AN INTENSIVE RECONNAISSANCE OF THE TOSAWIHI QUARRIES ARCHAEOLOGICAL DISTRICT (Site 26Ek3032)

by

Robert G. Elston, PhD
Christopher Raven, PhD
and
Elizabeth E. Budy, PhD

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Prepared for
Touchstone Resources Company
101-9 Carson Road
Box 73
Battle Mountain, Nevada 89820

Prepared by
Intermountain Research
Drawer A
Silver City, Nevada 89428

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ABSTRACT

Intermountain Research conducted an intensive reconnaissance of the 823-acre Tosawihi Quarries Archaeological District (26Ek3032) in Elko County, Nevada, on the Little Antelope Creek drainage about 40 miles northeast of Battle Mountain, Nevada. The District contains prehistoric opalite quarries known to have been exploited by the Battle Mountain groups of Western Shoshone.

The study was conducted in two phases. The first included a systematic survey of the entire district, recording 219 prehistoric localities: isolated artifacts, discrete clusters of artifacts, rockshelters, open residential localities, and quarry-related localities (isolated quarry pits, quarry pit complexes, outcrop quarries, adits, and surface cobble quarries). The second phase scrutinized archaeological variability in a 215-acre sample of the District. Second phase study addressed variability among quarry pits, and the nature of the ubiquitous lithic scatter covering the surface of the District.

<u>Areal Intensity Data</u>

Project Area = 823 acres
Area Surveyed = 823 acres

Transect Interval/No./Type = 30/75/linear

ACKNOWLEDGEMENTS

The conduct of this study was assisted immeasurably by Touchstone Resources Company who, in addition to funding the work, provided survey and mapping support. As well, the interest and attention accorded the study by the Bureau of Land Management Elko Resource Area and the Nevada Division of Historic Preservation and Archaeology facilitated its progress.

The Intermountain Research field team, directed by Robert Elston and supervised by Elizabeth Budy, included Robert Clerico, Michael Drews, Kenneth Juell, Christopher Raven, and Dave Schmitt, whose efforts were complemented by volunteers Clay Clerico and Michelle Raven. In the laboratory, Budy organized, verified, and reduced field data, while Elston described geography and analyzed site data and collections, and Raven prepared report background. Drews drafted maps and graphics, Juell processed collections, and Susan Davis and Allen McCabe prepared locality map plots. Cashion Callaway contributed editorial support and Katherine Nickerson saw to word processing and report production.

Special thanks are due Mary Rusco, who initiated systematic study of the Tosawihi Quarries. The present approach to Tosawihi relied on consultation with Rusco and access to her field data, with which she was generous.

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Chapter 1. INTRODUCTION

> .....White Knife [tosa, white + wihi, knife] people of the Battle Mountain region are so called because an excellent grade of white flint occurs in that country.
>
> - Julian Steward (1938:248)

The Tosawihi Quarries are to be found ca. 40 air miles northeast of Battle Mountain, Elko County, Nevada (Figure 1), on lands administered by the Bureau of Land Management Elko Resource Area (BLM). First described by Great Basin archaeologist Mary Rusco (1983), the Tosawihi Quarries Archaeological District (Figure 2) is the subject of the following report.

Just as the mineralization in the study region attracted aboriginal people in need of toolstone over millenia, so has it captured latter day seekers of quicksilver and gold. Touchstone Resources Company (TRC), by its Ivanhoe Project, is exploring for gold in an area corresponding to that of historic and prehistoric mining. Recognizing its sensitivity, TRC engaged Intermountain Research to inventory the Tosawihi Quarries Archaeological District and develop a plan to guide the management of cultural resources there, particularly as they may come into conflict with minerals exploration and, eventually, development.

This report describes the prehistoric localities that occur in the project area and attempts to characterize them. A report devoted to the historic period represented in the District is pending, as is a management plan, now in development. Following this introduction, Chapter 2 describes the physical setting of the project area and region, while Chapter 3 provides prehistoric and ethnographic background. Chapter 4 gives field and post-field study methods. The geography of the Tosawihi Quarries Archaeological District is described in Chapter 5, followed by summary details of prehistoric localities in Chapter 6. Chapter 7 characterizes the Tosawihi phenomena and Chapter 8 offers concluding comments.

Legal Description

Referring to USGS 7.5 min. quadrangles Willow Creek Reservoir SE, Nevada (1965), and Willow Creek Reservoir, Nevada (1965), the project area is located in Township 38N, Range 48E, portions of Sections 32 and 33; and in Township 37N, Range 48E, portions of Sections 4 and 5.

Figure 1. Regional Map.

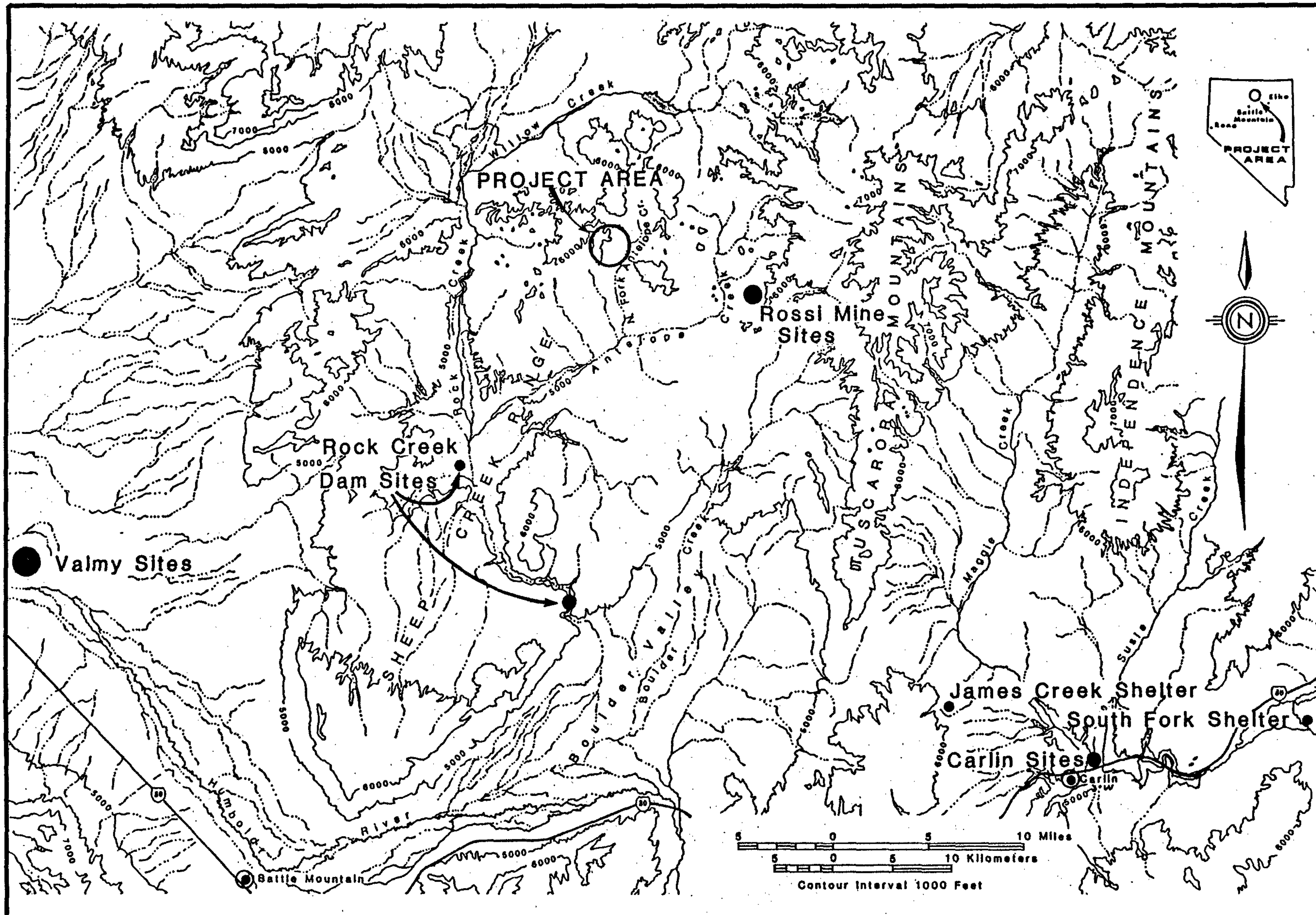
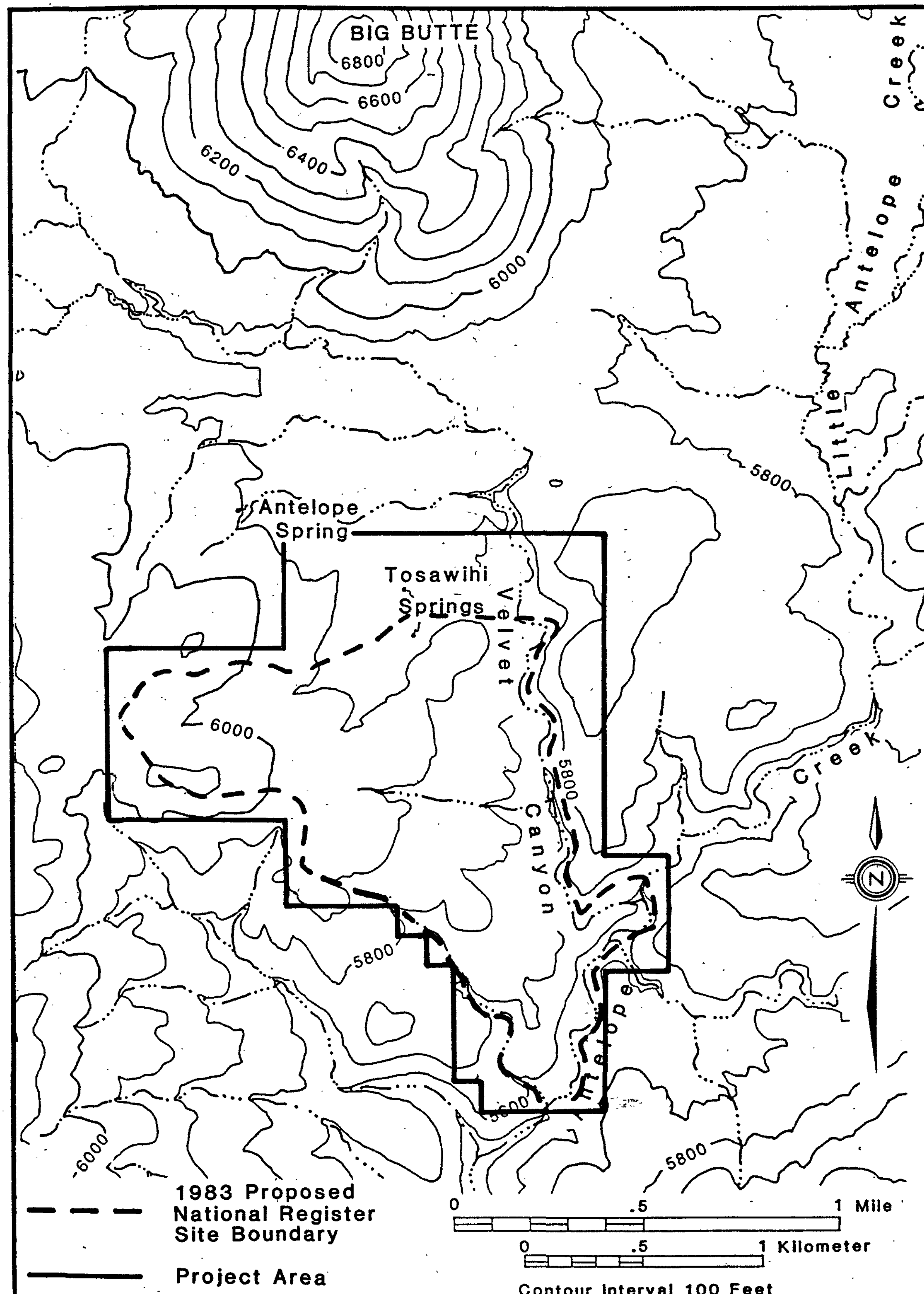

PROJECT AREA
Willow Creek
Rossi Mine Sites
Rock Creek Dam Sites
Valmy Sites
James Creek Shelter
South Fork Shelter
Carlin Sites
Carlin
Battle Mountain
Humboldt River
Boulder Valley
Boulder Creek
Antelope Creek
N. Fork Antelope Cr.
Rock Creek
SHEEP CREEK RANGE
TUSCARORA MOUNTAINS
INDEPENDENCE MOUNTAINS
Maggie Creek
Susie Creek
PROJECT AREA
Elko
Reno
10 Miles
10 Kilometers
Contour Interval 1000 Feet

Figure 2. Project Area Map.


BIG BUTTE
6800
6600
6400
6200
6000
Little Antelope Creek
5800
Antelope Spring
Tosawihi Springs
Velvet Canyon
Creek
6000
5800
5800
Antelope
5600
6000
5800
1983 Proposed National Register Site Boundary
Project Area
0 .5 1 Mile
0 .5 1 Kilometer
Contour Interval 100 Feet
N

Chapter 2. PHYSICAL SETTING

by Christopher Raven

The Tosawihi Quarries Archaeological District as defined here occupies 823 acres of the Ivanhoe Mining District, a rocky, gently undulating expanse lying at the junction of the Sheep Creek Range and the southwestern foothills of the Tuscarora Mountains (see Figure 1). Moderately dissected by currently seasonal drainages, landforms in the area clearly have undergone considerable erosion since their formation, although there is little evidence of high-energy episodes of runoff or deposition save in the gorges at the region's eastern margin. Measured against local vertical relief, the area constitutes a mid-to-upland zone transitional between nearby ecologically distinct milieus; encompassing elevations from 5500 to 6100 feet amsl, it stands some 700 feet above the extensive plains that flank it to the west and south, and some 1900 feet below the peaks of the Tuscarora Range 12-15 miles to the east. Intermediate between two more extensive ecozones, the study area hosts a biotic mosaic composed largely of communities and species more dominant in neighboring settings.

Save as noted, the following discussions are based on field observations made during the course of archaeological reconnaissance in July and August, 1987. A general environmental profile of the area has never been sketched and, aside from certain geological details relevant to the commercial extraction of minerals, few attributes of the local environment have been recorded by specialists. The descriptions presented below, therefore, are intended only to serve as background to this preliminary archaeological reconnaissance.

Geology

The geology of the study area has not been described formally, although a description of the stratigraphy, processes of alteration, and rock types is currently in preparation (Don Hruska, personal communication 1987). The chief component of archaeological concern, however, the extensive surface and near-surface deposits of opalite quarried prehistorically, has been examined and its genesis described relative to historic mercury mining in the area (Bailey and Phoenix 1944) and in the context of earlier stages of Tosawihi archaeological investigations (Duffe' 1976). The formation is the product of late Miocene or early Pliocene silicification of volcanic rocks and sediments (rhyolitic ash, tuffs, obsidian, and rhyolite) induced by a series of hydrothermal episodes. Permeation of the matrices by silica-rich solutions along fissures and bedding planes resulted in localized deposits of opalite that subsequent millenia of dehydration and crystalization have transformed into a chert-like group of cryptocrystallines (Bailey and Phoenix 1944:17-21). Minimal internal structure and relative homogeneity lent the material desirability as prehistoric toolstone; the entrapment of cinnabar in its lower members rendered it historically desirable as a source of mineable mercury ore.

The other principal surface geologic units consist of rhyolite flows dominating the plateaus of the eastern portion of the study area, and massive basalt that outcrops in the red hills just west of the project area boundary. Both materials were prehistorically transported as boulders, head-size or larger, for use as percussion projectiles and hammerstones in aboriginal quarrying operations.

Hydrology

Surface water is a fugitive resource in the Tosawihi vicinity. Although contributing eventually to the flow of the Humboldt River and flanked at lower elevations on the north and west by major perennial streams, the study area experiences rapid runoff and seasonally depleted aquifers. With the exception of the gorges of Velvet and Little Antelope Canyons, all drainages within the area are ephemeral; during storm episodes, the seasonal streams of the canyons probably are fed as much by direct slope-wash as they are by the contribution of the numerous minor tributaries.

While ground water is persistent and abundant at depth, as evidenced by late-summer drilling (Touchstone personnel, personal communication 1987), only two springs emerge within the study area. The larger (Tosawihi Springs) is located on flats north of the Butte No. 2 mine; the smaller is a seep at the confluence of Velvet and Little Antelope canyons. Both have been developed for livestock use. Testimony to their stability is that the only open habitation sites detected archaeologically occur in their vicinity. By mid-August, 1987, however, both were moribund, suggesting probable seasonality in their prehistoric use.

Vegetation

The study area is an expression of the Artemesian biotic province that is characteristic of the high desert valleys and lower foothills of the northern Great Basin (Billings 1951:110-113; Cronquist et al. 1972:122-125). At Tosawihi, two communities of this sagebrush-grass zone are tightly interdigitated in a complex mosaic responding to variation in soil depth and effective soil moisture. Both communities occur in relatively pure monotypes short distances outside the project area, where their incidence is conditioned largely by elevation.

Occupying much of the silty bottomlands and other areas of deeper soils, and semi-shadowed northern exposures, is a community dominated by big sage (Artemesia tridentata) and rabbitbrush (Chrysothamnus nauseosus) in the shrub component, and by Great Basin wildrye (Elgmus cinereus) and bluebunch wheatgrass (Agropyron spicatum) in the grass component. On the other hand, thin-soiled settings such as knoll-tops, cobble fields, and washes where seasonal drainage has continuously inhibited soil development, tend to be occupied by a community composed chiefly of low sage (Artemesia arbuscula), phlox (Phlox sp.), and the grasses squirreltail (Sitanion hystrix) and Idaho fescue (Festuca idahoensis).

