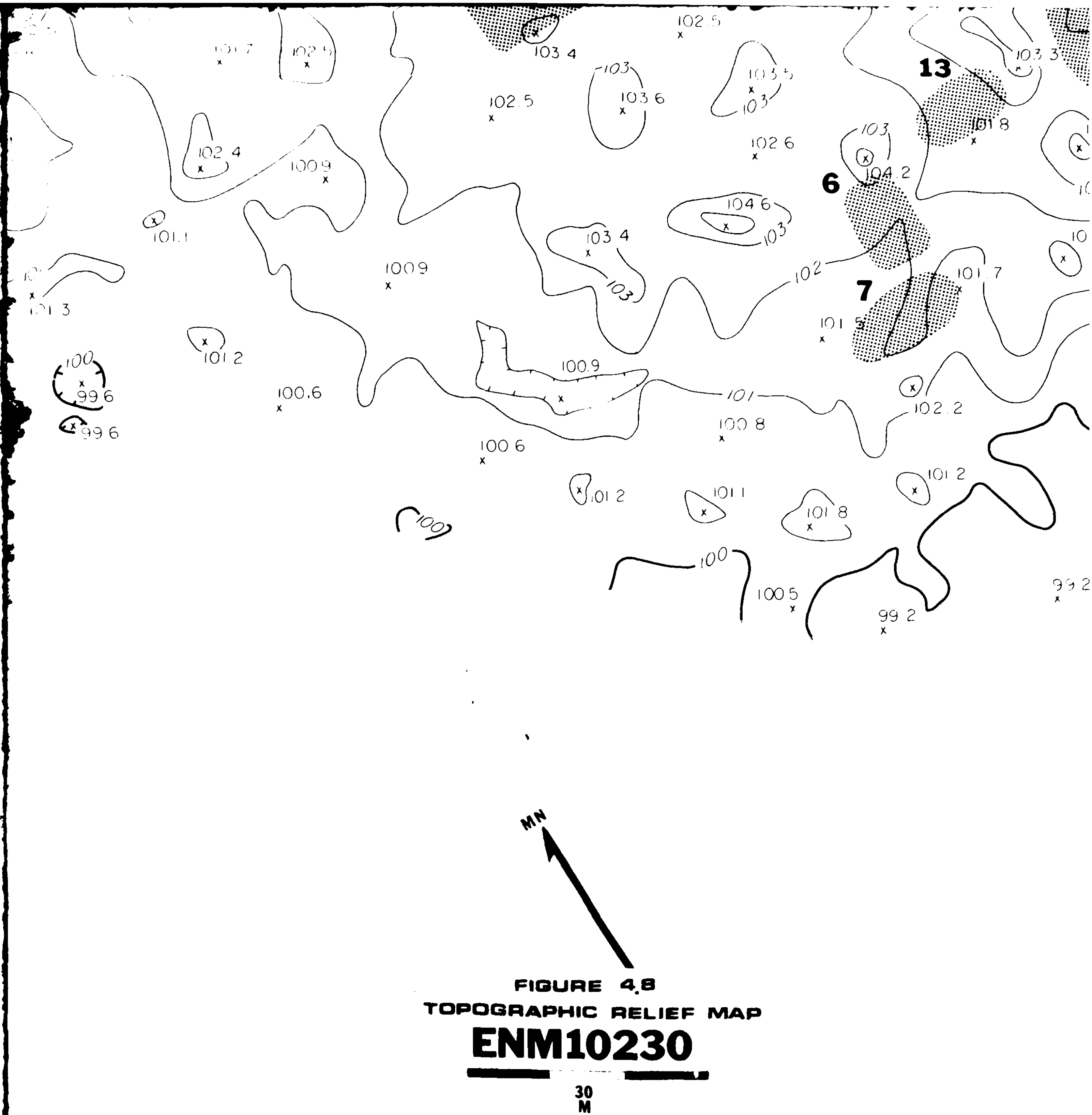
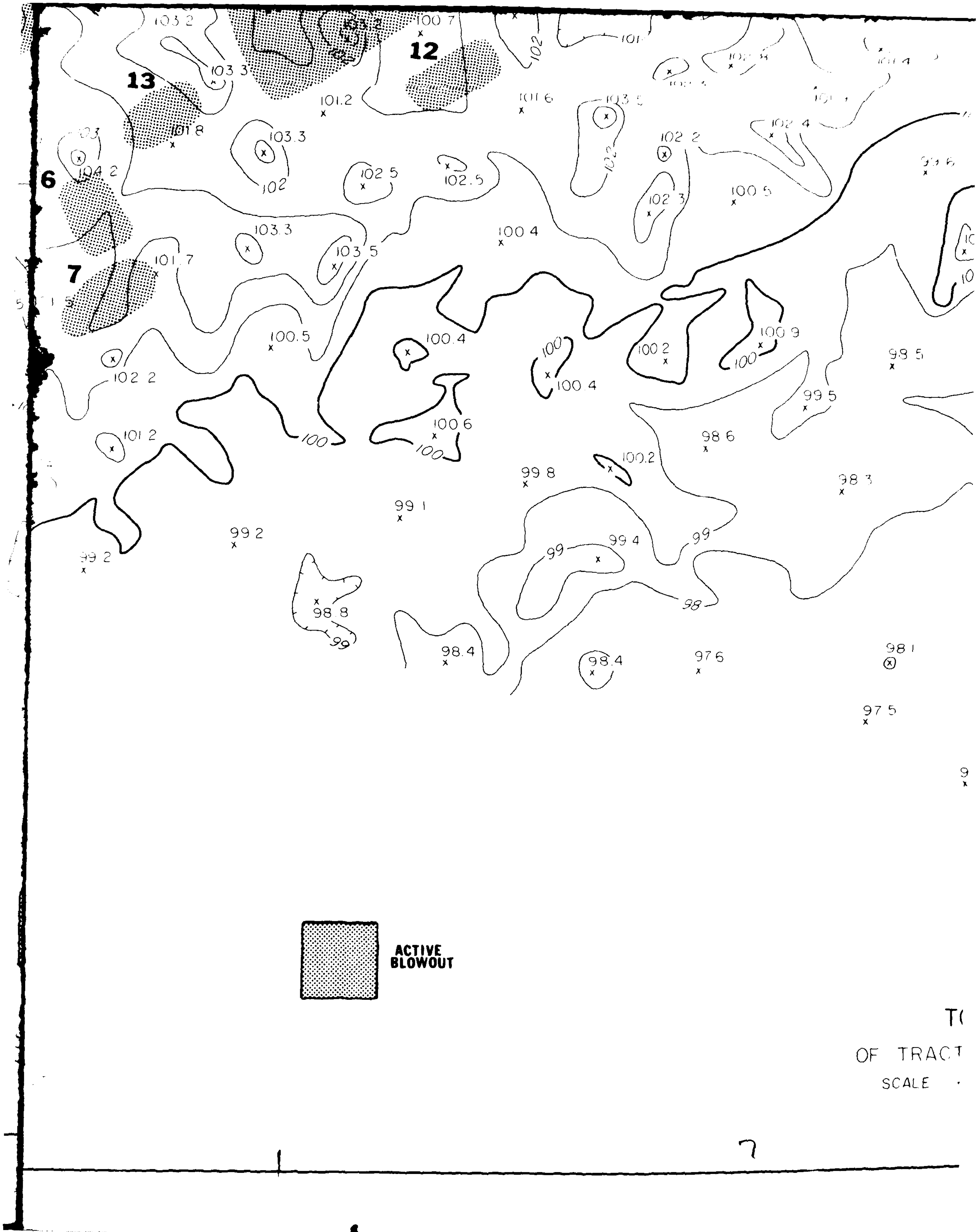
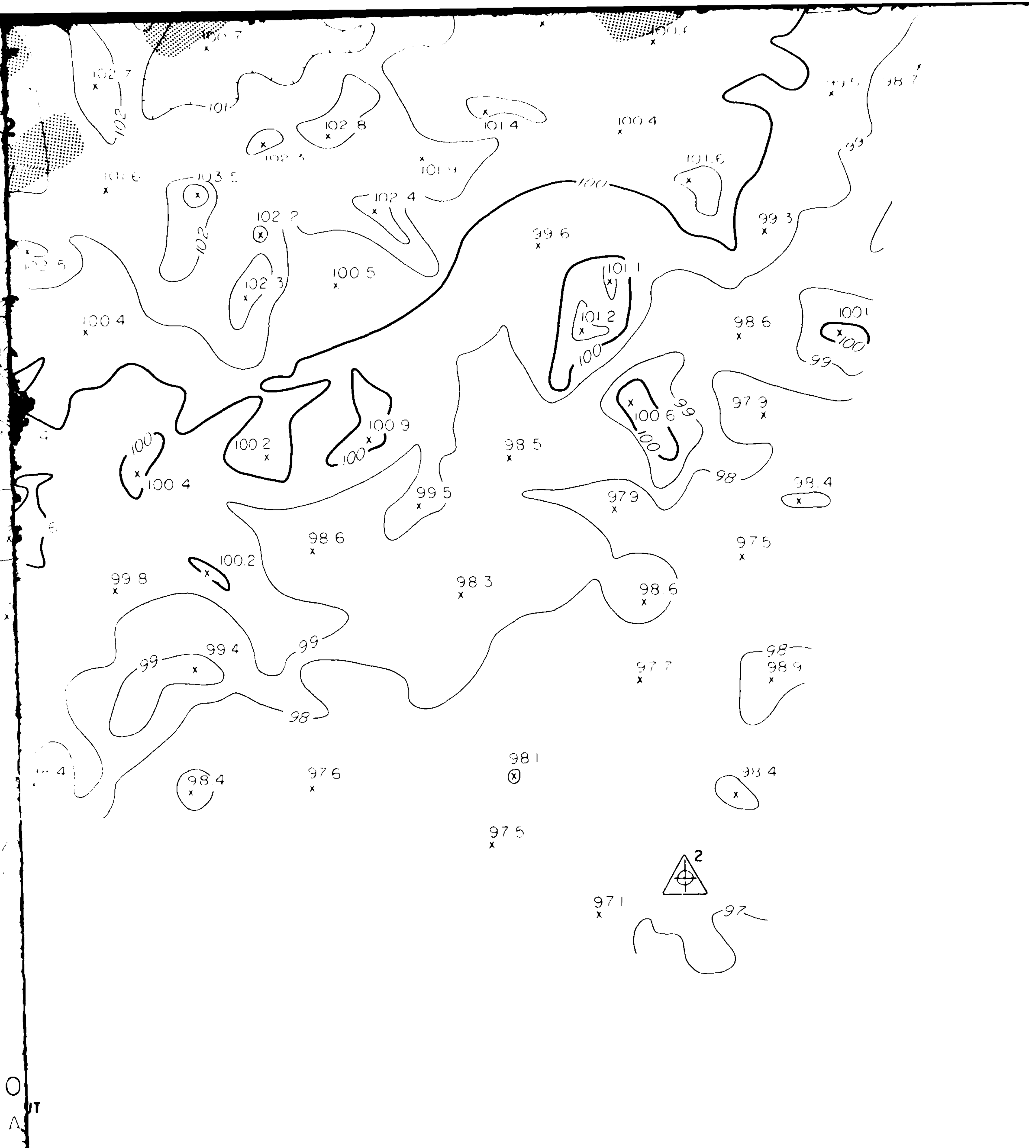


