PROJECT: CULTURAL RESOURCES TECHNICAL REPORT ON THE COSO GEOTHERMAL STUDY AREA

IN SUPPORT OF: COSO GEOTHERMAL DEVELOPMENT ENVIRONMENTAL STATEMENT

Technical Report No. EMSC 8312.20

Submitted to

Bureau of Land Management
Bakersfield District Office
800 Truxtun Avenue, Room 311
Bakersfield, CA 93301

Rockwell International

Environmental Monitoring & Services Center
Environmental & Energy Systems Division
2421 West Hillcrest Drive
Newbury Park, CA 91320
(805) 498-6771

April 1980

Contract No. YA-512-CT8-216

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Prepared under the supervision of
C. William Clewlow, Jr.

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I. INTRODUCTION

In compliance with Section 102(2)(C) of the National Environmental Policy Act (NEPA), the Bureau of Land Management (BLM) has contracted with Rockwell International to prepare an Environmental Impact Statement (EIS) on the consideration of the leasing of lands for geothermal development of the Coso Geothermal Study Area (CGSA). This proposed program of geothermal development is described in Chapter 1 of the EIS. Individual resource studies have been undertaken in the CGSA in order to provide a data base and to identify zones which are sensitive to geothermal development.

The following report, which was prepared for Rockwell International by Environmental Resources Group (ERG) under the supervision of C. William Clewlow, Jr.,[1] provides a description and evaluation of cultural and historical resources in the CGSA, identifies sensitive zones in regard to such resources, and recommends measures for the mitigation of potential impact to such resources that may result from the proposed geothermal development program. This is in accord with various legal requirements that mandate federal attention to cultural resources.

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1. Various portions were authored or compiled by C. William Clewlow, Jr., Helen Wells, and David S. Whitley.

II. BACKGROUND

A. LOCATION AND ENVIRONMENTAL SETTING OF THE STUDY AREA

The Coso Geothermal Study Area (CGSA) comprises 72,640 acres (113.5 square miles), located in southwestern Inyo County, California. Of the total, 28,160 acres are public lands administered by the BLM; 41,560 acres are within the Naval Weapons Center (NWC) withdrawal; and approximately 2,920 acres are NWC-owned lands. Most of the study area is located east of Highway 395, north of Little Lake, with approximately eight square miles located west of the highway between Dunmovin and a point one-half mile south of Coso Junction (see Figure 1). Figure 1 also depicts the Known Geothermal Resource area (KGRA).

The environmental setting of the study area is discussed in detail in the reports on other individual resources in the Environmental Impact Statement; and the environmental setting of the Darwin Planning Unit, of which the subject BLM lands are a part, is described in the Cultural Resources Overview (Norwood and Bull, 1978). Therefore, only the major features of the environmental setting of the CGSA will be sketched here.

The study area is situated at the western edge of the Great Basin and includes part of the northern Mojave Desert. Specifically, it encompasses most of Rose Valley and the lower reaches of the Coso Range. Numerous cinder cones and basaltic lava flows testify to recent volcanic activity in the area. Geological processes have produced not only the geothermal resources now under consideration for development, but various mineral deposits, including sulfur and mercury, which have attracted mining activity since the mid-nineteenth century. The presence of a major obsidian source, Sugarloaf Mountain, was of importance to the prehistoric inhabitants of the area (Harrington, 1951a), a statement supported by the present cultural resources inventory.

Climatic changes in the last 40,000 years have periodically affected the hydrology and vegetation of this presently arid region, where springs are the major source of a potable water supply most of the year. Another permanent water source is found at Little Lake at the southwest edge of the study area. During the Wisconsin Glaciation, the climate was much wetter, permitting the formation of a series of lakes in eastern California basins. Owens Lake overflowed into China Lake and Searles Lake, which in turn flowed into Panamint Lake and Manly Lake. Water levels were highest between 11,000 and 12,000 years before the present (BP) (Mehringer, 1977:118-120). Pluvial rivers shaped the basalt canyons which characterize the study area today. Small playa lakes, which fill after precipitation, dot the lower elevations.

Plant communities present today in the study area itself are Alkali Sink, Shadscale Scrub, Sagebrush Scrub, Creosote Bush Scrub and Joshua Tree Woodland. Although Pinyon-Juniper Woodland is found adjacent to the study area above 6,000 feet and must be considered as a part of the settlement-subsistence pattern of its prehistoric inhabitants, it is not present within the CGSA itself. When the climate was wetter, a marsh community similar to that found on the shores of Little Lake must have been more widespread.

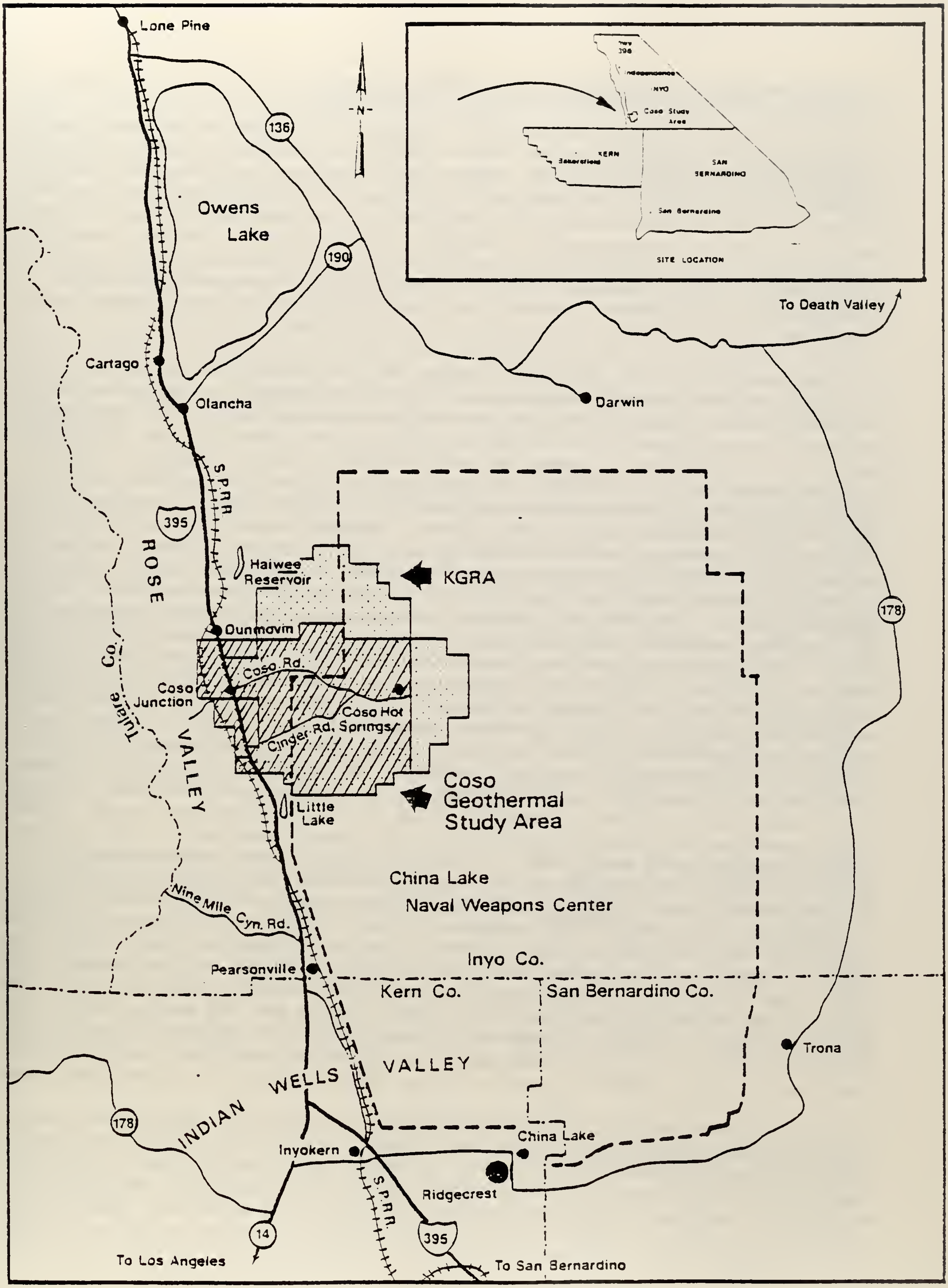

Figure 1. LOCATION OF THE STUDY AREA

B. RELATIONSHIP OF ENVIRONMENT TO CULTURAL RESOURCES

As a study area for archaeological research, the CGSA is characterized by a number of unique features which render it both 1) a superb setting for the investigation of aspects of prehistoric life which are not commonly available archaeologically, and 2) an area with particularly troublesome qualities for conducting initial assessment and evaluation of cultural resources in order that they might be appropriately managed by the responsible federal agencies. Because these unique features are critical for the understanding of the area archaeologically, and because they have necessitated some methodological innovations in the following report, they will be given specific attention at this point.

Geographically, the CGSA is situated at the general intersection of at least two or three major culture areas; and it is readily accessible, due to its location near natural mountain passes (like Walker Pass), and along major routes of trade, travel, and migration (the eastern Sierra slope, the Mojave Desert trail system) to a number of more distant cultural subareas. The fact that the area lies in a natural transit corridor, and is a source area for a major prehistoric economic trade item (obsidian) lends a special quality and an extraordinary complexity to its prehistoric remains. Major culture areas which converge, by their geographic contiguity, on the CGSA are the Great Basin, the Mojave Desert (regarded by some as an extension of the Great Basin culture), and the California culture area as represented by the eastern edge of the southern Sierra. Indirect or secondary links are detectable, both for geographical reasons, and from cultural data, which tie the CGSA secondarily to such areas as the western Sierra, the Central Valley of California, and the Colorado River. It is not unlikely that the area of the CGSA has enjoyed a culturally "cosmopolitan" position among the hunters and gatherers of the wider general region of which it is a part for many thousands of years. (Davis, 1978a, while not dealing specifically with the CGSA, makes this point eloquently and convincingly for the general region.) As might be expected, the visible prehistoric remains in the CGSA do not conform to the pattern that would be expected in an area that was more culturally insular. Thus, from the outset of the field investigation unusual sampling results were encountered, and methodological problems were compounded. Such difficulties were expected from perusal of published literature on the general area which made clear that it: 1) held the earliest accepted human habitation remains in California (*ibid.*); 2) contained the single most remarkable and inexplicable concentration of pecked rock art in the Great Basin, if not the entire nation (Grant, Baird and Pringle, 1968); 3) contained rock art elements which implied shamanistic cross-ties to other style areas (Garfinkel, 1978; Clewlow, 1980); and 4) had been used by sizable local groups, for long periods of time during which substantial culture change had occurred (Lanning, 1963; Harrington, 1957; Bettinger, 1975, 1976, 1977). These generally expected qualities were in fact confirmed for the specific area of the CGSA during the field sampling.

In addition to the unusual geographical qualities, and their general cultural consequences noted above, the CGSA possesses two singular and unique resources, better referred to as point sources. These are the Coso Hot Springs themselves, regarded as a ritual spot by Native Americans, and Sugarloaf Mountain, a massive source of good-quality obsidian which has been traded throughout California for many years (Ericson, 1977). It is clear that this source influenced the development of an aboriginal trading system established with the Kern River area and the Central Valley. Use of this point source has had such a dramatic effect upon the visible prehistoric remains of the CGSA (and has subsequently presented concomitant methodological difficulties in terms of sampling, predictability, sensitivity rating, and resource management evaluation and planning) that it deserves adequate characterization at this point in the report.

Sugarloaf Mountain is a large rhyolite dome with major obsidian outcrops. On and around its slopes are located a number of recognizable prehistoric quarry sites, many of them recorded as such. It appears clear that these quarry areas have received visits from prehistoric populations for millennia. Traces of these visits are heaviest near the primary and preferred deposits; they thin out as one leaves the area where most of the high-quality obsidian is obtained, but are observed throughout an area of several miles surrounding Sugarloaf.

Much of this obsidian has been worked or fashioned in some way by prehistoric knappers. Some pieces have received major purposeful shaping and are recognizable as tools (artifacts). Some of the nodules have received minimal shaping or retouch and are not readily recognizable as shaped tools. Some have been used by local inhabitants throughout prehistoric times in the course of their everyday economic activity, causing normal and expected wear patterns. Some nodules or hunks have been used by groups in transition through the area in the course of whatever activities were necessary to maintain their life during this transition. Such a pattern would be predictable as a result of the obsidian source alone, and has, in fact, been noted at obsidian quarries throughout the world. The effect in the CGSA, however, has been notably amplified by the convenience of access for peoples of several major geographical and cultural areas as noted above. The results, in field reconnaissance terms, are that considerable amounts of obsidian from the main procurement area at Sugarloaf have been transported to and deposited at various parts of the study area.

In addition to the quarried outcrops and the flow from those outcrops, much obsidian occurs in the form of airfall (pyroclastic) obsidian. This usually appears on the surface in nodule or lump form and results from explosions at the time of the obsidian formation. Such airfall (pyroclastic) obsidian occurs all over the study area. It is heavy in some localities and thinner in other patches. Much of this obsidian has been naturally deposited, but some has undoubtedly been transported throughout the area by human activity. Some is of high quality for use as tools and is quarried and transported much in the same manner as the larger source areas on the mountain itself. Nature has also transported much of this airfall obsidian by water, by slope wash, or by other natural means.

Thus a blanket of obsidian of varying density and thickness can be observed over almost the entire study area. As noted, much of this has been <u>intentionally</u> altered by human shaping, or altered in a regular and recognizable manner by the repetition of various prehistoric economic activities. This intentionally or purposefully altered or deposited obsidian, in addition to all the surface material which was naturally deposited in unaltered form, has been subjected to thousands of years of <u>accidental</u> or natural alteration. Such alteration can occur from natural agencies such as freezing and thawing, brush fires, and flash flood transport. Large game animals like deer, antelope, and bighorn sheep can alter obsidian flakes by stepping upon the pieces of obsidian and causing pressure flaking. Domestic or feral stock animals, such as cattle, sheep, horses and burros, can also cause obsidian to chip and fracture in ways which make them difficult to distinguish, under normal field conditions, from purposeful human alteration. Such determinations must be made in careful laboratory studies. Since stock animals have grazed the study area heavily for many years, it is a certainty that much of the natural obsidian has been altered by passing herds.

Human beings passing over obsidian surface material, either on foot or in vehicles, cause similar alterations. The area has seen active mining, ranching, and recreation for many years. It has also seen use in military training activities (abandoned tanks can still be seen in various sections of the study area), and has served up to the present time in naval bombing exercises. This activity has undoubtedly altered original or natural surface configurations of obsidian in the area, causing "autofacts" (a term sometimes used for rock fragments apparently altered by natural or accidental agents--including autos) which are difficult to evaluate in the field.

The result of all such activity for the present study is that a "masking" effect, consisting of large amounts of obsidian in various states of natural and cultural deposition and alteration, occurs over much of the surface of the study area. Since it is nearly impossible to characterize the agency responsible for such alteration without laboratory examination, it is difficult or impossible to assign the material to traditional site types or categories. Thus most of our sites must simply be called lithic scatters until further study. The obvious fact that surface concentrations of prehistoric cultural remains ("legitimate" sites) are almost invariably mixed, intermingled, and sometimes overlain by obsidian which was naturally deposited and then altered by agencies other than purposeful prehistoric cultural activity compounds the problem of initial field evaluation enormously.

This situation has two immediate practical results. The first is that Sugarloaf Mountain itself cannot be used as an environmental stratum for purposes of sampling. This is because the presence of obsidian cross-cuts all other recognizable environmental variables which can be used as strata. That is, it is present in all strata, and its presence and condition cannot, at the field investigation level, be assigned with certainty to natural or cultural factors. As such, it does not represent a truly environmental variable, and would make probability sampling hopeless if employed as a discrete stratum.

Secondly, it renders ineffective any attempt at an elegant predictive model. Stated simply, the obsidian "blanket" over the study area inhibits recognition of expected archaeological index artifacts which would allow correlation between recognizable site types and environmental variables. While hampering the above process, the large scatters themselves present a data mass which is itself not subject to adequate definition at the initial field stage of investigation. This explains our failure to produce a truly predictive model in standard format.

The same set of facts however, serves to emphasize the unique nature of the area archaeologically. The presence of the obsidian source, together with the unusual archaeological situation in which it is set, presents an almost unparalleled opportunity to investigate how primitive man exploited such a valuable resource as obsidian and how he patterned his social space and his subsistence activities in an area (the CGSA) which was the focus of such unusual economic activity and the locus of such wide cultural diversity.

With respect to Coso Hot Springs, it is clear that this area has served as a ritual location for a great number of years. The precise antiquity of ritual use of Coso Hot Springs is impossible to determine with the present data base. It is probable, however, that such use of the area extends far into the past. Two types of sites, in a broad sense, may be said to exist in and around the hot springs. One type comprises the normal economic productivity sites that are associated all over the Great Basin with prehistoric habitation. These involve the exploitation and use of various natural resources in the area. The other type comprises religious or sacred sites which relate to and result from use of Coso Hot Springs by Native Americans for religious or ritual purposes. These site types are not mutually exclusive but are overlapping and intermingled in the archaeological record. In terms of archaeological visibility, they are confused and not particularly separable. One must remember that in dealing with the ritual uses of Coso Hot Springs, we are dealing with a cultural variable and not an environmental variable. Sites of religious significance are often characterized by very low archaeological visibility. Cultural variables (such as recognition by prehistoric groups of an area like Coso Hot Springs as a sacred spot) are not comparable to environmental variables (such as the actual physiography of the hot springs) and are, therefore, not of utility in stratifying the area for sampling purposes in the process of understanding prehistoric activity there. This fact also rendered difficult the preparation of a standard predictive model.

It is also worth noting that, in contrast to other areas of the California desert, such as the East Mojave, plant communities do not demonstrate the wide diversity (on a gross level) that might be expected. This results principally from the limited range of elevations which is represented within the CGSA. In the Yuha Desert, for example, Weide (1974: 92) is able to designate Mountain Shrub, Conifer and Pinyon-Juniper communities as a single stratum, which can be distinguished principally on the basis of elevation from three other vegetation strata. In the Owens Valley, Bettinger (1975, 1976) recognizes four vegetation strata, two of which are distinguished from the others on the basis of their elevation above 6,500 feet; the two lower strata are distinguished from one another on the basis of their proximity to the Owens River. Such gross distinctions may be more relevant to the aims of archaeological research than are the finer distinctions produced by detailed vegetation mapping, because they approximate more closely the limits of the site catchment, as this term is defined by Vita-Finzi and Higgs (1970). For purposes of predicting the locations of cultural resources, then, the study area exhibits little diversity of plant communities.

One last consideration to be noted with respect to the CGSA is that it is actually (in terms of prehistoric settlement patterns) a relatively small area. It represents only a portion of a total settlement pattern that includes the many resources of the nearby Sierra as well as large pinyon stands at higher elevations outside the study area. With only a portion of the entire system represented, and with the complicating factors noted above, reliable predictable modeling proved to be very difficult.

Briefly then, an attempt to develop a predictive model which would relate site density and site types to environmental strata, defined strictly on the basis of landform and/or hydrology, has not succeeded here for reasons noted above. This should be recalled when reading sections below which detail our choice of usable environmental strata and our field approach to sampling. Elsewhere in the California desert such models have worked well (e.g., Wells, 1977); the CGSA, however, must be viewed as a unique and highly sensitive area. This introduction is provided as a conceptual guideline for sections which detail the study below.

C. RESEARCH OBJECTIVES

The specific objectives of the cultural and historical study were as follows:

- to provide baseline data on the nature, extent, diversity, dispersion and density of cultural resources within the Coso Geothermal Study Area;
- to develop a predictive model of cultural resource density, dispersion and diversity within the Coso Geothermal Study Area, based on an assessment of environmental and/or cultural variables; and
- to evaluate the cultural and historical resources identified against the National Register of Historic Places criteria.

In order to achieve these objectives, a review of the relevant literature was undertaken, other scholars familiar with the study area were consulted, and a field investigation was conducted. Books, articles and manuscripts consulted are listed under References Cited, and persons and institutions consulted are listed in Appendices A and B. The field investigation was designed as a two-stage stratified random sample of 25 percent of the study area. The sampling design, methodology and results of this investigation are presented below under the appropriate headings.