These two communities are so intricately interwoven that, while maintaining their geographic discreteness, neither occurs in unpunctuated form over more than about 40 acres throughout the study area. More characteristically, the landscape is mottled by one-to-ten-acre patches, streamers running down ridgecrests or along drainage bottoms, or isolated pockets where deeper or shallower soils offer favorable habitat. Associated forbs, particularly various buckwheats (Eriogonum sp.), lupine (Lupinus sp.), Mentzelia sp., and globe mallow (Sphaeralcea sp.) have been noted in abundance, but the season of observation excluded many early annuals.

Microenvironmental anomalies support sporadic appearances of species related to other communities, but their prevalence is always dominated by the area's two principal assemblages. Thus the bottoms of gorges are prone to sparse stands of wild rose (Rosa spp.); the bases of rims often shadow clumps of gooseberry (Ribes spp.), chokecherry (Prunus virginiana) or service berry (Amelanchier alnifolia); brief strings of willow (Salix sp.) cluster along the moistest of stream channels, and Artemesia ludoviciana sprouts in the driest and sandiest of them. All these instances, however, constitute probably less than 5% of the total study area. Of doubtless transitory nature, a large, recently burned zone at the area's northern margin currently hosts mustard (Brassica sp.), thistle (Cirsium sp.), and cheat grass (Bromus tectorum), together with remnants of the pre-fire big sage community.

Fauna

Animals were not observed in abundance during the field exercise, although those species noted suggest broader patterns characteristic of other settings. Antelope (Antilocapra americana), for instance, were seen only once, but their scarceness almost certainly was a function of the lateness of the season of observation; commensurate with other mid-to-upland zones, antelope probably are attracted to the area from the valley bottoms in spring when forbs are most plentiful and water sources most reliable. Mule deer (Odocoileus hemionus), likewise, are likely to be seasonal visitors, their presence in the area limited by the availability of forage and water.

In high valley/foothill settings such as the Tosawihi vicinity, the upper Sonoran life zone (Merriam 1898) hosts as well coyotes (Canis latrans), kit foxes (Vulpes macrotis), badgers (Taxidea taxus), marmots (Marmota flaviventris), jackrabbits (Lepus californicus), cottontails (Sylvilagus spp.), chipmunks (Eutamias spp.), and wood rats (Neotoma lepida), all of which were observed during the 1987 field season. Numerous of the mammalian species listed by Hall (1946) as typical of the zone, particularly several species of rodents, are probably present but went unnoticed.

Species of birds likely to inhabit the area are discussed by Linsdale (1936), reptiles by Stebbins (1966), and fish by LaRivers (1962). None of these phyla was given significant scrutiny during the archaeological investigations.

Chapter 3. CULTURAL SETTING

by Christopher Raven

The following discussions are intended to provide a culture-historical frame of reference for understanding observed patterns in the archaeological record of the Tosawihi Quarries. Derived in large part from primary and secondary sources themselves broader in scope, the synopsis focuses attention on those aspects of White Knife Shoshone culture and the prehistory of the upper Humboldt River drainage that seem particularly germane to explaining how the present archaeological record at Tosawihi came to be shaped as it is.

Ethnographic Patterns: The White Knife Shoshone

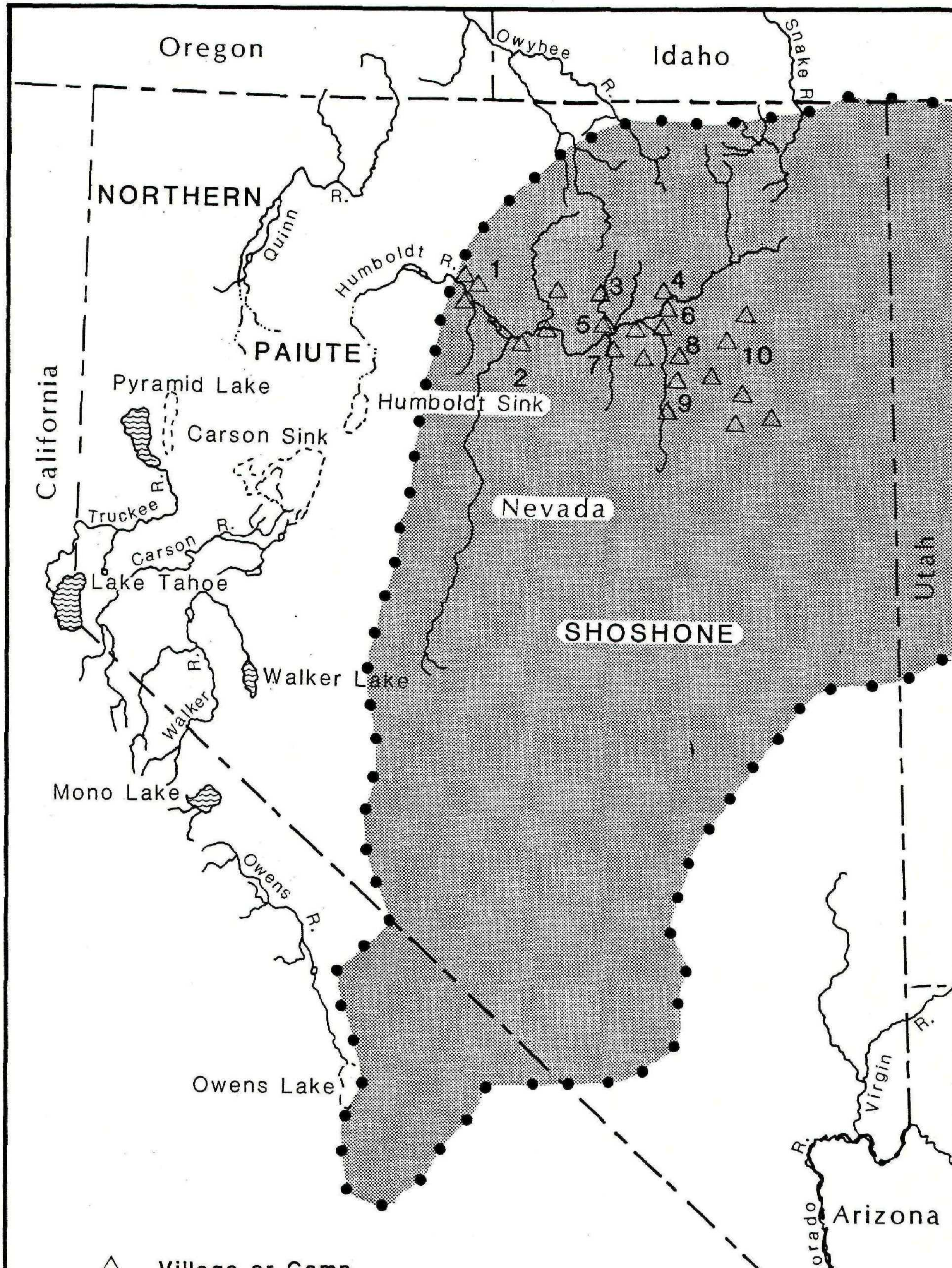
Of the vast territory (including about one-half the state of Nevada) occupied by the Western Shoshone in the nineteenth century (Figure 3), a much smaller region along the Humboldt River, in the immediate vicinity of Battle Mountain and the adjacent mountains, was inhabited by a local group called the Tosawihi or "White Knives". Steward (1937, 1938, 1939, 1941) regarded the name to apply properly only to those Shoshone who wintered around Battle Mountain and whose principal foraging area lay in the mountains flanking Rock Creek, although it was used variously to identify groups of widely different size and diversity (Harris 1940; Powell and Ingalls 1874). Thomas et al. (1986:283) discuss the synonymy of the name, of some importance here because it refers to the use of a high quality white toolstone found in the mountains north of Battle Mountain (Steward 1938:162), almost certainly the family of opalites that outcrop most prominently in the Ivanhoe Mining District. Possibly the broader application of the name at times may have subsumed more distant groups who procured the stone through exchange; alternately, "Tosawihi" living further east along the Humboldt may have exploited more local sources of visually similar material.

The White Knives shared a boundary to the west with the Northern Paiute (Stewart 1939, 1941), with whom they enjoyed generally amiable relationships including intermarriage and cooperation in hunting (Steward 1938:162); to the north, east, and south they met other Shoshonean groups. Because there was no strongly developed concept of land tenure, or even of exclusive rights in resources (Harris 1940:45), the White Knives and their neighbors were able to benefit mutually from the natural occurrence of scarce but valuable resources. In Harris's terms (1940:55):

Figure 3. Western Shoshone Territory (after Steward 1937, 1938).

Key to Settlements:

1 - White Knives
2 - Crescent Valley
3 - Independence Valley
4 - Elko
5 - Carlin
6 - South Fork
7 - Palisade
8 - Diamond Valley
9 - Huntington Valley
10 - Ruby Valley



Oregon
Idaho
Owyhee R.
Snake R.
NORTHERN
PAIUTE
R.
Quinn
Humboldt R.
1
2
3
4
5
6
7
8
9
10
Pyramid Lake
Humboldt Sink
Carson Sink
California
Truckee R.
Carson R.
Lake Tahoe
Nevada
SHOSHONE
Utah
Walker R.
Walker Lake
Mono Lake
Owens R.
Owens Lake
Virgin R.
Colorado R.
Arizona
Village or Camp

> There were no important property rights, no wars, no land-owning groups with bitterly defended boundaries, not even a marked ethnocentrism to separate one group from the rest and keep it intact.

The archaeological implications of such a pattern are significant in that, in the absence of exclusive rights to localized resources, ethnically and geographically diverse groups might exploit the same sources of critical materials; conversely, the distribution of such materials in the archaeological record might owe equally to the mechanisms of exchange and direct procurement.

While estimates of White Knife population at historic contact range from 194 (Powell and Ingalls 1874) to 800-1000 (Harris 1940:42), most sources report them to have been numerous and their territory, or at least the river bottomlands, densely populated. Steward (1937:628) estimates that in the more favorable localities (e.g., along the Humboldt River below Battle Mountain) population density may have reached one person per two square miles, a figure exceptionally high compared to other Great Basin subregions, aside from Owens Valley. That this was a microenvironmentally conditioned estimate pertaining only to certain riparian settings within White Knife territory is emphasized by Harris (1940:42) who, while accepting Steward's figure, suggests that, overall, the region was inhabited by about one person per fifteen or twenty square miles.

The heterogeneity of population distribution was especially pronounced in winter, when most people clustered along the banks of the Humboldt River. Steward (1938:161-162) reports that winter camps, comprised of three to five related families, were smaller and less permanent than characteristic of most other Shoshone groups. Harris (1940:44) further emphasizes the relative isolation of even the winter congregation by noting that each camp group (family band) settled from one-eighth to one-quarter mile away from the next, composing large but diffuse clusters of two to ten families.

This is notably at variance with the familiar Great Basin pattern of marked winter clustering, and has been remarked by the principal commentators on White Knife culture. Steward (1938:161) observes:

> Why they did not deliberately concentrate in larger winter villages, which local economy

> certainly would have permitted, is not clear. Apparently they had no great urge, innate or learned, to associate with large numbers of people.

Harris (1940:71) adds:

> The camp group, therefore, was practically a complete ethnic unit, a microcosm of almost the total White Knives culture.

If the pattern described by Steward and Harris had protohistoric or late prehistoric precedent, its archaeological consequences should include small, lowland riverine habitations in greater abundance than exhibited by surrounding regions, and a concomitant dearth of large, semi-permanent habitations. If, as seems more likely, the pattern was an artifact of the historic era, emerging in response to the early incursions of trappers and the subsequent floodtide of emigrants along the Humboldt River corridor, then protohistoric winter settlement in the area can be expected to exhibit the regional characteristic of large seasonal nucleations.

Summer saw the fragmentation of winter clusters into individual, family-based foraging bands. Harris (1940:44-45) suggests the seasonal foraging radius of individual "camp groups" ranged 25-100 miles from the winter camp, and the same round was not necessarily followed in successive years. To the White Knives who wintered in the vicinity of Battle Mountain, Steward (1938:162) assigns particularly the mountains around Rock Creek as foraging range, thus encompassing the the Tosawihi Quarries. The farthest reaches of the seasonal foraging radius often exceeded the limits of the loosely defined territorial boundaries discussed above; both Steward and Harris present examples in which the summer subsistence quest brought foraging groups into the territory of neighbors, and incursions by outsiders were not uncommon.

Few data were recorded ethnographically concerning the structure of summer foraging. While neither pine nuts nor salmon were available locally, they were procured directly through seasonal forays south to the vicinity of Austin and north to the tributaries of the Snake River (Steward 1938:162). Rabbits, antelope, deer, and mountain sheep were the animals most hunted locally (Harris 1940:40), and women engaged in the generalized gathering of plant foods. Both rabbit and antelope drives often benefitted from communal efforts involving multiple camp groups, with activities directed by task-specific, non-hereditary rabbit chiefs and antelope shamans (Harris 1940:154; Steward 1938:163). Most other subsistence pursuits were performed by the personnel of single camp groups (or from a series of campsites) deployed in a mixed forager/collector strategy (Binford 1980).

The only large gatherings occurred in the context of seasonal festivals. Harris (1940:53) reports that as many as 300 people might congregate from all nearby camps in the spring and fall for dancing and games. Steward (1938:163) suggests that Iron Point and Battle Mountain were particularly prominent festival sites. As during antelope and rabbit drives, the activities of each transitory congregation were directed by ad hoc leaders whose authority did not extend beyond the duration of the festival (Harris 1940:53-54). Since membership in festival gatherings was fluid, contingent upon the geographic proximity of camp groups at the time, festival leadership did not become consolidated into larger patterns of authority. It seems highly unlikely that wealth and prestige played significant roles in the procurement and distribution of material goods, and the archaeological record confidently could be expected to reflect a typically egalitarian society.

White Knife technology was simple, exhibiting a suite of classic Great Basin tools and processes, and the material culture of the group was correspondingly modest (Harris 1940). The archaeologically detectable features definitive of the White Knives probably consist of their isolating winter settlement pattern and their exploitation of Tosawihi opalite. To the extent the former reflects a prehistoric precedent and the latter was in any way exclusive, the White Knives should be distinguishable from their neighbors.

Archaeological Patterns

Little of the archaeological research conducted so far along the upper Humboldt River drainage has focused directly on the prehistory of the White Knife Shoshone, and that which has dealt with attributes of the Tosawihi Quarries remains largely unpublished. Much work has been performed in surrounding regions, however, and this provides a framework for developing expectations relative to the duration, nature, and intensity of prehistoric human use of the area. Moreover, broader syntheses have sketched a background against which to view Tosawihi data from the perspective of the western Great Basin (Elston 1986), northern Nevada (James 1981; Smith et al. 1983), and the Humboldt River Basin (Rusco 1982).

The first published regional survey to address the distribution of archaeological sites in central northern Nevada was performed by the Nevada Archaeological Survey (Stephenson and Wilkinson 1969). Apparently intuitive in approach, the campaign recorded 91 sites scattered through Paradise, Eden, Kelley Creek, Evans, and Squaw valleys; the authors infer a general time depth of human use of the area extending from 2000 B.C. to the protohistoric period. Since the work was conducted in the absence of much explicit problem-orientation, it resulted largely in raw inventory data. Stephenson and Wilkinson note, however, a predominance of hunting equipment in the observed assemblages and a concomitant dearth of groundstone, a pattern they attribute to the valley-margin and upland settings of most of the sites observed (1969:50). More importantly, Stephenson and Wilkinson (1969:50-51) noted an unequal distribution of exploited lithic materials; west of the Osgood Mountains obsidian was observed to dominate local assemblages, while various cherts, evidently including Tosawihi opalite, were favored to the east. Since the chert/obsidian boundary in the area closely approximates the reported ethnographic boundary separating the Northern Paiute from the Western Shoshone, the authors suggest that the cultural boundary may have had an exceptionally long tenure.

Identification of the nature and distribution of lithic materials derived, putatively or ostensibly, from the Tosawihi Quarries has been addressed by subsequent research in the region. At South Fork Shelter, for example, over 90 km from Tosawihi (see Figure 1), Heizer et al. (1968) ascribed the presence of a large number of white chert knives to the ethnographic use of the material reported by Steward. In the studies discussed below, more or less explicit attention was paid to identifying the presence and relative abundance of Tosawihi opalites in local archaeological deposits and, in some cases, to defining the functional role of the material in local assemblages.

The most sustained program of inquiry to date has been pursued around the Valmy power plant site, some 50 km southwest of the Tosawihi Quarries (see Figure 1). Initial surveys (Bard 1980; Busby and Bard 1979; Rusco and Seelinger 1974) had identified numerous sites that lay within the direct impact zone of the proposed power plant and its associated transmission line corridors, and three major data recovery efforts were mounted in response.

First, Davis et al. (1976) conducted intensive surface collections and sample excavations at three sites near Treaty

Hill, to conclude that human use of the area spanned perhaps as much as the past 7000 years, and that two of the sites had functioned as base camps, exhibiting a relatively wide diversity of functional artifact types including a modest but notable (22 specimens) component of ground, pecked, or battered stones. Time-marking artifacts included specimens of the entire Great Basin sequence of projectile points from the Northern Side-notched to Desert Series. Of particular relevance to the present study is that about 82.5% of the total lithic material present appears to consist of Tosawihi chert. Moreover, tool:debitage ratios of apparent Tosawihi material = 2.2:100, while the same ratios for obsidian (the next most prominent tool stone) = 6.3:100. The implication is that, despite the greater proximity of sources of useable obsidian (the authors suggest cobble sources only 15-20 miles north and northeast of Valmy [Davis et al., 1976:51]), the use of Tosawihi material was more profligate and entailed the production of more waste. Too, the pattern underwent little variation through time: "the ratio of obsidian to Tosawihi chert varied only slightly, if at all..." (Davis et al. 1976:36). Lithic analysis suggests that most of the Tosawihi material had been heated before it entered the reduction trajectory enacted at Valmy, although a smaller fraction apparently had been heat-treated on site.