FIGURE 4.8
TOPOGRAPHIC RELIEF MAP
ENM10230

NOTE: MAP COMPILED TO A MEAN OF
FIELD SURVEY DATA FURNISHED BY CLIENT



13
12
6
7
103.2
100.7
103.3
101.2
101.6
103.5
101.8
103.3
102.2
102.4
102.5
102.5
102.3
100.5
104.2
103.3
100.4
103.5
101.7
100.5
100.4
100.2
100.9
98.5
102.2
100.4
99.5
100.6
101.2
98.6
100.2
99.8
98.3
99.1
99.2
99.4
99.2
98.8
98.4
98.4
97.6
98.1
97.5
100
99
98
102
ACTIVE BLOWOUT
T(
OF TRACT
SCALE

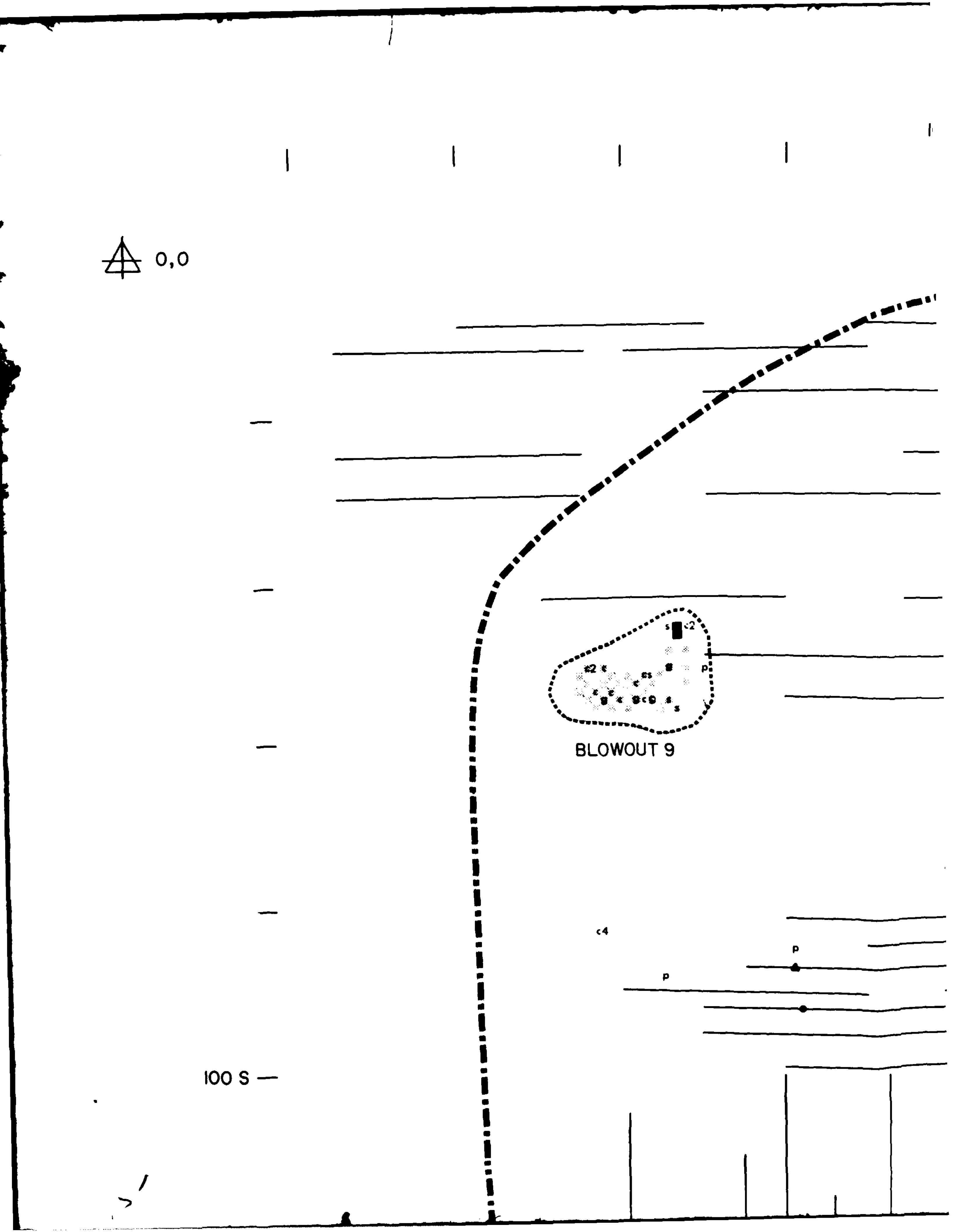


TOPOGRAPHIC SURVEY

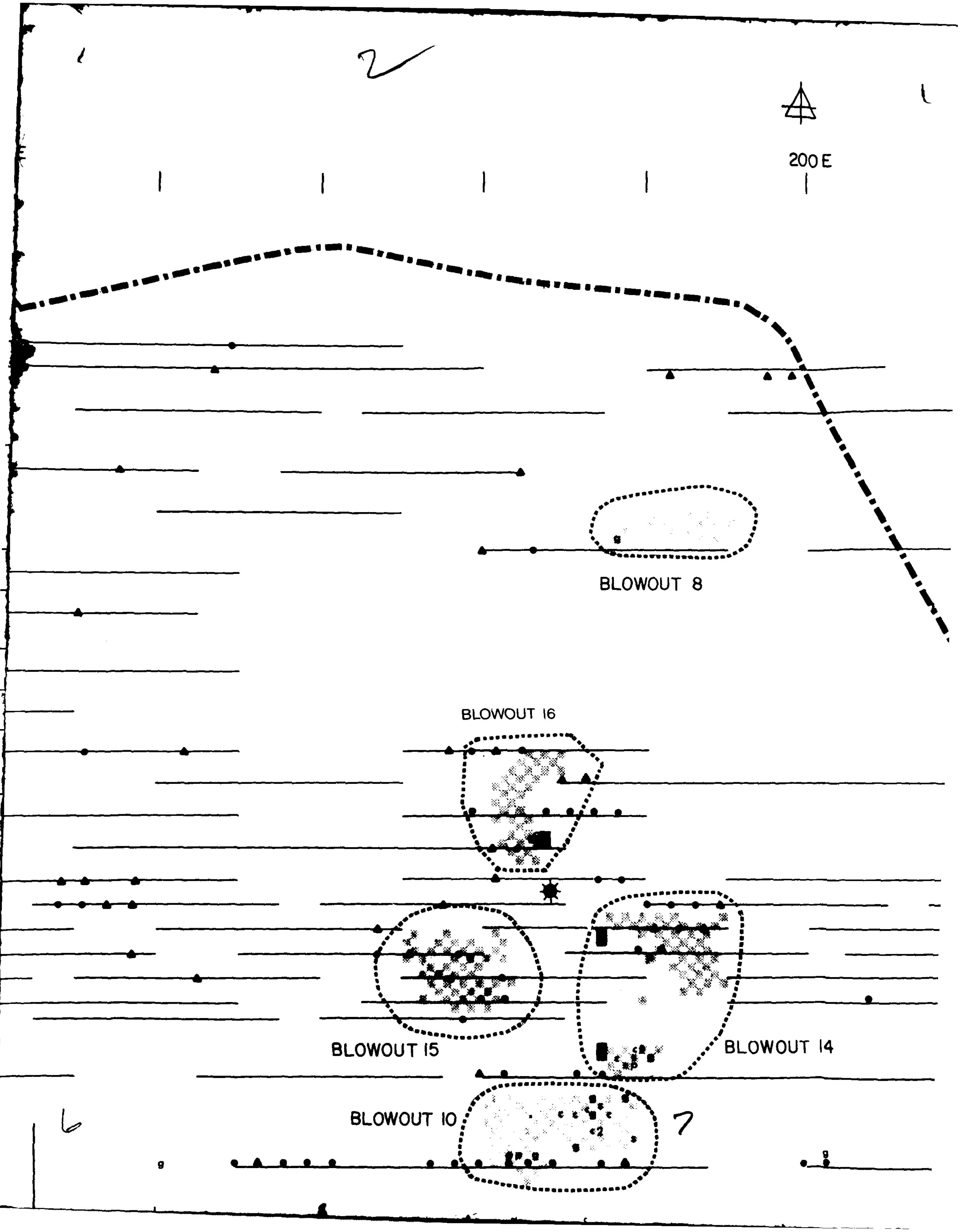
OF TRACT EAST OF CARLSBAD, NEW MEXICO

SCALE 1:0 CONTOUR INTERVAL 1 METER

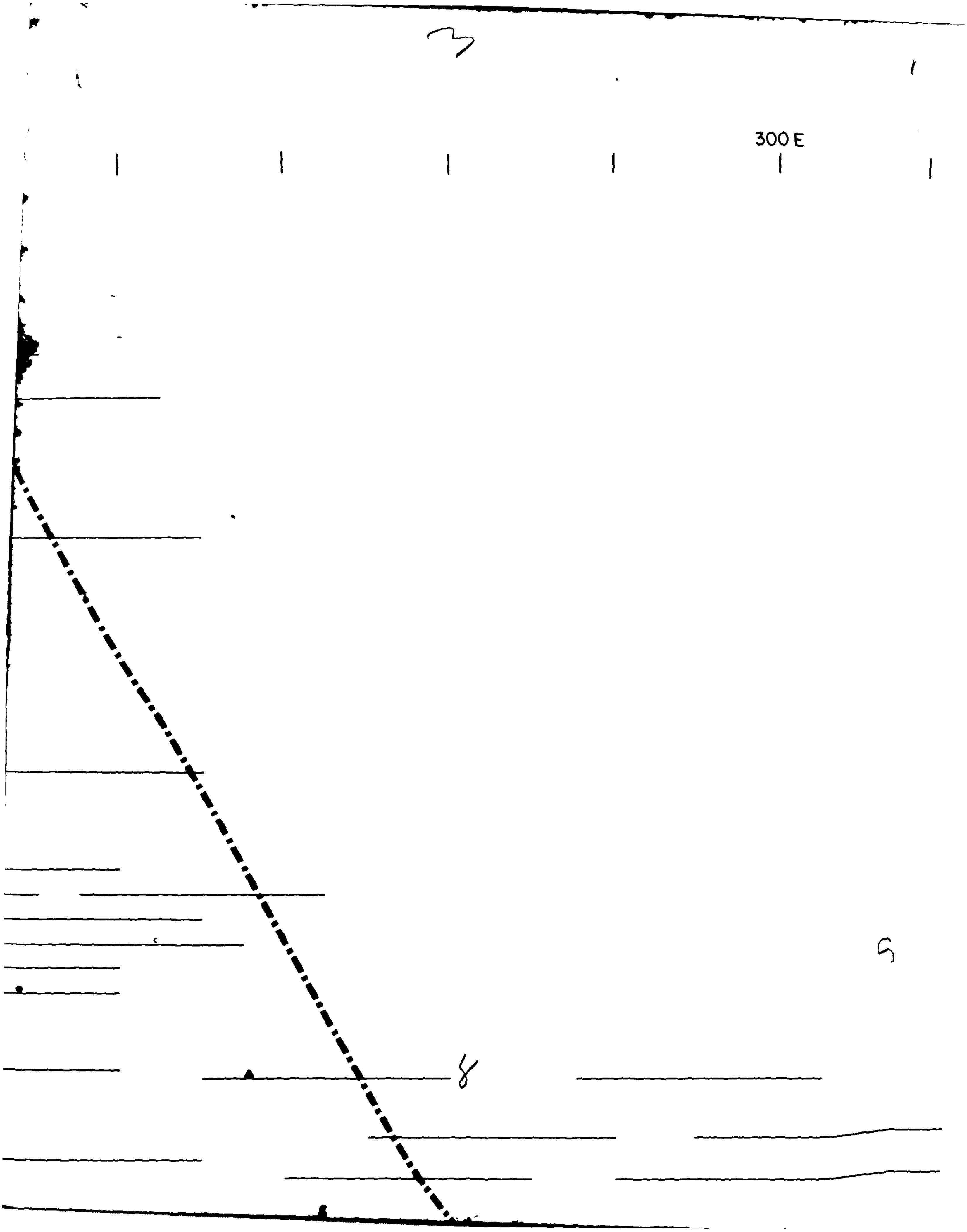
7



0,0
BLOWOUT 9
100 S



200 E
BLOWOUT 8
BLOWOUT 16
BLOWOUT 15
BLOWOUT 14
BLOWOUT 10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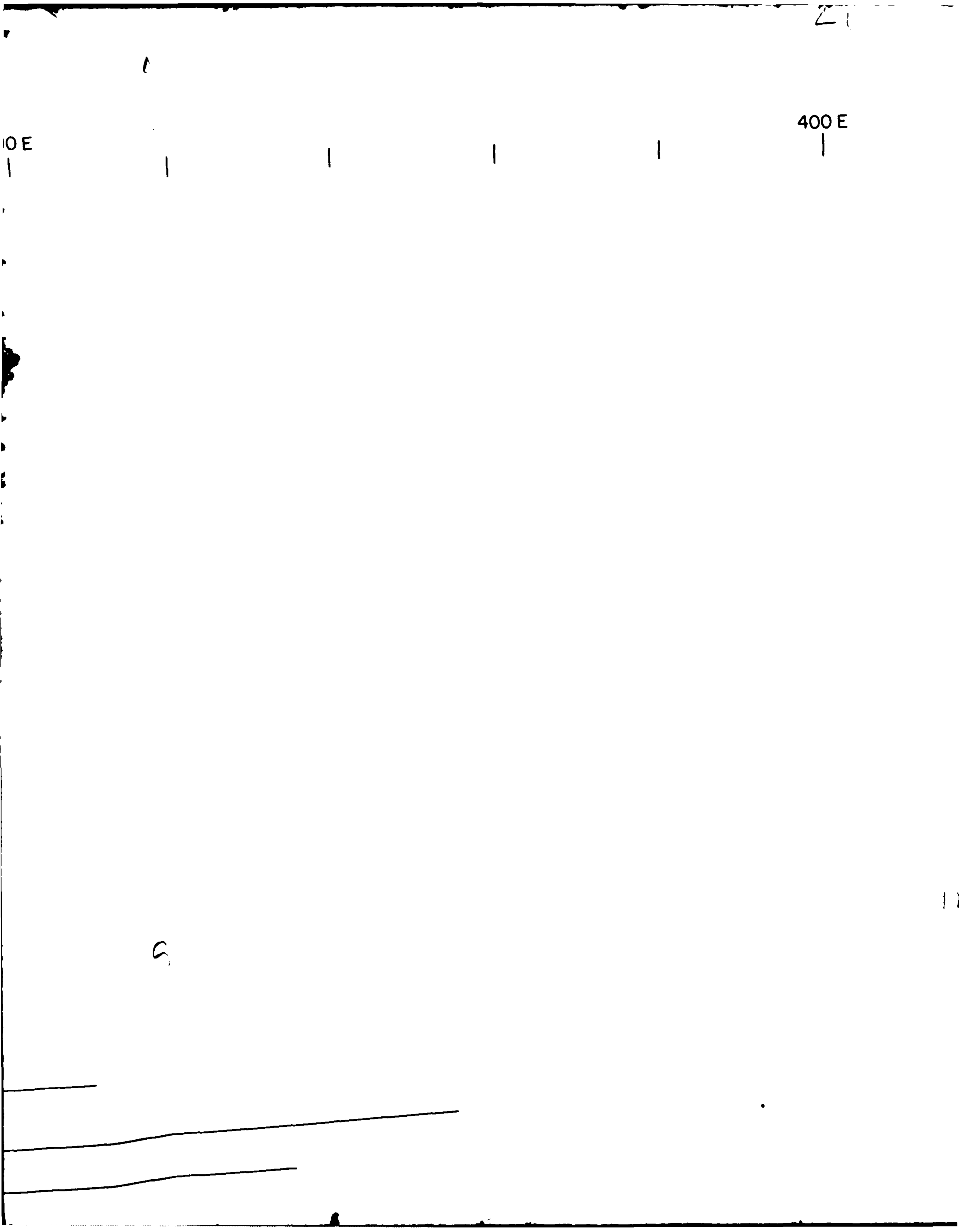