D. REGIONAL CULTURE HISTORY

The regional culture history of the study area (see Figure 2) may be divided into three parts: post-contact history, ethnography and prehistory. All three have been the subject of recent, intensive research projects concerned with the study area itself, with portions of it, or with the larger region of which it is a part. As the reader may refer to these other manuscripts and reports, in addition to the original sources, for more detailed information on specific subjects, this report will summarize briefly the regional culture history, restricting detailed discussion to the study area itself. The most recent of these reports, prepared by Iroquois Research Institute (1979) according to the terms of a contract with the NWC, focuses on the Coso Hot Springs and Devil's Kitchen area but also considers a much larger regional study area than the CGSA. An ethnographic study of Coso Hot Springs itself was prepared by Theodoratus and Smith-Madsen (1977) for the Office of Historic Preservation, Department of Parks and Recreation, State of California. A cultural resources overview was prepared by Norwood and Bull (1978) of RECON for the BLM on the Darwin, Eureka, Panamint and Saline Planning Units. (The BLM land within the CGSA is located in the Darwin Planning Unit.) Garfinkel's (1976) report on the archaeology of Fossil Falls and Little Lake focuses on a small area, part of

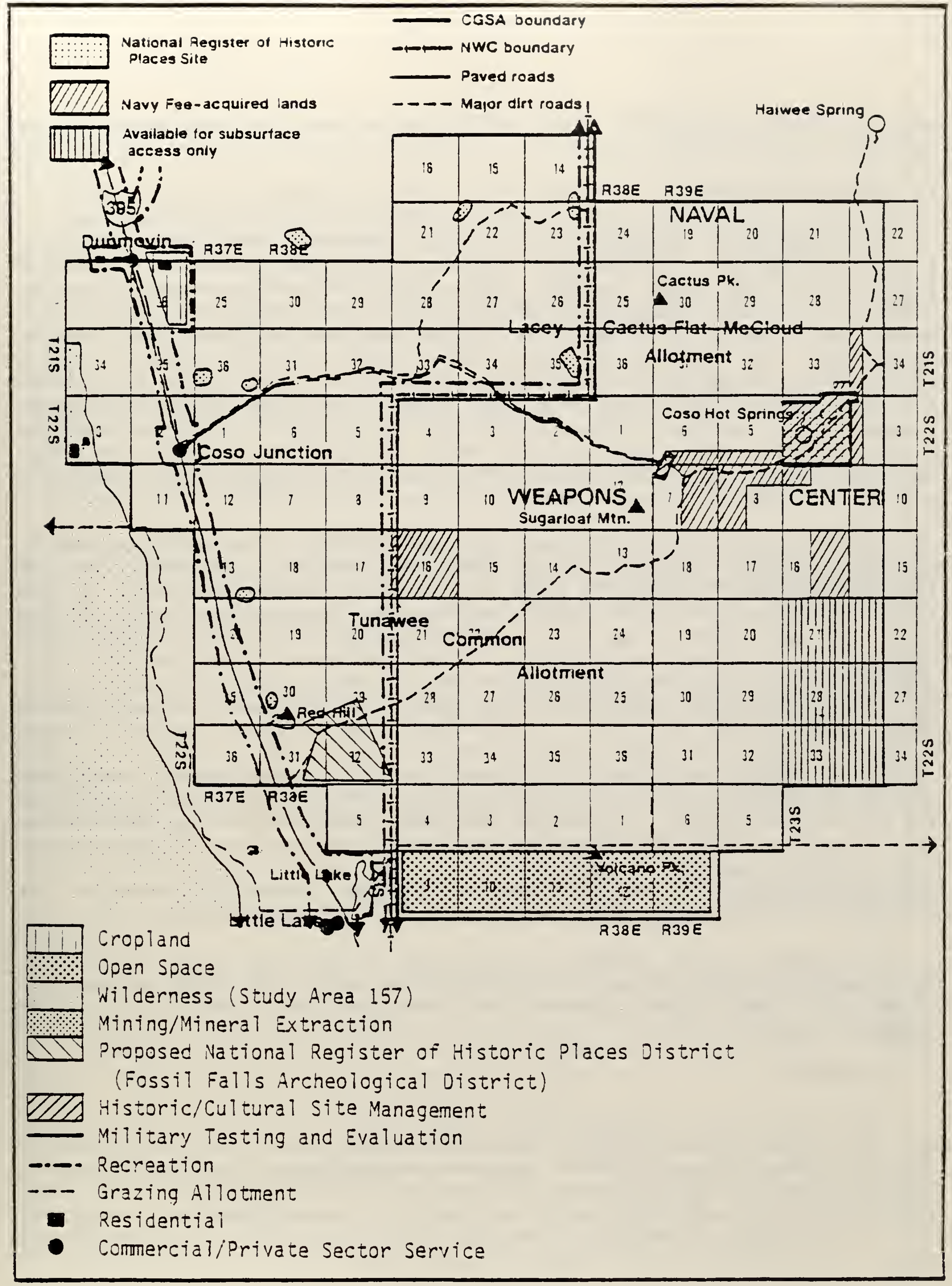

Figure 2. COSO GEOTHERMAL STUDY AREA (CGSA)

which is located within the CGSA, but provides a brief, clear summary of the relevant culture history.

1. POST-CONTACT HISTORY

This section is summarized principally from Iroquois Research Institute (1979) with additional information from Chalfant (1933) and Wilke and Lawton (1976). Until the 1850s, European penetration of the region was mainly by occasional trappers, settlers and prospectors. In the 1830s and 1840s, Joseph Walker led a series of expeditions through the region, giving his name to Walker Pass. One of these was Captain John Fremont's third expedition, which headed north through Indian Wells Valley in 1845. In 1859, Captain J.W. Davidson led a military expedition from Fort Tejon to the Owens Valley, seeking to recover cattle reportedly stolen by Indians from southern California ranchers. Davidson's route led through Indian Wells Valley, past Little Lake, Rose Spring, and Owens Lake. His report (Wilke and Lawton, 1976) provides an early account of the Owens Valley Paiute.

The first major mining discovery was made in 1860 in the Coso Mountains by Dr. Darwin French. Gold and silver mining activity was concentrated in the 1860s around Coso Village, 11 miles northeast of Coso Hot Springs. By the 1870s this activity had been considerably reduced, due to exhaustion of the ore body. The development of the Darwin and Cerro Gordo mines to the north probably contributed to the decline of mining in the Coso Range. Mining activity did, however, continue at a reduced level into the twentieth century. During World War I, sulfur deposits were mined in the Devil's Kitchen area. Cinnabar mining began in the 1920s.

Cattle ranches were first established in the valleys adjacent to the study area in the 1860s; and cattle, sheep and goats ranged on what is now the NWC by the end of the century. No ranches were established within the CGSA itself, but a cattle camp was maintained at Coso Hot Springs in the 1920s by the Eaton Land and Cattle Company. A network of wagon roads and trails crossed the study area by the 1880s; and today Highway 395 roughly follows the route of the Midland Trail, the major road through Rose Valley and Owens Valley.

The history of the commercial development of the Coso Hot Springs, known to miners and settlers as early as the 1860s, has been investigated and reported in detail in the Iroquois Research Institute Report (1979) and it will not be repeated here.

2. ETHNOGRAPHY

The study area is located at the western edge of the Great Basin, which was occupied ethnographically by Shoshonean peoples. The Great Basin Shoshoneans are Numic-speakers, most of whom shared certain basic cultural features. Kroeber (1925) and Steward (1938) are the basic ethnographic sources for the study area, which was occupied by the Koso or Panamint Shoshone. Additional data on the Panamint Shoshone are provided by Grosscup (1977). The neighboring Owens Valley Paiute are described by Steward (1933).

Steward places the study area in the Kuhwiji subsistence district. He describes it as a

> subsistence area, embracing about 1,000 squares miles and centering in the Koso Mountains, where the greater precipitation in the Upper Sonoran and Transitional Zones supported most of the important food plants, but including also the surrounding plains and the eastern escarpment of the Sierra Nevada. The inhabitants, who lived in three winter villages, exploited the entire territory, but lacked sufficient inter-village cohesion to constitute a true band (Steward, 1938: 80-81).

Steward (ibid.: 81) lists the names of four major villages and gives their locations as Little Lake, Coso Hot Springs, Cold Spring (five miles south of Darwin), and Olancha.

The following discussion of settlement-subsistence patterns is summarized from Steward (1938: 80-83).

In the winter, the inhabitants lived in pit houses, eating stored seeds and hunting rabbits. In April, some families moved to Haiwee Spring to gather greens; in June, they went to Cold Spring, where some families had wintered, to hunt rabbits. Antelope, which were found in Indian Wells Valley, were sometimes hunted communally at this time of the year.

In the summer some families might go to Saline Valley or even to Death Valley to gather mesquite, which they made into flour, storing any surplus. Between July and September they collected seeds in the Coso Range, remaining as close as possible to their winter villages to avoid long trips back and forth to seed caches in the winter. During September or October, families collected pine nuts in the higher elevations of the Coso Range, traveling there in groups and sometimes joining families from other villages. If the crop was small in the Coso Range, some families traveled to the Panamint Mountains.

Autumn was also the time for large rabbit drives, held at Rose Valley, Darwin Wash, Cold Spring, Little Lake, and Olancha, and for hunting ducks at Little Lake.

Steward (1938: 83) lists certain variations in the annual round, which might take the inhabitants of the area farther away. Mountain sheep were hunted by individuals in the Sierra Nevada, as well as in the Coso Range. Deer were also hunted in the Sierra Nevada, and acorns might be collected there. Larvae were collected at Owens Lake. A variety of another animals and fish were eaten, but meat was not of major importance in the diet.

Among the plant foods exploited by the Shoshone of this area, the pine (pinyon) nut (Pinus monophylla) was of major importance. Large quantities of this crop were harvested and stored each fall to provide sustenance through the winter. As the CGSA does not include the higher elevations of the Coso Mountains, where the pinyon grows, sites relating to this major activity would not be expected to be included in the data collected in the field survey.

The range of Pinus monophylla in the Great Basin has changed to some extent during the post-pluvial period. Such changes are indicated by palynological data from archaeological sites and from wood rat midden studies in various regions of the Great Basin (Beeson, 1974: 6; Madsen and Berry, 1975: 399; Mehringer, 1977: 134). As the direction, degree and duration of such changes vary, and as suitable data of this kind are unavailable for the study area, it is reasonable, following Bettinger's example (Bettinger, 1975, 1976), to expect most archaeological sites related to pinyon exploitation to occur within the present-day pinyon/juniper zone. The requirements of pinyon harvesting and the difficulties of transportation (see Coville, 1892; Dutcher, 1893) indicate that camps related to pinyon harvesting would be established as close as possible to the resource.

The social organization of the Shoshone who occupied the study area was typical of most hunters and gatherers of the Great Basin; it is described by Steward (1938: 83-84). The nuclear family was the basic economic unit. Village organization was loosely structured, as villages were not occupied throughout the year, and village composition might vary from one winter to the next. The major cooperative activities were rabbit and antelope drives, which were directed by village headmen who held little political power. The pine nut harvest might bring large groups together, but required little cooperative effort. Villages usually consisted of unrelated families, so village endogamy was permitted. Post-marital residence was usually matrilocal until the birth of the first child, then patrilocal or neolocal; but residence rules were flexible.

3. PREHISTORY

Major archaeological investigations have been conducted adjacent to the study area near Little Lake and at Rose Spring, where the excavation of deep, stratified deposits provided data which may be used in reconstructing a regional cultural sequence.

Excavations at the Stahl site (Iny-182) were conducted between 1948 and 1951. Situated on a low terrace northwest of Little Lake, the Stahl site represents a village attributed to the Pinto period (Harrington, 1948, 1949, 1950, 1951, 1957; Simpson, 1949). Seven house floors marked by postholes were discovered here (Harrington, 1957: 24). A stratified cave located at the edge of the village site, which was excavated by S.M. Wheeler, yielded material representing a sequence extending from the Pinto period to the protohistoric (Harrington, 1953). Harrington (1952) excavated another stratified deposit, known as the Fossil Falls site, the lower portion of which may date more than 10,000 years before the present (BP).

At Rose Spring, approximately one and one-half miles north of the study area, Harry Riddell and Francis Riddell (1963) conducted excavations in 1941 and 1956, respectively. The Rose Spring site, Iny-372, is a deep, stratified deposit, situated at the base of a cliff beside a spring. A large portion of the site had been destroyed by the construction of the Los Angeles Aqueduct in 1912-1913, but the intact portion revealed a cultural sequence which extends from the Lake Mojave period or before until the Late Prehistoric (Lanning, 1963). Lanning used data from the Little Lake site, from Cottonwood Creek (Iny-2), an Owens Lake site which was excavated by Harry Riddell (1951), and from the Rose Spring site to construct a general cultural sequence for the area. This sequence was shown to have validity, and was supported by radiocarbon dates from a wide area of the western Great Basin (Clewlow, Heizer, and Berger, 1970).

Lanning (1963: 281) interprets the site as a hunting camp and workshop, where obsidian artifacts were produced for trade with other areas. These items were exchanged for steatite and shell beads from the southern and central California coast, possibly through the Yokuts of the Central Valley (ibid.: 238). Middle Horizon shell bead types from the coast appear along with the introduction of Rose Spring series projectile points during Lanning's Middle Rose Spring phase, and evidence of trans-Sierran trade continues throughout the later phases of Lanning's sequence (ibid.: 268-269). Few grinding stones and no structural remains were encountered at the Rose Spring site, suggesting that it was probably a seasonally occupied camp, rather than a permanent village (ibid.: 240).

The Ray Cave site (Iny-349), located in the Coso Range 12 miles southeast of Coso Hot Springs, and the Baird site (Iny-1560), three rock shelters located approximately 10 miles southeast of Coso Hot Springs, provide additional archaeological data which are relevant to the study area. Radiocarbon dates from Ray Cave indicate that the shelter was occupied by 2,000 BC and possibly earlier. Panlaqui (1974) suggests that the main period of use was between 1,500 BC and AD 1,500, and that the site represents a temporary camp used by people en route to higher elevations for pinyon nut harvesting and sheep hunting. The artifact assemblage from the Baird site suggests a Late Prehistoric and historic occupation. Hillebrand (1974) interprets this site as a hunting shelter which was seasonally occupied.

An intensive study of rock art in the Coso Range was undertaken by Grant, et al. (1968). The sites discussed are adjacent to the study area, and one is situated within the CGSA. Rock art constitutes a subject of major interest in the study area. The Coso petroglyph style, which is unique to this region,[1] is worthy of further study. The rock art canyons, which are located between five and nine miles east of Coso Hot Springs, are listed on the National Register, and are a registered National Historic Landmark.

Bettinger (1975, 1976) reconstructed the settlement-subsistence pattern for a portion of Owens Valley, centering on the town of Big Pine. He surveyed a random sample of tracts in his study area, stratified by biotic zone, and compared the actual distribution of artifact categories with the predicted distribution, based on ethnographic data. He then classified the archaeological sites into five types and dated sites and components by means of diagnostic projectile points found on the surface in order to examine changes in settlement and subsistence patterns through time. Bettinger's data support an occupation for the region from ca. 3,500 BC to the beginning of the historic period.

He notes a shift away from the use of riparian resources and a greater dependence on those of the desert scrub community between 1,200 BC and AD 500. Bettinger suggests that pinyon exploitation begins between AD 600 and AD 1,000, prepresenting a broadening of the subsistence base. This, he argues (1976: 89-91), may be explained by either a reduction in the existing subsistence base, due to climatic change, or by an increase in population through inmigration. More recent work by Garfinkel, et al. (1979), McGuire, et al. (1980), and Hall (1980) suggests a probable date of 1,200 BC for pinyon exploitation.

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1. The region generally comprises the Coso Range and associated canyons, plateaus and basins.

Probably because the region is situated where physiographic and culture areas meet and overlap, at the southwest edge of the Great Basin and the northern extremity of the Mojave Desert of California, a number of chronological schemes and cultural sequences have been applied to the region. These are summarized by Norwood and Bull (1978: 47-75). For the Great Basin as a whole, the best ordering of cultural sequences is provided by Hester (1973); and the most up-to-date synthesis of projectile point types and series, and their chronological and geographical placement, is provided by Heizer and Hester (1978). For the eastern California portion of the Great Basin, a chronology has been developed by Bettinger and Taylor (1974), and has been discussed further by Bettinger (1977), Hall (1980), Garfinkel, et al. (1979), and McGuire, et al. (1980).

A paleoindian occupation of the region has long been postulated (Campbell, 1949; Davis, 1963; Borden, 1971) and disputed (Wilke, King and Bettinger, 1974; Bettinger, 1977); but recently published data from China Lake (Davis, 1978a, 1978b) do support the possibility of a paleoindian occupation, characterized by fluted points and the association of tools with Rancholabrean animal remains. The portions of the sequence proposed by Bettinger and Taylor (1974) are more generally accepted and provide the principal source for Table 1 below.

Further refinements of the cultural sequence for this region are needed. The more general outlines of the sequence are probably applicable throughout the region, but the local time range for some projectile point types requires refinement. Settlement-subsistence pattern studies have focused on particular valleys and local areas, making generalization of these data unreliable.

E. SUMMARY OF PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS IN THE STUDY AREA

Systematic surveys of portions of the study area had been conducted in 1976 by Alan P. Garfinkel, then an employee of the BLM, and in 1977 by the BLM Desert Planning Staff, as part of their inventory of the Darwin Planning Unit. Garfinkel's work concentrated on the Fossil Falls/Little Lake locality. BLM sample transects were surveyed west of Cactus Peak, at the west edge of Rose Valley in the area known as Portuguese Bench, and west of Highway 395 south of Red Hill. Concurrent with the surveys which were conducted for the present study, a survey of Red Hill and environs was undertaken by Christopher Drover (1979) of VTN Associates, as part of an environmental impact study for the Red Hill Cinder Mine. Ferris W. Borden (1971) of the Archaeological Survey Association of Southern California conducted a study of lithic material from the surface of Iny-1799, located in the Rose Valley east of Coso Junction. A survey and inventory of the Coso Hot Springs area was conducted in less than one day prior to its nomination to the National Register. This site is discussed separately below.

Additional sites in the study area were recorded in 1971 by Tom Chapman for the Maturango Museum/Mojave-Sierra Archaeological Society (MOSARC). Iny-105 was recorded in 1963 by G. Redfeldt of the Archaeological Survey Association (ASA). Redfeldt undertook some excavation of the site, which consists of a pictograph and associated rock shelters, but no report has been published. The site is also briefly mentioned by Grant, et al. (1968: 89), in their study of rock art of the region.

Table 1. CULTURAL SEQUENCE FOR CENTRAL EASTERN CALIFORNIA

Date	Period	Diagnostic Artifacts	Characteristics	References
8,000 BC - 4,000 BC	Lake Mojave	Silver Lake and Lake Mojave points	Lacustrine adaptation, focusing on Little Lake and Owens Lake (Western Pluvial Lakes Tradition)	Bedwell, 1970
4,000 BC - 1,200 BC	Little Lake	Little Lake points, Humboldt series points	Hunting and gathering, emphasis on riparian plants and large ungulates	Bettinger, 1975
1,200 BC - AD 600	Newberry	Elko series points	Shift away from riparian resources, trans-Sierran trade begins	Bettinger, 1975, 1977
AD 600 - AD 1,300	Haiwee	Rose Spring and Eastgate series points	Emphasis on plant procurement, pinyon exploitation begins in Owens Valley; intensification of trans-Sierran trade	Bettinger, 1977
AD 1,300 - Historic	Marana	Cottonwood and Desert side-notched points, Owens Valley Brown Ware pottery	Increased pinyon exploitation, irrigation in northern Owens Valley	Bettinger, 1976; Lawton, et al., 1976; Steward, 1938

Appendix C contains a list of previously recorded sites in the study area and discusses those which either were not relocated or were reclassified or redefined by the ERG crew.

Coso Hot Springs, an area comprising approximately 820 acres of the CGSA, was listed on the National Register of Historic Places on January 3, 1978. Included in the historic area are portions of three health resorts dating from the early part of the twentieth century, as well as the Hot Springs itself and a prayer area on the former Inyo County road (now Coso Road), both of which are loci of religious value to Native Americans. Discussions of the significance of Coso Hot Springs are to be found in Theodoratus and Smith-Madsen (1977), Johnson (1977), NWCTS 78-59 (1978), and Iroquois Research Institute (1979).

The State Historic Preservation Officer has concurred with the BLM's recommendation for nominating the Fossil Falls Archaeological District (comprising 770 acres within the CGSA near its southwestern boundary) to the National Register of Historic Places. The proposed district includes a wide range of sites, including lithic scatters, camps, shelters, rock art sites, milling stations and midden deposits. Physiographic features include the Red Hill Playa, the channel of the pluvial Owens River and the Fossil Falls "waterfall." The area is described in detail in Garfinkel (1976).

III. ARCHAEOLOGICAL INVENTORY OF THE STUDY AREA

A. FIELD METHODOLOGY

The field crew generally consisted of six teams, comprising four persons each, although the size of each team varied at times. Illness occasionally reduced crew size, and individual teams were augmented part of the time by the presence of Native American monitors or of Clewlow or other non-crew personnel and professional visitors. On each team the crew chief, a graduate-student-level experienced field worker, was responsible for locating the assigned sample unit, ensuring that it was adequately surveyed, coordinating the recording of sites and making sure that NWC security procedures were followed. Each team included one member who was responsible for photography, in addition to the usual duties of a crew member. Drawing of artifacts and sketch maps was done by various members of the crew, but an attempt was made to utilize the talents of persons skilled at these jobs. Geological and botanical observations were contributed by all members of a team; but, again, certain persons were particularly knowledgeable about or interested in these subjects, resulting in some specialization of duties on some teams. Projectile points were typed on the basis of field observations; no surface collections were made.

Sample units were assigned before going into the field each day. The usual procedure was to locate one corner of the sample unit, using a USGS 15-minute series map. Compasses and rangefinders were also used. Sample units were generally accessible and easy to locate because of the presence of roads throughout the study area. The 1/2 mile quadrat (quarter section) was then covered in a series of traverses, with team members walking 20-30 meters apart, depending on the terrain. An effort was made to check all rock outcrops for rock art, shelters or grinding features.

Sites were recorded on BLM site record forms and continuation sheets (see Appendix D). Historic sites were recorded on historic forms and prehistoric sites were recorded on archaeological site record forms. Both black-and-white photographs and color slides were taken throughout the survey. Every site and every sample unit was photographed, as well as representative or diagnostic artifacts and features within sites. Diagnostic artifacts were also drawn and sketch maps were drawn to show the internal arrangement of complex sites or to give locational information.

A BLM sample unit record (see Appendix D) was also filled out for each quadrat surveyed. These records provide environmental data, as well as information on field conditions, route of surveyors across the sample unit, and number of sites recorded. A diagram of the sample unit showing major features was included.

The survey was conducted in three sessions. The first-stage sample was completed during the first of these sessions, between November 3 and November 11, 1978. Following a rest break, a preliminary analysis of the first-stage results and the drawing of the second-stage sample were performed; a second field session was then undertaken. The second-stage sample was surveyed during this session, which lasted from November 20 to November 28, 1978. By the last days of this session, some teams had completed all assigned sample units earlier than anticipated; additional units were then selected and assigned to these teams, thereby increasing the sample size beyond the requirement. Following the end of the second session, the data were reviewed and data gaps were identified: e.g., one sample unit in a playa zone had inadvertently not been surveyed; problems with site definition in an area where sites had been previously recorded required further investigation; and two major site complexes appeared to require more intensive survey and recording, including additional photographs.