Subsequent investigations near Treaty Hill (Rusco and Davis 1979) consisted of intensive surface collections and the subsurface testing of two additional sites. The results of the work suggested to the authors that at least 7000 years of human use was evident in the area, and that five sites they observed had functioned as base camps, owing to their diversity of functional artifact categories. Again, Tosawihi cherts dominate the local assemblages; 92.9% of the debitage, and 69% of the recovered projectile points, are apparently of Tosawihi origin. Ninety-five percent of the tools observed have been heat-treated, as opposed to 84% of the debitage, suggesting that some measure of heat-treatment of lithic raw materials was performed on-site. The recovery of cultural materials from test excavations was notably low (0-<3 specimens/m^3, as opposed to the ca. 100 specimens/m^3 recovered during 1976 excavations), suggesting the sites in Section 29 were the consequence of a much lower intensity of use. The projectile point assemblage is dominated by forms relating to the Great Basin Stemmed series through the Elko series, with a notable efflorescence of activity marked by a preponderance of Humboldt Concave Base points (which account for 65% of the projectile points recovered). Rusco and Davis (1979:75) note that Tosawihi cherts constituted the preferred material for all tool types (including projectile points), save the few specimens of the Great Basin Stemmed projectile point series.

Finally, the most intensive program of investigation in the Valmy vicinity was performed by Elston et al. (1981), who conducted systematic surface collections, subsurface testing, and backhoe trenching at three major sites and several small localities in Section 20 of the Treaty Hill township. Among the research questions addressed was a more rigorous examination of the identification by Rusco and Davis (1979) of various of the large sites in the vicinity as multi-functional base camps, and an analysis of the lithic production systems operative, particularly during the era in which Humboldt Concave Base projectile points dominate local assemblages. At NV-Hu-634, which exhibited the densest concentrations of cultural materials within the area of inquiry, the investigators report that Tosawihi cherts constitute 92.8% of the lithic assemblage by weight. The occupation is seen as ranging from 6000-3000 B.P., with an earlier component possibly reflecting use of the area between 11,500-8000 B.P. (owing to the incidence of Great Basin Stemmed projectile points). None of the sites investigated suggests use as a semi-permanent base camp; all exhibit a paucity of hearths and fire-cracked rock, and all display artifact assemblages oriented toward hunting and short-term seed-gathering activities. While nearby sites NV-Hu-629 and -631 are viewed as "more or less permanent winter camps" (Elston et al. 1981:154), most of the prehistoric activity in the area is viewed as task-specific and transient, although reenacted over several millennia.

Closer to the Tosawihi Quarries (ca. 29 km southwest), investigations relative to the proposed Rock Creek Dam entailed data recovery from five sites bearing on prehistoric use of the present study area (see Figure 1). Recorded initially by Botti (1985), an open site and four rockshelters were studied for evidence of chronology and function in local lithic procurement systems (Clay and Hemphill 1986). The reduction of bifaces of Tosawihi opalite was found to be a primary activity at the open site; about 99% of the debitage is of Tosawihi material, much of it expressed as tertiary flakes, and it was inferred that the material was brought to the site in the form of Stage II or Stage III bifaces. Various of the rockshelters exhibited well-developed late prehistoric components, with faunal assemblages dominated by small mammals; at least one shelter displayed a much lower proportion (58%) of Tosawihi material in its debitage.,

In the western foothills of the Tuscarora Mountains, some 10 km east of the Tosawihi Quarries, Rusco (1982) conducted intensive surface collection and limited subsurface testing at seven sites in the vicinity of the Rossi Mines (see Figure 1).

Recovered time markers indicate a possible time depth of 8500 years, with all the principal projectile point types, Great Basin Stemmed to Desert Series, represented. Numerous groundstone artifacts, as well as a diversity of flaked stone implements, were recovered. The relatively small faunal assemblage indicates a focus on grassland species.

Tosawihi opalites dominate the lithic profile of the sites, accounting for more than 90% of the tools and more than 99% of the debitage; other materials seldom were knapped, as evidenced by the observed tool:debitage ratios (1:46.7 for Tosawihi opalites, 1:3.2 for all other materials). Rusco (1982:52-74) uses the Rossi Mine data to test a generalized gravity model of resource product distribution, with special reference to qualitative variation in assemblage as a function of distance from Tosawihi; data from the Valmy sites and from two sites near Carlin (Rusco et al. 1979) were included. The results generally support the gravity model, in that at greater distances from the Tosawihi Quarries, lithic assemblages exhibit progressively later stages in biface and core reduction. On the other hand, a predicted decline in the frequency of cortical flakes was not found; the Carlin sites, furthest from Tosawihi, exhibit the highest incidence of cortical flakes. This may be the result of misidentification of material source, since, unknown to Rusco at the time of her study, a Tosawihi-like white chalcedony is available from a source near the Carlin sites (Elston and Budy, in press).

The only investigations directly concerned with the Tosawihi Quarries have been conducted by Rusco and her associates over a period of more than a decade. In a series of unpublished papers (Rusco 1976a, 1976b, 1978, 1979, 1983), the composition of the Tosawihi Quarries has been characterized, the distribution of apparent Tosawihi material in sites outside the District has been examined in light of gravity models and ethnic boundaries, and the chemical characterization of Tosawihi opalites has been attempted. Results of the latter effort, utilizing X-ray fluorescence, so far have proven equivocal (Duffe' 1976a, 1976b), but other approaches still are being contemplated (Mary Rusco, personal communication 1987). The matter is of critical concern for understanding not only the culture history, but also the anthropological implications, of the Tosawihi data; given the unreliability of visual identifications of lithic materials, it is only when it becomes possible to identify Tosawihi opalites objectively and irrespective of context that we can begin to address questions of ethnicity and exchange networking in the archaeological record.

Cultural Chronology

Among the factors limiting the integration of archaeological data into regional culture-historical sequences and, in turn, into processual models of culture change, is the gradual, often piecemeal, manner in which the archaeological record yields information on when its reconstructable events occurred. Thus, while research on the prehistory of the upper Humboldt River drainage has been pursued for more than two decades, the structure of the regional chronology is emerging only now and, in the view of the most current assessment, it remains prone to certain gaps that only further research will be able to close.

The sequence proposed for the upper Humboldt (Elston and Budy in press) is based on recent excavations at James Creek Shelter, some 50 km southeast of Tosawihi (see Figure 1), and incorporates data from several regional surveys and excavations (Figure 4). Its probable relevance for Tosawihi is a function of geographic proximity, ecological comparability, and, in the recent past, ethnic relationship.

The Dry Gulch Phase is the earliest proposed for the Humboldt River drainage. Terminating at about 6000 B.C., its diagnostic attributes include large concave-base projectile points as well as points of the Great Basin stemmed series, flaked stone "crescents" (Tadlock 1966), heavy core tools, scrapers, and choppers. Originally defined as a Western Pluvial Lakes Tradition (Bedwell 1973) because of its prevalence in ancient lacustrine landscapes, hallmarks of the phase have been recognized in riparian and upland settings as well. Regarded as "pre-Archaic" in the broader sequence of Great Basin adaptations (Elston 1982), the phase is characterized by big game hunting on an encounter basis (Binford 1980); little intersite variability in assemblages has been detected so far. Although not represented at James Creek Shelter (Elston and Budy in press), attributes of the phase have been noted at Valmy (Elston et al. 1981), Susie Creek (Armentrout and Hanes 1986), and Rye Patch Reservoir (Rusco and Davis 1982); too, Great Basin Stemmed projectile points, distinctive features of the phase, have been recovered during our preliminary reconnaissance within the Tosawihi District.

The No Name Phase marks the emergence of the early "Archaic" adaptation in the upper Humboldt River drainage (Elston and Budy in press); elements of the transition from the pre-Archaic to Archaic so far have not been forthcoming. Spanning the period 5000-2500 B.C., the phase is marked by Northern Side-notched and Humboldt Series projectile points

Figure 4. Prehistoric Chronology for the Upper Humboldt Valley, Nevada (from Elston and Budy, in Press).

DIAGNOSTIC ARTIFACTS AND C14 DATES FROM UPPER HUMBOLDT VALLEY					PHASES OF UPPER HUMBOLDT VALLEY	JAMES CREEK SHELTER		KEY DATES	GATECLIFF SHELTER	MONITOR VALLEY
JAMES CREEK VALLEY	SUSIE CREEK SURVEY	CARLIN SITES	LOWER SOUTH FORK SHELTER	UPPER SOUTH FORK SHELTER		COMPONENT	HORIZON		COMPONENT	PHASE
DESERT SERIES POINTS SHOSHONI POTTERY	SHOSHONI POTTERY	DESERT SERIES POINTS SHOSHONI POTTERY	DESERT SERIES POINTS SHOSHONI POTTERY	SHOSHONI POTTERY	EAGLE ROCK	EAGLE ROCK ?	I HIATUS	1800 1869 1600	YANKEE BLADE	YANKEE BLADE
ROSEGATE POINTS	ROSEGATE POINTS	1230– ROSEGATE POINTS 850–	ROSEGATE POINTS FREMONT POTTERY?	ROSEGATE POINTS 740–	MAGGIE CREEK	MAGGIE CREEK	II III	1300 1200 700	UNDERDOWN	UNDERDOWN
ELKO POINTS	ELKO POINTS	580– 230– 160– 360– ELKO POINTS	ELKO POINTS	610– 440– 320– 230– ELKO, PINTO, GYPSUM AND HUMBOLDT POINTS	JAMES CREEK	JAMES CREEK	IV V	A.D. B.C. 450 850	REVEILLE	REVEILLE
GATECLIFF POINTS	PINTO AND HUMBOLDT POINTS	HUMBOLDT POINTS	1370– PINTO AND HUMBOLDT POINTS 2360– STERILE 2410–		SOUTH FORK	SOUTH FORK ? EARLIEST C14 DATE (NON-CULTURAL)	VI	1250 1300 1940 2300 2500	DEVILS GATE	DEVILS GATE
	?		LIMITS OF EXCAVATION ?	NORTHERN SIDE-NOTCHED AND ELKO POINTS 3840– MAZAMA ASH	NO NAME	CULTURALLY STERILE DEPOSITS		3000 3150 3400 4950 5000	? CLIPPER GAP CULTURALLY STERILE DEPOSITS MAZAMA ASH	CLIPPER GAP ?
	GREAT BASIN STEMMED POINTS			LIMITS OF EXCAVATION ?	? DRY GULCH ?	BEDROCK		6000 7000	LIMITS OF EXCAVATION ?	

(Heizer and Hester 1973; Thomas 1981, 1983). The early Archaic adaptations (inception of intensified seed use, increased locational diversity in land-use patterns, probable increase in diet-breadth, and logistical structuring of subsistence pursuits) are not signalled strongly by the sparse data presently available along the upper Humboldt, where few details beyond chronology have been recovered (Elston and Budy in press).

The South Fork Phase (2500-850 B.C.), marked by Humboldt and Gatecliff Series projectile points, reflects a fully Archaic adaptation, although ambiguities blur the distinctive features of the phase in the upper Humboldt River drainage (Elston and Budy in press). Few artifacts are associated with the phase at James Creek Shelter, and data from nearby sites do not clarify much.

With the James Creek Phase (850 B.C.-A.D. 700), the Archaic adaptation reaches its fullest expression. Elko Series projectile points are the principal phase-markers, and their distribution indicates the exploitation of an extremely wide range of settings and resources. While certain chronological ambiguities persist regarding the placement of Elko projectile points (O'Connell 1967; Thomas 1983; Elston and Budy in press), their ubiquity across diverse landscapes signals a marked broadening of the prey-base and a more eclectic use of the environment.

The Maggie Creek Phase, extending from A.D. 700-1300, is characterized by further intensification of plant exploitation, increased pursuit of small game, and introduction of the bow and arrow. The phase is recognized archaeologically chiefly by the occurrence of Rosegate Series (Rose Spring and Eastgate) projectile points, and by the infrequent incidence of Fremont Grayware ceramics. The abundance of time markers (chiefly projectile points) recovered archaeologically suggests that the phase may have been characterized as well by a peak in local population levels (Elston and Budy in press).

The Eagle Rock Phase is marked along the upper Humboldt by Desert Series projectile points (Desert Side-notched and Cottonwood), and by Shoshone Brownware ceramics (Elston and Budy in press). The phase spans the period from A.D. 1300 to the protohistoric era, apparently representing the archaeological record of the Numic peoples who occupied the area at historic contact. Elston and Budy (in press) note that the incidence of time-marker artifacts suggests the phase witnessed an intensity of occupation diminished significantly from that of earlier times; whether this reflects reduced population levels or merely a diminished emphasis on hunting (as signalled by the incidence of projectile points) remains to be tested.

Chapter 4. STUDY METHODS

by Christopher Raven

Field work was accomplished in two ten-day field sessions, with a ten-day interval between them devoted to preliminary data analysis and refinement of the technical approach to study objectives. The methods and procedures employed by field and post-field investigations are the focus of the following discussion.

Field Methods - Session I
June 15 through June 24, 1987

Initial survey of the project area was designed to identify the range of variation in the kinds, quality, and distribution of cultural resources at a level of scrutiny sufficient to characterize the overall abundance of the resource base, to segregate zones of minimal research potential, to signal those areas requiring further investigation to evaluate their significance, and to provide a point of departure for planning such evaluative studies. To this end, a party of four was fielded with the charge of examining at a uniform intensity the entire project area and recording at a preliminary level its cultural attributes. The effort consumed 32 workdays (8 calendar days).

Project Boundary

Delineation of the project boundary responded to the coincidence of the Tosawihi (White Knife) Quarry National Register of Historic Places draft nomination (Rusco 1983) with mining interests identified by Touchstone Resources Company. TRC provided topographic maps of its area of concern (scale 1:6000; contour interval 5 feet), and upon these the boundary of the proposed National Register district was superimposed. To accommodate examination and reliable geographic control, the project boundary was regularized to a rectangular polygon encompassing the original irregular boundary of the district; in the field, minor adjustments, particularly at the southern and western margins, responded to observations of continuities and discontinuities in the distribution of cultural resources. In all, 823 acres comprise the area scrutinized (see Figure 2).

Ground Survey

Survey of the project area was accomplished by following a series of regularly spaced, north-south transects blanketing the entire study area. In order to take advantage of a grid staked and flagged at 400-foot intervals by TRC surveyors, transects were aligned to the grid and spaced 100 feet apart. In effect, every fourth transect corresponded to a north-south ordinate of the staked grid and could derive therefrom a much tighter geographic precision than otherwise would have been feasible. Transects were plotted on 1:6000 scale topographic maps of the project area marked with the coordinates of the TRC grid.

The field party surveyed sets of four adjacent transects simultaneously, the westernmost surveyor anchored along a staked grid line, and the remaining team arrayed at 100-foot intervals to the east. Each surveyor was equipped with an appropriate section of the project map, recording materials, compass, pin flags, and a two-way radio. The party advanced along a generally uniform front, the gridline anchorman calling by radio the coordinates of each grid stake as it was passed, until the end of the transect set or an agreed subdivision of it was reached. In most instances the party then realigned along the adjacent transect set and surveyed in the opposite direction, returning to a point 400 feet from its original station of departure.

In practice, the manner of coverage deviated from the above approach in response to two field contingencies. In one case, it proved strategically advantageous, owing to the disposition of roads in the area, to allow a two-member team to survey the four transects of a set in a single round trip. In another case, a small measure of geographic precision was lost owing to the occurrence of transects or portions thereof outside the zone in which grid corners had been staked. Survey of these transects relied upon close attention to topographic details and compass bearings, distance pacing, and group consultation via radio. While these approaches allowed generally good cross-checks on locational accuracy, features in the less topographically distinctive northern and western margins of the project area, may have been recorded with less geographic precision than they were where the grid provided a continuous frame of reference.

Recording

Each field party member was responsible for recording all cultural attributes observed along each transect that he/she traversed. Two general categories of data were collected, based on expectations derived from prior surveys and preliminary project reconnaissance.

Features

Features were defined as geographically discrete cultural phenomena of identifiable type, size, location, and constituency. As recorded in the field, individual features consisted of single distinctive artifacts, clusters of artifacts, structures, and discernible modifications of the landscape. Roads, cairns and other mining claim monuments, and survey stakes were not recorded.

Upon encountering a feature along a transect line, the surveyor assigned it a transect-specific sequential number, plotted its location on the appropriate transect map, and recorded details of its location, type, size, and associations on a record form maintained for each transect. Descriptions and pertinent observations were incorporated in the recording. Radio communication allowed adjacent surveyors to confer on the coincidence of like features, with the result that in several instances the boundaries of feature clusters or complexes were sketched approximately with the intent of subjecting them to more intensive scrutiny in a subsequent phase of investigations. Pin flags marked with the corresponding feature number were placed in all features to facilitate their future relocation.

While it was customary practice to record only features lying directly along transect lines, and not to search for intertransect features, deviation from this approach was entertained along Velvet and Little Antelope canyons in the eastern portion of the project area, where the coincidence of rockshelters, intensive prehistoric quarrying activity, and extremely irregular relief mandated additional measures to avoid missing features of preeminent significance. Accordingly, survey of these areas, while maintaining the standard transect interval as a minimal level of coverage, sought to identify and record all features present. The exercise was aided by the advantage in perspective that the steep slopes always afforded one or the other end of the survey line; in several instances surveyors could be directed off-transect by team members with a better overview to examine promising rockshelters, alcoves, and shelves otherwise in defilade.

Debitage Density

Owing to the near ubiquity of knappable lithic resources, only a relatively small proportion of the project area is utterly vacant of scattered debitage. In order to define better the distribution of this material and to assess its relationship to the incidence of recorded features, a running observation of debitage density was maintained along each transect, recorded at 100-foot intervals.