400 E

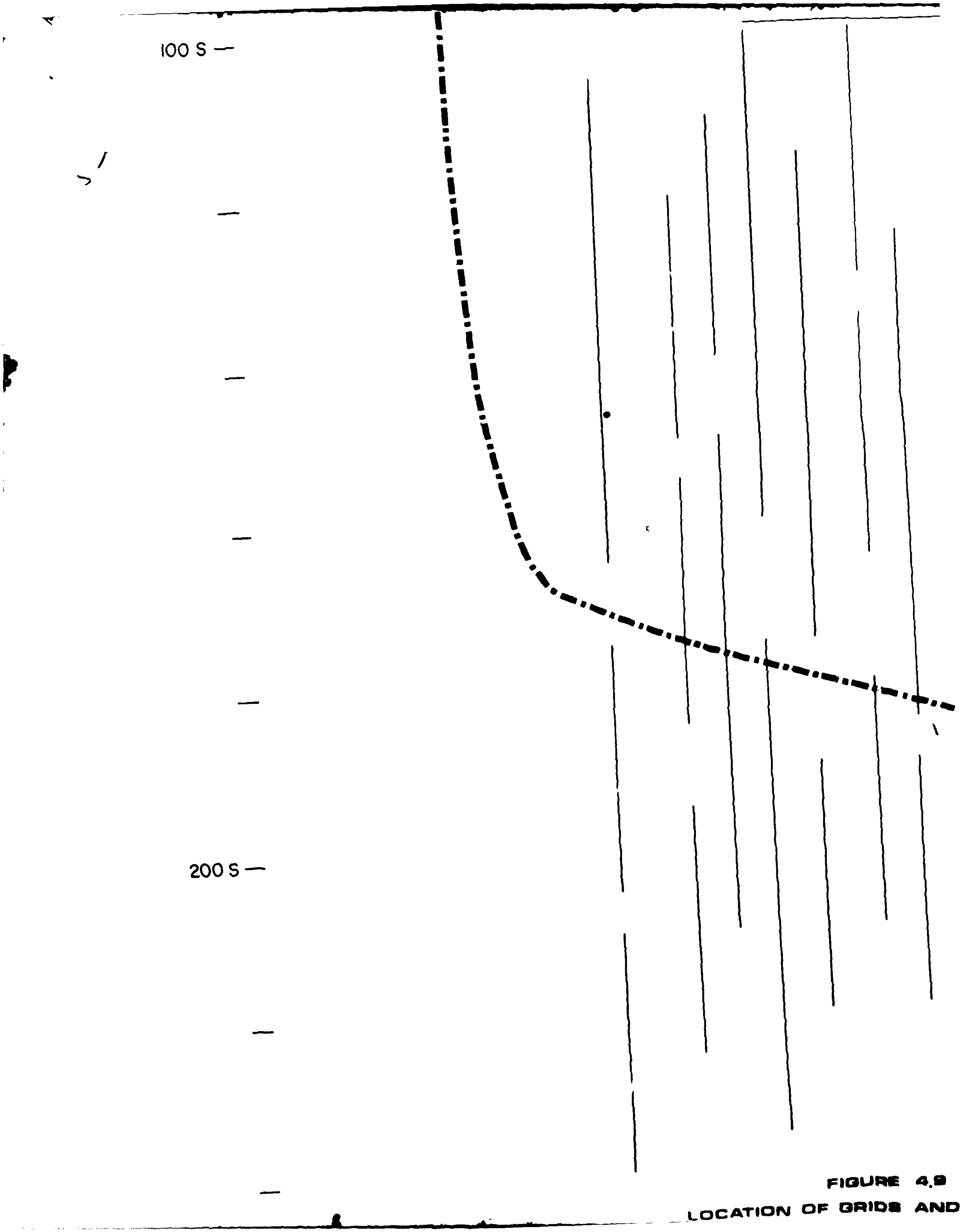