The final field session, which was estimated to require a small crew organized into two teams for two days, was delayed until February due to weather conditions. Shortly before going into the field, site records from the VTN Red Hill Cinder Mine survey were received; apparent discrepancies between these records and our own were also resolved during the final survey (see Appendix C).

The time required to survey a sample unit, according to sample unit records, varied from two to six hours, depending upon team size, terrain, weather conditions, and number of sites encountered. Because travel times to and from units, and time spent locating units, were very short, a team was therefore able to survey an average of two units per day. Only two work days were lost because of snow, and no appreciable time was lost due to vehicle breakdowns. One half day of field time was spent in briefing and training crews regarding BLM recording procedures, and part of a day was required for NWC orientation. Some field trips were taken to acquaint the crew with the archaeology of the area, but the longer trips were scheduled on days when it was not possible to survey because of snow and on non-work days after a session had been completed.

B. DEFINITIONS AND CHARACTERISTICS OF SITE TYPES

All sites recorded were classified as to type, using the information provided on the site records and BLM site type definitions. The BLM site record lists 18 site types and provides an additional box labeled "other" (see forms in Appendix D). In the field, crew chiefs checked the appropriate box or boxes, determining the preliminary site classification. During the analysis, however, many sites were reclassified after reviewing additional information on the site record, such as features and artifacts present. Some sites were then classified according to subtypes. This was done with all lithic scatters, as the necessary information could be obtained from the site record. In the case of rock shelters, however, it was not always possible to determine the subtype based on the available information. A few of the sites were classified as more than one type, since the site categories listed on the BLM record form do not include combinations of types. The use of more than one type per site was avoided when a site could be classified as a temporary camp, a village or an occupation rock-shelter--types which include a number of artifacts and features representing several different activities. The use of more than one type was occasionally necessary in the case of a lithic scatter with associated rock alignment, or rock art associated with a temporary camp, village or occupation shelter. In all,10 of the 154 sites identified were recorded as more than one type; this small number had no measurable effect on data analysis or predictive modeling.

Site types found in the study area are defined below, using the BLM designation for each:

Archaeological Site Types

Lithic Scatter--A site usually consisting of flakes, cores, utilized flakes and flaked stone tools; other cultural material is absent. Study findings were classified as large scatters (greater than 50 m^2), small (less than 50 m^2), heavy or high-density (more than 30 flakes or flaked stone tools/10 m^2), and light or low-density (less than 30/10 m^2).

Quarry--A site where lithic material has been extracted from a seam, vein or outcrop. The by-products of tool manufacture, including flakes, cores and unfinished tools, are found at quarries.

Cemetery--A location where evidence of human interment is found.

Rock Alignment--Lines or more complex arrangements of cobbles and boulders, sometimes representing hunting blinds.

Petroglyph--A site consisting of pecked figures and/or designs on a boulder, rock outcrop, or shelter wall.

Pictograph--A painted figure or design on a boulder, rock outcrop, or shelter wall; petroglyphs and pictographs are frequently discussed together as "rock art."

Isolated Find--An occurrence of a single artifact or feature which is not included in another site type.

Cairn--A mound of cobbles or boulders that appears to have cultural significance.

Milling Station--A site indicating the procurement and/or processing of seeds and other food items; portable milling tools and/or bedrock milling features may be present.

Temporary Camp--A site that was occupied for a short period of time by a few people. Such an occupation would occur periodically over several hundred years.

Utilized Shelter or Cave--Archaeological material (other than rock art) in a rock shelter or cave, or under a rock underhang.

Village--An occupation site that was utilized for a long period of time, generally on a year-round basis. Such a site is distinguished from a temporary camp by the presence of a wider range and larger quantity of artifacts, occupational debris, and usually a midden.

Historic Sites--Sites representing the activity of Hispanic and Euro-American populations. In this context any site older than 50 years is usually regarded as an historic site. As few historic sites were recorded in the course of this study, they will be discussed individually in Section G, below.

C. FIRST-STAGE SAMPLING DESIGN

As required by the Statement of Work, a sampling design was developed to guide the first stage of the archaeological investigations of the Coso Geothermal Study Area. This design, which can be considered an areally-stratified probability sampling strategy, was constructed with the goal of providing a predictive model of prehistoric and historic site locations and density. The theoretical considerations on sampling techniques and predictive modeling which guided the selection of this strategy are discussed in Appendix H. This section discusses the sampling universe, the sampling method and the field implementation.

The location of the study area is shown in Figure 1. Approximately 74 percent of the 113.5 square miles included in this area are within the NWC, to the east of Interstate 395; the remainder are public lands administered by the BLM.

In order to provide a stratified probability sample that ensured adequate survey coverage of all portions of the study area, the Coso Geothermal Study Area was arbitrarily divided into five strata, or large areal units. For the first stage, arbitrary strata, based solely on an attempt to divide the study area into zones of approximately equal size, were used rather than strata based on environmental variables. This produced a sample that was distributed throughout the CGSA. Data collected in the course of the first-stage survey were then used to determine which environmental variables would be appropriate for restratifying the study area prior to second-stage sampling.

The locations of the first-stage strata are illustrated in Figure 3, in end pocket. Stratum I is located at the northern end of the study area and consists of 18 sections, all within the Naval Weapons Center. Stratum II is situated immediately south of Stratum I. It comprises 22.5 sections and, again, lies completely within the Naval facility. Stratum III is within Bureau of Land Management land to the west of the NWC installation. It contains 25 sections. Stratum IV, to the south of II and III, consists of a band of 25.5 sections cutting across the entire width of the study area. Three of these sections are Bureau of Land Management property. Finally, Stratum V is a band of 22.5 sections, located immediately south of Stratum IV. Four sections are public land administered by the BLM and the rest are within the NWC.

Once strata had been determined which ensured that no single portion of the study area would receive a disproportionate number of sample units, a grid was imposed on each stratum. This grid, consisting of consecutively numbered quadrats, 1/2 mile square in size (or 1/4 section each), was used to randomly locate the first-stage sample units within each stratum. Thus, the sample design can be termed an areally-stratified probability sample.

A series of random numbers was generated using a computer program written for this project and run at the Office of Academic Computing facility at the University of California, Los Angeles. For the first stage of the field work, 10 percent of the total study area, as originally defined, was chosen to be surveyed. It should be noted that the CGSA was subsequently redefined and reduced somewhat in area. However, because of logistical plans already made, it was decided to retain the original sampling strategy, though no units outside the newly defined boundaries were planned to be surveyed. This decision resulted in a sample comprising 11 percent of the reduced area. The design was approved by the BLM's District Archaeologist at that time, Helen Castillo.

Sampling was done without replacement. Thus, 50 sample units, each 1/2 mile square (1/4 square mile or 1/4 section) were surveyed in this stage. These 50 sampling units were allocated to each areal stratum in an approximate proportion to the total number of sections each contained, as shown in the following listing: Stratum I, 9 units; II, 11; III, 11; IV, 13; V, 6. Portions of Stratum 6 had already been surveyed by Garfinkel. Originally, numbers 1-50 were arbitrarily assigned to the units drawn for Stage 1 (i.e., random numbers drawn were arbitrarily renumbered 1-50). However, when the CGSA was redefined slightly by BLM and some units scheduled for sampling were removed, higher numbers were drawn to replace these and to retain the Stage 1 sample size of 50 units; see Figure 3 in end pocket. (Section 4, T22S,R39E, removed by BLM, erroneously received a second-stage sample, Unit 161, shown on Figure 3.)

The sample that was used appears to provide a very adequate areal coverage for the entire study area, and probably is very reasonable as a stage-one sample. The BLM portion of the study area (that is, the area outside of the Naval Weapons Center), for example, comprises approximately 26 percent of the total study area. This area, which includes portions of three different areal strata, was randomly allocated 26 percent of the total number of first-stage sampling units. Thus, all areas were well sampled.

To summarize this section, an areally-stratified probability sampling design was used to select 10 percent of the original Coso Geothermal Study Area for the first stage of the archaeological assessment; theoretical and practical factors were considered in the development of this design.

D. ANALYSIS OF THE FIRST-STAGE RESULTS AND DISCUSSION OF THE PREDICTIVE MODEL

After an examination of the first-stage archaeological survey results, a consideration of the geothermal model developed by Rockwell International, and consultation with Helen Castillo, Chief of Resources (BLM), a second-stage design and sampling unit apportionment was constructed to guide further archaeological research in the Coso Geothermal Study Area. While no rigorous analysis of the first-stage data had been made at the time the second-stage design was constructed, a detailed examination and discussion of the results during a series of crew-chief meetings identified five environmental strata that appeared to influence site locations. These strata were used to apportion the second-stage sampling units so that the potential for the recovery of information on certain types of sites was maximized. Additionally, the areas of highest probable geothermal development were emphasized in the second stage so that, if development of the area is initiated, the potential impacts to cultural resources could be predicted and necessary mitigating procedures designed.

The first-stage archaeological survey sample, then, investigated 50 one-half-mile-square sample units on 11 percent of the entire Coso Geothermal Study Area. Thirty-nine of the fifty sample units contained a total of 66 archaeological sites.

A review of the first-stage data, existing site survey records and the published reports on the area's archaeology suggested that there are five environmental strata that might be significant in terms of site locations.

Basically, the areas that appeared to be the most sensitive, in terms of site density and site significance (determined by the presence of sub-surface deposits or rock art, the density of the surface remains, and unusual features) are the playa lakes and their environs; the upper terraces on the west side of Rose Valley; and the areas within the Coso Range which are adjacent to intermittent stream drainages, as indicated by a broken blue line on the USGS 15-minute topographic maps. Weide (1973) uses the same criteria. Alternately, two areas of expected minimal archaeological significance were identified. These are valley areas of unstable alluvial activity, consisting of the eastern side of Rose Valley; and areas in the Coso Range lacking identifiable intermittent stream courses.

These environmental strata were defined, using geomorphological and hydrological features signified on the USGS 15-minute topographic quadrangles covering the study area, such that each sample unit was assigned to one of the five strata and assigned a consecutive identifying number within that stratum. This procedure was conducted prior to undertaking the second-stage field work. The five strata and the criteria used in their selection are shown in Figure 4. This figure graphically represents the classification of all potential sample units into environmental strata. The units that had been sampled during the first-stage sample were next classified into these five strata, and the first-stage site data for each stratum were examined prior to conducting the second-stage field work. This procedure is known as "post-stratification" (see Cowgill, 1975: 271; Matson and Lipe, 1975: 134; Thomas, 1973). In this case, it is a means of utilizing archaeological and environmental data collected in the first-stage sample to select meaningful environmental strata to be used in second-stage sampling and data analysis. Table 2 lists the three strata expected to be the most sensitive first, followed by the other two. The number of sample units, number of sites recorded and the site density (sites/sample unit) are shown in this table. Number of hits is also shown; this statistic, which is used elsewhere by the BLM (n.d.), simply gives the number of sample units containing sites.

Table 3 classifies the first-stage sites recorded in each environmental stratum by type. The total is greater than the number of sites recorded, because some sites were classified as more than one type, as discussed above. This problem is avoided whenever possible by using a site type such as temporary camp, but in a few cases the use of more than one type is necessary. For example, DA-253 is both a pictograph site and a cluster of utilized shelters, and both hunting blinds were found in lithic scatters.

No statistically significant differences in site densities between environmental strata can be demonstrated from the data in Table 2, and no statistically significant associations of site type with environmental stratum can be demonstrated from the data in Table 3. This may reflect the fact that environmental variables have altered somewhat in the past few millenia; for example, some mountainous areas may have in post-pluvial times contained intermittent streams which have since disappeared. It is also quite probable that heavy alluvial activity has buried earlier deposits. However, the most important factor is the masking effect of the obsidian deposits, as discussed in detail in Section II-B.

The following discussion is based on professional judgment, taking into consideration such factors as the small sample size for playa and terrace strata and the existence of supplementary data from areas not included in the

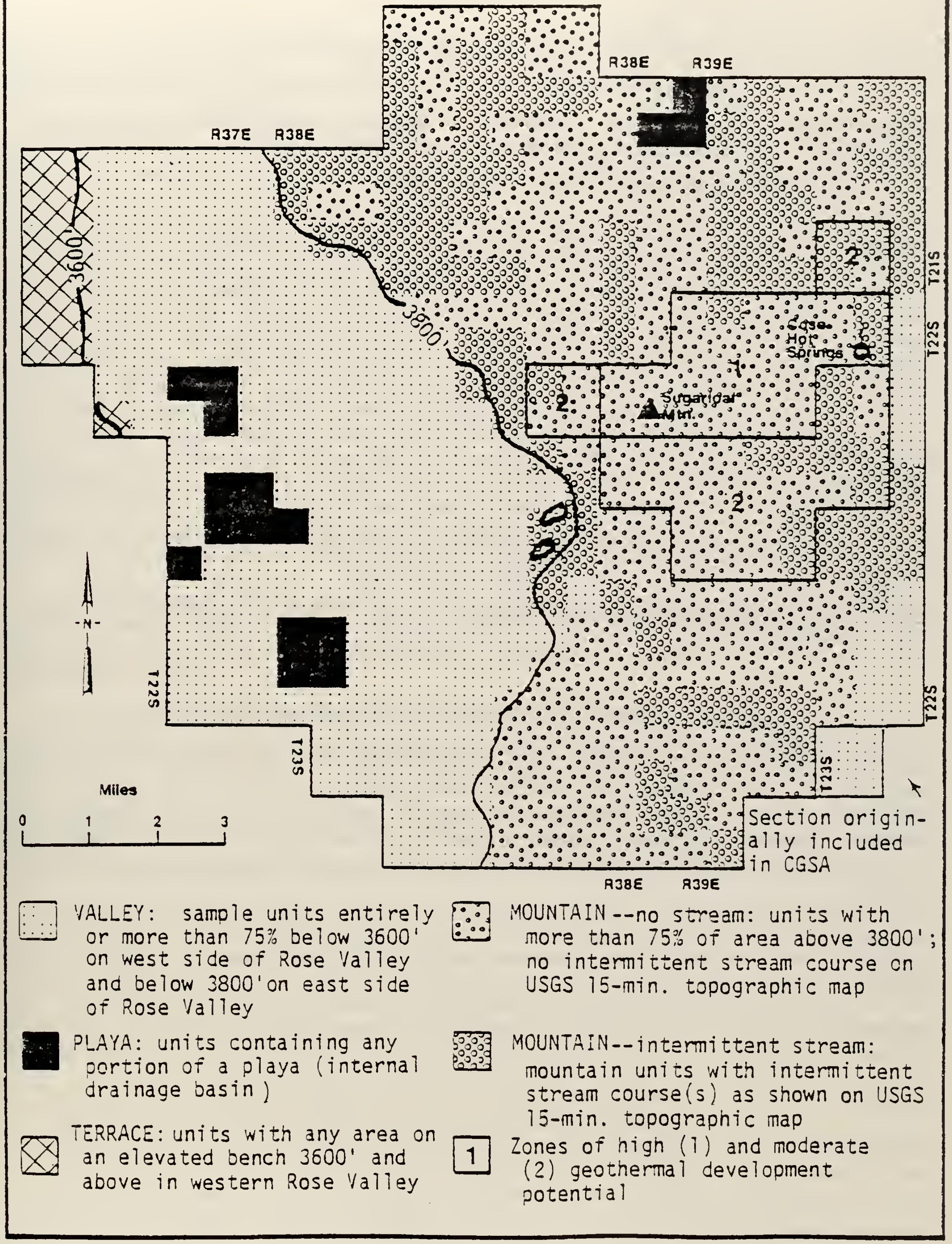

Figure 4. DISTRIBUTION OF ALL POSSIBLE CULTURAL RESOURCE INVENTORY SAMPLE UNITS BY ENVIRONMENTAL ZONE

Table 2. FIRST-STAGE SITE DENSITIES

Environmental Stratum	Number of Sample Units	Number of Hits	Number of Sites	Hits/Sample Unit	Sites/Sample Unit
Terrace	2	2	2	1.00	1.00
Playa	5	5	8	1.00	1.60
Mountain/ Stream	14	12	29	0.86	2.07
Valley	12	7	10	0.58	0.83
Mountain/ No Stream	17	13	17	0.76	1.00
TOTALS:	50	39	66		

Table 3. STAGE 1 SITE TYPES BY ENVIRONMENTAL STRATUM

Environmental Stratum	Lithic Scatter	Temporary Camp	Isolated Find	Utilized Shelter	Hunting Blind	Cairn	Quarry	Picto-Graph	Historic
Terrace			2						
Playa	4	3		1					
Mountain/ Stream	22	4	2		1	1			1
Valley	7	3				1	1		
Mountain/ No Stream	10	4	1	1	1		1	1	1
TOTALS:	43	14	5	2	2	2	2	1	2

sample. This evaluation was deemed necessary prior to planning the second-stage sample.

The highest site densities were found in the mountain units with intermittent streams and in the playa stratum. Mountain units with streams are those areas over 3,800 feet in elevation containing at least one intermittent stream course as indicated by a broken blue line on the USGS 15-minute topographic map. The playa stratum comprises units situated in, or intersecting to any degree, playa lakes which are shown on the USGS topographic maps. These lakes fill after rains or snow melts, so they may be considered an intermittent source of water in post-pluvial times, as well as a reliable source in pluvial times. The figures for the terrace zone do not accurately reflect the archaeological potential of this zone. (This stratum consists of the elevated pluvial terraces, above 3,600 feet in elevation, on the western side of Rose Valley.) The sample size from this stratum, consisting of two units, is too small, and the sites recorded, both isolated finds, are of little archaeological significance. Supplementary data were used to evaluate the sensitivity of this stratum. Two previously recorded sites, Iny-2283 and Iny-2284, described respectively as a temporary camp and a village with associated rock art, are located in this stratum within the study area. Furthermore, the Stahl site is situated in a similar environment just outside the study area. Therefore, it appeared that additional investigation of this stratum was warranted.

(The remaining strata consist of the areas of unstable alluvial activity on the eastern floor of Rose Valley, below 3,800 feet, and mountain units lacking any indication of intermittent streams, as shown on USGS 15-minute topographic maps.)

The high site density indicated for the playa stratum was, again, based on a small sample; but in this case, site types identified included temporary camps and a utilized shelter. Supplementary data were again considered. During the course of the first-stage survey, a village site, DA-313, was recorded at the edge of a playa just outside the northern boundary of the study area. As no village sites were recorded in the first-stage sample, this supplementary information on villages in playa and terrace strata was worthy of consideration.

The first-stage sample units in the Coso Range areas with intermittent streams yielded the highest site density: 2.07 sites/sample unit or 8.28 sites per square mile. Twenty-two of the sites recorded, or 76 percent, were classified as lithic scatters. One of these was associated with a cairn and one with a hunting blind. Supplementary information suggests that rock art sites might also be found in this zone. According to Grant, et al., petroglyphs are found principally at four types of locations:

> Most are at the entrances to gorges containing piled rock hunting blinds; others are located in conjunction with blinds, on rocky points dominating saddles between watersheds; isolated rocks in the immediate vicinity of springs have engravings, and the rocky crags near Coso and Silver Peaks have innumerable drawings and many blinds (Grant, et al., 1968: 30).

In the areas around Louisiana Butte and Wild Horse Mesa (within the NWC, to the east of the CGSA), rock art sites are found in canyons containing rock basins (or <u>tinajas</u>) which collect and hold water during the winter months (<u>ibid</u>.).

E. SECOND-STAGE SAMPLING DESIGN

The second-stage sample required surveying 15 percent of the study area or 68 half-mile-square units. The areas of both the highest archaeological interest and the greatest potential for geothermal development were emphasized in apportioning sample units for this stage. All remaining units containing playa lakes and upper terraces were selected for sampling, and 75 percent of the first- and second-probability areas for geothermal development (Development Zones 1 and 2) were investigated. These areas of probable development are located within the Coso Range and include units with and without drainages. Thus, two environmental strata are included in this portion of the second-stage sample. Additionally, it should be noted that the area of non-competitive leasing received five sample units in the second stage as part of the stratum containing playa lakes. The remainder of the second-stage sample was distributed within the Coso Range among units containing intermittent stream courses. Sampling units were allocated randomly within each of the environmental strata and development zones. This was done by using a series of random numbers generated by a computer. The procedure is the same as that used for the first stage, as discussed above. (All possible quadrats, however, were consecutively numbered within each environmental stratum prior to allocating Stage 2 sample units; this resulted in a discontinuity of unit numbers within the second stage.)

Although no sample units were allocated to the eastern side of Rose Valley, it was discovered in the course of the second-stage field work that the field crew would be able to survey a sample larger than the 68 units required for the second stage. Therefore, when some crews completed their assigned units ahead of schedule, additional units were assigned to them. This decision was regarded as productive of a larger sample. The additional 20 units were randomly selected throughout the two least-sensitive strata: valley, and mountain with no observable stream courses. As noted above, some units in geothermal development Zones 1 and 2 are located in one of the two environmental strata which were predicted to be the least sensitive (mountain/no stream). More than half of the sample units selected in the first and second development zones are in mountain areas without drainages.

Table 4 shows the allocation of the first- and second-stage sample units, using the zones which were employed in selecting the second-stage sample. Figure 3 (end pocket) shows the location of first- and second-stage sample units; and Figure 4 shows the location of the environmental strata.