Since actual counts would have been prodigiously time-consuming to affect, the estimation and recording of debitage density observed the following conventions:

- O: No debitage noted over 100 transect-feet.
- Sparse: Average density of less than 1 flake/m^2.
- Light: Average density of 1-100 flakes/m^2.
- Moderate: Greater than 100 flakes/m^2; bare ground visible.
- Heavy: Unbroken pavement of debitage; bare ground not visible.

Frequent radio consultation allowed surveyors to confer on the assignment of density rankings, and the field supervisor monitored the accumulating record for consistent patterning of estimates; it seems inevitable, nonetheless, that a small degree of individual variation may have entered the record of debitage density. On the other hand, the generally gradual clines, both along and across the grain of the transects, evident in the compilation of the individual records suggests that the effect of minor individual variation has been minimized.

Collection

While the collection of artifacts encountered during survey was not a principal component of this phase of research, temporally diagnostic projectile points were plotted and recorded as features in the field and then were collected for further analysis. Their locations were flagged for more precise mapping during a subsequent phase of investigation.

Summary of Results

A total of 489 features or feature clusters was recorded, 167 historic and 322 prehistoric.

Field Methods - Session II

July 6 through July 15, 1987

A party of five archaeologists characterized and recorded a sample of those archaeological observations made during the first field session. Forty workdays (8 calendar days) were expended by the field party, whose efforts were incremented by 9 workdays of volunteer labor. During the course of the session, 40 feature complexes and areas of special interest were revisited and examined in detail.

Objectives

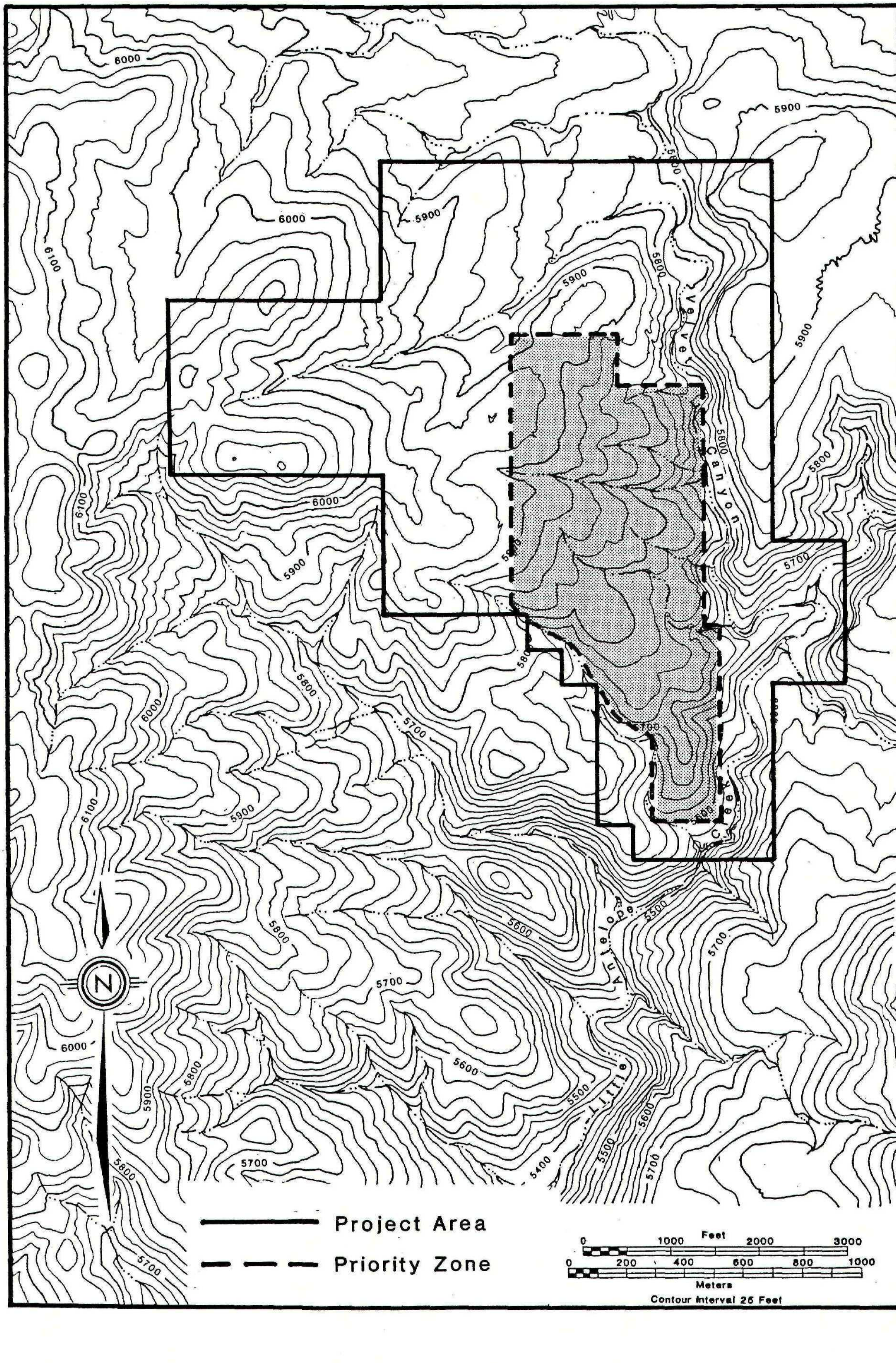
The second field session was designed to return data on the structure and range of variability of archaeological phenomena recorded during transect reconnaissance, with special attention given the abundance and distribution of discrete features, their composition, and associated lithic debris. It was the intent of the exercise to support the design of site-specific, as well as thematic, research strategies and, at the same time, to signal zones of minimal research potential.

Study Units

Session II was confined entirely to a 215-acre priority zone of immediate concern relative to minerals exploration (Figure 5). Having judged that our initial transect inventory had characterized sufficiently certain discrete localities such as rockshelters, small flaking stations, small outcrop quarries, and isolated artifacts, we excluded such categories from treatment during the second field session. Instead, we concentrated on formally characterizing quarry pit complexes. These are the most abundant features in the project area, and pose the greatest challenge to formal characterization owing to their size and internal complexity.

On the basis of data assembled during Session I, boundaries were identified for 36 localities targeted for further examination (although more than 36 localities occur within the priority zone). Twenty-eight of these were prehistoric quarrying features or complexes of features; eight

Figure 5. Project boundary and priority zone.



Project Area
Priority Zone
Feet
0 1000 2000 3000
0 200 400 600 800 1000
Meters
Contour Interval 25 Feet
Velvet Canyon Creek
Little Antelope
6000
5900
6100
5800
5700
5600
5500
5400

were areas of light to moderate debitage density selected for closer scrutiny (see Chapter 7). Boundaries of these localities reflected the previously observed distribution of features and feature complexes, patterns of debitage density, topographic configurations, and the occurrence of naturally exposed sources of raw lithic material.

Field Procedures

Field operations at each locality consisted of mapping, feature recording, and the observation and recording of cultural attributes. All aspects of the work were performed concurrently, with specific tasks assigned a 2-person mapping team and a 2-person feature-recording team; the project lithics specialist was charged with locality description and characterization of the cultural attributes of features.

Mapping

Plan maps were prepared depicting each of the 28 prehistoric quarry feature localities. At each locality, a datum point marked by a 2-in. x 2-in. wooden stake was located with reference to mapped corner stakes of the 400-foot grid network. Mapping was accomplished with transit and stadia rod, locating precisely all features selected for formal recording, delineating the boundaries of feature clusters, and establishing the elevations and dimensions of significant geological associations. Zones of intruding historic disturbance were plotted as well.

Feature Recording

Within each mapped locality, special attention was given the formal recording of attributes of those features identified during Session I transect survey. Of the several features comprising a feature cluster, only that representative flagged in the earlier exercise was selected for additional scrutiny.

In the case of quarry pits, the selected examples were drawn in plan and profile using measured distances from a staked datum (usually placed in the bottom of the pit) and a levelled line for control. The locations of tools (especially bifaces and hammerstones) and anomalies (e.g., cobble clusters, sub-depressions) were plotted on the plan drawings.

Subsequent to the drawing of plans and profiles, each recorded feature was visited by the project lithics specialist, who recorded observations on the character of the cultural attributes and available raw lithic material in the feature. Particular attention was given the recording of the quality, color, size, and abundance of raw material; the size and material type of hammerstones; the size, stage, and material selection of bifaces; and the character, abundance, and distribution of debitage. A sample of debitage was collected from each recorded feature to characterize the range of variation in material quality and flaking technique. In addition, several non-pit features (outcrop quarries, discrete lithic scatters) were visited and characterized for the same suite of attributes.

Areas of Special Interest

Session I transect survey identified areas of light (1-100 flakes/m^2) or moderate (100+ flakes/m^2) density debitage scatters within which no discrete features had been recognized. A sample of these areas was revisited by the entire field party with a view to identifying portions of the priority zone where research potential is minimal. The areas selected for scrutiny consisted of relatively flat or topographically homogenous places where the effects of colluvial redeposition are believed to have been minimal. At each, the party conducted surface reconnaissance to identify and record discrete features, and record observations on the character, abundance, and distribution of debitage and available raw lithic material. Four areas of light density scatter and four of moderate were so treated; the exercise resulted in the recording of 10 features not noted during Session I survey.

Post-field Methods

The information recovered in the field was analyzed, manipulated, and reduced variously, and collections were processed and analyzed, as described below.

Data Reduction

Field investigations generated data on nearly five hundred cultural features. Confronted with a great deal of raw data and a pressing need to make sense of it without delay, we attempted to structure information for interpretation and presentation in ways that would address the needs of research and of cultural resources management at the same time.

First, we decided to address the historic and prehistoric periods separately. Results of investigation of the historic period are pending, to be presented in their own document. Left with 332 observed and recorded prehistoric phenomena, we grouped related features based on topographic association, to arrive at a total of 219 prehistoric localities. Boundaries for mapped prehistoric quarry localities in the priority study zone are defined accurately, established by transit data; maximum boundaries for other, unmapped localities in the priority zone and all localities outside it are approximate, established by mapped artifact density clines surrounding features or feature clusters.

A narrative description of each locality (Appendix A) was compiled from transect feature records (Session I) and sample feature-locality descriptions (Session II); locality dimensions and topographic information were taken from 1:6000 contour map plots made in the field. Each description, which is accompanied by a USGS 7.5 minute topographic map plot, includes the following categories of information:

- -- reference number (1-219);
- -- general type of cultural manifestation (rockshelter, open residential site, reduction station, soil mound, quarry);
- -- UTM grid coordinates;
- -- physical dimensions;
- -- description of topographic setting (landform, slope, aspect) (slope terms are from Soil Survey Manual, Agricultural Handbook No. 18);
- -- description of nature of opalite source (bedrock edge outcrop, near-surface bedrock, cobbles in colluvium);
- -- description of toolstone color and quality;
- -- description of features, relevant feature numbers, and associated artifacts;
- -- condition of site (kind and degree of historic and/or recent disturbance); and
- -- remarks indicating inferred relationships, notable artifact and/or natural opalite associations, interpretations, and research potential.

Finally, localities were grouped on the basis of topography. Thus, the "neighborhoods" of the District, to which we assigned place names, have been defined and can be discussed as discrete entities.

Collections Management

Collected artifacts were cleaned, numbered, cataloged, and bagged for storage. Field and laboratory notes and logs, mapping notes, photo logs and negatives, artifact assemblage and catalog, and this report will be accessioned by the Museum of Anthropology, University of Nevada, Reno, where they will be available to future teaching and research endeavors. An Intermountain Antiquities Computer System (IMACS) site form, to which are appended all 219 prehistoric locality descriptions and map plots, has been forwarded to the BLM Battle Mountain District office. One Smithsonian trinomial designation, 26Ek3032, has been assigned to the Tosawihi Quarries Archaeological District as delineated herein.

Lithics Analysis

Classification of projectile points is based upon morphological criteria specified by Thomas (1981). Bifaces were classified according to the 3 stage reduction scheme developed by Muto (1971). Projectile point and biface measurements and observations appear in Appendix B.

Chapter 5. THE GEOGRAPHY OF THE TOSAWIHI DISTRICT

by Robert G. Elston

The Tosawihi Quarries Archaeological District is located in an upland of volcanic buttes and plateaus cut by canyons and ravines. Since most of these topographic features in and around the project area heretofore lacked placenames, we have assigned many to ease present and future discussion of the microterrain. Place names, the lay of the land and the positions of prehistoric localities relative to it, are given in the following discussion and depicted in figures 6, 7, and 8.

The roughly conical Big Butte rises about 1100 feet above surrounding terrain, to 6889 feet asl. Somewhat higher buttes rise a few miles to the north and northeast. Wrapped around Big Butte on the west, south, and east is crescent-shaped Big Butte Valley, about four miles long and one mile wide. The southern boundary of the valley is the highland area of the Tosawihi Quarries Archaeological District, including Mary's Ridge (6107 feet), Twin Butte (6125 feet), Tosawihi Ridge (5934 feet), and Little Butte (5962 feet).

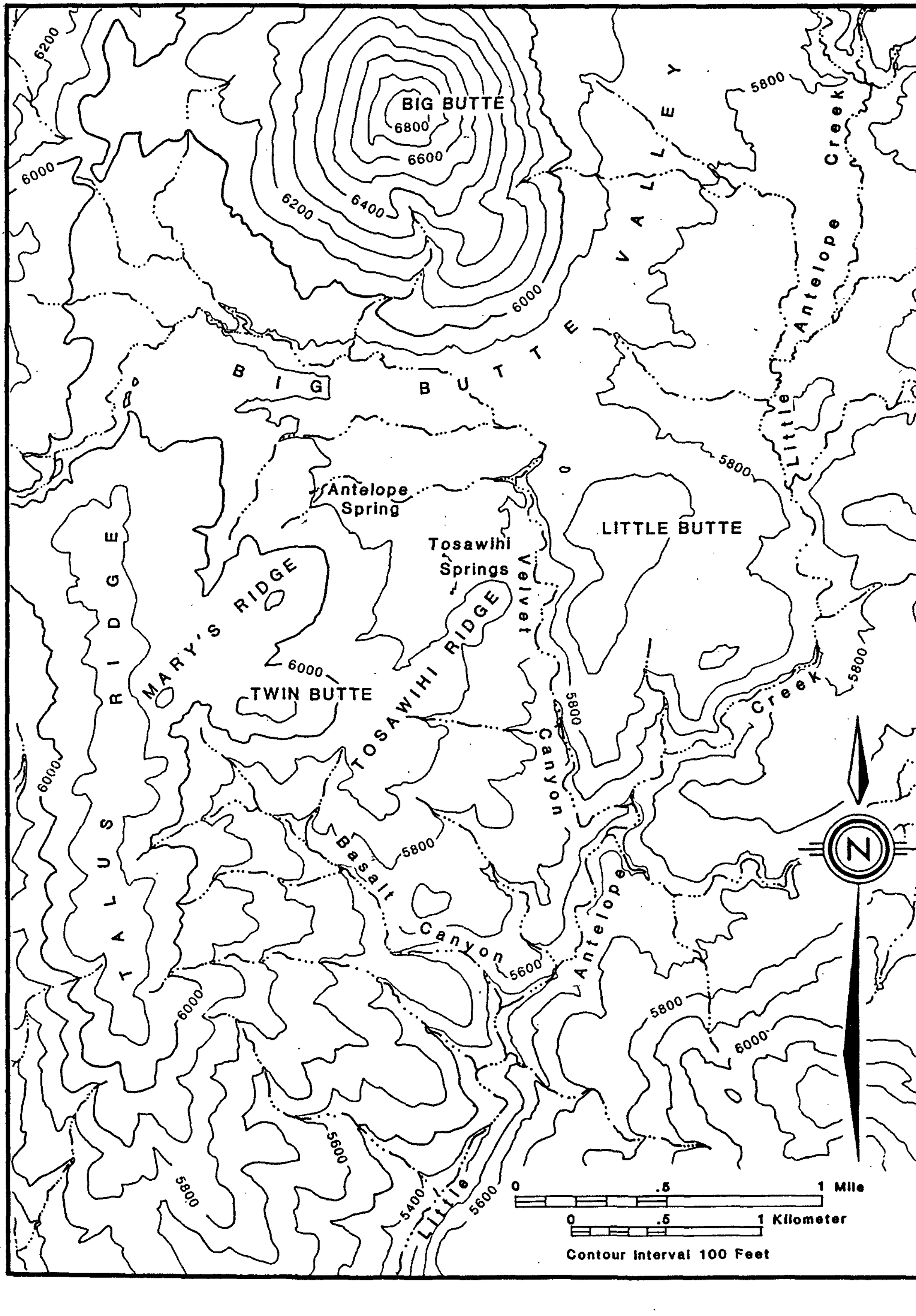
In the eastern portion of the valley, the valley floor is at 5750 feet elevation. Here heads the main branch of Little Antelope Creek which flows south-southwest, east of Little Butte, 1.5 miles through a steepwalled canyon cut in Tertiary rhyolite. Perennial Hunting Blind Spring occurs on the far southeast margin of the valley in the drainage of Little Antelope Creek.

The valley floor in the southwestern portion of the valley, at 5820 feet, is drained by Velvet Creek which flows 0.75 mile southward through steep-walled Velvet Canyon, between Owl Ridge on Little Butte and Tosawihi Ridge, to its confluence with Little Antelope Creek. A northward extension of Owl Ridge forms a low divide (> 20 feet) in Big Butte Valley between the two drainages.

The Tosawihi Quarries Archaeological District occupies a roughly triangular area in the highlands south of Big Butte Valley. The highest point in the District is on its eastern edge at Twin Butte (6125 feet); the topographic trend is a slope eastward to Little Antelope Creek.