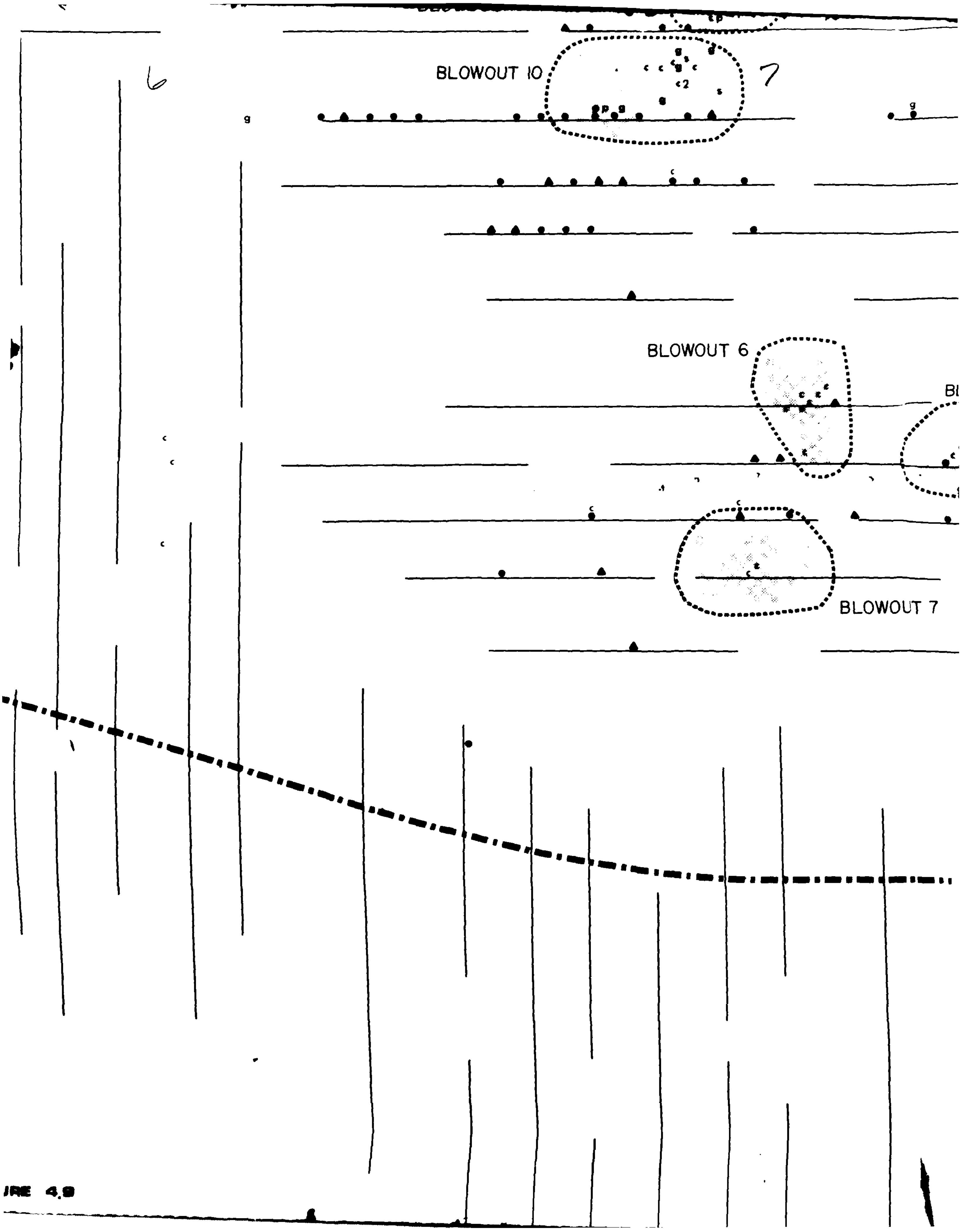
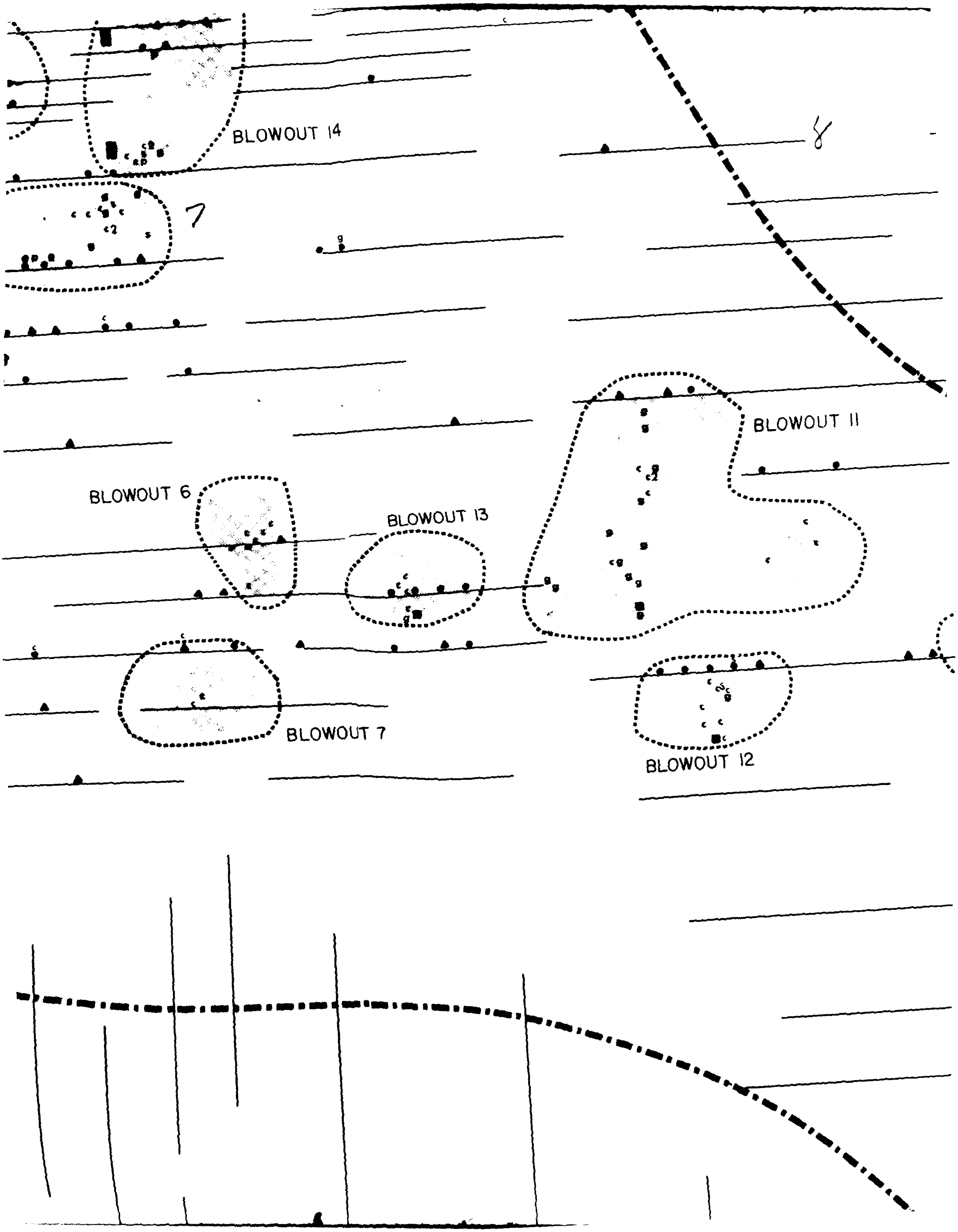