What Table 4 does not indicate is what would be required for a representative sample: i.e., one in which the apportionment of sample units is based on the percentage each stratum contributes to the total area in the study. A representative sample would require four units containing playas, three units of upper terraces, 21 units in the mountain stratum with intermittent streams, six units in the area of highest probability for development, and nine units in the area with the second highest probability. As is obvious, the second-stage sample was designed so that all areas considered to be sensitive, either for

Table 4. ALLOCATION OF SAMPLE UNITS

Sampling Stratum or Zone	Total Units in Study Area	Units Sampled in First Stage	Units Allocated in Second Stage	Percent of Stratum or Zone to be Completed (Stages 1 and 2)	Percent of Total Planned Sample (118 Units)
Playa	16	5	11[1]	100	13.5
Terrace	13	2	11	100	11.0
Valley	162	12	0		10.2
Mountain/ Stream	85	12	12	30	20.3
Mountain/ No Stream	164	8	0		6.8
Geothermal Zone 1[2]	(24)	3	15	75	15.3
Geothermal Zone 2[2]	(36)	8	19	75	22.9
TOTALS:		50	68		100.0

1. Includes five units in noncompetitive leasing area.
2. Geothermal Zones 1 and 2 are entirely within the mountain areas; see Figure 4. The numbers of units allocated to mountain areas (with and without streams) during the first and second stages of the survey do not include these units examined in Zones 1 and 2. That is, 15 units were allocated to Zone 1 and 19 to Zone 2 for the second-stage survey; 12 additional units were allocated in the mountain/stream stratum outside of Zones 1 and 2. However, mountain units in Column 1 (Total Units in Study Area) include those units, shown in parentheses, actually situated in Zones 1 and 2.

archaeological or potential developmental reasons, are representatively sampled. Additionally, it can be noted that the area of noncompetitive leasing received five sampling units in the second stage as part of the stratum containing playa lakes.

Table 5 shows the actual distribution of sample units by environmental stratum only. Thus, it includes those units in Geothermal Development Zones 1 and 2 with those in mountain/stream and mountain/no stream, and it also shows the number of additional units which were actually surveyed both in mountain areas without stream courses and in Rose Valley during Stage 2.

F. ANALYSIS OF THE SECOND-STAGE RESULTS AND EVALUATION OF THE PREDICTIVE MODEL

Table 6 assigns all sample units from the second stage to environmental strata and gives the number of hits, number of sites, and sites/sample unit, as well as the hits per sample unit and sites per sample unit from the first stage.

For the first three strata shown in Table 5, which were predicted to be the most sensitive, both the hits per sample unit and the sites per sample unit were less than expected in the second stage (on the basis of first-stage results). For the two other strata, both the hits per sample unit and the sites per sample unit were higher than expected in the second stage. The site density for the study area as a whole is 1.01 sites per sample unit or 4.04 sites per square mile in the second stage. This slightly lower than the 1.32 sites per sample unit (or 5.28 sites per square mile) which were recorded in the first stage.

Table 7 shows the combined site densities for Stage 1 and Stage 2 by environmental stratum and for the area as a whole.

Throughout this report, mean site density is expressed as the number of sites recorded, divided by the number of sample units surveyed. These figures may give a false impression, however, of the density of archaeological remains within the study area, because many of the archaeological sites are large in horizontal extent. Twenty-three of the sites recorded exceed 100 acres (ca. 40 ha.) in size. The archaeological sites recorded comprise approximately 50 percent of the area surveyed.

Because archaeological site definition involves an element of subjective judgment, another researcher surveying the same area and observing exactly the same remains might record a larger number of sites, thereby producing a higher site density figure. An example of this kind of difference in site definition has been discussed under Summary of Previous Archaeological Investigations in the study area, above. Drover (1979) recorded six lithic scatters where the ERG crew recorded one, for example; see Appendix C. Although the number of square meters of ground covered with archaeological remains is approximately the same (ca. 200,000 m^2), Drover's method of site definition would yield a higher site density figure. In this case, the ERG crew observed a continuous scatter of obsidian flakes with concentrations within it. Drover focused on the concentrations themselves, viewing them as discrete sites with an occasional flake in the intersite spaces. The problem of site definition is particularly difficult in the CGSA because of the occurrence of airfall obsidian between and within sites. This aspect of site definition is discussed in more detail under Summary Description of Cultural Resources Identified, below.

Table 5. DISTRIBUTION OF ACTUAL SAMPLE UNITS BY ENVIRONMENTAL STRATUM

Stratum	Units in Study Area	Units Sampled in Stage 1	Units Sampled in Stage 2	Percent of Stratum Sampled
Playa	16	5	11	100
Terrace	13	2	11	100
Mountain/ Stream	85	14	24	44
Valley	162	12	8	12
Mountain/ No Stream	164	17	34	31
TOTALS:	440	50	88	

Table 6. SECOND-STAGE SITE DENSITIES

Environmental Stratum	Number of Sample Units	Number of Hits	Number of Sites	Hits/ Sample Unit	Sites/ Sample Unit	First Stage	
						Hits/ Sample Unit	Sites/ Sample Unit
Terrace	11	7	8	0.64	0.73	1.00	1.00
Playa	11	8	12	0.73	1.09	1.00	1.60
Mountain/ Stream	24	14	23	0.58	0.91	0.86	2.07
Valley	8	6	8	0.75	1.00	0.58	0.83
Mountain/ No Stream	34	29	37	0.85	1.09	0.76	1.00
TOTALS:	88	64	88				

Table 7. STAGE 1 AND 2 SITE DENSITIES

Environmental Stratum	Number of Sample Units	Number of Hits	Number of Sites	Hits/ Sample Unit	Sites/ Sample Unit	s[1]
Terrace	13	9	10	0.69	0.77	0.60
Playa	16	13	20	0.81	1.25	1.06
Mountain/ Stream	38	26	51	0.68	1.34	1.67
Valley	20	13	18	0.64	0.90	0.96
Mountain/ No stream	51	42	54	0.82	1.02	0.77
TOTALS:	138	103	153[2]	0.75	1.11	(4.44/ sq. mi.)

1. Standard Deviation.

2. Sites recorded in two sample units are counted twice.

In summary, the site density for the study area as a whole appears to be slightly lower than that expected (approximately 5.28 sites per square mile, on the basis of the first-stage sample). Combining the data from both stages gives a site density of 1.11 sites per sample unit or 4.44 sites per square mile. Site densities for the three strata which had been predicted to be the most sensitive (terrace, playa, and mountain/stream) are lower than expected and site densities for the two other strata are higher than expected. The lowest site densities are found in the terrace stratum (0.77 sites per sample unit) and in the valley stratum (0.90 sites per sample unit). The mountain units without intermittent streams have a site density of 1.02 sites per sample unit or the third highest. The highest site density (1.34 sites/sample unit) is found in mountain units with intermittent streams. These differences are obviously very small.

As the distribution of the data appeared normal, a series of t-tests (Thomas, 1976: 235-239) were performed on the mean site densities for the environmental strata sampled in order to determine whether the differences observed were due to a real difference in site densities in these zones throughout the CGSA, or should be attributed to chance. The results indicate that the differences are not significant at the .05 level. Combining the two mountain strata does not alter these results. These results have implications for the predictive model, discussed below.

Table 8 classifies the data from both stages by site type and environmental stratum. Village sites were expected to be found in playa and terrace units. In fact, no villages were found in association with playas within the sampled area, and no additional villages were found in the terrace stratum. Two villages were recorded in the mountain/intermittent stream stratum, and one of these extended into a unit without a streambed. Petroglyphs were expected to be found in the mountain/intermittent stream stratum. Two of the three petroglyphs recorded were found in this stratum, and the third was recorded in a terrace unit. It may also be observed that two of the three petroglyph sites are associated with villages, that both cemeteries are associated with villages, and that the third petroglyph site is associated with a temporary camp. We are dealing with so few village and petroglyph sites that no statistical measurement is indicated for these categories.

Some other correlations are suggested by the combined data from both stages. Seven of the eight quarry sites are found in the mountain units without intermittent streams. A test of statistical significance would appear to be less enlightening in this case than a look at the specific resources located near these sites; quarries by definition are located near sources of lithic material. The seven quarry sites which are located in mountain units without intermittent streams are associated with Sugarloaf Mountain. A correlation of quarry sites with the mountain/no stream stratum would be of no use in finding quarries in other parts of the study area, but we predict that additional quarry sites will be found in unsurveyed areas adjacent to Sugarloaf Mountain.

Table 8. SITE TYPES BY ENVIRONMENTAL STRATUM
(Both Stages Combined)

Site Type	Terrace	Playa	Mountain/ Stream	Valley	Mountain/ No Stream	Totals
Lithic Scatter	5	11	31	13	24	84
Temporary Camp		5	10	5	16	36
Isolated Find	4		4		2	10
Utilized Shelter		3	1		1	5
Hunting Blind			1		1	2
Cairn			1	1		2
Quarry				1	6	7
Pictograph					1	1
Petroglyph	1		2			3
Milling Station					1	1
Historic		1	2		5	8
Cemetery	1		1			2
Village	1		2			3
TOTALS:	12	20	55	20	57	164(1

1. A few sites were recorded as more than one type, as noted in text, Section III B.

Using a chi-square test (Thomas, 1976: 264-284), no statistically significant correlation of site type and environmental zone can be demonstrated from Table 8, although the associations between shelters and playa units and between quarries and mountain units without intermittent streams appear high.

In order to determine whether the division of the Coso Range into two strata, on the basis of hydrology, was obscuring a real correlation between site type and topographical variables, the two mountain strata were combined and a chi-square test again performed, but no statistically significant correlation between site type and environmental stratum was found.

It may be observed, however, that seven of the eight historic sites occur within the Coso Range; four of these are definitely related to mining, while the location of a fifth is related to the presence of Coso Hot Springs. In the Darwin Planning Unit, preliminary analysis indicates that the location of historic sites within the mountains is determined by the presence of mineral resources, rather than by hydrological variables (BLM, n.d.). It is possible that for the purpose of predicting the location of historic sites in the CGSA, the distinction between the two mountain strata is not useful.

In summary, the combined data from Stages 1 and 2 do not indicate a statistically significant correlation between site type and environmental stratum. On the basis of professional judgment, however, we can predict that quarry sites will be found in unsurveyed areas around Sugarloaf Mountain and that historic mining sites will be found in unsurveyed areas of the Coso Range.

G. SUMMARY DESCRIPTION OF CULTURAL RESOURCES IDENTIFIED (See Plates 1-6)

1. LITHIC SCATTERS

The majority (55 percent) of sites recorded are lithic scatters; these have been classified according to BLM guidelines into four subtypes (see Table 9). Type 5b, which consists of extensive, light scatters of flakes, mixed with occasional tools and cores, is the most common type of site encountered in the study area. This site type is often found in an area where a source of airfall (pyroclastic) obsidian is available, and the cultural material is found scattered among cobbles and natural flakes of obsidian. The high proportion of large, dense scatters (nine sites) in units classified as mountain/no stream is explained by the local occurrence of the source material. These nine sites all occur in the Coso Range in areas where, according to the site records, an obsidian source was available; several are in the vicinity of Sugarloaf Mountain.

We have discussed above the widespread occurrence of obsidian throughout the study area, which presents difficulties in site definition and site recording. It should be noted, however, that the types of sites produced under such circumstances have been recently discussed by Gould (1978). He found a similar situation in the Western Desert of Australia, where he conducted ethnoarchaeological studies: Nonquarry localities or surface scatters of stone were used to procure "instant tools" (Gould, 1978: 818), flakes that were picked up, possibly retouched, used and discarded in quick succession. Such sources might be used infrequently or only once.

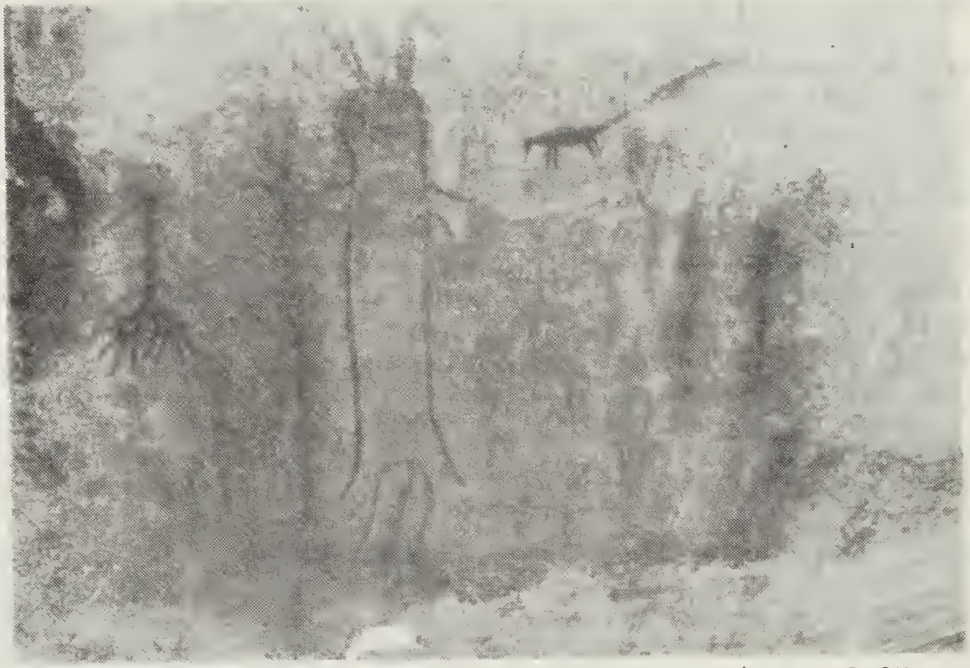

PLATE 1. DA-253: COSO STYLE PICTOGRAPHS (LOCATED ON EAST FACE OF LARGE BOULDER ASSOCIATED WITH UTILIZED SHELTER/CAVE)

PLATE 2. DA-375: VILLAGE SITE (WITH DENSE SURFACE SCATTER, VIEW NORTH TO SOUTH)

PLATE 3. DA-282: ALIGNMENT OF STONE MEN ALONG DRY CREEK BED, 3-1/2 MILES WEST OF CACTUS PEAK; VIEW WEST

PLATE 4. DA-253: ROCK SHELTER WITH ROCK WALL IN FRONT; VIEW NORTH

PLATE 5. DA-264: LITHIC SCATTER 1-1/2 MILES NORTHEAST OF SUGARLOAF MOUNTAIN

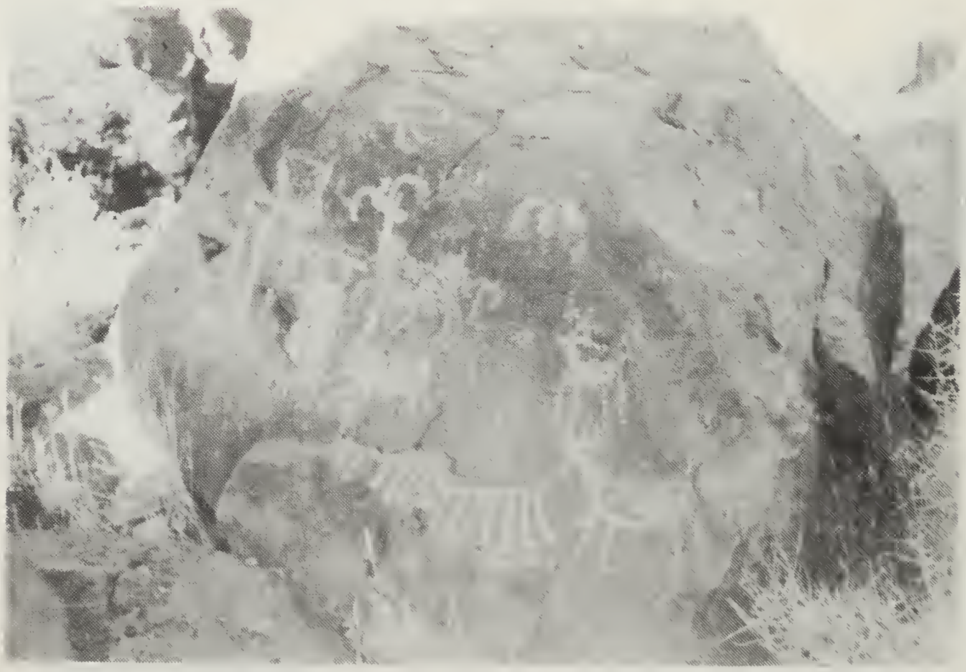

PLATE 6. DA-375: COSO STYLE PETROGLYPHS LOCATED NEAR SOUTHERN BOUNDARY OF VILLAGE SITE

Table 9. DISTRIBUTION OF LITHIC SCATTERS BY SUBTYPE

Subtype	Mountain/Intermittent Stream	Playa	Terrace	Valley	Mountain/ No Stream	Total
5a (large, dense)	2	1	0	1	9	13
5b (large, light)	17	10	3	9	12	51
5c (small, dense)	3	1	0	1	1	6
5d (small, light)	6	1	2	1	2	12
TOTALS:	28	13	5	12	24	82

Utilized flakes and bifaces are the most common artifacts found at sites in the CGSA classified as lithic scatters. Scrapers, knives, unifacial tools, projectile points, retouched flakes and choppers are also listed on site records. A drill was noted and drawn at one site (DA-303). Obsidian is the principal lithic material utilized at sites of all types, but chalcedony, chert, quartzite and basalt were also recorded. It is interesting to note the frequent occurrence of obsidian blades at sites in the study area, a characteristic which was first observed near the beginning of the first-stage survey. (A blade is a long, thin flake, usually defined as having a length-to-width ratio of 2:1 or greater. Blade industries characterize various cultures throughout the world.)

Two of the lithic scatters are associated with cairns of undetermined age or cultural affiliation; three scatters are associated with hunting features, two described as hunting blinds and the other as "stone men," which are piles of rocks, presumably used in driving game. One lithic scatter was found around a boulder with petroglyphs; this site has been classified both as a rock art site and as a lithic scatter. Lithic scatters associated with quarries have been classified as quarries only, and lithic scatters found with other types of artifacts have been classified as temporary camps.

At the Rose Spring site, Iny-372, a high frequency of large obsidian biface blanks was found, probably intended as products for trade to the Central Valley (Lanning, 1963: 256; Riddell, 1963: 284). Lanning casually refers to the implements as blades or blade blanks. It should be noted that these are not blades in the sense that they are described in the present report. They are more like bifaces in contemporary terminology. Such bifaces, which often are primary products in quarry areas, have been noted in the CGSA.

2. QUARRIES

A quarry site has been defined as a locus where lithic material has been extracted, as from an outcrop or vein. Six of the seven quarries which were identified in the study area are associated with the obsidian outcrops on Sugarloaf Mountain. All of these are located within the Development Zone 1 or Zone 2 leasing blocks and within mountain units without intermittent streams. Three of these sites have also been classified as temporary camps, because of the presence of milling stones and/or hearths. One of these, DA-392, includes a hunting blind and several cairns, as well as ground stone.

The seventh quarry site, DA-346, is found at an outcrop of unidentified coarse-grained gray chert-like material located southeast of Sugarloaf. Numerous percussion flakes and cores, as well as some crude tools, were found at this site, which, because of the presence of a large rock ring feature, has also been classified as a temporary camp. Tools and flakes of this material were rarely recorded at other sites in the study area.

3. ROCK ART

Petroglyph and pictograph sites will be discussed together, as only four rock art sites were recorded. DA-253 (Iny-105) consists of pictographs in association with utilized rock shelters. The occurrence of pictographs is rare in the Coso Range; and preliminary study of Iny-105, which is located in a mountain unit without an intermittent stream, shows influence from three sources. Coso elements, in the form of wide-bodied quadrupeds, are present. At most Coso petroglyph sites these creatures are bighorn sheep. At Iny-105, however, they represent an antlered animal, probably the tule elk. Tule elk were common in the Central Valley and were important economically to the Yokuts. Graphic animal representations are common in Yokuts painted sites from the Southern Sierra style area (Heizer and Clewlow, 1973), and the small mammal representations at Iny-105 fit this tradition. The entire panel shows striking similarities to a number of Southern Sierra painted sites. The large anthropomorphic "spirit" on the Iny-105 panel is nearly identical to a similar prominent element on the famous San Emigdio panel, one of the most spectacular of Chumash painted sties (Grant, 1965, Pl. 27). The presence of Chumash and Yokuts artistic influence may thus be seen in this striking example of painted rock art.

Pictographs containing Coso-style elements are rare. Garfinkel (1978: 95-106) reports two from the southern Sierra in an area where Shoshone from the Little Lake region probably gathered pinyon during historic times. The implication is that these people may have painted the pictographs, which have been dated to the historic period. It is also possible that Tubatulabal artists from the Kern River vicinity were responsible for a number of drawings in the area.

DA-374 consists of a number of very weathered petroglyphs on the walls of a basalt canyon. The petroglyphs are not visible in bright sunlight. This site is located in a mountain unit with intermittent stream drainage. Closely associated with DA-374 is DA-375, located to its north on a bench of the same canyon. DA-375 has been classified both as a village and as a rock art site. Petroglyphs occur on two boulders among the occupation debris, and on a third boulder directly below the village in the canyon. The fourth rock art site, DA-380, is found on an isolated boulder located in a terrace unit. This petroglyph was previously recorded as part of a nearby village site, Iny-2284, but is actually located at a distance from the village and is itself associated with a small lithic scatter.

4. TEMPORARY CAMPS

Thirty-six sites, all of which consist of lithic scatters, together with features other than flaked stone, were classified as temporary camps. (These other features included milling stones, hearths, and pottery sherds.) The classification "temporary camp" includes sites ranging from small lithic scatters with one or two manos to larger sites with a variety of artifact types present. While this category is useful for quickly classifying sites which do not fit into any more narrowly defined type, it is difficult to discuss the temporary camps as a group due to their nature as a generalized site type. More intensive investigation would be necessary to determine specific functions, intensity of use and probable reason for location in each case. Four of the temporary camps recorded have also been classified as quarry sites, as discussed above.

Data on temporary camps are provided in Tables 10 and 11 below.

5. UTILIZED SHELTERS/CAVE

Five sites were classified as utilized shelters or caves, all of them with lithic scatters and other artifacts associated, suggesting use as temporary camps. Two are clusters of shelters located in the Coso Range. One of these, DA-253, is also classified as a pictograph site. The other three sites are located in playa units. DA-278 (Iny-1636) consists of three rock outcrops which served as windbreaks for associated camps, and DA-275 is a single shelter of this type. The third playa site, DA-316, is a real cave entered through a crawl-way, with an expanded interior space, located in an isolated basalt outcrop, and appears to contain midden.