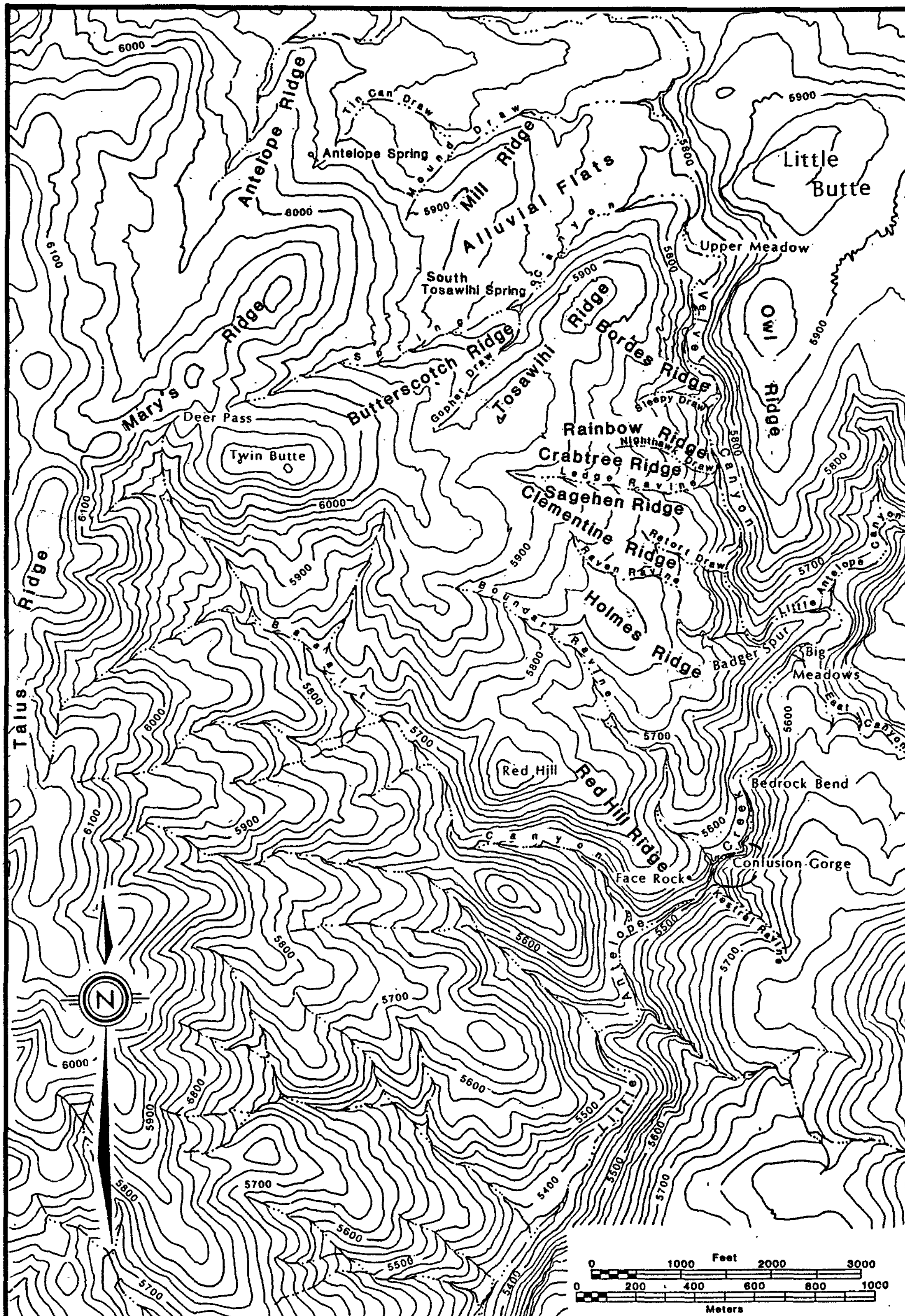
Just outside the eastern boundary of the project area, north-south trending Talus Ridge rises to 6193 feet. The ridge is named for prominent stripes of basalt and rhyolite

Figure 6. The geography of the project vicinity.



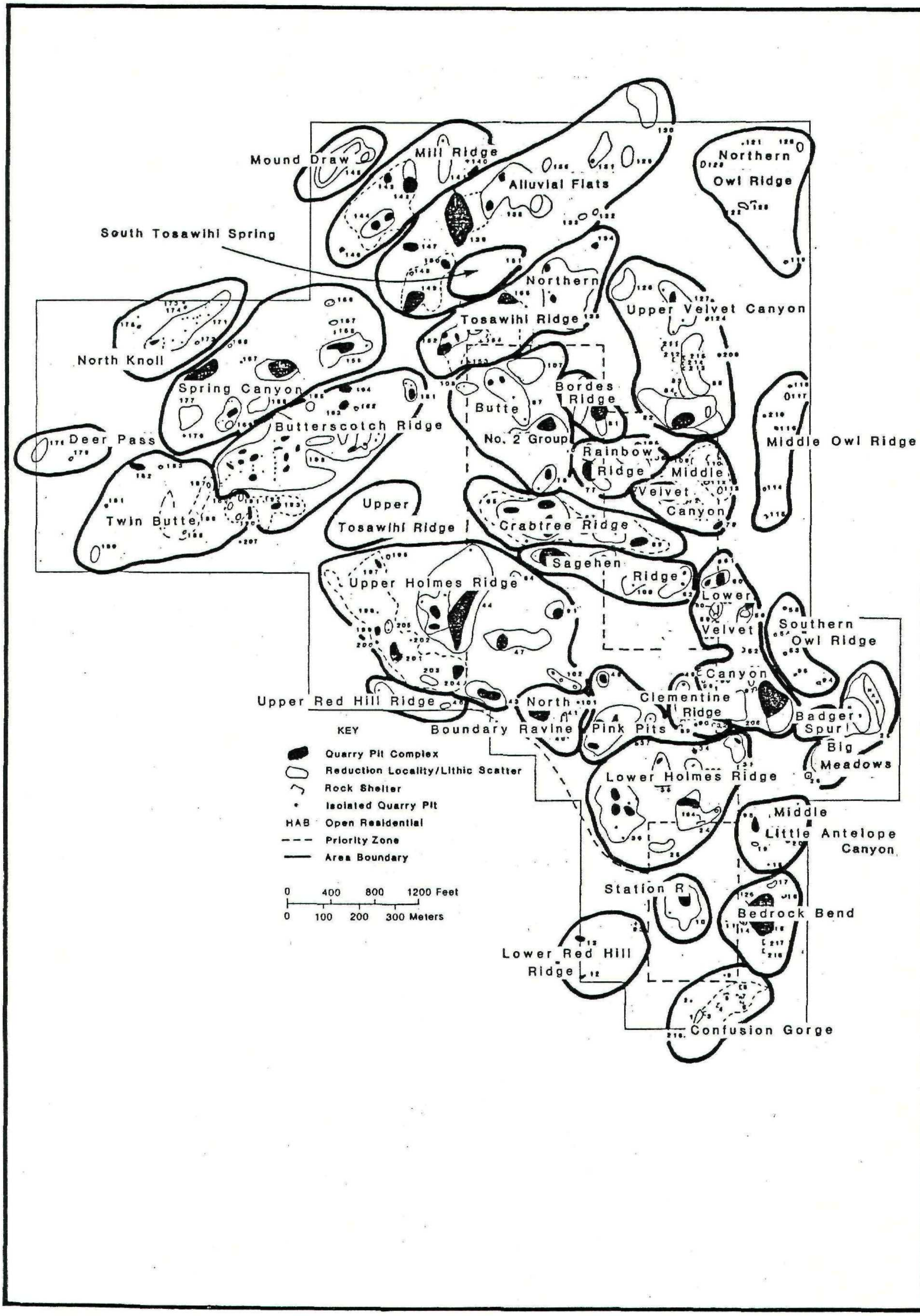
BIG BUTTE
6800
6600
6400
6200
6000
BIG BUTTE VALLEY
5800
Little Antelope Creek
Antelope Spring
LITTLE BUTTE
Tosawihi Springs
Velvet Canyon
TALUS RIDGE
MARY'S RIDGE
TWIN BUTTE
TOSAWIHI RIDGE
Basalt Canyon
Antelope Creek
5600
5400
Little
N
0 .5 1 Mile
0 .5 1 Kilometer
Contour Interval 100 Feet

Figure 7. The geography of the project area.



Antelope Ridge
Tin Can Draw
Mound Draw
Antelope Spring
Mill Ridge
Alluvial Flats
Little Butte
Upper Meadow
South Tosawihi Spring
Spring Canyon
Mary's Ridge
Butterscotch Ridge
Gopher Draw
Tosawihi Ridge
Bordes Ridge
Sleepy Draw
Owl Ridge
Deer Pass
Twin Butte
Rainbow Ridge
Nighthawk Draw
Crabtree Ridge
Ledge Ravine
Sagehen Ridge
Clementine Ridge
Retort Draw
Raven Ravine
Boundary Ravine
Holmes Ridge
Badger Spur
Little Antelope Canyon
Antelope Canyon
Big Meadows
East Canyon
Talus Ridge
Red Hill
Red Hill Ridge
Bedrock Bend
Canyon
Face Rock
Creek
Confusion Gorge
Kestrel Ravine
Antelope
Little
6000
6100
5900
5800
5700
5600
5500
5400
N
Feet
0
1000
2000
3000
0
200
400
600
800
1000
Meters
Contour Interval 25 Feet

Figure 8. Archaeological localities grouped by geographic area.


Mound Draw
Mill Ridge
Alluvial Flats
Northern Owl Ridge
South Tosawihi Spring
Northern Tosawihi Ridge
Upper Velvet Canyon
North Knoll
Spring Canyon
Butte No. 2 Group
Bordes Ridge
Deer Pass
Butterscotch Ridge
Rainbow Ridge
Middle Velvet Canyon
Middle Owl Ridge
Twin Butte
Upper Tosawihi Ridge
Crabtree Ridge
Sagehen Ridge
Upper Holmes Ridge
Lower Velvet Canyon
Southern Owl Ridge
Upper Red Hill Ridge
North Boundary Ravine
Pink Pits
Clementine Ridge
Badger Spur
Big Meadows
Lower Holmes Ridge
Middle Little Antelope Canyon
Station R
Bedrock Bend
Lower Red Hill Ridge
Confusion Gorge
KEY
Quarry Pit Complex
Reduction Locality/Lithic Scatter
Rock Shelter
Isolated Quarry Pit
HAB Open Residential
Priority Zone
Area Boundary
0 400 800 1200 Feet
0 100 200 300 Meters

talus that appear on its slopes. Mary's Ridge is an offshoot of Talus Ridge.

The northwest shoulder of Twin Butte is connected to Mary's Ridge at Deer Pass. Mary's Ridge trends to the northeast, terminating in Big Butte Valley, and has two roughly parallel, northeast trending spurs; Antelope Ridge extends from the northern flank of Mary's Ridge, and Mill Ridge from the southern flank. Antelope Spring rises in Tin Can Draw on the east side of Antelope Ridge.

Two drainages head on the slopes of Twin Butte, one on each side of Deer Pass. The largest is Basalt Canyon, trending southeast past Red Hill Ridge, to its confluence with Little Antelope Creek south of Kestrel Ravine. The other is Spring Canyon, trending northeast past Mary's Ridge and Mill Ridge to enter Velvet Creek just above Upper Meadow in the entrance to Velvet Canyon. This drainage is fed by South Tosawihi Spring rising just downstream from the end of Butterscotch Ridge and Gopher Draw. North Tosawihi Spring, which rises at the northeastern margin of Mill Ridge, apparently flows only in winter. Grass and/or sage covered mounds of fine grained soil in the Velvet Creek drainage of Big Butte Valley, and in the highlands as well, may represent old spring locations.

Underlain by massive beds of opalite and other silicified rocks, the terrain east of Twin Butte is more subdued and has less relief than surrounding areas of more easily eroded rhyolite and basalt bedrock. The eastern flank of Twin Butte is a broad bench that slopes eastward to Velvet and Little Antelope canyons. The upper portion of the bench, between 5925 feet and 5975 feet, forms the long, northeast trending Tosawihi Ridge, parallel to Mary's Ridge. The lower slopes of the bench are dissected into several smaller east-southeast trending ridges by minor drainages. South to north, these are Basalt Canyon, Red Hill Ridge, Boundary Ravine, Holmes Ridge, Raven Ravine, Clementine Ridge, Retort Draw, Sagehen Ridge, Ledge Ravine, Crabtree Ridge, Nighthawk Draw, Rainbow Ridge, Sleepy Draw, and Bordes Ridge.

The eastern wall of Velvet Canyon rises abruptly to the crest of south trending Owl Ridge on Little Butte. Just above its confluence with Little Antelope Creek, Velvet Creek makes a sharp bend east, around the toe of Owl Ridge on the north and Badger Spur (an outlier of Holmes Ridge) on the south. In the short reach of Little Antelope Canyon between Velvet Canyon and East Canyon to the south, is Big Meadows, a series of low, broad, grassy terraces. Pools and seeps were observed in Velvet and Little Antelope Canyon through June; a perennial spring may have been present where a stock pond now is located at Big Meadows, at the confluence of Velvet Canyon and Little Antelope Canyon.

Below Big Meadows, Little Antelope Canyon narrows. At Confusion Gorge, Little Antelope Creek flows through a deep (23 m), narrow cut in bedrock, making a bight around a bedrock spur at the confluence of Boundary Ravine on the west and Kestrel Ravine on the east. Face Rock, a monolith some 7 meters high (which resembles a human face when viewed from the north), stands on the western rimrock about 200 m southeast of Boundary Ravine.

In the following sections, the 219 archaeological localities observed in the District have been grouped tentatively on the basis of geographic proximity and geology (see Figure 8).

Basalt Canyon

Basalt Canyon is named for the basalt cropping out in talus stripes on Talus Ridge and present in stream deposits in this drainage to at least 5900 feet. The drainage apparently was the source of basalt boulders and cobbles used as hammers throughout the quarry area.

Red Hill Ridge

Red Hill Ridge, between Basalt Canyon and Boundary Ravine, is named for the bright red, iron-rich soil on much of the ridge, especially that exposed in numerous road cuts made during past mining activity. Opalite is present on Red Hill Ridge only toward its eastern end and along Boundary Ravine.

Two prehistoric localities were found on slopes near the western head of Boundary Ravine. Locality 45 is a small pit complex where relatively poor quality toolstone was quarried, while locality 46 is a discrete lithic scatter on a slope a little further downstream. Near the east end of the ridge, localities 12 and 13 are small outcrop quarries; locality 93, on a slope overlooking Boundary Ravine, is an isolated metate. Numerous other localities on Red Hill Ridge are represented by discrete flake scatters or reduction stations. Several of these were observed, but not recorded, outside the project area on benches overlooking Basalt Canyon northwest of Red Hill.

Boundary Ravine

Boundary Ravine heads in the terrain southeast of Twin Summit Hill, and trends southeast between Red Hill Ridge and Holmes Ridge for about a mile (roughly parallel to Basalt Canyon) to its confluence with Little Antelope Canyon in Confusion Gorge. This feature marks a natural divide between the opalitic and silicified rocks of the Tosawihi Quarries Archaeological District, and the red, iron-rich rhyolites and tuffs to the south.

North Boundary Ravine

Two archaeological localities on Holmes Ridge overlook the north side of Boundary Ravine. Localities 40 and 41 are adjacent (east) to a small, north-south tributary ravine, just below rim rock on the 5825 foot knoll. Locality 41 is a single quarry pit and associated lithic scatter, while locality 40 is comprised of a single quarry pit; a filled, south facing rockshelter (Boundary Shelter); other alcoves, and associated lithic scatter. The soil below the rimrock at locality 40 is grey and the place has a residential "feel" to it.

Locality 42, a small group of quarry pits at a bedrock outcrop west across the tributary ravine from locality 41, has one of the deepest quarry pits we observed. Locality 101 is an isolated quarry pit located east of locality 40.

Little Antelope Canyon

A mile-long reach of Little Antelope Canyon lies inside the project area. This reach extends from just above the confluence with Velvet Canyon to the confluence with Boundary Ravine in Confusion Gorge.

Confusion Gorge

Little Antelope Creek in Confusion Gorge was dry in late June, but apparently water had pooled there a short time before. Currant and wild rose are common along the creek bottom and along ledges of the cliffs above. Steep slopes and rocky cliffs form both sides of Confusion Gorge, but most cultural material is on the west side where Boundary Ravine cascades into the gorge. A group of localities in and adjacent to Confusion Gorge appear to be related. An isolated quarry pit (locality 2) is located on the southern edge of

Boundary Ravine, just above Confusion Gorge; poor quality chert outcrops along the rimrock between Boundary Ravine and Face Rock. Locality 216, represented by 11 bifaces discarded or forgotten below Face Rock, and a complex of discrete lithic scatters along the edge of the rimrock (locality 1) may represent material from either or both these sources. Several small rockshelters and overhangs (localities 3, 5 through 8) among the western cliffs contain small lithic scatters apparently representing reduction and biface thinning activities, and another small, discrete scatter (locality 9) occurs on a ridge slope to the north. Most of these shelters lack any depth of deposit, except Rose Leap Shelter (locality 4) which extends back into the rock at least 8 m, and seems to have considerable depth of deposit, much of which may be dry. Artifacts observed at the shelter include a metate, drill, and Cottonwood Triangular point, suggesting residential occupation.

It is worth noting that the most direct route between the Tosawihi Quarries and the Humboldt River is down Little Antelope Creek to Antelope Creek, thence to Rock Creek and on to Boulder Flat on the Humboldt. For people travelling this route, Confusion Gorge offers the first (or last) residential base close to the quarry area, although lack of water may have rendered it an undesireable place to stop in certain seasons.

Bedrock Bend

North of Confusion Gorge, Little Antelope Creek makes a sharp bend (Bedrock Bend) west around an outcrop of resistant, opalite bedrock. The outcrop contains an intensive bedrock quarry (locality 15), associated shallow rockshelters (localities 16, 126, 217, and 218), and a biface reduction station (locality 17). An isolated pit feature (locality 11) where blood-red toolstone was quarried, and a rockshelter/lithic scatter (locality 14) occur west of locality 15 on the western slope of the canyon.