FIGURE 4.9
LOCATION OF GRIDS AND



IRE 4.9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BLOWOUT 6
BLOWOUT 13
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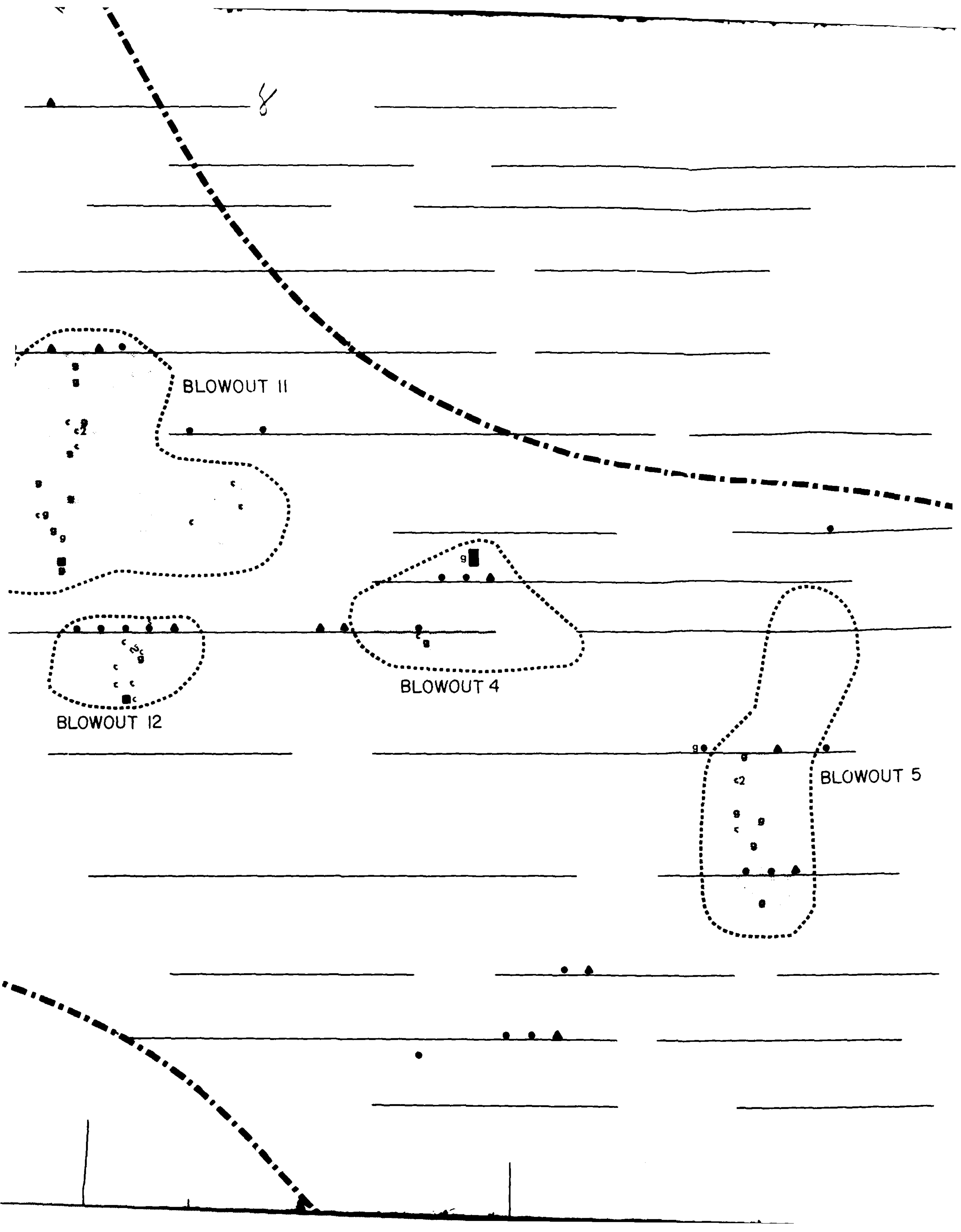
BLOWOUT 12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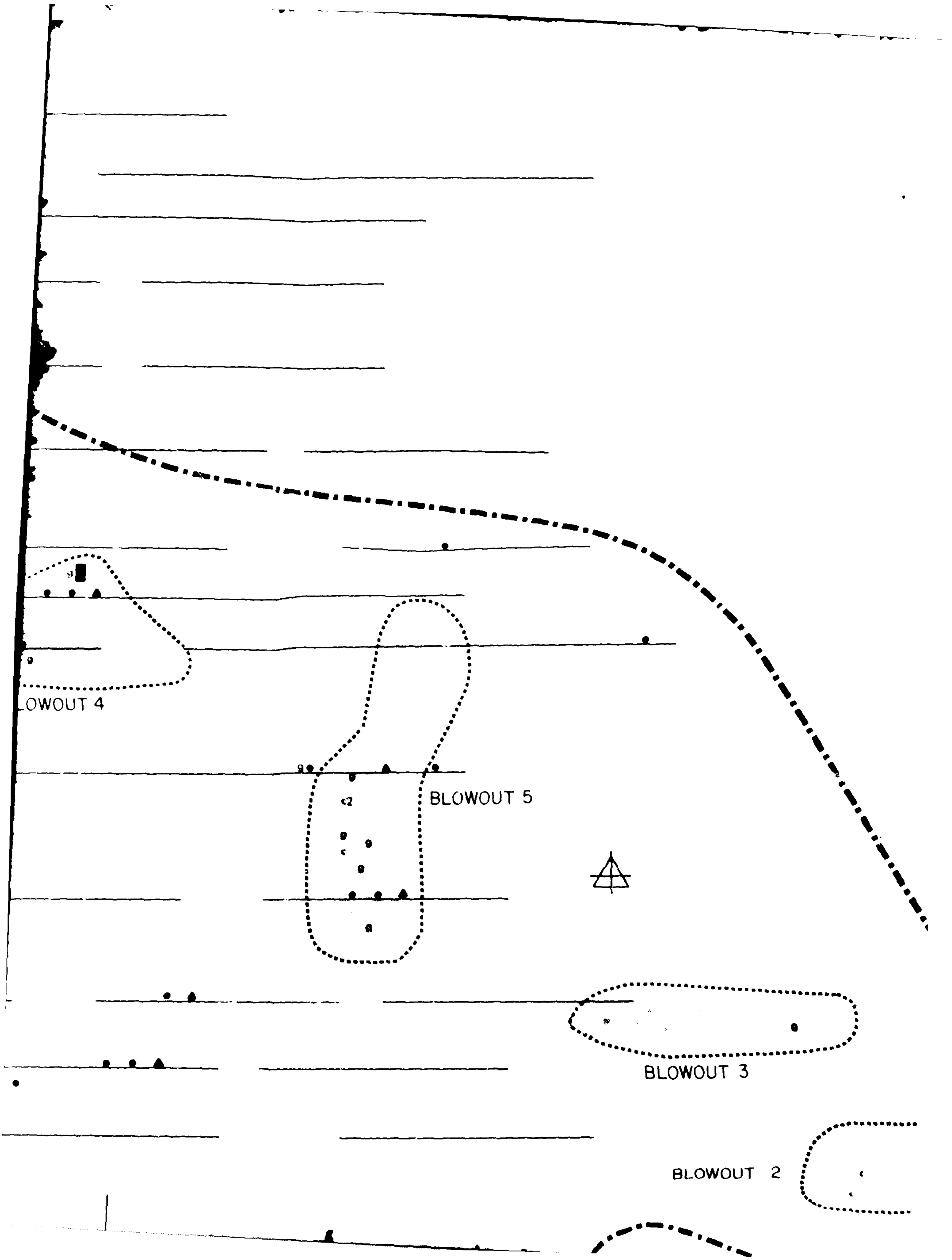
BLOWOUT 4
BLOWOUT 12
BLOWOUT 5