6. VILLAGES AND CEMETERIES

Three village sites were recorded in the study area and a fourth was recorded outside the study area immediately adjacent to a sample unit. This site (DA-313) must be excluded from any quantitative analysis of data from the study area, because, for the purpose of predicting site densities and the location of site types in relation to environmental variables, this analysis utilizes probability sampling; and site DA-313 is situated outside the sampling universe. It does, however, provide useful comparative information for the small but important category of village sites. Two of the three villages recorded within the study area are located in the Coso Range in units with intermittent streams and the third is located in a terrace unit, adjacent to a spring.

DA-381 (Iny-2284) includes house depressions, bedrock mortars, hearths and burials, as well as a wide range of artifacts. A deep midden is visible in

Table 10. CHARACTERISTICS OF TEMPORARY CAMPS

Artifact or Feature	No. of Sites Where Present	Percent
Flaked Stone	36	100
Milling Stones	22	61
Hearths	12	33
Pottery Sherds	2	5

Table 11. LOCATION OF TEMPORARY CAMPS

Stratum	No. of Sites
Mountain/No Stream	16
Mountain/Intermittent Stream	10
Valley	5
Playa	5
Terrace	0
TOTALS:	36

potholes. Local ranchers report that human bone has been found here. A rock art site, DA-380, is located ca. 100 meters from the village and is probably associated with it. DA-375 includes bedrock grinding slicks, hearths, and rock art, both within and adjacent to the site itself, as well as a dense surface scatter of lithic material and potsherds. Midden appears to be present, but no subsurface exposure exists. DA-273, which overlooks Coso Hot Springs, includes house depressions, hearths, a bedrock grinding slick, and cairns which may mark interments. There is no way to determine whether or not they do mark interments, based on surface observations, but the extreme sensitivity of burial sites warrants a statement of this possibility. This site is almost 600 acres (ca. 240 ha.) in size, extending into adjacent sample units without intermittent stream courses.

7. MILLING STATIONS

Only one milling station was recorded within a sample unit. DA-263 is a large basalt metate with an associated basalt mano, located in the Coso Range in a mountain unit without an intermittent stream. Both portable and bedrock milling tools were found throughout the study area, but other than DA-263, all were found in association with temporary camps, villages or rock shelters.

8. ISOLATED FINDS

Ten isolated finds, eight of them consisting of flaked stone tools or projectile points, and two rock rings, were recorded in the sample units. The rock rings appeared to be hearths, because the rocks at each site had been reddened and cracked, an effect usually caused by exposure to fire; but it was not possible to ascertain that these apparent hearths were prehistoric.

9. HISTORIC SITES

The eight historic sites recorded will be discussed here individually. DA-304, which is part of the Coso Hot Springs area on the National Register of Historic Places, has already been discussed (see Section II, E, above). DA-255, located in the Devil's Kitchen area, includes both prehistoric and historic components. The historic material consists of a small decomposed adobe structure, a concrete and rock structural foundation, and a small amount of debris, including glass, nails, and cans, estimated to date from the 1920s. This site is probably associated with cinnabar mining. DA-348 consists of several pits, pipes, mining cairns and associated debris, probably dating to the 1940s. Additional data on these sites is provided in the Iroquois Research Institute (1979) report. DA-317 is a trash dump, comprising material dating from 1900 to 1945, including two automobiles. DA-396 and DA-399 are mining claim cairns dating from 1945 and 1934, respectively. DA-294 and DA-341 are both low U-shaped rock structures, the function and date of which are unknown.

All the historic sites recorded are located in the Coso Range, four in sample units with intermittent streams and four in sample units without. Six date to the first half of the twentieth century and four of these are associated with mining activity. Further information is needed on the rock structures.

10. TIME PERIODS REPRESENTED

An inventory of this kind does not provide sufficient information to date individual sites absolutely or to discuss with confidence the length of time the study area was occupied or utilized prior to the historic period. The excavation of stratified sites at nearby Little Lake and Rose Spring has, however, provided chronological data for adjacent areas, and several regional and local cultural sequences have been proposed, primarily on the basis of projectile point types. These sequences have been discussed above in the section on Regional Culture History.

It is possible for trained field workers to tentatively assign projectile points observed in the field to recognized types or series, and to record their observations by means of drawings and photographs. While somewhat less accurate than the measurement and classification of artifacts in the laboratory, these methods provide preliminary temporal data without removing the archaeological material. Table 12 lists the projectile point types or series tentatively recognized, by site and site type, and lists the local time period represented by each. (A series consists of a group of related point types (Heizer and Hester, 1978: 2.) It is sometimes possible to recognize the series (e.g., Elko) when the type (e.g., Elko Eared) is not identifiable due to incompleteness of the specimen.) Occurrences of ceramic material are also listed, as they indicate a late prehistoric date.

Weide (1973: 18) suggests that in an inventory of this kind, all village sites and 25 percent of other sites may be dated. Temporal indicators were recorded for all three village sites in the study area, but for only 14 percent of other sites, including isolated finds. The 34 projectile points identified represent all time periods in the regional sequence from 8,000 BC to the beginning of the historic period.

It has already been noted in the section on historic sites that all datable historic material recorded represents twentieth century activity. Identifiable protohistoric and nineteenth century historic material is absent. Protohistoric material would consist of Euroamerican trade goods in Native American sites.

11. SETTLEMENT AND SUBSISTENCE IN THE CGSA

Unfortunately, chronological information from the CGSA inventory is not sufficient to discuss changes in the local prehistoric settlement and subsistence pattern through time. It is, however, possible to speculate on the relationship of the data we have to the regional patterns which have been described in the section on Regional Culture History.

No positive evidence of a paleoindian occupation, similar to that proposed for the China Lake Valley, directly south of the CGSA (Davis, 1978a, 1978b) was encountered in the course of the recent survey. It is possible that more careful investigation might reveal such an occupation. Davis (1978b: 184) found 12 associations of flaked stone artifacts and Rancholabrean faunal remains in the China Lake Valley. If Davis's interpretation of her data is correct, paleoindian foragers exploited the resources of this area, focusing on the marshes as sources of food and materials and as traps for large herbivores (Davis, 1978b: 215). Positive evidence of a paleoindian occupation in the CGSA would consist of the definite association of flaked stone tools and extinct

Table 12. TEMPORAL INDICATORS

Site No.	Site Type	Diagnostic Artifact Type	Time Period	Dates[1]
DA-321	Lithic Scatter	Fluted Point ?	Fluted Point Tradition[2]	pre-8,000 BC
309	Lithic Scatter	Fluted Point ?	Fluted Point Tradition[2]	"
366	Temporary Camp	Lake Mojave	Lake Mojave	8,000-4,000 BC
374	Temporary Camp	Lake Mojave	Lake Mojave	"
394	Temporary Camp	Lake Mojave	Lake Mojave	"
		Humboldt	Little Lake	4,000-1,200 BC
316	Utilized Shelter	Lake Mojave	Lake Mojave	8,000-4,000 BC
		Eastgate Expanding Stem	Haiwee	AD 600-1,300
381	Village	Lake Mojave	Lake Mojave	8,000-4,000 BC
		"Pinto"[3]	Little Lake	4,000-1,200 BC
		Eastgate Expanding Stem	Haiwee	AD 600-1,300
		Rose Spring Corner Notch	Haiwee	"
		Cottonwood Triangular	Marana	AB 1,300-Hist.
315	Lithic Scatter	Humboldt Basal Notch	Little Lake	4,000-1,200 BC
319	Temporary Camp	Humboldt Basal Notch	Little Lake	"
		Humboldt Concave Base	Little Lake	"
320	Lithic Scatter	Humboldt Basal Notch	Little Lake	"
367	Lithic Scatter	Humboldt	Little Lake	"
389	Lithic Scatter	Humboldt Concave Base (2)	Little Lake	"
266	Isolated Find	Elko Side Notch	Newberry	1,200 BC-AD 600
267	Lithic Scatter	Elko Corner Notch	Newberry	"

Table 12 (continued)

Site No.	Site Type	Diagnostic Artifact Type	Time Period	Dates[1]
269	Temporary Camp	Elko Eared	Newberry	1,200 BC-AD 600
		Elko	Newberry	"
361	Temporary Camp	Elko Corner Notch	Newberry	"
		Rose Spring	Haiwee	AD 600-1,300
375	Village	Elko	Newberry	1,200 BC-AD 600
		Rose Spring	Haiwee	AD 600-1,300
		Ceramic	Marana	AD 1,300-Hist.
273	Village	Eastgate	Haiwee	AD 600-1,300
305	Temporary Camp	Rose Spring Corner Notch	Haiwee	"
326	Isolated Find	Rose Spring Contracting Stem	Haiwee	"
335	Lithic Scatter	Rose Spring (2)	Haiwee	"
366	Temporary Camp	Cottonwood Triangular	Marana	AD 1,300-Hist.
346	Temporary Camp, Quarry	Ceramic	Marana	"

1. Dates are from Bettinger and Taylor (1974).

2. See Davis, 1978a, 1978b.

3. The "Pinto" series is an amorphous classification including morphologically different projectile points. Even if types could be defined clearly, dating of the series is not certain. See Bettinger and Taylor (1974: 13-14), and Heizer and Hester (1978: 3-5, 12-13) for discussion.

megafauna. An occupation as early as that hypothesized by Davis for China Lake Valley, however, would require additional support in the form of geological evidence or chronometric data. Davis (1978b: 216) is suggesting an occupation perhaps as early as 40,000 years BP. It may be that these early foragers did not extend their wanderings into the CGSA, where fewer resources were available.

The earliest evidence of use of the CGSA is represented by artifacts which have been tentatively classified as fluted points, which Davis (ibid.) dates as recently as 10,000 years BP in their "classic Clovis" form. Laboratory examination would be necessary to positively identify them as such. It is possible that sporadic visits to the CGSA were made by early hunters, who used these points. The use of fluted points as time markers in this region has, however, been challenged (Wilke, et al., 1974).

Lake Mojave period projectile points were found at three temporary camps, one shelter and one village site. The Lake Mojave period is a regional manifestation of Bedwell's (1970) Western Pluvial Lakes Tradition, characterized by the exploitation of lakeside environments. Locally, the focus of occupation would be expected on the shores of Little Lake and Owens Lake. During this period, occupation of the Stahl site may have begun, as indicated by the presence there of Lake Mojave points (Harrington, 1957). At this time, food resources and obsidian quarries of the CGSA may have been exploited by small groups on a temporary basis. Excavation of the CGSA village sites would be necessary to determine whether these were occupied during the Lake Mojave period.

During later periods, a more diversified pattern of hunting and gathering may have resulted in greater use of the CGSA. Occupation of the Stahl site became more intensive during the Little Lake period, but the focus of resource exploitation may have begun to shift away from the lake. Harrington (1957) refers to this intensive occupation of the Stahl site as a "Pinto" period occupation. By this time, the site at Rose Spring had been occupied (Lanning, 1963: 264). Groups from this base camp may have been using the resources of the CGSA. By the Newberry period, they may have been quarrying the obsidian from Sugarloaf Mountain for the purpose of manufacturing bifaces or blanks for trans-Sierran trade.

As discussed earlier, Bettinger's (1976) studies further north in the Owens Valley suggest that pinyon exploitation did not become a significant subsistence strategy in eastern California until ca. AD 600. There is a difference of opinion regarding this chronology; see Section II, D, 3 above. If Bettinger's assumptions are correct, then at this time (the beginning of the Haiwee period), there might have been an increase in camps in the CGSA, where groups stopped en route to the pinyon areas of the Coso Range. The occupation of the Rose Spring site continued, but the harvest and storage of pinyon for other adjacent areas might have provided a staple which encouraged the establishment of villages within the CGSA, as well. The intensification of trans-Sierran trade during this period (Bettinger, 1977: 51) may have increased the demand for obsidian from Sugarloaf Mountain. Projectile points recorded in the CGSA from the Haiwee period are the most numerous (10 specimens). This may have been the period of most intensive occupation. If Bettinger's inferences about pinyon exploitation are incorrect, then this exploitation may have played an important role in subsistence patterns as early as 1,200 BC.

During the Marana period, there is less direct evidence of use of the CGSA. Occupation continued at Rose Spring, north of the westernmost portion of the study area. The settlement and subsistence pattern was probably similar to that described by Steward (1938). He does list a village site at Coso Hot Springs (1938: 81), but the area exploited by the Koso or Panamint Shoshone was far-flung, including the east slopes of the Sierra Nevada and Owens Lake.

The sparseness of protohistoric and historic remains dating to the nineteenth century suggests that the population of the CGSA may have been somewhat reduced by that time, possibly due to cattle grazing and mining exploration in the area. Garfinkel (1978: 100) states that the "Little Lake Shoshone" had moved south and were probably exploiting pinyon in the southern Sierra Nevada instead of the Coso Range by the mid-nineteenth century.

The above speculations on prehistoric settlement and subsistence patterns can be utilized to formulate archaeological research questions to be investigated in the CGSA (see Section VII, below).

IV. SUMMARY OF NATIVE AMERICAN CONTACTS AND INPUT

Contacts with Native Americans are listed in Appendix A of this report. As in all such archaeological investigations, it was considered essential to inform local Native American groups and individuals of the nature and intent of the project, to request their input and to attempt to establish a cooperative working relationship between archaeologists and Native Americans. Because Native American groups and individuals have expressed a strong concern regarding the possible impact of the proposed geothermal development on Coso Hot Springs, particular attention was given to the coordination of archaeological research in the CGSA with local and other Native Americans.

Initial contacts were made before the beginning of the fieldwork, in the form of personal interviews, telephone calls and letters. In some cases, letters were sent following repeated failures to make personal contact. In each case, the Native American individual or group representative contacted was informed of our plans for archaeological fieldwork and was encouraged to contribute comments and opinions, as well as to ask questions about our work.

During the first few days of fieldwork, an arrangement was made through Ms. Neddeen Naylor of the Coso Hot Springs Ad Hoc Committee to hire three members of the Lone Pine Native American Community as monitors. These monitors joined the archaeological crew for the remainder of the November fieldwork, walking with survey teams during the day, eating their meals with the rest of the crew and occasionally participating in evening social activities.

Ms. Patti Wermuth of the Kernville Native American Community also visited the crew in the field one day.

In March, a follow-up meeting was held with Ms. Naylor to inform her of the progress of the cultural resources study and to solicit any further input on the part of the groups she represents.

Although members of the Bishop and Big Pine Native American communities were also contacted, the proximity of Lone Pine to the CGSA led to closest coordination between this group and the archaeological crew. It should also be noted that some of the individuals contacted represent the Coso Hot Springs Ad Hoc Committee as well as their local communities.

The scope and nature of these contacts differed from those which are described in the reports by Theodoratus and Smith-Madsen (1977) and the Iroquois Research Institute (1979), because the purpose was different. The above mentioned reports provide abundant ethnographic data on Native American use of Coso Hot Springs.

Rather than duplicate these efforts, the archaeologists contacted Native Americans for the purposes of acquainting them with the archaeologists' role in the project, allowing them to monitor the crews' activities in the vicinity of Coso Hot Springs and elsewhere in the CGSA, and obtaining any information or opinions on archaeological resources that were encountered. Thus, the majority of contact took place between archaeologists and monitors in the field.

In addition, other members of the study team preparing the EIS on leasing for geothermal development in the CGSA contacted Native American representatives to discuss their concerns regarding the proposed action.

V. SUMMARY EVALUATION OF THE STUDY AREA'S CULTURAL RESOURCE SENSITIVITY

A. CRITERIA FOR DETERMINING SENSITIVITY AND USE OF THE PREDICTIVE MODEL FOR DETERMINING POTENTIAL SENSITIVITY

The cultural resources survey sampled more than 29 percent of the study area; stratification by area in the first stage and by environmental strata and potential leasing zone in the second stage provided a sample that is well distributed and representative of the area as a whole. Published data from the excavation of stratified sites and the study of rock art in adjacent areas supplemented the survey data in assessing the archaeological sensitivity of the study area.

An overall site density of 4.44 sites per square mile is estimated for the study area as a whole. Little variation is found between environmental strata, but the terrace stratum does have the lowest site density: 0.77 sites per sample unit or 3.08 sites per square mile. These site density figures are, however, misleading. Sites are unusually large in the CGSA (as discussed above), so that the actual density of archaeological sites is high, approaching 50 percent of the ground surface surveyed. This is illustrated graphically in the sensitivity map (Figure 5). Areas which were surveyed and found to contain sites are shown as high sensitivity; areas which were surveyed in which no sites were found are shown as low sensitivity. Additional areas of extremely high sensitivity included villages, rock art sites, or possible burial sites.

A ranking of the sites recorded in the course of this survey in terms of sensitivity or significance is not offered, since further data are required to determine the relative significance of most sites. Classification of sites by type on the basis of this kind of survey is, in itself, tentative. The information necessary to determine relative significance of sites can be obtained in the early phases of the proposed mitigation program and can still be used in decision-making regarding the specifics of development. The following kinds of information are needed in order to rank sites: presence or absence of subsurface deposit, relative quantities of culturally and non-culturally modified or unmodified lithic material present on the surface, types of activities represented, classes of artifacts and features present for purposes of confirming site type, and integrity of the deposit.

The following sites have been classified as extremely high sensitivity, along with the Coso Hot Springs site: Iny-105, DA-273, DA-373, DA-375, DA-380, DA-381. The location of these is shown (by sensitivity zone) in Figure 5. This does not mean that other sites may not later be classified as extremely high-sensitivity areas based on additional information. Villages, rock art sites and cemeteries or possible cemeteries are extremely sensitive. Villages hold the potential of revealing a long sequence of occupation, thereby allowing the refinement of local chronologies. They provide data on a variety of activities, and may contain faunal and floral remains providing data on diet, which is not elsewhere obtainable. Burials may be found in association. Burials or cemetery sites are extremely sensitive because of Native American religious concerns. Rock art sites have artistic as well as archaeological value, and each is potentially a unique source of data on Native American religion, mythology, cosmology and art, issues which can rarely be studied in

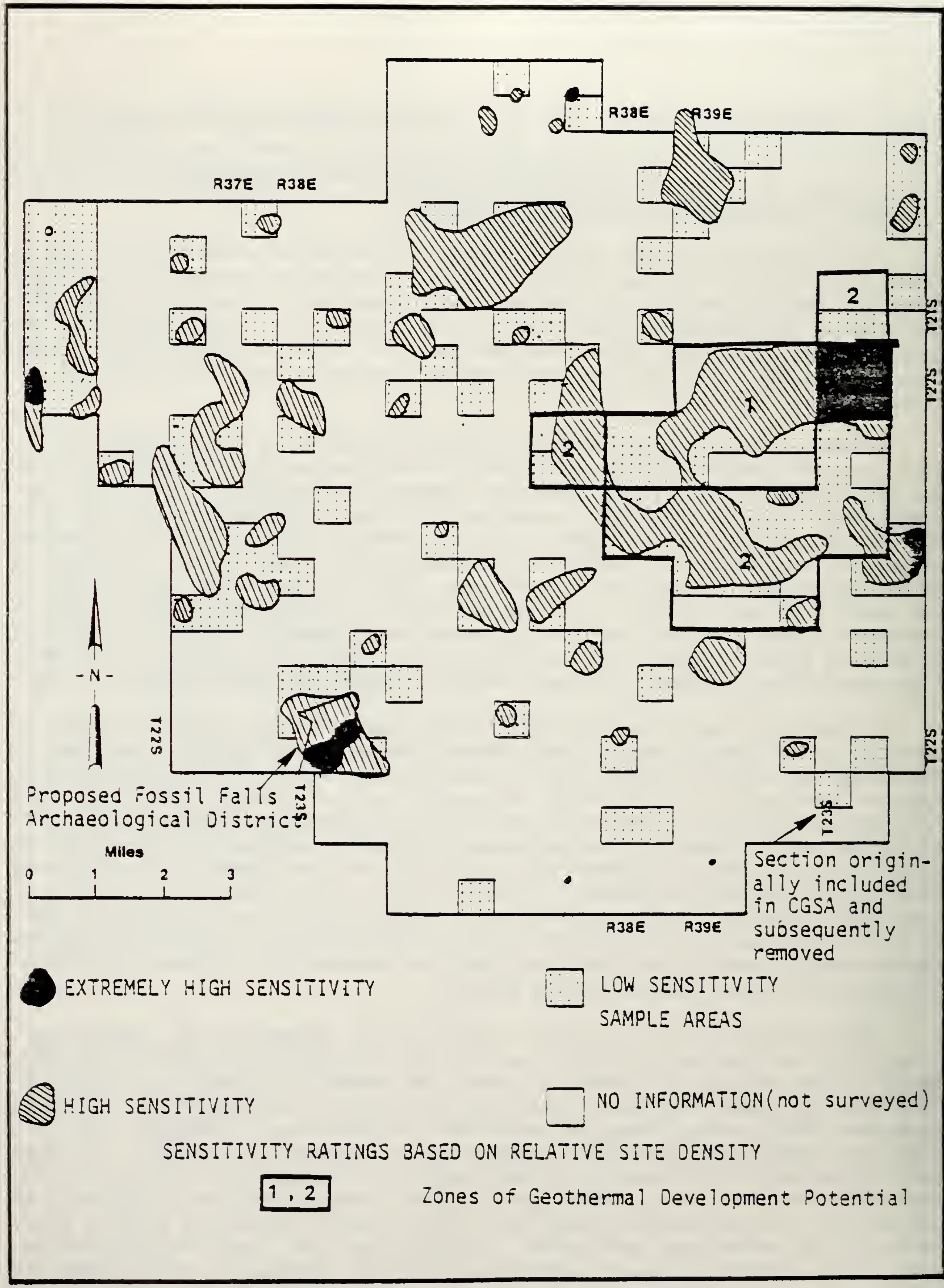

Figure 5. AREAS OF ARCHAEOLOGICAL SENSITIVITY

other cultural resources. In the case of such highly sensitive resources, avoidance may be the only mitigation of impact, as discussed below in Section VII.

The CGSA is less sensitive in terms of historic resources than in terms of prehistoric resources. Aside from the complex at Coso Hot Springs, which includes historic, prehistoric and Native American religious values, the historic material recorded in the CGSA is sparse and generally lacking in integrity. All the recorded sites which could be attributed to a time period date from the twentieth century and do not relate to significant historical events. The study area is peripheral to the homesteading and mining areas of the nineteenth century.