Middle Little Antelope Canyon

Little Antelope Canyon is somewhat wider in its middle reach, between Bedrock Bend and the confluence with a large drainage to the east (East Canyon). Through late June, the middle reach contained several pools of water, but cultural localities are relatively sparse, limited to single pit features (including locality 18 where mustard yellow chert was obtained, as well as localities 20 and 23), a bedrock outcrop (locality 98), two streamside lithic scatters (localities 21 and 22), and a small lithic scatter with groundstone (locality 19). The latter is interesting because it occurs on a small bench well above the canyon floor and covers a very small area.

Big Meadows

In the short reach between East Canyon and Velvet Canyon, Little Antelope Canyon contains broad, grassy, meadow-like terraces, 0.5 to 1 m above the stream bed. This reach also contained pools in late June, and a large stock pond there appears to be fed by a perennial spring. Locality 26 is a small pit complex in bedrock which represents high quality toolstone. Locality 27 is series of overlapping flake scatters (at least one with groundstone) and historic debris scatters on a terrace at the confluence with East Canyon. Just below the confluence with Velvet Creek, flake scatters (locality 28) were observed on low terraces on both sides of Little Antelope Creek.

Badger Spur

Through most of its length, Velvet Creek trends south-southeast, but just before its confluence with Little Antelope Creek, it bends sharply to the east-northeast, creating Badger Spur, a narrow ridge between Velvet Creek and Little Antelope Creek, overlooking Big Meadows. Locality 29 is a small quarry pit complex exploiting high quality cream-to-light-yellow opalite. This locality seems more likely related to the terrace localities of Big Meadows than to other localities further up Velvet Canyon.

Holmes Ridge

Holmes Ridge trends southeast from the east flank of Twin Butte between Boundary Ravine on the south and Raven Ravine on the north, to Little Antelope Canyon. Station R is a contemporary mapping point established on a south trending spur off the lower end of Holmes Ridge between Boundary Ravine and Little Antelope Canyon north of Confusion Gorge. Groups of archaeological localities are abundant on Holmes Ridge; they include Station R, Lower Holmes Ridge, Pink Pits, North Boundary Ravine (described above) and Upper Holmes Ridge.

Station R

Station R, at 5707 feet, is just below the 5710 foot knoll at the end of Holmes Ridge and occurs within locality 10, where the soil contains angular, multi-colored chert cobbles and resembles an alluvial fan deposit. Locality 10 is comprised of a single large pit (probably a complex of overlapping pits) and associated lithic scatter from surface exploitation. The saddle above the knoll probably once contained a discrete lithic scatter possibly related to both localities 10 and 25, but this has been nearly obliterated by historic mining activities.

Lower Holmes Ridge

Lower Holmes Ridge comprises a number of archaeological localities above the knoll between 5705 and 5790 feet, including 24, 25, 31, 34 through 37, and 164. Locality 24 contains two pit complexes and a lithic scatter; Prospect Shelter (locality 164) is adjacent. The shelter has been disturbed by historic mining exploration, but at least 50% of the prehistoric deposits remain, and these are at least 1 m deep. Locality 25 is a series of discrete lithic scatters along a bedrock outcrop. Locality 36 is a complex of more than 55 individual quarry pits where good quality toolstone was obtained; a few pits have been disturbed by a historic road, but most of the locality is intact. Locality 35 contains quarry pits in association with a bedrock outcrop; material quality is only so-so. Locality 34 is represented by a discrete flake scatter and locality 206 by a single small quarry pit which appears to have been disturbed by past mining and road construction. Locality 31 is a place where surface lithic material exploitation occurred, involving angular, multi-colored chert cobbles in a deposit similar to that at locality 10; just down slope are four quarry pits where white to bluish white opalite was obtained.

Pink Pits

The Pink Pits area is located on the major axis of Holmes Ridge between 5770 and 5810 feet, and includes localities 38, 39, and 48. Locality 38 (the Pink Pit) is an isolated quarry pit and associated lithic scatter where the toolstone is good quality, predominately salmon pink opalite (and about 30% cream-to-buff material). A few purple flakes and a possible metate fragment also were observed here. Locality 39 comprises several relatively shallow quarry pits; material color is similar to that at locality 38, but quality is poorer. Locality 48 is smaller in area than 39, but quarry pits are much larger and deeper; toolstone is good quality pink and buff opalite.

Upper Holmes Ridge

This is a large area containing numerous archaeological localities; while some were examined in detail and transit mapped for the present study, others were recorded only briefly. Of those transit mapped, locality 44 is the largest and most complex. Between 5880 and 5920 feet elevation, talus stripes of chert cobbles occur on the ridgetop where numerous large quarry pits appear to have been sunk into the talus and into thin colluvium over bedrock. Subsequent twentieth century minerals exploration trenches have revealed a deposit of debitage, cores, and soil at least 2 meters thick. The origin of this deposit is not understood, unless it is derived from prehistoric quarrying and reduction on the knolltop where, however, there is little surface evidence of such intensive activity.

To the east and downslope are localities 43, 47, 64 and 91. Locality 43 is a large quarry pit complex along a bedrock ridge. Locality 47 is a small complex of three adjacent quarry pits in shallow colluvium, exploiting high quality cream-to-tan opalite; bedrock is near the surface at locality 47 and surface boulders are common. A narrow stripe of surface boulders extends from locality 47 toward the east and locality 91; this area contains a moderate density lithic scatter. Locality 91 is a small quarry pit complex (7 features) excavated into colluvium between bedrock boulders. Raw material is similar to that at locality 47, but poorer quality. Locality 64 is a single quarry pit and associated lithic scatter.

Further west, overlooking Boundary Ravine, localities 196 and 200 are open lithic reduction stations. Localities 197, 201, and 204 are bedrock outcrop quarries; localities 199 and 205 are small quarry pit complexes; and locality 203 is a possible talus quarry. Localities 198 and 202 are isolated quarry pits.

Locality 102 is comprised of three discrete flake scatters (each associated with stands of big sage) in the saddle above the tributary ravine on which localities 40, 41, and 42 are located. These scatters contain mostly white opalite flakes, but a few obsidian flakes were also observed, and a point preform collected.

Clementine Ridge

Raven Ravine drains southeasterly to its confluence with Velvet Canyon, separating Clementine Ridge from Holmes Ridge to the south. In its lower reach, Raven Ravine makes a Z-shaped bend around the 5775-foot knoll at the end of Clementine Ridge. Several archaeological localities are situated on this knoll; on its southern slope above Raven Ravine are shallow rockshelter localities 88 and 89, and locality 90 where two large bifaces were observed on the top of a boulder. Raven Shelter (locality 32), near the confluence of Raven Ravine and Velvet Canyon, is a deep, possibly residential, rockshelter with potential for depth of deposit; bifaces are abundant on the apron in front of the shelter and debitage represents a range of opalite colors.

Locality 33 occupies the top and western slopes of the knoll where it is capped by unsilicified bedrock. One quarry pit occurs at the north end of the locality, while the western slopes bear a large diffuse flake scatter with numerous discrete flaking stations.

Twentieth century debris from the Clementine Mine is found in Retort Ravine, which separates Clementine Ridge and Sagehen Ridge to the north, as well as in the saddle between the knoll and the rest of Clementine Ridge.

Sagehen Ridge

Sagehen Ridge is bounded by Retort Ravine on the south and Ledge Ravine on the north. Archaeological localities on upper Sagehen Ridge include locality 62, a quarry pit complex which has been disturbed by historic mining activities, and locality 63, a complex of widely scattered quarry pits in a boulder and cobble field. Localities 100 and 104 are isolated quarry pits surrounded by moderate density lithic scatters.

Crabtree Ridge

Crabtree Ridge is bounded by Ledge Ravine on the south and Nighthawk Draw on the north. Ledge Ravine is named for the 3 m high opalite ledge exposed along the southern margin of Crabtree Ridge. Several archaeological localities are arrayed along this ledge, both along its base and in the colluvial mantle above. Locality 65 comprises several quarry pit complexes, including pits excavated into both shallow colluvium and bedrock ledges. Locality 67 is a small complex of seven quarry pits in colluvium and an adjacent moderate density flake scatter in a stand of big sage along the ledge margin. Locality 68 is a bedrock outcrop quarry that includes a prehistoric adit in the bottom of the ledge, and an adjacent quarry pit in the colluvium below. The sheltered location at the bottom of the ledge makes residential occupation a possibility here; a fragment of groundstone was found on the berm of the quarry pit. Locality 69 is a deep pit, possibly a true vertical shaft, excavated in colluvium at the base of the ledge, and into the underlying bedrock to an undetermined depth. Locality 75, also on Crabtree Ridge, is described later with the Velvet Canyon Group.

Rainbow Ridge

Rainbow Ridge is bounded by Nighthawk Draw on the south and Sleepy Ravine on the north. Archaeological localities 77 and 103 are both small quarry pit complexes; locality 103 is remarkable for the colors of opalite (ranging from yellow through orange to red) available there. Locality 105 is an isolated quarry pit in colluvium and locality 106 is an area on the ridgetop where several small, discrete lithic scatters occur.

Bordes Ridge

Bordes Ridge is north of Sleepy Ravine. On upper Bordes Ridge, locality 81 is a quarry pit complex excavated into thin colluvium over bedrock. Material colors include grey-white with pink streaks as well as a distinctive brown, purple, and pink material. Locality 86 is a small quarry pit complex yielding opalite of salmon and cream with red streaks similar to locality 81.

The twentieth century Velvet Mine occupies a large area, mostly on upper and northern Bordes Ridge.

Velvet Canyon

Lower Velvet Canyon

Lower Velvet Canyon is the reach between Raven Ravine and Ledge Ravine. Localities 52 and 97 are small rockshelters, while locality 96 is a rockshelter with a surface lithic scatter. Just north of Raven Shelter (locality 32), on the southeastern slope of the knoll overlooking Velvet Canyon, is locality 208, a moderate density lithic scatter with no recorded quarry pits or adits. This locality was not examined in detail during the field phase of work and needs further investigation.

On the northeastern slope of the knoll in Velvet Canyon are locality 51, a small shelter, and localities 49, 50, and 99, all discrete lithic scatters. Across Velvet Creek, on the toe of Owl Ridge, locality 30 is a very large bedrock quarry complex exploiting high quality opalite exposed there. The locality contains numerous small pits and adits excavated into the bedrock and colluvial benches; reduction debris forms a thick talus deposit on the slopes and below. This locality marks some of the most intensive prehistoric quarrying in the District.

Several archaeological localities are located on the eastern end of Sagehen Ridge in Velvet Canyon. Locality 56 is a bedrock quarry along a ledge near the bottom of Velvet Canyon. Localities 58 and 59 are smaller outcrop quarries located higher up the slope. Locality 57, Clementine Shelter, is a residential rockshelter with considerable depth of deposit. Both burned rock and groundstone, along with abundant later stage bifaces, were observed on the apron outside the shelter. Two localities are associated with a narrow bedrock ridge; a small rockshelter of undetermined type (locality 80) on the south side of the ridge is nearly filled to the ceiling, while a moderate density flake scatter and incipient quarry pits (locality 66) are found along the north side. Locality 60 contains two quarry pit complexes in a moderate density scatter; locality 61 is a possible prehistoric adit and small debitage scatter in an opalite outcrop.

Middle Velvet Canyon

Middle Velvet Canyon is the reach between the confluence of Night Hawk Ravine and Sleepy Ravine.

Localities 74 and 75 are quarry pit complexes; locality 75 is situated in a small saddle and on slopes near the end of Rainbow Ridge, while locality 74 is located further downslope to the southeast. Locality 76 is a reduction station north of locality 75, in front of a small overhang in rimrock overlooking Velvet Canyon. Locality 73 is a similar feature located southeast of locality 75 below the rimrock. Just a few meters northeast, Rainbow Shelter (locality 72) is a small residential rockshelter similar to Clementine Shelter (locality 57), with a cached metate inside, also overlooking Velvet Canyon. Yellow opalite debitage resembling material from locality 103 on Rainbow Ridge is on the apron of the shelter. Locality 71 is a small bedrock outcrop quarry located downslope from locality 72. Localities 70, 92, and 109 are small bedrock outcrop quarries; locality 109 has been disturbed by past mining activity. Locality 110 is a small rockshelter and associated lithic scatter. Locality 111 is a small shelter, where no cultural deposits were observed, adjacent to the stream bed. Locality 112 is a small open reduction station above locality 111. Locality 113 is a small bedrock outcrop quarry near the bottom of the canyon.

Upper Velvet Canyon

Upper Velvet Canyon is the reach between Sleepy Ravine and Upper Meadow, where several intermittent springs occur along the creek bottom. The bedrock spur of Bordes Ridge north of Sleepy Ravine forces Velvet Creek into a sharp bend to the east. All archaeological localities in this reach are on the west side of the canyon. Locality 128, on the shoulder of Butte Ridge north of the twentieth century Velvet Mine, is a moderate density scatter without recorded features. Locality 82 on the end of Bordes Ridge is an intensive bedrock quarry pit complex with a pit and adit feature, six large pits excavated into the colluvium at the base of the slope, and myriad smaller pits in the upper slopes.

The lowest terrace along Velvet Creek is covered with flakes and may have served as a base for short-term residential use. Localities 85 and 127 are zones of intensive quarrying activity along bedrock ledges in Velvet Canyon north of Bordes Ridge. A thick accumulation of cultural talus (debitage, cores, and bifaces) occurs below the ledges. Locality 127 contains quarry pits excavated into colluvium on the slope below the ledge. Localities 214 and 215 are prehistoric adits into the bedrock ledge; locality 213 is a small rockshelter in the bedrock. Localities 84, 211, and 212 are small rock overhangs with associated flake scatters, although locality 84 actually may represent packrat accumulation rather than cultural deposition. Locality 83, Velvet Shelter, is the largest rockshelter site in the District. It is comprised of three adjacent chambers opening into a common mouth 30 m long; one chamber extends back at least 8 m. All three chambers are nearly filled (distance from present surface to ceiling is ca. 0.5 m) with soil and debitage. A road cut along the front of the apron shows cultural material to over a meter in depth.

Localities 124 and 209 are small flake scatters on the east side of the canyon below Owl Ridge.

Owl Ridge

Owl Ridge is a north-south trending ridge on the west side of Little Butte, above Velvet Canyon. Most of the ridge is rhyolite; opalite outcrops only in Velvet Canyon. Consequently, debitage is present only in patches of sparse density or in small discrete scatters. Small rockshelters or overhangs are present above Velvet Canyon.

Southern Owl Ridge

The southern end of Owl Ridge is narrow and steep. Localities 53, 54, 55, 94, and 95 are small flake scatters which may be related to the very large quarry pit complex at locality 30.

Middle Owl Ridge

Localities 114, 116, 117, 118, and 210 are small, discrete flake scatters on the top and west slopes of Owl Ridge. Locality 115 is a small rockshelter with associated flake scatter.

Northern Owl Ridge

Localities 119, 120, 122, and 125 are small, discrete flake scatters; locality 121 is comprised of two large bifaces sitting on a rock. Locality 123 is a small rockshelter with associated flake scatter.

Tosawihi Ridge

The localities in this group are to be found on the top and northwest slopes of Tosawihi Ridge.

Northern Tosawihi Ridge

Localities in this area overlook residential locality 151 at South Tosawihi Spring in Big Butte Valley. The presence of groundstone at several localities on the ridge give a residential appearance to the entire area. Locality 134 is an isolated quarry pit in colluvium, while locality 135 is comprised of several pit feature complexes surrounded by a moderate density scatter, disturbed in part by past minerals extraction at the Velvet Mine.

Localities 152 through 155 are a group of features which are probably closely related to each other and to locality 151, the open residential site at South Tosawihi Spring. Locality 152 is a large quarry pit complex on the top of the 5890-foot knoll at the end of Butterscotch Ridge. Just across a minor drainage to the east, locality 177 is a small quarry pit complex; locality 219 is an isolated Elko Series point within locality 177. Two metates were found in quarry pits here. In addition, localities 153 and 154 are isolated metates on the slopes above locality 152. Locality 155 is a small quarry pit complex on the slopes above southern Tosawihi Spring.

Butte No. 2 Group

The 5950-foot knoll on the southwest end of Tosawihi Ridge was one of the areas exploited most intensively in prehistoric times. Much of the prehistoric activity in the center of the knoll has been disturbed by workings of the twentieth century Butte No. 2 Mine, but several prehistoric localities were observed around the edges of the mine disturbance. Locality 108 is a badly disturbed small quarry pit complex. Locality 107 is a light-to-moderate density flake scatter in the saddle just south of Tosawihi Springs containing a wide variety of lithic materials. A feature consisting of seven bifaces and an Elko point was collected in this locality. Locality 87 is a large quarry pit complex in colluvium, also disturbed by past mining activities. Locality 79 comprises a series of shallow quarry pits excavated into weathered bedrock along a ledge outcrop. A lobe of fine-grained soil covered with grass (possibly an old spring mound) overlies the bedrock ledge on the north; several large quarry pits have been excavated (1m+) through the soil to the underlying bedrock. Locality 78 is a small quarry pit complex in shallow colluvium.

Upper Tosawihi Ridge

Localities 194 and 195 are discrete reduction stations located on upper Tosawihi Ridge below Twin Butte.

Big Butte Valley

South Tosawihi Spring

Locality 151 is a large, open, moderate density flake scatter on flats along the ephemeral Spring Canyon. Debitage includes many different opalite types; other artifacts include stage I through stage III bifaces, a mano, and firecracked rock. This locality is probably a prehistoric residential base camp which saw similar use by twentieth century miners, as evidenced by a concrete foundation, a debris scatter, and a spring box.