LOWOUT 4
BLOWOUT 5
BLOWOUT 3
BLOWOUT 2

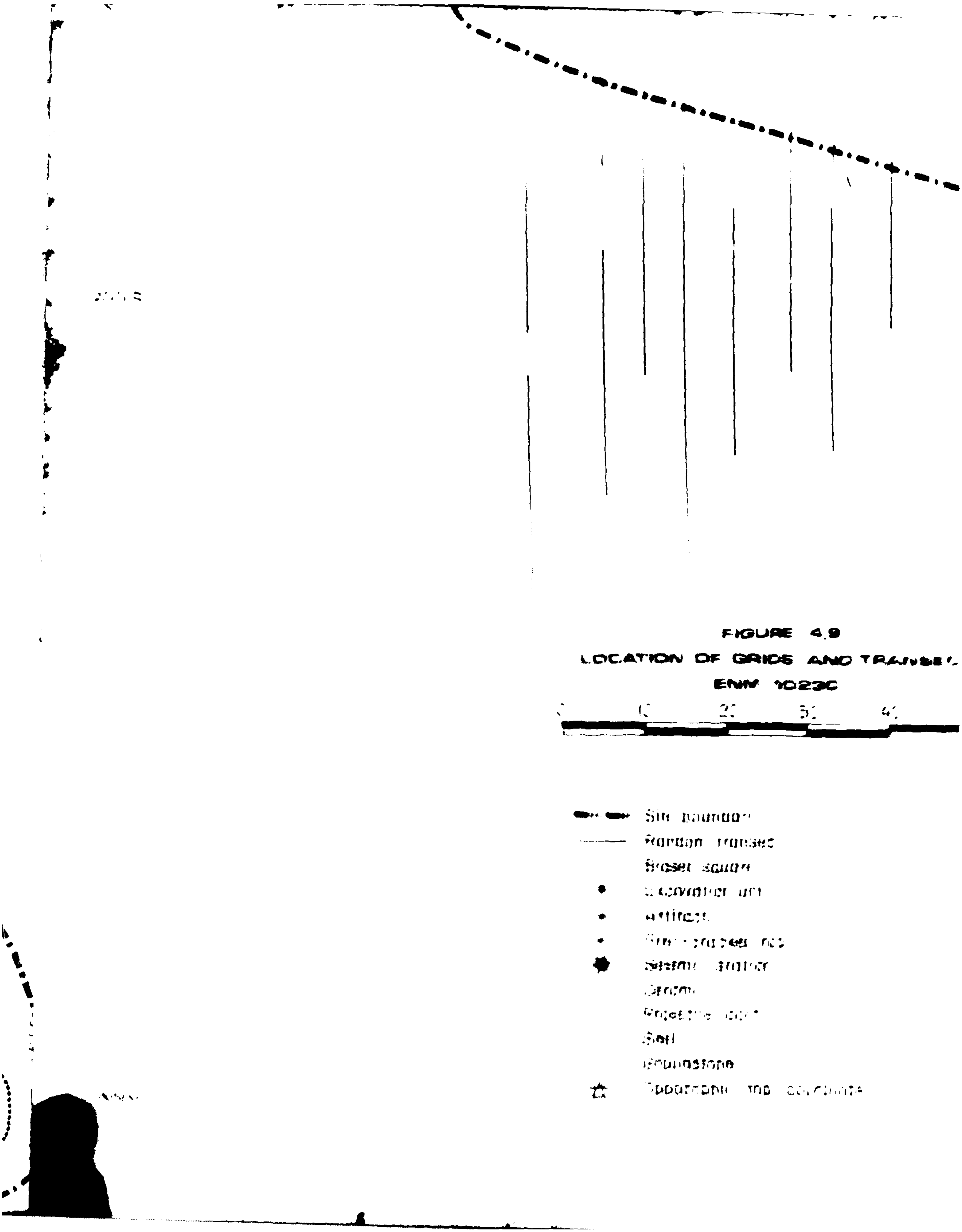
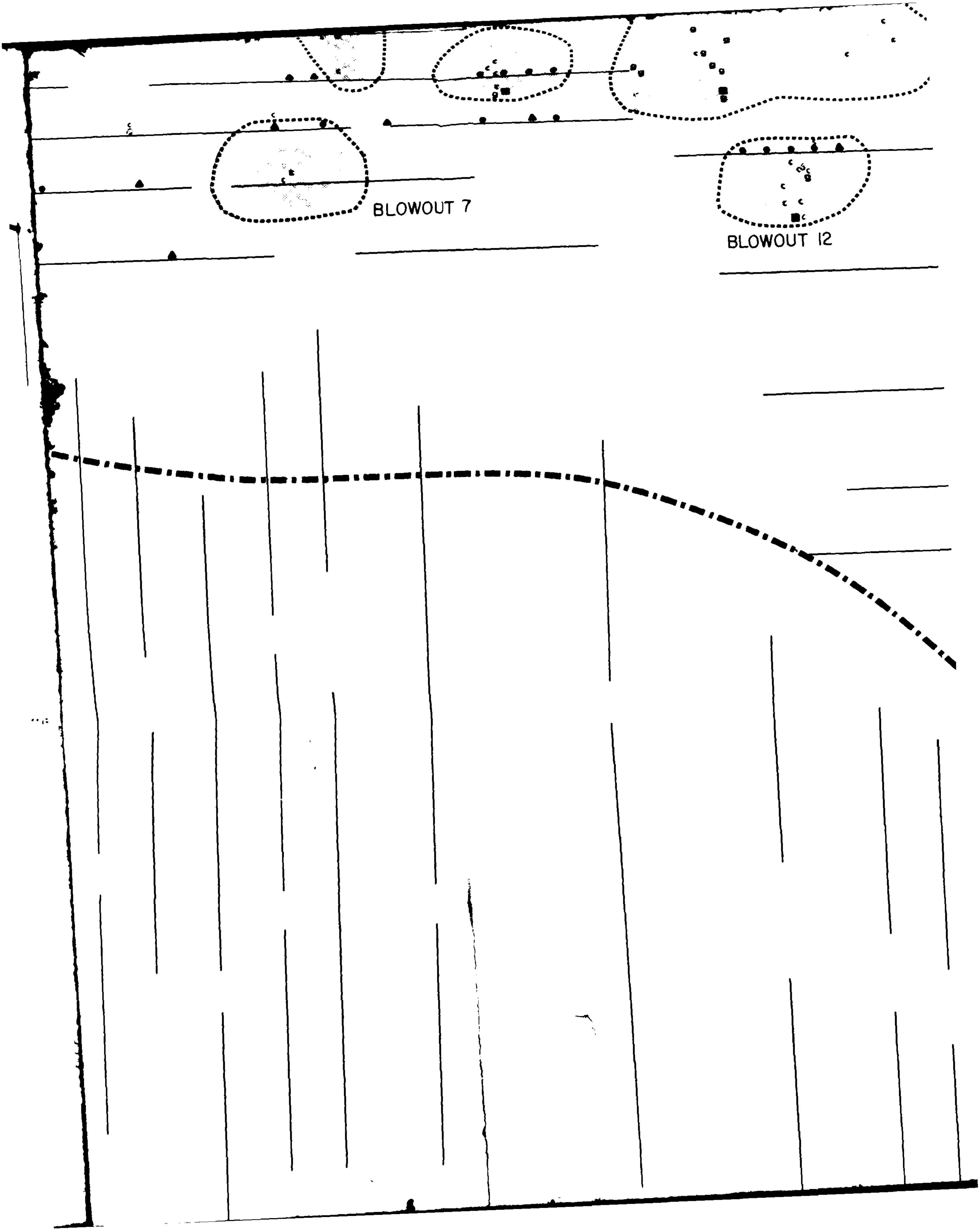