Based on the sensitivity of the prehistoric resources, however, the CGSA warrants careful planning of future management.

Zones 1 and 2 of potential geothermal development were investigated during the recent survey. The sample sizes of 19 units (79 percent) and 28 units (77 percent) respectively are sufficiently large to provide a reliable estimate of site densities and evaluation of cultural resources for these two areas. Both areas are located in the Coso Range and contain units both with and without intermittent streams. Table 13 gives the site density data for these zones of potential geothermal development.

Table 13. SITE DENSITY IN ZONES OF POTENTIAL GEOTHERMAL DEVELOPMENT

Geothermal Development Zone	Sample Units	Number of Hits	Number of Sites	Hits/ Sample Unit	Sites/ Sample Unit	S[1]
1	19	17	19	0.89	1.00	0.57
2	28	21	27	0.75	0.96	1.15

1. Standard Deviation

As can be seen from the table, site densities are slightly lower in these two areas than in the study area as a whole. These differences are not, however, statistically significant, as determined by t-tests (Thomas, 1976: 235-239). Nine empty sample units may be considered areas of minimal sensitivity.

Within these development zones the area of maximal sensitivity is the Coso Hot Springs National Register site. Secondarily, clusters of sites occur in Section 16 in Zone 2, others north of Devil's Kitchen and around Sugarloaf Mountain. These are areas of high sensitivity, as are specific localities where single sites are located. Figure 5, the Sensitivity Map, presents these data graphically. The National Register site is shown as an area of extremely high sensitivity, as are certain sites in other zones. All other sites and site clusters are shown as areas of high sensitivity. The empty sample units and portions of sample units where no sites were encountered are shown as areas of low sensitivity, because there is a low probability that unknown subsurface cultural deposits occur here.

No estimate of sensitivity is offered for the areas which were not surveyed, because the information which can be derived from the predictive model is extremely limited. In general, we can predict a mean site density of 4.44 sites per square mile throughout the study area. Within the unsurveyed areas, we cannot predict with any degree of confidence that the site density will be higher or lower than this mean in certain strata. Furthermore, because site size varies from a few square meters to more than 600 acres (240 ha.), this site density figure may be misleading. Approximately 50 percent of the ground surface surveyed can be considered within the boundaries of one archaeological site or another. A similar amount of coverage is predicted for the unsurveyed areas, but the pattern of distribution of this coverage in relation to environmental strata cannot be predicted.

All of the terrace and playa strata have been surveyed, so the actual site densities, site types and specific locations are known for these strata. Based on sampling of the other strata, the highest site density is found in mountain areas with intermittent streams and the lowest in valleys. A series of t-tests performed on these mean site densities and variances indicates, however, that these different mean site densities cannot be extended to the entire populations from which the samples were drawn. In other words, it may be due to chance that a lower site density was found in the sample of the valley stratum which was surveyed.

In order to develop a true predictive model of site types and environmental strata, it would be necessary to demonstrate a statistically significant correlation between site type and environmental stratum. Correlations between site type and environmental stratum were found not to be statistically significant at the .05 level (predetermined to be the acceptable level of significance) when chi-square tests were performed.

We have, however, offered some observations on site types recorded in the different environmental strata, and based on these observations and our professional judgment, have made some limited and tentative predictions. We predict that quarry sites will be found adjacent to Sugarloaf Mountain and elsewhere where suitable outcrops of lithic material occur. We predict that historic sites related to mining activity will be found in the Coso Mountains. We predict that the majority of sites in the unsurveyed areas, regardless of environmental stratum, will be lithic scatters.

In other regions of the California desert, the BLM has developed predictive models, based on statistically significant correlations, which relate site density and site type to environmental strata. As discussed in the introductory seciton, "Relationship of Environment to Cultural Resources," the CGSA is a unique region. In terms of range of elevations and associated vegetation zones, there is less variation within the CGSA than there is in many areas of comparable size in the California desert. Two unique resources are found here: Sugarloaf Mountain with associated sources of airfall (pyroclastic) obsidian which blanket much of the area, and Coso Hot Springs. The presence of these two resources in a region where two or three major culture areas met on a route of trade and travel, has, at different times in the prehistory and history of the region, drawn groups of Native Americans to the CGSA. The obsidian source accounts for the high density (in terms of area covered with archaeological remains) of cultural lithic material, and masks the relationship of site type to other environmental variables. The presence of Coso Hot Springs introduces cultural variables which further complicate any attempt to apply a model of site type and environmental stratum to the CGSA.

B. EVALUATION OF SITES FOR NATIONAL REGISTER ELIGIBILITY

The study conducted clearly demonstrates that the CGSA is an area which contains cultural resources of high potential scientific value. These values relate directly to criteria set forth in 36 CFR 800. Cultural resources within the CGSA are of high research potential when considered as a whole and are also of significant research potential when taken individually. For these reasons, a determination of the eligibility of large portions of the CGSA for inclusion in the National Register of Historic Places is recommended. The National Register is an official listing of the nation's cultural resources deemed worthy of preservation. In the case of the CGSA, it is recommended that a thematic nomination be considered. A determination of National Register eligibility and an eventual thematic nomination would in all probability allow the greatest flexibility for future planning, development of the area's resources, and scientific investigation of cultural resources which are present within the CGSA. A thematic nomination is one which includes a finite group of resources related in one or more ways to each other by a common theme. All known properties linked by the chosen theme must be included in such a nomination, and the geographical area containing these properties must be clearly defined. The recommended theme for the CGSA is: human exploitation of the environment, over an extended period of time, in an area containing two critically important resources. One of these resources is a major obsidian source which may have provided the economic focus for much of the the human activity in the area during prehistoric times. The second such resource is the Coso Hot Springs. Some undiscovered cultural resources located outside the CGSA, but clearly associated with aboriginal use of these two point sources within the CGSA, may later be recorded and considered for inclusion within this thematic group. At present, however, it is the cultural resources within the CGSA that are being assessed in such a manner. The notion of a thematic nomination was developed by the ERG archaeological team in consultation with Helen Castillo, Chief of Resources, Bureau of Land Management, Bakersfield District Office, and with Jeff Bingham of the State Historic Preservation Office. Mr. William Olsen of the State BLM office was also included in discussions on this proposal.

It should be stressed that a thematic nomination with its inherent flexibility for both land use and scientific investigation and interpretation, should not result in any serious management problems.

The archaeological resources of the CGSA appear to meet the National Register criteria on the basis of their scientific and cultural value. The study area has potential for the investigation of a series of specific research questions which may be related to broader, regional problems in archaeology. It is an area of contact between several distinct prehistoric culture areas. As it was in historic times, this region was a prehistoric corridor of migration, travel and trade between these areas. Meighan (1978), in fact, has suggested that it was through this corridor that the earliest migrations into California occurred. In later times, beginning in the Newberry period, Lanning (1963: 275) suggests that shell beads and ornaments were traded from the coast to the Central Valley and through the Owens Valley region to points north and east in the Great Basin. Shell beads are common in the Rose Spring site (ibid.: 60), as are obsidian biface blanks, which Lanning (ibid.: 284) suggests were made by the inhabitants for trade to the San Joaquin Valley. The Tubatulabal, who were situated in the Kern River area, between the Central Valley and the CGSA, were probably involved in some phases of this trade. According to ethnographic accounts (Smith, 1978) they travelled as far as the coast for clamshell beads, and they also engaged in short-range trade with their neighbors. In historic times, they engaged in hostilities with the Koso or Panamint Shoshones and in alliances with the Owens Valley Paiute (Smith, 1978: 440-441). Also in historic times, Shoshone from the Little Lake region migrated south, probably into Tubatulabal territory (Garfinkel, 1978: 100). A rock art site (Iny-105) which has been recorded in the CGSA, reflects the influences of Yokuts and Chumash culture, as well as local Coso style elements; and two Southern Sierra pictographs reported by Garfinkel (1978), in turn, show the influence of the Coso style in Tubatulabal territory.

Thus, the study area may be viewed for both geographical and cultural reasons, as a part of two culture areas, Great Basin and California, and as having been influenced by and influencing, in turn, the California cultures of the Kern River area, the Central Valley and possibly the coast.

Clearly, then, the area has long been a locus of substantial prehistoric activity by more than one aboriginal group. The generalized geographical location of the CGSA would account for the trace presence of such characteristics as noted above; however, the intensity of some traits, particularly those associated with obsidian exploitation trade, and economic patterning, are directly related to the presence of the major point source at Sugarloaf Mountain. The study of prehistoric trade and migration has therefore promising research potential in the CGSA. Cultural values from at least two or three major culture areas, representing diverse ecological adaptations, are manifest in the cultural resources of the CGSA, and present an unusual opportunity to examine prehistoric subsistence patterning in an area of great wealth in terms of non-edible natural resources (i.e., obsidian and the hot springs).

A full range of site types (except for those which are found only in certain other ecological strata) and a high density of archaeological remains have been recorded for the study area. While the precise interpretation of such density awaits further research, it is nevertheless a salient feature of the resource base. Preliminary temporal data suggest a lengthy record of aboriginal occupation. This is not unexpected in an area affording easy transit and rich lithic resources. Refinement of the local chronology, based on a study of inter-site and intra-site comparisons of projectile points and other lithic tools and waste material, using obsidian hydration and other methods of analysis, could lead to the development of a diachronic model of prehistoric land use patterns for the CGSA, which could in turn be related to the regional models which have been proposed by Bettinger (1977), Hall (1980), Garfinkel et al. (1979), McGuire et al. (1980), and others.

A specialized research problem, involving the investigation of the Sugarloaf Mountain quarries, provides a unique opportunity for the study of lithic quarrying and tool manufacture techniques. Although the Sugarloaf obsidian presently obscures the identification of site types and activity loci, correct analytical procedures will not only clarify these difficulties, but will provide unique and valuable data concerning the economics of obsidian procurement and trade in prehistoric times. Other specialized research problems include the comparison of CGSA rock art sites to other rock art sites in the Coso Range. Rock art studies have made major methodological advances in recent years, and the materials in the CGSA contain abundant data for further analysis and research. It is because the area has been protected to some extent from construction and development, by the presence of the NWC, that this relatively intact representation of a large portion of a local settlement and subsistence pattern is found here. Pot-hunting has, however, resulted in some loss of data. The absence of projectile points from the surface of most sites is evidence of amateur collecting activity. Pot-holes, representing the devastating effects of unauthorized excavations, were observed at Iny-105 and DA-313. Nomination to the National Register should provide recognition of the importance of these resources and focus attention on the need to plan wisely for developments which may jeopardize them. While certain individual sites and site complexes in the study area, e.g., rock art sites, villages and cemeteries, probably meet National Register criteria in themselves, nomination of all the sites as part of a thematic district will better serve the goals of archaeological research.

Isolated finds are excluded for several reasons: they may not be in situ; their potential data may be recovered simply by recording and/or collecting them; and they are not always relocatable.

Historic sites are excluded for other reasons. The study area itself was peripheral to nineteenth century exploration, settlement and mining. The sparse historic resources recorded lack integrity and potential data yield as individual sites. Most are, in fact, quite recent and would not yield significant information about an historical period or activity that is not already known, nor do any of them apparently relate to an event of historic significance.

Because of the location of the CGSA and because of certain features of its environmental setting, the density and patterning of its archaeological resources are unusual. In addition, the NWC withdrawal in the 1940s has limited further destruction of sites by planned construction and development, which elsewhere have obliterated so many of California's cultural resources. If sites in the study area are preserved in the future, they will present an unusual opportunity for archaeological research concerned with regional problems. Specific research questions are discussed under Evaluation of Sites for the National Register and Recommendations for Mitigation.

A large area, comprising 820 acres (ca. 332 ha.), located within Zone 1 of probable geothermal development, has already been placed on the National Register of Historic Places as the Coso Hot Springs National Register site. A second area, comprising 770 acres near the southwest boundary of the CGSA, has been nominated by the BLM as the Fossil Falls Archaeological District. Finally, based on the research conducted in the preparation of this report, a nomination of a thematic archaeological district has been proposed for the remainder of the CGSA.

VI. PREDICTED IMPACTS OF THE PROPOSED PROGRAM ON CULTURAL RESOURCES

Even with careful planning of geothermal development to avoid disturbance of cultural resources, there is potential for significant impact because of the high density of archaeological material in the CGSA (sites are estimated to cover approximately 50 percent of the ground surface). It is expected that a site density of 4.5 sites per square mile would be found throughout the CGSA, a possible total of over 500 sites within the study area as a whole.

Site boundaries have not been tested (see Mitigation Measures, below) and therefore no reliable estimate of average site size can be given. The sizes of individual sites range from isolated finds (e.g., single projectile points) to one with an areal extent of over 600 acres (ca. 240 ha.); it would appear that 23 sites are 100 acres (40 ha.) or more in size.

Within Geothermal Zone 1, which comprises six square miles, 19 of 24 possible sample units were surveyed, and all but two of these contained sites. Four of the sites exceed 100 acres in size, and one exceeds 600 acres. One extremely high sensitivity area (see Figure 5), the Coso Hot Springs National Register Site, is found within this zone. This area has special significance for Native American groups. (A more comprehensive discussion of their concerns in connection with the proposed project is contained in the Environmental Impact Statement, under Socioeconomics.) The proposed program would obviously have a potential for significant impact (up to 100 percent possible destruction of individual sites) within Zone 1; this is discussed in greater detail below under Summary of Impacts.

The development model of the CGSA outlined in Chapter 1, Proposed Action, of the Environmental Impact Statement, can be used to develop approximate predictions of the impacts of geothermal development on archaeological and historical sites. Five development phases are delineated. Although this model is procedurally evolutionary, in fact these phases may be concurrent. For example, Preliminary Exploration may occur in Zones 3 and 4 while Field Development is occurring in Zones 1 and 2.

The following discussion will consider the predicted impacts of the proposed action by phase of development, with emphasis on Zones 1 and 2; see also Summary of Impacts, below.

PRELIMINARY EXPLORATION

Minimal exploratory operations are anticipated for geothermal Zone 1 prior to drilling (EIS Chapter 1). Impact would nonetheless result from even minimal operations where these involve disturbance of the ground surface. Surface disturbance at a locus of archaeological material will remove, displace and possibly damage that material in proportion to the size of the area disturbed. We assume that most impacts for preliminary exploration in Zone 1 have already occurred.

Gravity and magnetic measurements would not impact archaeological sites if these measurements are taken from aircraft. Impacts to cultural resources would result from offroad vehicle traffic which may occur in connection with measurements of micro-seismicity, and resistivity and magnetic measurements.

Driving across a site disturbs, rearranges and damages surface material. If the site is located on the surface, as many of the sites in the CGSA appear to be, a large proportion of potential archaeological data would be lost. If the site includes a subsurface deposit, that portion of the data below the surface may remain undisturbed; hence, the proportion of total data loss would be smaller.

The drilling of holes for heat flow measurements in archaeological sites would destroy any subsurface material where the hole is drilled. Surface disturbance would result not only from the drilling itself but also from human traffic and movement of vehicles: water trucks, trucks transporting the light drilling rig, and possibly personnel vehicles. (No drill pad, however, is required for heat flow measurements.) A small, dense lithic scatter--less than 50 square meters with more than 30 artifacts per 10 square meters--could suffer virtual obliteration from such surface disturbance. A larger scatter would obviously experience proportionately less disturbance. Several large, dense lithic scatters, some over 100 acres in extent, have been found in the vicinity of Sugarloaf Mountain in Zone 1. The extent of impact on such a site, resulting from approximately one acre or less of surface disturbance, could be characterized as less than one percent; the significance of the impact would depend on such factors as the density and character of the deposit. Heat flow test drilling in a village site several hundred acres in surface area would cause not only surface disturbance wherever traffic or drilling occurred, but also destruction of whatever subsurface deposits were encountered in drilling.

As ground covered by archaeological sites is estimated at 50 percent of the total surface, the number of archaeological sites in Zones 1 and 2 (and throughout the CGSA) that could be impacted by exploration could be calculated as one-half of the number of onsite exploration loci.

EXPLORATORY DRILLING

The types of surface/subsurface disturbance described for the Preliminary Exploration phase would be magnified in this phase. Well drilling at a locus of archaeological material will destroy that material. In addition to the actual drilling, disturbance of the ground surface, and therefore disturbance of archaeological material, if present, would result from access road construction and drill site preparation.

Access road construction would impact archaeological sites which lie in the path of the access road by disturbing both surface and shallow subsurface deposits. It would also disturb the surface of archaeological sites adjacent to the route, due to grading and because road construction equipment would have to be driven to the place where the road is to be constructed and may at times be moved or parked off the access road itself. New 24-foot-wide access road construction would disturb three acres for each mile of such road, and 13.8-foot-wide maintenance road construction would disturb 1.7 acres per mile. An access road constructed through an archaeological site consisting of a surface and shallow subsurface deposit would disturb less than five percent of a large lithic scatter, 100 acres in size, but could disturb up to 100 percent of a very small site. The placement of gravel or cinder on the surface of the road would impact remaining subsurface archaeological deposits slightly by impeding access to the deposits in the future.

Drill site preparation would impact archaeological sites to a considerable extent by clearing and leveling the land. Leveling would remove both surface and subsurface archaeological deposits. Each drill pad would average 150' x 500' in area (approximately 1.7 acres), but surface disturbance from pad preparation could amount to much more than 1.7 acres if pads are required in rough terrain, because of the increase in cut and fill operations. The excavation of sumps and reserve pits approximately 150' by 150' in area and 10 feet deep would further impact archaeological deposits. One hundred percent of a small archaeological site less than 150' by 150' in size at the locus of excavation would be destroyed, but less than five percent of one of the larger sites in the CGSA (over 100 acres in area) would be destroyed by the construction of one of these pits. As it is not likely that an archaeological site in this area extends more than 10 feet below the surface, the excavation of a pit 10 feet deep would probably completely destroy any subsurface archaeological deposit within the 150' by 150' area.

Drilling would impact whatever subsurface deposits remain after the leveling of the drill site, both by the drilling operation itself and the installation of drilling equipment. If the impact of drill site preparation has been major, resulting in the total or almost total destruction of the archaeological deposit, then the additional impact of well drilling would be considerably less. There is a low probability that drilling would encounter deeply buried, unknown, archaeological deposits.

Disposal of waste may impact cultural resources through accidents. An accident during transport of drilling mud for disposal outside the CGSA may result in the covering of an archaeological site with this material. This could cause displacement or damage to surface archaeological material and could impede access to the data in the archaeological deposit. Clean-up operations following an accident would probably impact archaeological deposits more than the accident itself. Movement of heavy vehicles to dump or collect other waste in the waste sump may result in the accidental disturbance of adjacent archaeological deposits which have not already been impacted by drill site construction.

Extensive exploratory drilling prior to production in Zone 1 may not be necessary; more would be expected in Zone 2 (EIS Chapter 1). In the event that a total of four well pads, eight sumps, four reserve pits, two reinjection wells and one mile of 13.8'-wide maintenance road were required in Zone 1 prior to production, a surface disturbance of at least 18 acres would result; this does not allow for extensive grading due to steep terrain, or for accidental spillage and clean-up. Given the predicted 50 percent ground coverage by archaeological sites, it is expected that approximately nine of the 18 acres would constitute sites and that these would be impacted unless care were taken to inspect the area beforehand (see following chapter). Far more extensive exploratory drilling is anticipated in Zones 3 and 4, and again about half of the disturbed area could be expected to constitute sites.

FIELD DEVELOPMENT

Field development would have the greatest impact on archaeological sites. Because the number of wells is greater, field development would disturb a larger surface area at a single locus than would exploratory drilling (six well pads per 50-MW plant, together with sumps). The increased length of operations and increased waste production will increase the probability of accidentally depositing waste on archaeological sites. The nature of impacts from construction of any additional access roads or drill pad sites, as well as from well-drilling and waste disposal, should be the same as that described for the exploratory drilling phase.

Including the power plant construction and construction of additional roads, transmission and pipelines, the total disturbed area would be approximately 71 acres per 50-MW plant, in addition to the area required for the common transmission line and water pipeline (a one-time impact). Total disturbance for eleven 50-MW plants could amount to 800 acres or more, not including additional exploratory or replacement wells. This could conceivably result in 100 percent destruction of eight of the largest recorded sites in the CGSA, or it could result in 100 percent destruction of a larger number of smaller sites. The most likely situation is that it would destroy 100 percent of some sites while impacting others to a lesser extent. As the project description ultimately calls for approximately 600 wells (including exploratory and replacement wells) in Zones 1 and 2, it is estimated that as many as 300 of these wells could impact archaeological site in this area. Since five of the eleven 50-MW plants are envisioned for Zones 1 and 2, approximately 350 acres of such disturbance would result from construction of the plants and associated facilities. Approximately 175 acres of this disturbed surface is predicted to contain archaeological material; an unknown amount of subsurface material would also be expected to sustain impact. In addition, for every group of four exploratory (or, eventually, replacement) wells, the associated structures mentioned in connection with drilling above would be required: well pad, two sumps, reserve pit, a reinjection well pad (shared with another group of four exploratory wells), and an average of 1/4 mile of 13.8'-wide road--a total of 4.5 acres of added surface disturbance. Again, the likelihood is that 2.25 acres of that area would have surface deposits.

RESOURCES UTILIZATION

Some additional impacts to archaeological materials would occur during the operational phase of the program (within a given lease) as a result of the drilling of replacement wells; these impacts would be similar to those described for exploration drilling and are described more fully in the Summary of Impacts. In general, however, this phase of development would have less impact on archaeological resources than the preceding phases.

Well blowouts, which could occur during any of phases 2-4, could cause additional surface disturbance from the use of emergency vehicles; the geothermal fluid would, however, probably be contained in the reserve pits.