Alluvial Flats

Archaeological localities in southern Big Butte Valley are in alluvial flats north of Tosawihi Ridge and South Tosawihi Spring. Locality 137 is an isolated metate. Localities 132 and 133 are grassy mounds with flake scatters; locality 133 also contains a flaked stone knife fragment and bifaces. Locality 136 is a grassy mound where no surface cultural material is apparent; other grassy mounds observed bore cultural material as this one may on closer inspection. Locality 138 is a large area containing several small discrete lithic scatters that contain many different types of chert, obsidian, and basalt flakes, small bifaces, and projectile points. Localities 139, 147, 148, and 149 are boulder field quarries; locality 150 is a small quarry pit complex. Locality 129 is a moderate density flake scatter with no recorded features. Locality 130 is an undifferentiated lithic scatter in a stand of big sage. Locality 131 is a possible circular stone alignment in a moderate density scatter.

Mill Ridge

Mill Ridge is a northeast trending ridge between Spring Canyon and Mound Ravine. Archaeological localities on Mill Ridge include locality 140, an isolated metate. Locality 141 is an isolated quarry pit in a light-to-moderate density scatter with numerous bifaces. Locality 146 is a boulder field quarry. Localities 142, 143, and 144 are probably all related; 142 and 144 are quarry pit complexes, while locality 143 is a light-to-moderate density scatter of pink and white debitage.

Mound Draw

Mound Draw is on the north side of Mill Ridge. Locality 145 is comprised of three grassy mounds in the draw, each of which bears a light density lithic scatter.

Spring Canyon

Spring Canyon is a major drainage between the north side of Twin Butte and Mary's Ridge. The twentieth century Butte No. 1 mine is located on the top of a small knoll on the north side of the drainage. Locality 156 is a small pit complex in a boulder field, while locality 157 is a small outcrop quarry. Locality 158 is an isolated Desert Side-Notched projectile point. Localities 159 and 160 are quarry pit complexes along a bedrock ledge below the mine; they apparently reflect intensive prehistoric quarrying along the weathered bedrock edging a small knoll, and now are separated by Butte No. 1 mine disturbance.

Further west, locality 166 is a lithic scatter of undetermined type, locality 167 is an isolated quarry pit feature in a moderate density lithic scatter, and locality 168 is a small reduction station. Locality 170 is a quarry pit complex where the toolstone to wasterock ratio seems low. Locality 169 is a quarry pit complex associated with a grassy mound. Locality 176 is an isolated pit at the head of a cone-shaped, medium density lithic scatter.

Mary's Ridge

North Knoll

Locality 171 is a very large outcrop quarry and quarry pit complex on the southeastern slopes of Mary's Ridge below the 6105-foot knoll. Locality 175 is a small cobble quarry. Localities 172, 173, and 174 are discrete lithic scatters with abundant biface thinning flakes.

Deer Pass

When surveying this portion of the District, we flushed a mule deer in Basalt Canyon. The deer ran up the drainage and crossed into Spring Canyon over Deer Pass. Locality 179 is a small flake scatter in the pass, while locality 178 is a complex of several small discrete, scatters on the top of a small knoll overlooking it. Both localities are probably hunting stations.

Twin Butte

Most archaeological localities on the upper slopes of Twin Butte are discrete lithic scatters or reduction stations, including localities 180, 181, 183 through 187, and 189 through 191. Locality 182 is a small outcrop quarry pit complex. Locality 207 is an isolated quarry pit near a boulder outcrop surrounded by a light density scatter of grainy off-white and pink opalite.

Butterscotch Ridge

Butterscotch Ridge, trending northeast from the eastern summit of Twin Butte, is bounded by Spring Canyon on the north and Gopher Ravine on the south. Locality 188, the largest quarry pit complex in the District, is located down the axis of the ridge. Shallow pits on the upper (west) end of the complex may be older, based on greater vegetation development and more rounded contours. Opalite of several colors was exploited here, but particularly distinctive is opaque yellow to translucent "butterscotch" material in the central part of the pit complex. Several late stage bifaces with hafting elements were noted in this locality. Locality 188 is also noteworthy for an abundance and large size of basalt hammerstones and hammerstone spalls.

Somewhat south of locality 188, locality 192 is an isolated quarry pit, and locality 193 is a small quarry pit complex. Further downslope to the northeast, localities 161, 162, and 163 are small quarry pit complexes, while locality 165 is a moderate density lithic scatter defined from survey data.

Chapter 6. PREHISTORIC LOCALITY TYPES IN THE TOSAWIHI DISTRICT

by Elizabeth E. Budy

Two hundred nineteen prehistoric localities have been been identified in the Tosawihi Quarries Archaeological District, ranging from isolated artifacts such as projectile points and grinding stones, to discrete clusters of artifacts (usually debitage), to features or clusters of features. Each locality has been assigned to one of eight general types isolated by the present study: rockshelter, open residential locus, reduction station, quarry pit, outcrop quarry, surface cobble quarry, undifferentiated lithic scatter, and isolated artifact. Subtypes have been identified among general types, as well.

Locality type and subtype definitions and assignments are the topics of the following discussion. It should be noted that the site type analysis is based on limited examination of surface cultural manifestations and, therefore, is provisional.

Open Residential Localities

Eleven localities are identified as open residential (Table 1). Habitation is inferred from abundance of tools other than bifaces, lithic raw material variety, and range of biface stages; groundstone artifacts were noted at three open residential localities.

Open residential localities are segregated according to size and geomorphic situation. Large open residential localities (ranging from 5,400 to 21,600 square meters in area) are located on stream terraces (927 and 28) or on ridges near perennial springs (107 and 151). Others (130, 138 and 145) are on grass or sagebrush-covered mounds in western Big Butte Valley. Small open residential localities range in area from 10 to 150 square meters. Two (132 and 133) are located in western Big Butte Valley on grassy mounds, while one (19) was recorded on a bench above Little Antelope Canyon. Locality 131 is, apparently, a partially buried rock circle feature, which has been designated a small open residential/ rock circle.

Table 1. Open Residential Localities.

Subtyped	Locality No.	Maximum Area (m^2)
Small Open Residential	19	10
Small Open Residential/ Soil Mound	132	150
	133	110
Small Open Residential/ Rock Circle	131	25
Large Open Residential	27	6,750
	28	21,600
	107	5,400
	151	18,000
Large Open Residential/ Soil Mound	130	6,750
	138	21,600
	145	10,200

Quarry Pit Localities

Quarry features comprise the most abundant locality types in the District. Quarry locality types are segregated according to presence or absence of useable toolstone outcrops and to extraction features.

Prehistoric toolstone procurement in quarry pit localities (n=22) focuses on extraction of subsurface raw materials; this is evident by the presence of quarry pit features where high quality opalite outcrops are absent. Numerous pits have been excavated through thin layers (10-30 cm) of colluvium into underlying weathered bedrock, others into thick colluvial deposits (upwards of 2 meters) containing sparse to abundant opalite cobbles. Quarry localities are variable in size, raw material quality, numbers and sizes of extraction pits, and numbers and kinds of artifact associations. Subtypes include isolated quarry pit, quarry pit complex, quarry pit complex/groundstone, and quarry pit complex/soil mound (Table 2).

Table 2. Quarry Pit Localities.

Subtype	Locality No.	Maximum Area (m2)
Isolated Quarry Pit	2	15
	11	100
	18	150
	20	200
	23	30
w/groundstone	38	15
	41	1,800
	64	225
	100	2,700
	101	100
	104	900
	105	25
	134	400
	141	3,600
	167	200
	176	5,400
	192	50
	197	450
	198	25
	202	225
	206	2280
	207	30
Quarry Pit Complex	10	10,000
	15	10,800
	24	9,000
	26	150
	29	2,250
	31	3,375
	35	2,700
	36	21,600
	39	24,000
	42	2,100
	43	7,200
	44	45,000
	45	2,700
Quarry Pit Complex (cont'd)	47	8,100
	48	900
	60	2,250
	62	3,500
	63	4,500
	65	24,000
	66	1,800
	67	1,350
	75	2,700
	77	3,000
	78	2,250
	81	3,375
	82	20,700
	86	3,900
	87	12,750
	91	3,600
	103	900
	108	1,350
	135	27,000
	150	375
	152	4,725
	155	1,650
	156	200
	159	6,750
	160	5,400
	161	1,800
	162	108
	163	400
	170	3,000
	188	69,000
	199	600
	205	450
Quarry Pit Complex w/Soil Mound	79	9,000
Quarry Pit Complex/Groundstone	177	3,600
Quarry Pit Complex/Soil Mound	169	4,050

Isolated quarry pits (n=22) are localities distinguished by the presence of only one excavation pit feature. Reduction debitage surrounding each pit varies in area from as little as 15 to as much as 5,400 square meters. These localities are of special interest because of their spatial limits, often distinctive opalite materials (e.g., the Pink Pit), and lack of disturbance from other kinds of quarrying activities.

Quarry pit complexes (n=46) are defined as two or more quarry pit features and their surrounding reduction debris. Pit complexes vary in size, from 150 square meters with no more than 2 pit features to 69,000 square meters with as many as 55 pits. Associated artifacts include debitage, bifaces, cores, chunks, assayed cobbles, and hammerstones. Quarry pit complexes reflect the most intensive prehistoric quarrying in the District. The largest complexes probably were utilized over the longest period of time.

A single quarry pit complex/groundstone locality represents the unique association of two metates with intensive pit quarrying above southern Tosawihi Spring. The only quarry pit complex/soil mound locality is distinguished by an enigmatic deep soil feature.

Outcrop Quarry Localities

Twenty-five localities are classified as outcrop quarries, where the primary focus of prehistoric opalite quarrying was on exposed bedrock outcrops or ledges. Quarry pits may or may not be present, but, in any case, are of secondary importance. Subtypes include small outcrop-assay quarry, small outcrop quarry, outcrop quarry complex, and adit (Table 3).

Small outcrop-assay quarries (n=7) are distinguished by debitage which reflects, primarily, raw material assay (battered bedrock, angular shatter, irregular chunks of opalite, and some primary flakes); they range from 60 to 900 square meters in area. Small, incipient quarry pits are present at locality 71.

Small outcrop quarries (n=4) range from 75 to 900 square meters in area; all lack quarry pits. Associated debitage reflects core and/or biface reduction (primary and secondary flakes, cores, bifaces); use of the local exposed bedrock is assumed.

Table 3. Outcrop Quarry Localities.

Subtype	Locality No.	Maximum Area (m^2)
Small Outcrop-Assay Quarry	12	150
	50	60
	70	600
	71	200
	92	300
	98	900
	113	150
Small Outcrop Quarry	1	900
	13	375
	59	500
	157	75
Outcrop Quarry Complex	30	11,250
	56	2,400
	68	2,250
	69	900
	85	9,000
	127	11,250
	171	16,125
	182	900
	201	1,200
	204	1,200
Adit	58	25
	61	9
	214	50
	215	50

Outcrop Quarry Complexes (n=10) are characterized by intensive exploitation of exposed bedrock at ledges or vertical faces on outcrops. Reduction debris often forms a thick talus composed of cores, bifaces, and primary and secondary flakes, as well as rejected cobbles and waste rock. Quarry pits (at localities 30, 68, 69, 85, 127 and 171) and adits (at locality 68) also may be present, but usually they are relatively small, minor components of the quarry complex.

Adits (n=4) are small tunnels excavated into bedrock outcrops for the purpose of toolstone extraction. Similar historic features occur in the Tosawihi Quarries

Archaeological District and it is sometimes difficult to distinguish between them. The four adits defined as prehistoric localities include evidence of toolstone extraction and reduction (debitage and/or bifaces, cores, extracted nodules).

Surface Cobble Quarry Localities

All surface cobble quarry localities are located on low ridges or alluvial flats in western Big Butte Valley, at the extreme northern edge of the District (Table 4). Here, poor quality opalite cobbles are mixed with natural shatter and colorful pebbles. Although most cobbles and pebbles are opalite, they seem to represent a range of colors different from those exhibited by the opalite toolstone sources throughout the larger quarry district to the south. The origin of the deposits and the prehistoric extraction/ processing technology used at surface cobble quarries remains enigmatic at this time.

Table 4. Surface Cobble Quarry Localities.

Subtype	Locality No.	Maximum Area (m^2)
Small Cobble-Assay Station	148	100
	175	100
	193	300
Surface Cobble Quarry	139	9,000
	142	1,575
	143	225
	144	4,500
	146	300
	147	1,350
	149	3,375

Small Cobble-Assay Stations (n=3) are discrete areas covering less than 300 square meters. Quantities of shatter and assayed cobbles indicate a focus on raw material assay.

Surface Cobble Quarries (n=10) are components of cobble-boulder fields characterized by light-to-moderate density flake scatters and quantities of natural shatter; some localities (142 and 144) have shallow quarry pits. Surface cobble quarries are generally quite large (averaging about 2,900 square meters in area), but range in area from 225 to 9,000 square meters. Artifacts suggest that surface cobbles were assayed and some raw materials reduced on-site.

Reduction Station Localities

Reduction station localities evidence little or no on-site quarrying; rather, they represent small concentrations of lithic reduction debris that includes cores, primary and secondary flakes, bifaces, biface thinning flakes, and chunks of raw material. Some of these may reflect brief, isolated episodes of tool reduction; others probably reflect several such visits. Since tool reduction often is embedded in other activities (such as hunting) that leave a less visible archaeological record, the primary functions of these sites may not be evident from surface observations. Reduction station localities are listed in Table 5 below.

Small reduction stations (n=36) are discrete debitage scatters ranging from 1 to 300 square meters in area. One locality (84) was identified as a small reduction station/ secondary deposition because of the possibility that the cultural material there may have been accumulated by pack rats. Another locality (183) is defined as a small reduction station/soil mound due to its proximity to a grassy soil mound.

Reduction station complex localities (n=10) are defined as two or more adjacent, discrete reduction stations (102 and 106) or as apparent overlapping accumulations of reduction debitage in areas where no on-site quarry source was noted. One locality (25) was further segregated as a reduction station complex/outcrop assay, due to extensive assaying along a poor quality outcrop ledge where many flaking stations were noted.

Rockshelter Localities

Rockshelters are localities where protection from the elements is offered by overhangs at the bases of cliffs, in cliff faces, or rock outcrops. Some rockshelters are true caves, deeper than they are wide. In the Great Basin, rockshelters saw residential use, as well as providing short-term protection from the elements while task-specific activities were in progress; they also were employed as goods caches and as burial chambers. Based on surface indications, the first two uses are represented at Tosawihi.

Table 5. Reduction Station Localities.

Subtype	Locality No.	Maximum Area (m^2)
Small Reduction Station	9	300
	21	100
	22	5
	34	345
	37	10
	53	25
	54	225
	55	10
	94	3
	99	2
	112	28
	114	16
	116	100
	119	2
	122	25
	124	15
	125	225
	168	225
	172	4
	173	100
	174	100
	179	25
	181	20
	184	4
	185	10
	186	1
	187	4
	189	90
	190	300
	191	25
	194	4
	195	9
	196	1
	200	25
	209	5
	216	20
Small Reduction Station/ Secondary Deposition(?)	84	2
Small Reduction Station/ Soil Mound	183	6

Table 5, continued.

Subtype	Locality No.	Maximum Area (m^2)
Reduction Station Complex	17	450
	33	2,700
	46	600
	74	600
	102	6,000
	106	3,600
	120	600
	178	4,050
	180	1,000
	203	1,400
Reduction Station Complex/ Outcrop Assay	25	2,250

Thirty-five rockshelter localities are segregated into six subtypes: residential, rockshelter complex/residential, reduction station, assay station, undetermined type, undetermined type/adit (Table 6).

Four rockshelter/residential localities appear to have potential for significant buried cultural deposits and may contain habitation features and artifacts. Tools (bifaces, projectile points, and/or groundstone) found on the surface at Clementine, Raven, Rainbow, and Rose Leap shelters are indicators of residential use.

Two rockshelters are designated as rockshelter complex/residential types. Velvet and Boundary shelters are complexes of several adjacent shelters; in each case, one shelter in the group demonstrates evidence of cultural deposition (but no tools were found on the surface).

Rockshelter subtypes with small alcoves, bedrock floors, and only limited associated reduction debitage or assay materials are designated as rockshelter/reduction station (n=17) and rockshelter/assay station (n=1).

Table 6. Rockshelter Localities.

Subtype	Locality No.	Maximum Area m^2
Residential		
(Rose Leap Shelter)	4	200
(Raven Shelter)	32	70
(Clementine Shelter)	57	200
(Rainbow Shelter)	72	150
Rockshelter Complex/ Residential		
(Boundary Shelter)	40	*1800
(Velvet Shelter)	83	900
Reduction Station	3	50
	5	25
	6	15
	7	50
	8	15
	14	50
	16	10
	51	75
	73	75
	76	45
	88	50
	89	50
	110	25
	115	10
	123	35
	126	50
	210	10
Assay Station	111	50
Undetermined Type	52	75
	80	15
	96	50
	97	75
(Prospect Shelter)	164	25
	211	50
	212	50
Undetermined Type/Adit	109	75
	213	50
	217	20
	218	25

* includes area surrounding rockshelter.

At eight localities designated Rockshelter/undetermined type, depth of deposit is unknown and surface evidence of function is lacking. For instance, localities 80 and 97 both show potential for deep deposits, and historic disturbance at Prospect Shelter (locality 164) suggests at least one meter of deposits. However, functionally diagnostic artifacts are not present on the surface at any of the three localities. One enigmatic rockshelter/undetermined type/adit also has a possible prehistoric adit feature.

Undifferentiated Lithic Scatters

Seven localities are lithic scatter/undetermined type; two more have been designated lithic scatter/undetermined type/ soil mound (Table 7). Locality 118 is associated with a sagebrush-covered mound on the crest of Owl Ridge; locality 136 is on a grassy mound in the alluvial flats of Big Butte Valley. Undifferentiated lithic scatters include moderate density debitage scatters where no features were observed during transect survey, as well as possible short-term habitation loci on ridge tops and saddles.

Table 7. Undifferentiated Lithic Scatters.