FIGURE 4.9
LOCATION OF GRIDS AND TRANSEC
ENM 10230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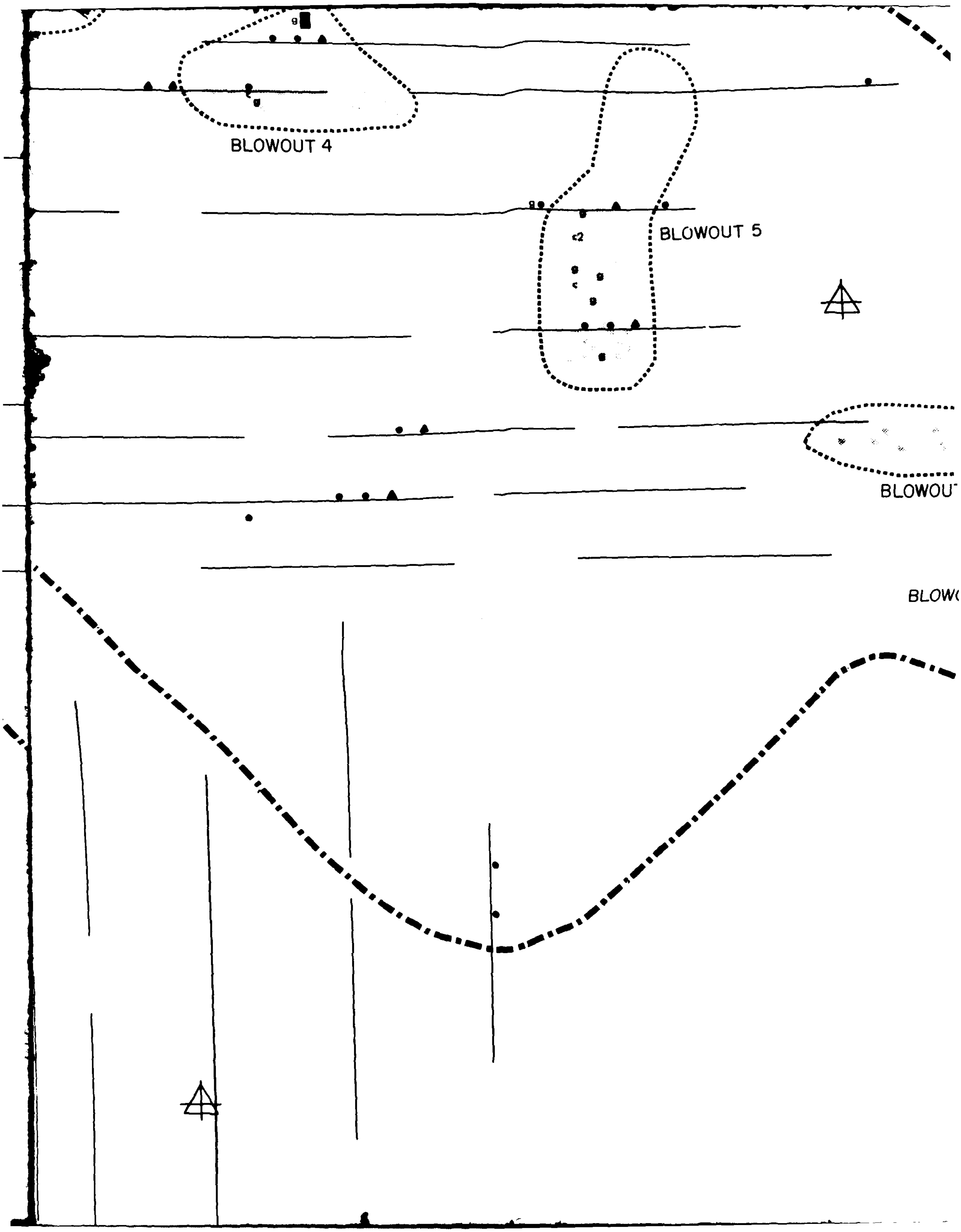
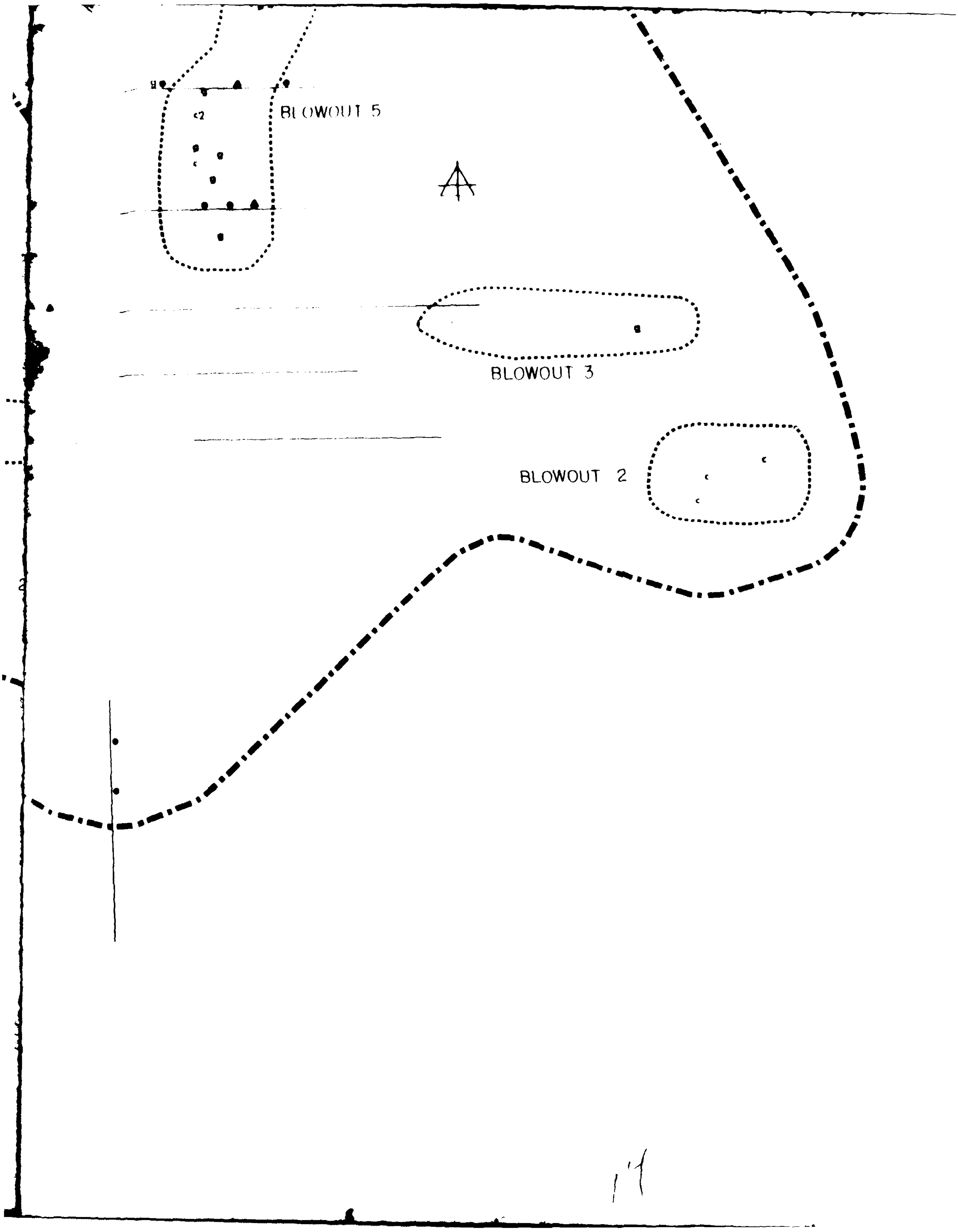

BLOWOUT 4
BLOWOUT 5
BLOWOUT
BLOW



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