CLOSEOUT

Abandonment of wells would not impact archaeological resources. Restoration of the area, depending on how it is accomplished, may impact archaeological sites. For example, refilling of sumps and reserve pits, if accomplished by cutting other areas, would obviously have the potential for archaeological impact in the area of excavation. If berms are bulldozed to their original grade and this material is used to fill sumps, any deposits contained in the berm would have already been disturbed, and additional data loss would probably be minimal. However, any surface, or shallow subsurface, materials at the original grade would be disturbed when the overburden is removed.

OTHER IMPACTS

The presence of numbers of workers, engineers and scientists in the CGSA in connection with this proposed program is predicted to impact archaeological sites through an increase in amateur collecting and excavation, and possible vandalism of rock art sites. The rock art sites of Renegade and Petroglyph Canyons have been vandalized as a result of publicity and consequent heavy visitor traffic, and many of the sites encountered in the survey showed the effects of pothunting.

NO PROJECT

Even if the proposed action does not take place, the Navy geothermal development plan will be implemented. Impacts from that project should be less than but similar to those from the project under consideration. The cumulative effects of these are discussed under Summary of Impacts.

SUMMARY OF IMPACTS

Full field development would involve surface disturbance of over 800 acres in all four zones for the eleven 50-MW plants and associated facilities. The NWC development is estimated to require approximately 110 additional acres, including replacement wells. In addition, an estimated 1,200 exploratory and replacement wells would be required throughout the CGSA during the lifetime of the proposed action. It is not possible to predict exactly how many of these wells would be exploratory and how many replacement, how many productive and how many abandoned. However, the impact of drilling is the same in any case. Hence, they are considered together in this summary section.

As discussed above, each group of four wells (exploratory, replacement/productive, or ultimately abandoned) requires disturbance of 4.5 acres of land for associated sumps, reserve pits, roads, reinjection, etc.; hence, total disturbance for 1,200 wells would be 300 x 4.5 acres or 1,350 acres. Total area disturbed by full field development including plant sites and NWC operations would thus be 2,260 acres (figures derived from EIS Chapter 1). It is assumed that waste materials and any accidental blowout fluids would be contained in sumps and reserve pits; no prediction is made as to the likely amount of spillage on surface areas.

Of this total of 2,260 acres, approximately 40 percent or 900 acres (five of the eleven plants and a smaller proportion of the total wells) would probably lie within Zones 1 and 2, an area of 15 square miles. It could be assumed that 450 acres of this surface area in these two zones would constitute archaeological sites. The estimate of disturbed area in these two zones may be in fact conservative; it could be significantly greater due to the steepness of the terrain, necessitating longer roads, increased cut and fill, and longer pipeline access.

Given the extremely-high-sensitivity area within Zone 1, the severe topographic conditions (which may constrain plant locations), the relatively small size of this zone (6 square miles), and the probable concentration of geothermal development there, the likelihood of impacting archaeological sites in Zone 1 is considered very high. For example, at least one section (640 acres) is required for one 50-MW plant and ancillary facilities, although only a small proportion (71 acres) of land disturbance would occur within that section. Reference to Figure 3 (end pocket) and the Sensitivity Map (Figure 5) shows no complete section of 640 acres without a known site. Appendix E shows locations of known sites; it is clear from reference to this map that within Zone 1 there is no surface area of one mile square (regardless of section boundaries) without archaeological or historical material, and that terrain is severely restrictive, there being only one or two relatively flat areas of any extent outside of the National Historic Register Site (Section 4). Thus, extreme care would have to be taken to avoid impact to cultural resources in Zone 1.

A few assumptions can be made regarding the placement of facilities; for example, it is conceivable that wellheads or pads might be located on top of rhyolite domes, though not sumps, reserve pits or power plants. However, it is not safe to assume that such locations would be without archaeological sites; in fact, several quarry sites are found on rhyolite domes.

In summary, the prediction is that half of the surface of the CGSA (total 72,640 acres) contains cultural materials. If 2,260 acres were to be disturbed by geothermal development, total disturbed area would equal 3.1 percent of the total area, one-half of which (1.5 percent of the total) could be expected to contain archaeological/historical material. Put another way, half of the disturbed 2,260 acres, or 1,130 acres, could be covered with sites; the total disturbed area would constitute 3.1 percent of the predicted cultural resources in the CGSA.

In a worst possible case (however, statistically improbable), if every one of the 2,260 disturbed acres were found to be covered with sites, 6.2 percent of the cultural resources within the CGSA would be disturbed or destroyed.

Such figures, of course, take no account of the density, nature, or condition of the individual deposits, but only the quantitative impact. If areas of extremely high sensitivity, such as villages, rock art, or burial sites, were to be destroyed, the significance of the loss (of research data) might be out of proportion to the small percentage of area destroyed.

It has been noted above that the practical likelihood of impact is greatest in Zones 1 and 2 where greatest geothermal development is expected within a small area, and where there are known areas of extremely high sensitivity. It has also been noted that, despite the NWC withdrawal, which has protected parts of the CGSA to a great extent, considerable pothunting has already taken place; and vandalism, as mentioned, has been a significant problem within the region as a whole. However, the extent, variety, and overall condition of the CGSA's cultural resources (together with other known sites within the vicinity, such as Petroglyph Canyon) are such as to present extremely valuable data for research into regional archaeological questions. Some of these research questions, and methods of protecting the data from further avoidable impact, are discussed in the following chapter.

VII. RECOMMENDATIONS FOR MITIGATION OF IMPACTS

This discussion of recommended mitigating measures considers three alternatives: total preservation, avoidance, and data recovery through collection and analysis.

Total preservation is defined here as no surface entry. This alternative will be applied to known sites in the extremely high sensitivity category and to sites not yet recorded which meet the same criteria. These include rock art sites, aboriginal village sites, aboriginal cemeteries, certain rock shelters and the Coso Hot Springs National Register site. The sites presently included in this category are DA-253, 268, 273, 313, 316, 340, 373, 375, 380, 381, recorded by the ERG crew; and DA-3, 9, 12, 28, and 35, recorded by Garfinkel. Additional rock shelter sites within the proposed Fossil Falls Archaeological District (not within sample units examined in the present survey) should be reexamined for evidence of occupational midden. These sites may also be worthy of preservation. No further mitigation measures, except monitoring, will be required at the above sites. The SHPO will evaluate sites yet to be discovered which appear to be of extremely high sensitivity in order to determine the appropriate mitigation measures.

No surface disturbance will be permitted on other cultural resource sites determined to be eligible for inclusion on the National Register, or on sites yet to be inventoried until the National Advisory Council on Historic Preservation has commented and the SHPO has agreed on appropriate mitigation measures. Until such agreement is reached, these sites will be totally avoided.

An assessment strategy will be developed and implemented, in consultation with the SHPO, in order to provide an evaluative standard whereby the potential data yield of lithic scatters yet to be discovered by lessee-funded archaeologists can be assessed.

Mitigation measures will be implemented in three phases. Phase I will consist of additional survey and mapping in order to determine the extent of known sites and the location of unknown sites within specific areas proposed for development. These procedures are automatic, as prescribed by the USGS/BLM memo of agreement, 36 CFR 800 procedures, and the geothermal lease stipulations. This phase will be implemented in conjunction with the development of specific plans for geothermal development. It should provide some of the additional information necessary for the purpose of determining the sensitivity of specific areas and specific sites.

After leasing, the following Cultural Resources Assessment Strategy (Phase II) will be fully developed and implemented in consultation with the SHPO. The lessees within the CGSA will each be requested to assist the BLM in funding this strategy so that it may be completed in a timely manner prior to intensive exploration and early stages of development. The Cultural Resources Assessment Strategy will provide an evaluative standard whereby the potential data yield of aboriginal lithic scatters, both known and yet to be discovered by lessee-funded archaeologists during exploration and development, can be assessed. This strategy will first require the development of a detailed research design to penetrate the obsidian "masking effect" and to allow further appropriate mitigation measures for impacts to lithic scatters with the CGSA to be developed. This research design would be implemented to achieve the following objectives:

1. Inventory at least eight transects 50 meters wide outward at equal intervals from Sugarloaf Mountain to the boundaries of the CGSA. Record all sites encountered along each transect, conduct a limited surface collection of every lithic scatter inventoried, and excavate up to 5 subsurface units within those sites that appear to require subsurface sampling for evaluation. The information collected on variability and attenuation of archaeological materials at different distances from Sugarloaf Mountain can be used in evaluating future sites encountered by lessee-funded archaeologists.

2. The information collected in this inventory should provide data to:

   a. define the local chronology, based on inter-site and intra-site analysis of flaked stone artifacts, obsidian hydration studies, and other relative and absolute dating techniques;

   b. provide an initial understanding of local aboriginal subsistence and lithic exchange systems, based upon analyses of flaked stone tools and projectile points, lithic use-wear, flake-core ratios and obsidian sourcing (studies of exchange systems should emphasize Great Basin - Coso, Kern River - Coso and Coast - Coso trade relationships); and

   c. generate a diachronic land-use model, based upon the analysis of data from this inventory, and propose a methodology for testing the model.

Any further mitigation measures for those lithic scatters which are determined to be eligible for inclusion on the National Register and which may be impacted by geothermal development will be developed and implemented by the BLM, NWC and SHPO in consultation with one another. It is anticipated that implementation of the Cultural Resources Assessment Strategy will, in large measure, provide the required mitigation for most of the extensive lithic scatters that may be impacted by geothermal development.

Phase III would consist of monitoring during construction, development and extraction of geothermal resources. Buried sites may be revealed in the course of drilling or other excavation activities. In this case, the activity must be halted (see GRO 4) until archaeologists can examine the material and recommend mitigation measures. Native American consultants should be contacted if material of possible religious or other cultural value to Native Ameraicans is encountered.

<u>Additional Considerations</u>

The presence of numbers of workers, engineers and scientists in the CGSA in connection with the proposed program and, in addition, the presence of their families and possibly related service industries nearby, poses an increased threat to the cultural resources of the area, which have already been impacted by amateur collectors and excavators. A program of education regarding the cultural value of these resources and the legal sanctions against pothunting should be directed at this group. Patrolling of some site areas, particularly rock art sites, which are subject to vandalism, is also recommended.

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IX. APPENDICES

APPENDIX A

CONTACTS WITH NATIVE AMERICANS

MEETINGS

Date	Native Americans	Contacted by	Time Spent	Remarks
11/3/78	Neddeen Naylor	D.Whitley	1 hour	Whitley explained the archaeological project, requested her input and offered to arrange meetings with other members of the community. Mrs. Naylor gave her views on Coso Hot Springs. She also suggested contacting Blanche Shippentower.
11/9/78	Neddeen Naylor	D.Whitley	1 hour	Whitley and Naylor discussed the Native American visit to the Hot Springs planned for 11/11. Mrs. Naylor explained the curative powers of Coso Hot Springs mud. Plans were made for the employment of Native American monitors on the survey.
11/27/78	Patti Wermuth	D.Whitley	1 day	Ms. Wermuth walked with crews as they surveyed Coso Hot Springs and other areas. She also talked with Whitley at the Little Lake Hotel. The local archaeology and the possibility of a Native American Museum were discussed, as well as the importance of Coso Hot Springs to Native Americans.
3/11/79	Neddeen Naylor	H.Wells	1 hour	Wells brought Mrs. Naylor up-to-date on the archaeological project and requested any input. Mrs. Naylor asked what we expect to accomplish with our study. She commented on the Iroquois Research Institute report. She said that recent problems with the tribal elders have been straightened out, so the Navy's plan for use of the Hot Springs will probably be accepted. She also spent some time explaining her position in the Native American Community and her views on Native American issues in general.

Date	Native Americans	Contacted by	Time Spent	Remarks
3/11/79	Raymond Stone	H. Wells	15 Min.	Wells requested Mr. Stone's input and questions regarding the archaeological project. He asked if we had found any graves. He said that the area right around the Hot Springs had been for religious use only. His attitude toward geothermal development is that now all the Native Americans can do is pray. He also discussed his present position within the Native American community

LETTERS SENT (Attached)

Date	To	From
11/3/78	Neddeen Naylor	D. Whitley
11/9/78	Blanche Shippentower	D. Whitley
11/10/78	Patti Wermuth	D. Whitley

NATIVE AMERICAN MONITORS

Name	Week Ending	Hours Worked
Russell Shepherd	11/10/78	8
	11/17/78	16
	11/24/78	40
	12/1/78	32
Valorie Naylor	11/10/78	8
	11/17/78	16
	11/24/78	8
	12/1/78	32
Eloise Naylor	11/10/78	8
	11/17/78	16
	11/24/78	40
	12/1/78	16

RECEIVED MAY 15 1979 November 5, 1978

Dear Mrs. Naylor,

I want to thank-you for spending the time on Friday afternoon discussing your views on the Sacred Hot Springs (and all the other topics we managed to cover) with me. I would like to emphasize again that I am anxious to receive any input the Ad Hoc Committee might have concerning the project, and to meet with any of its members or any of your community to discuss the work we are doing. Sometime later this week (after my crews get into the routine of getting to breakfast, out to work, back for dinner, etc., on time) I will go up to Bishop, give Mrs. Shippentower a call, and go by the legal office to look at the archival records.

Our field work began on Saturday and my crews are in very high spirits. They seem to be finding the archaeology and this area, in general, more interesting than the work they have been doing lately in the suburban Thousand Oaks area near Los Angeles. I think they had forgotten how nice it can be to do field work in the Great Basin area. Each crew managed to find and record at least one (and in one case three) archaeological site on the first day of hiking. It appears that Sugarloaf Mountain was a major obsidian source, and that the whole northern section of the study area contains small stone tool workshops scattered just about everywhere. Hopefully we will find some new petroglyph sites soon.

I will stop in and see you sometime later this week. I'm staying at the Willow Motel in Lone Pine (phone: 876-5655) if you want to get in touch with me before then.

Best wishes,

Dave Whitley

11/9/78

Mrs. Blanche Shippentower
205 S. Barlow
Bishop, Ca. 93514

Dear Mrs. Shippentower:

I have been trying to reach you by phone and was hoping to drop in and visit you in Bishop this week but so far I have been unsuccessful in contacting you. As you undoubtably know, the Coso Geothermal Study Project has gotten underway and I have a crew of thirty archaeologists doing an archaeological site survey of 25% of the study area. This involves locating, recording and photographically documenting all prehistoric and historic sites that we encounter; no excavation or collection of artifacts is being made in this study. Additionally, each site that is discovered is being evaluated for nomination as a national historic monument.

As a member of the Coso Sacred Hot Springs Ad Hoc Committee and the Native American Heritage Commission, I would be very happy to receive any input you or other members of your committee and community might have as regards the study area and its importance to the Native American community. I would be very happy to meet with you and discuss our project in the study area. I have been in contact with Mrs. Naylor in Lone Pine who has arranged for us to hire three members of her local community to act as liasons between our project and the council offices in Lone Pine, but I think additional input from the Bishop area might also be beneficial.

I am staying at the Willow Motel in Lone Pine, phone number 876-5655, if you would like to reach me. I will keep in contact with you for the next few weeks and keep you informed on our project and I am looking forward to meeting you in person.

Sincerely,

David Whitley

David Whitley,
Field Director
Coso Study Archaeological Survey

11/10/1978

Ms. Patti Wermuth
P.O. Box 1138
Kernville, Ca. 93238

Dear Ms. Wermuth:

As a member of the Coso Sacred Hot Springs Ad Hoc Committee, I thought you might be interested in knowing that we have begun an archaeological site survey in the Coso area as part of the Coso Geothermal Study Project. My crew of thirty archaeologists is locating, recording and photographically documenting prehistoric and historic sites within 25% of the geothermal study area; no excavations or artifact collections are being made in this project. Our goal in this study is to produce a report inventorying the cultural resources of the region. This report will assess the significance of the sites we have discovered as potential National Historical Monuments, as the cultural heritage of the Native American community, and as unique and irreplaceable scientific resources. Thus, any negative impact from the geothermal project can be avoided in areas of cultural and scientific importance.

I have been in contact with Mrs. Naylor, of Lone Pine, and Mrs Shippentower, of Bishop, in regards to this project. I have asked both ladies for any input they, their committee, and their communities might have in respect to our project and the importance the Coso area has to the Native American community. I would like to extend this request to you also; any input you wish to forward to me would be greatly appreciated. Mrs. Naylor has arranged for us to hire three members of her local community to act as liaisons between our project and the council offices in Lone Pine. I think the perspective of other areas and other communities might also be beneficial towards adequately assessing the importance of the study area.

I am staying at the Willow Motel in Lone Pine, phone number (714) 876-5655, if you would like to contact me. I will keep you updated on our project and am anxious to here from you.

Sincerely,

(signed)

David Whitley

Field Director,
Coso Study Archaeological Survey

APPENDIX B

PERSONS AND INSTITUTIONS CONSULTED

1. INDIVIDUALS

Name	Affiliation
Tillie Barling	NWC
Christopher Drover	VTN Associates
Robert F. Heizer	US Berkeley
Mr. and Mrs. Phil Hennis	Rose Valley ranchers
Andy Jackson	VTN Associates
Mr. and Mrs. Rodney Lane	Rose Valley ranchers
Georgia Lee	UCLA Rock Art Archive
Garth Portillo	BLM, Bishop
Carol Rector	US, Riverside
Nancy Ridgeway	BLM, Bishop
Eric Ritter	BLM, Desert Planning Staff
Carolyn Shepherd	NWC
Nancy Walter	

2. INSTITUTIONS

Bureau of Land Management, Bakersfield District Office, Site Files

Bureau of Land Management, Desert Planning Staff, Riverside

APPENDIX C

SITES PREVIOUSLY RECORDED IN THE STUDY AREA

APPENDIX C
SITES PREVIOUSLY RECORDED IN THE STUDY AREA

Table C-1 lists the previously recorded sites in the study area. An attempt was made to relocate all sites situated within sample units selected for the present study. These attempts were usually successful, but in some cases, sites could not be relocated, and in others the recorded location or extent of a known site required modification. Unrelocated sites are discussed below, site by site.

Three of the sites recorded by Garfinkel were not relocated. One of these, Iny-1646 (DA-15), consists of one obsidian flake, one mano and one metate, classified as isolated finds. Iny-1665 (DA-38) and Iny-1666 (DA-39), both milling stations, also were not relocated, despite a careful search of rock outcrops. In the case of Iny-1665, it is believed that the rock outcrop described by Garfinkel was relocated, but it was not possible to identify grinding slicks on any of its surfaces.

Of the 18 sites recorded by Drover, 13 fall within sample units surveyed by ERG crew. Six of Drover's sites, all described as lithic scatters, are located by Drover within the northeast quarter of ERG's Sample Unit 81. Our own observations suggest that this entire area consists of a light lithic scatter with numerous concentrations. Furthermore, the scatter extends into the southeast quarter of the sample unit, where Drover did not record any sites. RH-6, in the southwest quarter of the sample unit, is described as a lithic scatter consisting of less than 20 flakes in a 20-foot by 20-foot area with a recent historic firepit associated. The firepit had been noted by the ERG crew, but no flakes were observed. Four other sites, all small lithic scatters recorded by Drover in the same sample unit, had not been found by the ERG crew. An attempt to relocate these in February with the VTN site records in hand was unsuccessful. One of these, RH-17, should have been found if the description in the site record is accurate. It lists several artifacts and less than ten flakes at a possible campsite near basalt outcrops. A crew of four persons spent an hour in February making a thorough search of the northwest quarter of the sample unit, checking particularly around the numerous basalt outcrops, but found nothing.

RH-15 falls within Sample Unit 82, which had been selected, but not surveyed, in November. Described as a scatter of less than ten flakes within an area 30 by 30 meters, this site would be easy to miss. Attempts to relocate it during the February survey of Sample Unit 82 were unsuccessful.

Drover's site RH-11 (Iny-1588 and 1636) is described as two rock shelters with associated flakes and manos. He places it in our Sample Unit 81. Garfinkel's DA-5 (Iny-1636) appears to be the same site, and it is shown in the same location in his proposed Fossil Falls Archaeological District, but his site record places it in the northwest quarter of the section. The ERG crew recorded the site in the location given by Drover and found a third rock shelter about 20 meters southwest of the other two. It was decided to include this third shelter as part of the same site.

Sites Iny-2246 and 2247, recorded by the BLM in 1977, are found in our Sample Unit 6. These two sites have been equated with our site DA-289, although the locations are not congruent. This appears to be another case of concentrations of worked obsidian in an area where obsidian nodules and natural flakes occur extensively, making site definition difficult.

The BLM recorded two sites on the Lewis Ranch, now occupied by Rodney Lane. These two are Iny-2283, a temporary camp, and Iny-2284, a village with associated rock art. The ERG crew conducted an intensive survey of this area, located within Sample Unit 94, and determined that Iny-2283 is actually an extension of the village site. The crew did not, however, survey outside the boundary of the CGSA to relocate the southern boundary of this site. The rock art, consisting of petroglyphs, located on an isolated boulder with a lithic scatter associated, is located at a distance of ca. 100 meters from the habitation site; it was therefore given a separate site number. Additional modifications of site boundaries and descriptions are noted under "Remarks" in Table C-1.

The above account of problems encountered in relocating sites and correlating our findings with those of other archaeologists underlines some of the difficulties of archaeological site survey. Despite good coverage and careful surveying techniques, trained crews may fail to find small sites. In desert areas, particularly, surface material may be covered and uncovered periodically by the forces of wind and water, and human activity may remove, destroy or obscure site remains. The Red Hill area, particularly, appears to have been subject to considerable recent disturbance. Finally, despite attempts to standardize procedures, site definition remains a problem in which subjective judgment plays a role. In the desert, extensive light lithic scatters containing concentrations of material always present recording problems. In the study area, these problems are complicated by the widespread occurrence of airfall obsidian with loci of archaeological material within them. This problem is discussed further in connection with lithic scatters under Summary Description of Cultural Resources Identified, above.

TABLE C-1

PREVIOUSLY RECORDED SITES WITHIN CGSA

Site No.				First recorded by	Type	S.U. #	Remarks
Iny-	BLM DA-	VTN	ERG DA-				
105			253		Rock art shelters	2	Relocated; intensive survey
1538/				Unknown	Lithic scatter(?)	--	Site record incomplete
1588/ 1636	5	RH11	278	Littleton and Snyder; Garfinkel	Rock shelters	81	Two shelters known; third shelter recorded by ERG crew
1634	3			Garfinkel	Village	--	
1635	4			Garfinkel	Village	--	
1637	6			Garfinkel	Lithic scatter	--	
1638	7			Garfinkel	Milling station; lithic scatter	--	
1639	8			Garfinkel	Rock shelter	--	
1640	9			Garfinkel	Rock shelter and petroglyph		
1641	10			Garfinkel	Rock shelter	--	
1642	11			Garfinkel	Temporary camp	--	
1643	12			Garfinkel	Village	--	
1645	14			Garfinkel	Milling station	--	
1646	15			Garfinkel	Isolated find	82	Not relocated
1647	16		276	Garfinkel	Lithic scatter, isolated find	83	Site much larger than indicated

TABLE C-1 (continued)

Site No. Iny-	BLM DA-	VTN	ERG DA-	First recorded by	Type	S.U. #	Remarks
1651	24			Garfinkel	Rock shelter	--	
1652	25			Garfinkel	Temporary camp	--	
1653	26			Garfinkel	Milling station, lithic scatter	--	
1654	27			Garfinkel	Milling station	--	
1655	28			Garfinkel	Village	--	
1656	29			Garfinkel	Historic	--	
1661	34			Garfinkel	Milling station	--	
1662	35			Garfinkel	Village, rock shelter	--	
1663	36		387	Garfinkel	Temporary camp	78	Site much larger than indicated
1665	38			Garfinkel	Milling station	81	Not relocated; rock outcrop found; no milling features
1666	39			Garfinkel	Milling station	81	Not relocated
1667	40			Garfinkel	Rock shelter	--	
1668	41			Garfinkel	Temporary camp, rock alignment	--	
1669	42			Garfinkel	Milling station, lithic scatter	--	

TABLE C-1 (continued)

Site No. Iny-	BLM DA-	VTN	ERG DA-	First recorded by	Type	S.U. #	Remarks
1670	43			Garfinkel	Isolated find	--	
1671	44		275	Garfinkel	Rock shelter	39	
1672	45		277	Garfinkel	Milling station	39	Light lithic scatter associated; temporary camp
1673	46			Garfinkel	Temporary camp	--	
1674	48			Garfinkel	Lithic scatter	6	
2246	134		289	BLM	Lithic scatter	6	Relocated
2247	135		289	BLM	Lithic scatter, rock cairns	6	Relocated
2248	136		261	BLM	Lithic scatter	305	Relocated, but boundaries modified
2249	137			BLM	Temporary camp	--	
2283	172		381	BLM	Temporary camp	94	Recorded as extension of Iny-2284, a village
2284	173		380, 381	BLM	Village, cemetery, rock art	94	Rock art and village recorded as two sites; Iny-2283 and 2284 combined
2333	205		306	BLM	Lithic scatter	14	Relocated
2334	206			BLM	Lithic scatter		--

TABLE C-1 (continued)

Site No.							
Iny-	BLM DA-	VTN	ERG DA-	First recorded by	Type	S.U. #	Remarks
		RH1		VTN	Lithic scatter, rock ring, historic	--	
		RH2		VTN	Lithic scatter		
		RH3		VTN	Historic	--	
		RH4		VTN	Rock alignment	--	
		RH6		VTN	Lithic scatter	81	Not relocated
		RH13		VTN	Lithic scatter	81	Not relocated, disturbed area
		RH14		VTN	Lithic scatter	81	Not relocated, disturbed area
		RH15		VTN	Rock shelter	82	Not relocated
		RH16		VTN	Lithic scatter	81	Not relocated
		RH17		VTN	Temporary camp	81	Not relocated
		RH7	297		Lithic scatter	81	DA-297 is a large, light lithic scatter in the east half of S.U. 81. Drover's RH7, 8, 9, 10, 12 and 18 are concentrations within this continuous scatter.
		RH8	297		Lithic scatter	81	
		RH9	297		Lithic scatter	81	
		RH10	297		Lithic scatter	81	
		RH12	297		Lithic scatter	81	
		RH18	297		Lithic scatter	81	

APPENDIX D

FORMS USED IN CULTURAL RESOURCES SURVEY

CALIFORNIA DESERT PROGRAM
ARCHAEOLOGICAL SAMPLE UNIT RECORD

1. Planning Unit__________________ 2. Sample Unit #_______ 3. Date_______

4. Twp._______ Range_______ Section_________ 5. Map____________________

6. General Location:

7. Vegetation:

8. Fauna:

9. Geology/Geomorphology:

10. Hydrology:

11. Weather Conditions:

12. Sites Recorded:

13. Duration of Survey:

14. Survey Crew:

Recorder:______________________

15. General Interpretations & Comments (Attach additional pages as necessary):

16. Sketch Map of Sample Unit   Indicate: a) Dimensions of sample unit; b) Pertinent or prominant land forms; c) Survey pattern, including approximate area covered and portion of unit covered by individual crew members; d) Location of sites recorded.

N

BLM CALIFORNIA DESERT PROJECT

ARCHAEOLOGICAL SITE SURVEY RECORD

[1] County	
[2] District	
[3] Planning Unit	
[4] Sample Unit	
[5] Photos	
[6] Date	
[7] Recorder	

[8] Site # ________ [9] Other # ________

[10] Site Name ____________________

[11] Cadastral Location: Twn ____ Rng ____ _____of_____ of Sec _____

[12] Quadrangle ____________________ [13] Elevation ________

[14] UTM Grid Loc. Zone ________ Northing ________ Easting ________

[15] Reference Points: ____________________

[16] OWNER

BLM	OTHER FED.	STATE	PRIVATE	UNKNOWN

[17] NAT'L REGISTER

(A) STATUS					(B) TYPE		
LISTED	CANDIDATE	POTENTIAL	NOT ELG.	NO DET.	DISTRICT	SITE	OTHER

[18] DISTURB

DEVELOPMENT	ANIMAL	VANDALISM	ORV	OTHER

[19] CNDT

GOOD	FAIR	POOR

[20] COMMENTS

[21] SITE TYPES

VILLAGE	TEMPORARY CAMP	SHELTER/CAVE	MILLING STA.	LITHIC SCATTER	QUARRY SITE	POTTERY LOCUS	CEMETERY	CREMATION LOCUS	INTAGLIO	ROCK ALIGNMENT	PETROGLYPH	PICTOGRAPH	TRAIL	ROASTING PIT	ISOLATED FIND	CAIRN	HISTORIC	OTHER

[22] AREA

0-10 Sq. M.	11-50	51-250	251-1000	1001-5000	over 5000

[23] DEPTH

SURFACE	1-20 Cm.	21-100	over 100	UNKNOWN

[24] General Site Description:

[25] FEATURES

STRUCTURAL DEP.	ROCK RING	ROCK STRUCTURE	CAIRN /SHRINE	ROASTING PIT/FAR	HEARTH	PETROGLYPHS	PICTOGRAPHS	BEDROCK MORTAR	GRINDING SLICK	OTHER

[26] ARTIFACTS

PROJECTILE POINT	FLAKED STONE TOOL	CORE-DETRITUS	MILLING TOOL	OTHER GROUND STONE	CERAMIC	BONE	PERISHABLE	ORNAMENT	HISTORIC	OTHER

[27] ECO.

FIRE AFFECTED ROCK	FAUNA	FLORA	OTHER

[28] MAT.

CRYPTOCRYSTALLINE	OBSIDIAN	FELSITE	OTHER

[29] Describe:

[30] VEGETATION																	
BARREN	SALTBUSH	CREOSOTE	JOSHUA/CREOSOTE	JOSHUA/YUCCA	YUCCA/CACTUS	BLACKBRUSH	SAGEBRUSH	PINYON/JUNIPER	CONIFER	SHADSCALE	CHAPARRAL	OAK WOODLAND	MESQUITE	RIPARIAN	WASH	GRASSLAND	OTHER

[31] COVERAGE					
CONTINUOUS (over 75%)	INTERRUPTED (50-75%)	PARK-LIKE (25-50%)	RARE (6-25%)	BARELY PRESENT (1-5%)	ABSENT (0-1%)

[32] WATER				
INTERMITTENT STREAM	PERMANENT STREAM	SPRING	PLAYA	OTHER

[33] Describe

[34] LANDFORM											
MOUNTAIN	HILL	TERRACE	RIDGE	ALLUVIAL FAN	CANYON	ARROYO	SAND DUNE	DESERT PAVEMENT	BADLANDS	PLAYA	OTHER

[35] BEDROCK					
EXTRUSIVE IG.	INTRUSIVE IG.	METAMORPHIC	SEDIMENTARY	QUATERNARY ALLUV.	OTHER

[36] TEXTURE				
SAND	LOAM	SILT	CLAY	OTHER

[37] SOILS					
MIDDEN	ALLUVIAL	COLLUVIAL	EOLIAN	BEDROCK	[OTH]ER

[38] Describe

[39] SLOPE								
POINT OF INFLEX	LOWER 1/3	MID 1/3	UPPER 1/3	0-5°	6-15°	16-30°	31-60°	over 60°

[40] ASPECT							
NORTH	NORTH/EAST	EAST	SOUTH/EAST	SOUTH	SOUTH/WEST	WEST	NORTH/WEST

[41] EROSION						
DEFLATION	RILLING	GULLYING	SHEET/WASH	ROCK/DEBRIS	SLUMPING	OTHER

[42] DRAIN.			
CONVERGING	DIVERGING	BRAIDED	OTHER

[43] Remarks

APPENDIX E.
MAP SHOWING SITE LOCATIONS
(On file in BLM Office, Bakersfield)

APPENDIX F
SITE RECORDS
(On file in BLM Office, Bakersfield)

APPENDIX G
SAMPLE UNIT RECORDS
(On file in BLM Office, Bakersfield)

APPENDIX H

SOME CONSIDERATIONS ON ARCHAEOLOGICAL SAMPLING TECHNIQUES AND PREDICTIVE MODELING

APPENDIX H

SOME CONSIDERATIONS ON ARCHAEOLOGICAL SAMPLING TECHNIQUES AND PREDICTIVE MODELING

As a result of the "quantitative revolution" that swept through the social sciences during the second half of this century, many researchers realized the potential of, and began to apply, investigative and analytical techniques requiring a sophisticated knowledge of the mathematical theories of probability and statistics. Unfortunately, as Thomas (1978) has pointed out, while it is easy to use the techniques, a responsible application of them and a meaningful interpretation of their results require more background in mathematics than most archaeologists are willing to acquire. The use of probability sampling designs illustrates the lack of insight most archaeologists have regarding mathematical statistics.

Two types of archaeological sampling problems are faced by researchers: the selection of sampling units when excavating sites and the selection of sampling units for regional surveys. The problem of selecting a sample for a regional survey is best handled by plane-sampling theory. Unfortunately most archaeologists have only been exposed to survey sampling techniques.

Plane-sampling can be defined as the rigorous selection of a series of areally-distributed observations. Thus, it is a problem involving the arrangement of items across two-dimensional (R_2) space. Survey-sampling (or non-serial sampling) involves the selection of observations from a population; this population, as regards the theory of non-serial sampling, has no spatial or temporal dimensions. Additionally, there is also the case in which temporal data, or time-series, must be sampled. Time-series, or linear-sampling, is based on the arrangement of items in a one-dimensional (R_1) space.

Unfortunately, amost all statistical theory has been developed with the dimensionless population in mind and, correspondingly, the majority of our sampling theory has followed that trend. This non-serial sampling and the statistical techniques that correspond to it are based on the conceptualization of sampling as a problem in which all the potential observations are thrown into a box and randomly pulled out until the desired sample size is obtained. The addition of one dimension to the population of potential observations, time, confounds the sampling problem and any statistical analysis attempted on the observations. Here an obvious dependence is added to the data: the occurrence of one discrete event in one time period will influence the outcome during the next.

By moving to a problem of data distributed in two-dimensional space, the mathematical obstacles become considerable. Here, the dependence (or autocorrelation) between discrete events becomes a function of angular direction as well as distance (Holmes, 1970). That is, in linear sampling, dependence is only possible in one direction, through time, and it is expected to decrease as (temporal) distance increases. In plance sampling dependence is, similarly, expected to decrease with distance, but this dependence can extend in any direction from the observation in question.

Statistical analyses require, as a basic assumption, independent samples. Problems arise, then, when dealing with spatial-data series, because location alone is the major determinant of the independence of the sample. Two approaches can be taken to overcome this problem: A locationally-randomized sample can be drawn to minimize autocorrelation effects, or the spatial-location factor can be built into the statistical model. Archaeologists have tended to opt for the first alternative, basically because their exposure has been to non-serial sampling, where random theory remains appropriate. The theory of plane-sampling actually indicates many things contradictory to what archaeologists have assumed, and indicates that archaeologists' attempts at areal sampling have often been the least precise available.

Consider an idealized regional sampling approach (cf. Weide, 1973): the area to be sampled is stratified along environmental variables, usually including vegetation, hydrology and physiography. A randomly selected series of quadrats or transects is then selected from each stratum, as a first-stage sample. After completion of this first-stage survey, collected data is used to isolate sensitive strata and these are re-sampled. The goal here is to provide a predictive model of site location and density, based on the gross environmental variables.

First, it is emphasized that the sampling strategy must be consistent with the proposed method of analysis and final goals for the study. The selection of any stratifying variables, then, becomes critical in regard to the assumptions upon which the final analysis is to be made. This is discussed in greater detail below.

Second, quadrats or transects are randomly selected from each stratum. The justification for this, seemingly, is based on non-serial sampling theory, and it is usually argued that this randomization will provide more precision, avoid problems due to periodicity in the data, and result in unbiased estimates of the mean. This reflects an unfamiliarity with the methodological literature outside of archaeology. To quote Holmes (1970: 385), "There has been a growing recognition that randomization is an inferior approach to serial sampling."

First, as regards precision, properly designed systematic samples can provide considerable increases in precision when compared to equivalent random or stratified random designs (ibid.). Even in serial data with marked periodicity or a continuous linear trend, the systematic sample will be more precise if the appropriate sampling interval is chosen (Cochran, 1963). Finally, evidence exists indicating that periodicity, itself, is a much less serious problem for sample designs of spatial series than for temporal series (Holmes, 1970).

Second, regarding unbiased estimates of the mean, it is now widely recognized that the importance of the theoretical lack of bias in estimates from random samples is overemphasized in serial-sampling. Matern (1960), for example, has argued that the results of random samples generally have a higher error than systematic samples, even when periodicities are present in the data.

However, obtaining unbiased estimates in systematic samples requires an adequate prior knowledge of the spatial parameters of the distribution in question. Specifically, some knowledge of the autocorrelation function of the data is needed. When no notion of this trend is available, partial randomization is acceptable, as long as strong locational control is maintained. In this case, a strategy such as a stratified, systematic-unaligned design may be appropriate. The importance of obtaining a good estimate of the autocorrelation function, however, cannot be ignored. Without some notion of its form no reasonable estimate of the sample spacing interval can be made, which is a critical concern regardless of whether the sample is randomly or systematically drawn.

Thus, the generally-used, stratified-random sample, in certain forms, may be an acceptable plane sample, although it is the last choice that should be made in design construction. As a first-stage design, then, it is a reasonable approach if no previous information on the data is available. Next, another stage is initiated, either to test the model developed during the first stage, or with an improved sampling strategy based on previously recovered data.

Finally, some confusion over the nature of the sampling units themselves seems to exist. Although it can be argued that practical considerations ultimately determine the type of design and nature of the sample units, from a theoretical perspective, different types of units are preferable. Because of the problems in serial sampling, as outlined above, a sample of individuals, rather than of areal units, is best. This reflects the fact that our statistical theory has been based on, and sampling theory has been best developed in, situations in which the population is not structured by temporal or spatial dimensions. For studies in which plane-sampling is required, it must be remembered that the unit of analysis is the sample unit. Thus, for an archaeologist doing a regional study, the investigation concerns areal units and not archaeological sites. Archaeological sites, as the real interest of the study, become measurements taken upon each sample unit.

Additionally, the shape and size of the areal units are of some concern. A number of archaeologists have argued that transects are the most reasonable sample unit shape. Matern (1960), on the other hand, has pointed out that designs with units of this shape generally result in lower precision and higher sampling error than occur in samples employing units that are not elongated. Redundancy in collected data can result both from using transects for sample units and from employing sampling units that are inordinately large, regardless of the unit shape. This problem is particularly pronounced when the sample units are distributed using a stratification system based on variables determined, _a priori_, to have a causal relationship with the phenomenon in question.

To summarize this section, archaeologists have opted for randomization strategies in their sampling techniques, based on the erroneous assumption (as regards plane-sampling) that these are the most efficient and reliable. A consideration of sampling theory appropriate to the regional site survey indicates that these techniques, such as a stratified-random design, are the _least preferable_, although in some situations they may be acceptable. These situations are those in which no prior knowledge of the distribution of the data under investigation has been obtained. Additionally, the more that the researcher knows about his data distribution (and, hence, the better able he is to stratify his sampling design), the smaller in size his collection units should be, so that redundancy in data collection can be avoided.

E R R A T A

Technical Report No. EMSC 8312.20

Page 19, Temporary Camp: "Such an occupation could occur...."

Page 19, Utilized Shelter or Cave: "... under a rock overhang."

Page 23: "... UNITS BY ENVIRONMENTAL STRATUM"

Page 62: Insert the following prefatory statement:

"The following mitigation recommendations are suggestions by the contractor and should not be interpreted to represent the recommendations or policies of the Bureau of Land Management."

Page 63, paragraph 4, line 6: "... cultural value to Native Americans is..."

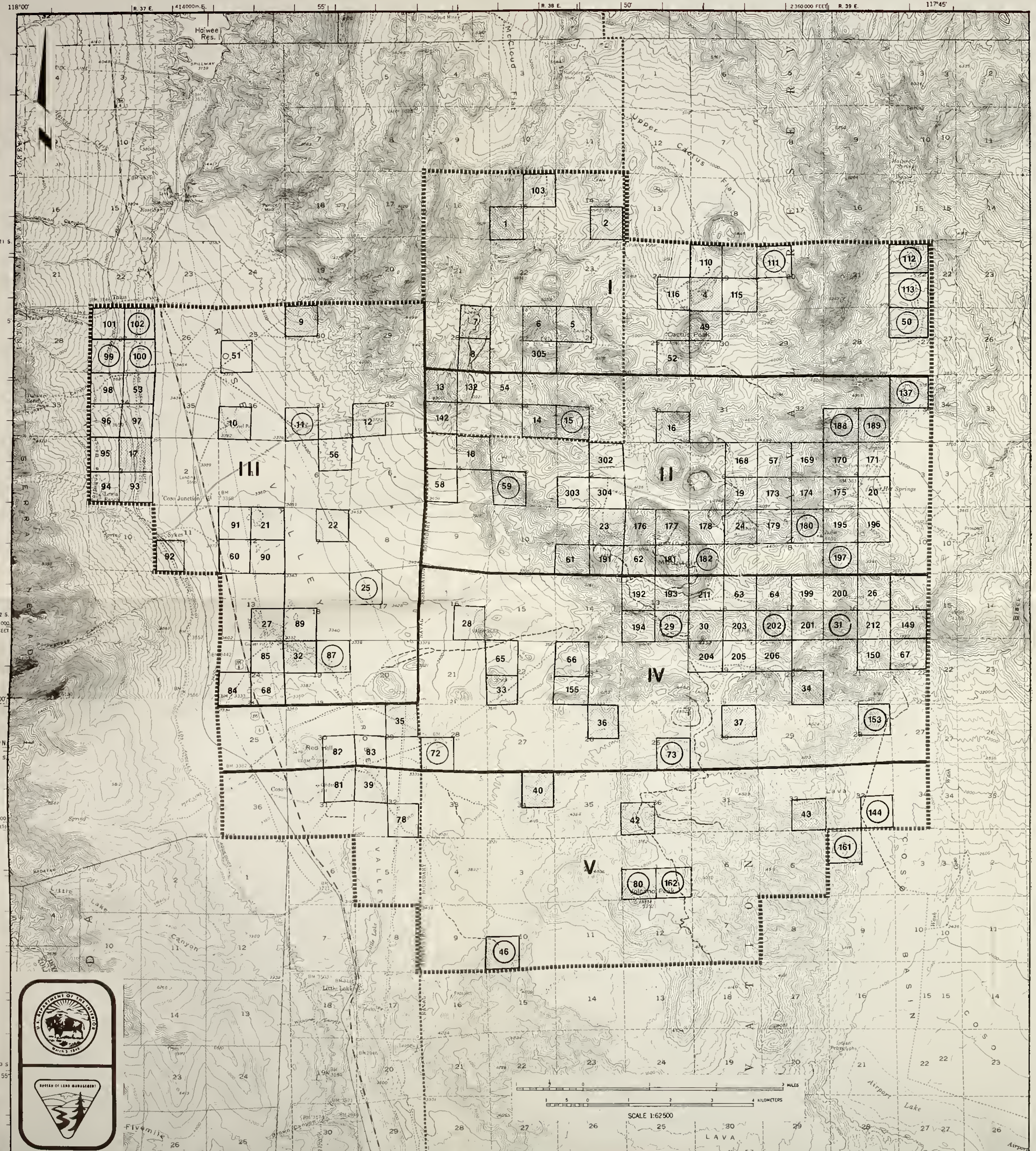

Figure 3. CGSA CULTURAL RESOURCES INVENTORY SAMPLE UNITS AND SAMPLING STRATA

EXPLANATION

I, II — Geographical Strata Divisions; total number of units sampled within all divisions during both stages of survey: 138 units.

25 — Units sampled in first stage of survey; total, 50 units.

200 — Units sampled in second stage of survey; total, 88 units.

○ — Circled numbers indicate those units in which no archaeological findings were made. Units without circles are those in which some artifacts were encountered.

Figure 3. CGSA CULTURAL RESOURCES INVENTORY SAMPLE UNITS AND SAMPLING STRATA