Subtype	Locality No.	Maximum Area (m^2)
Undetermined Lithic Scatter	49	525
	117	300
	128	3,375
	129	1,800
	165	400
	166	3,375
	208	5,000
Undetermined Lithic Scatter/ Soil Mound	118	81
	136	1,200

Isolated Artifacts

Ten localities consist of only one to three artifacts each (Table 8). Two localities are projectile points collected near recorded features; they were assigned discrete locality numbers to provide reference in mapping notes and artifact catalog. Five are isolated metates (significant given the rarity of groundstone in the District), and three are collections of two or three bifaces found in unusual contexts.

Table 8. Isolated Artifact Localities.

Locality No.	Artifact Type	Description
90	Biface	White Chert, Stage II (n=2)
93	Groundstone	Metate fragment (n=1)
95	Biface	White Chert (n=3)
121	Biface	White Chert (n=2)
137	Groundstone	Metate fragment (n=1)
140	Groundstone	Metate fragment (n=1)
153	Groundstone	Metate fragment (n=1)
154	Groundstone	Metate fragment (n=1)
158	Projectile Point	Obsidian Desert Side-notched (n=1) (collected)
219	Projectile Point	Obsidian Elko Series (n=1) (collected)

Summary

The 219 localities recorded in the Tosawihi Quarries Archaeological District are summarized in Table 9, below.

Table 9. Summary of Localities by Type

Open Residential Localities (n=1)	
Small Open Residential	1
Small Open Residential/Soil Mound	2
Small Open Residential/Rock Circle	1
Large Open Residential	4
Large Open Residential/Soil Mound	3
Quarry Pit Localities (n=70)	
Isolated Quarry Pit	22
Quarry Pit Complex	46
Quarry Pit Complex/Groundstone	1
Quarry Pit Complex/Soil Mound	1

Table 9, continued.

Outcrop Quarry Localities (n=25)	
Small Outcrop Quarry	4
Small Outcrop-Assay Quarry	7
Outcrop Quarry Complex	10
Adit	4
Surface Cobble Quarries (n=10)	
Surface Cobble Quarry	7
Small Surface Cobble Assay Quarry	3
Reduction Station Localities (n=49)	
Small Reduction Station	36
Small Reduction Station/Secondary Deposition	1
Small Reduction Station/Soil Mound	1
Reduction Station Complex	10
Reduction Station Complex/Outcrop Assay	1
Rockshelter Localities (n=35)	
Residential	4
Rockshelter Complex/Residential	2
Reduction Station	17
Assay Station	1
Undetermined Type	7
Undetermined Type/Adit	4
Undifferentiated Lithic Scatters (n=9)	
Lithic Scatter (Undetermined Type)	7
Lithic Scatter (Undetermined Type/ Soil Mound	2
Isolated Artifacts (n=10)	
Biface(s)	3
Groundstone	5
Projectile Point	2
Total	219

Chapter 7. ARCHAEOLOGICAL LOCALITIES WITHIN THE PRIORITY STUDY ZONE

by Robert G. Elston

The major goal of the second phase of field work was to characterize archaeological variability in the priority study zone (see Chapter 4), particularly among quarry pits and outcrop quarries. Quarry features are not only the most abundant classes of archaeological phenomena in the priority zone, but are crucial to an understanding of prehistoric lithic quarrying and processing throughout the District.

We prepared transit maps of 28 prehistoric localities in the priority zone, as well as detailed descriptions, maps, and profiles of 41 archaeological features within those localities. Localities sampled are given in Table 10. Geographic areas represented include several localities on Holmes Ridge: Station R, Lower Holmes Ridge, Pink Pits, North Boundary Ravine, and Upper Holmes Ridge. Other areas sampled were Lower Velvet Canyon, Sagehen Ridge, Crabtree Ridge, Middle Velvet Canyon, Rainbow Ridge, Bordes Ridge, Upper Velvet Canyon and Butte No. 2 Group.

A second problem addressed was presented by the veneer of debitage overlying the surface nearly everywhere throughout the District (Figure 9). While convinced that most of this material had been generated by assaying, quarrying, and processing, and further scattered by various geologic and biotic processes, we were concerned that some of it might reflect non-quarry related activities. Predicting where such evidence was most likely became a process of elimination. We assumed that residues of non-quarry activity would be hopelessly masked by moderate-to-heavy density quarry-related debitage, or by historic mining disturbance. We further assumed that little or no in situ material exists on slopes greater than 5%, leaving for consideration the flatter portions of ridge crests (benches and saddles) in sparse-to-light density areas. Four such "areas of special interest" (L1 through L4) were chosen for investigation (Figure 10).

In addition, density plots revealed small areas of moderate density debitage unassociated with transect-recorded quarry features. In order to understand what prehistoric activities these localities represented, four (M1 through M4) were also chosen for further investigation (Figure 10).

Table 10. Archaeological Localities by Type and Area In Priority Zone

* Locality transit mapped, plans and profiles prepared.

Confusion Gorge

9 - Small Reduction Station

Lower Red Hill Ridge

12 - Small Outcrop - Assay Quarry
13 - Small Outcrop Quarry
93 - Isolated Artifact

Station R

* 10 - Quarry Pit Complex

Bedrock Bend

11 - Isolated Quarry Pit

Lower Holmes Ridge

* 24 - Quarry Pit Complex
* 25 - Reduction Station Complex/Outcrop Assay
* 31 - Quarry Pit Complex
* 34 - Small Reduction Station
* 35 - Quarry Pit Complex
* 36 - Quarry Pit Complex
37 - Small Reduction Station
164 - Rockshelter (undetermined type) - Prospect Shelter
206 - Isolated Quarry Pit

Pink Pits

* 38 - Isolated Quarry Pit
* 39 - Quarry Pit Complex
* 48 - Quarry Pit Complex

Table 10, Continued.

North Boundary Ravine

40 - Rockshelter (Residential)/Quarry Pit
41 - Isolated Quarry Pit
* 42 - Quarry Pit Complex
101 - Isolated Quarry Pit

Upper Holmes Ridge

* 43 - Quarry Pit Complex
* 44 - Quarry Pit Complex
* 47 - Quarry Pit Complex
* 64 - Isolated Quarry Pit
* 91 - Quarry Pit Complex
*102 - Reduction Station Complex

Clementine Knoll

32 - Rockshelter (Residential) - Raven Shelter
33 - Reduction Station Complex
88 - Rockshelter (Reduction Station)
89 - Rockshelter (Reduction Station)
90 - Isolated Artifact

Lower Velvet Canyon

49 - Lithic Scatter (undetermined type)
50 - Small Outcrop - Assay Station
51 - Rockshelter (Reduction Station)
57 - Rockshelter (Residential) - Clementine Shelter
58 - Adit
59 - Small Outcrop Quarry
* 60 - Quarry Pit Complex
61 - Adit
66 - Quarry Pit Complex
80 - Rockshelter (undetermined type)
99 - Small Reduction Station
208 - Lithic Scatter (undetermined type)

Table 10, Continued.

Sagehen Ridge

* * 62 - Quarry Put Complex
* * 63 - Quarry Pit Complex
* 100 - Isolated Quarry Pit
* 104 - Isolated Quarry Pit

Crabtree Ridge

* * 65 - Quarry Pit Complex
* * 67 - Quarry Pit Complex
* * 68 - Outcrop Quarry Complex
* * 69 - Outcrop Quarry Complex

Middle Velvet Canyon

* 70 - Small Outcrop Quarry - Assay Quarry
* 71 - Small Outcrop Quarry - Assay Quarry
* 72 - Rockshelter (Residential) - Rainbow Shelter
* 73 - Rockshelter (Reduction Station)
* 74 - Reduction Station Complex
* 75 - Quarry Pit Complex
* 76 - Rockshelter (Reduction Station)
* 92 - Small Outcrop - Assay Quarry
* 109 - Rockshelter (undetermined type/adit)
* *110 - Rockshelter (Reduction Station)
* 111 - Rockshelter (Assay Station)
* *112 - Small Reduction Station
* 113 - Small Outcrop - Assay Quarry

Rainbow Ridge

* * 77 - Quarry Pit Complex
* 103 - Quarry Pit Complex
* 105 - Isolated Quarry Pit
* 106 - Reduction Station Complex

Bordes Ridge

* * 81 - Quarry Pit Complex
* 86 - Quarry Pit Complex

Table 10, Continued.

Upper Velvet Canyon

* 82 - Quarry Pit Complex

Northern Tosawihi Ridge

*153 - Isolated Artifact
*154 - Isolated Artifact

Butte No. 2 Group

* 78 - Quarry Pit Complex
* 79 - Quarry Pit Complex
* 87 - Quarry Pit Complex
107 - Large Open Residential
108 - Quarry Pit Complex

Figure 9. Surface debitage density in the Tosawihi Quarries Archaeological District.

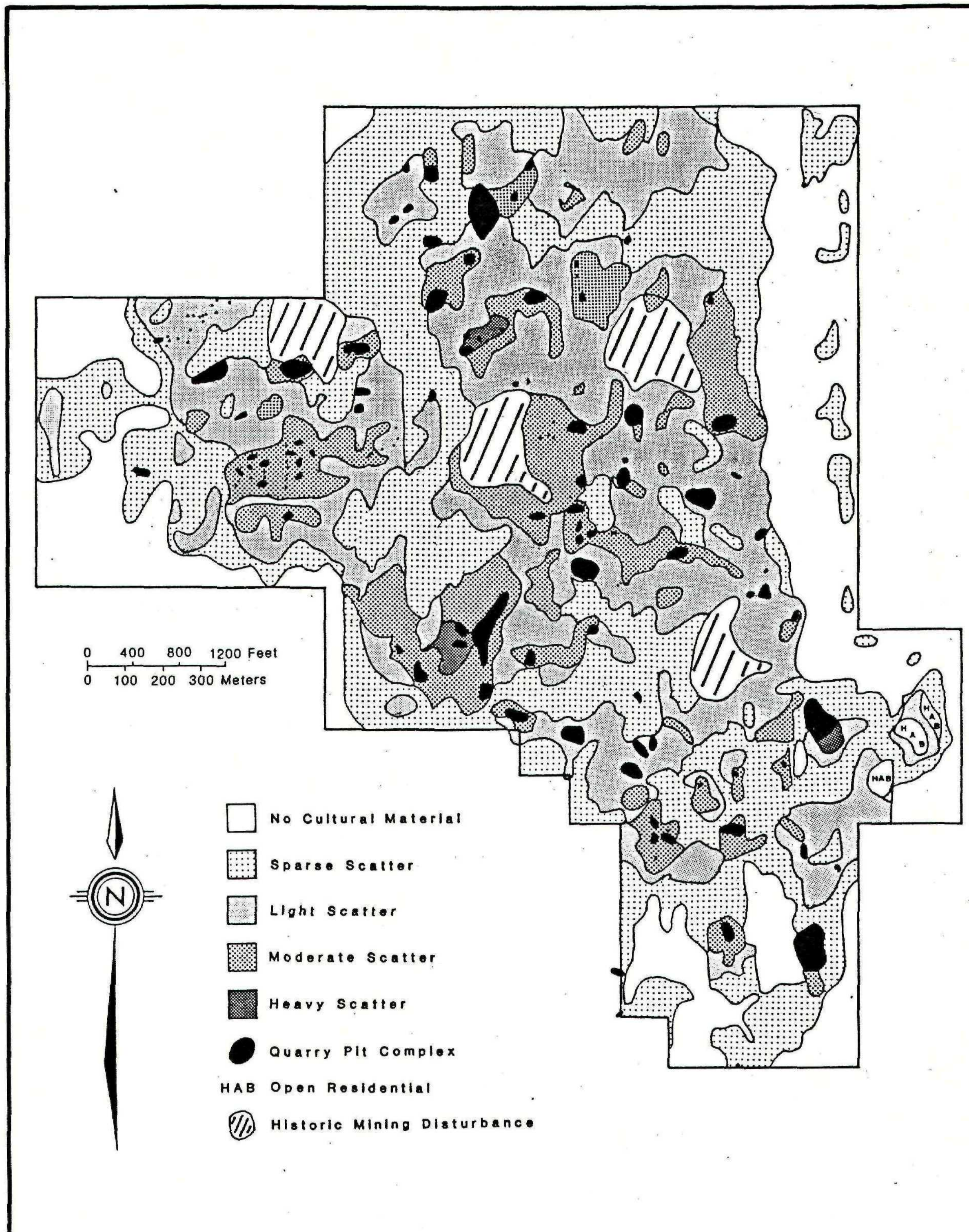
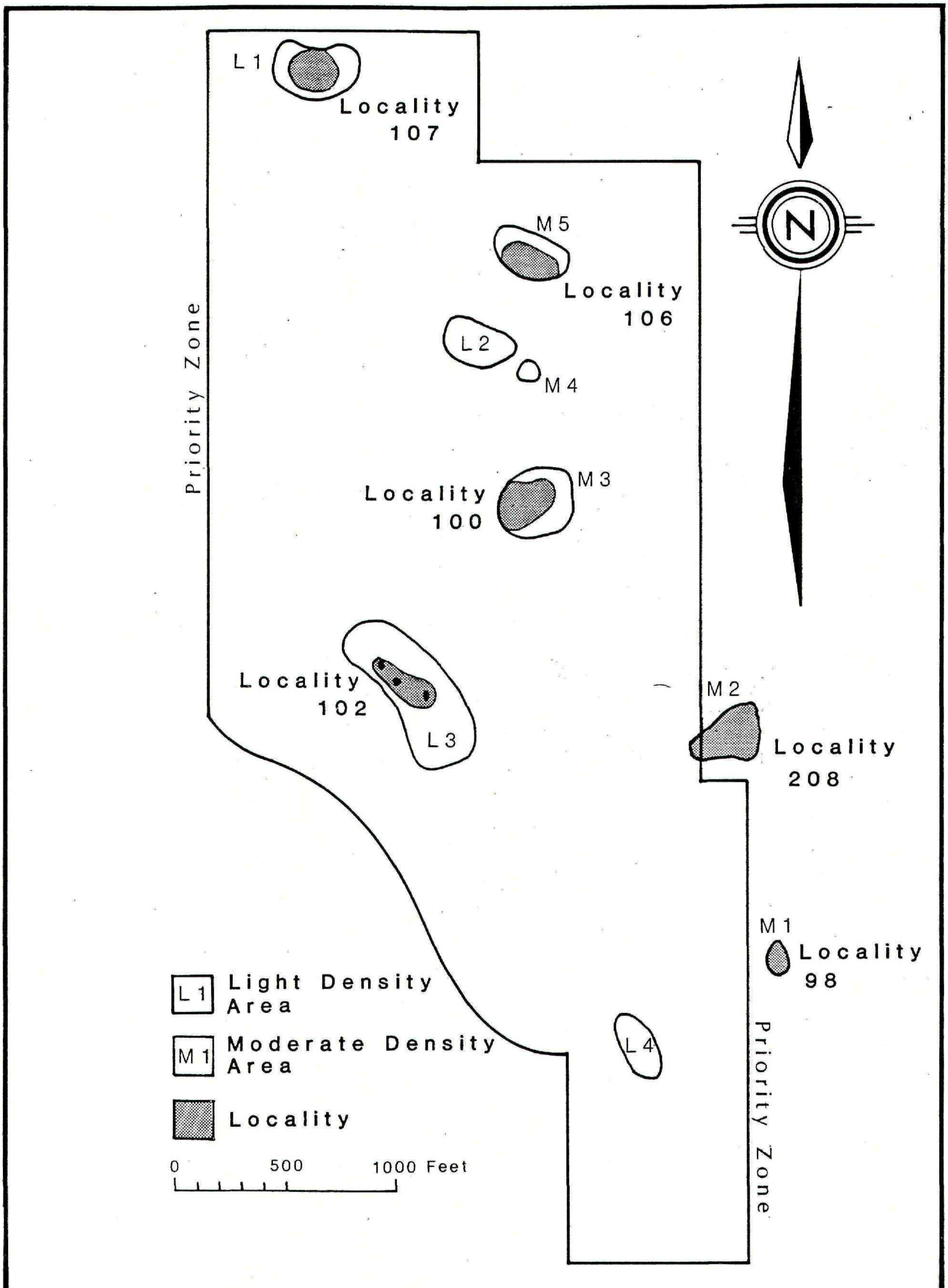

0 400 800 1200 Feet
0 100 200 300 Meters
No Cultural Material
Sparse Scatter
Light Scatter
Moderate Scatter
Heavy Scatter
Quarry Pit Complex
HAB Open Residential
Historic Mining Disturbance
N
HAB

Figure 10. Moderate and light density areas selected for investigation.



L 1
Locality 107
M 5
Locality 106
L 2
M 4
Priority Zone
Locality 100
M 3
Locality 102
L 3
M 2
Locality 208
M 1
Locality 98
L 4
Priority Zone
N
L 1 Light Density Area
M 1 Moderate Density Area
Locality
0
500
1000 Feet

In the following discussion, the distribution of archaeological locality types in the priority zone are compared to the District as a whole, and then variability among the localities selected for closer study is examined.

Distribution of Prehistoric Locality Types

Of the total 823 acres comprising the Tosawihi Quarries Archaeological District, the priority zone comprises 215 acres, or 26%. However, 35% of all prehistoric localities in the District lie inside the priority zone boundary. The density of prehistoric localities inside the priority zone is 0.36 localities per acre, as opposed to 0.23 localities per acre outside the zone.

Moreover, the proportions of locality types are different inside and outside the zone. These are compared in Table 11, where proportions for the District overall also appear. The greatest difference between the two populations is the much higher proportion of quarry pit localities in the priority zone (45%) compared to the District outside the zone (25%).

Table 11. Proportions of Prehistoric Locality Types in the Tosawihi Quarries Archaeological District

	Outside Priority Zone			Inside Priority Zone			Total District	
	Observed	%	Expected	Observed	%	Expected	N	%
Open Residential	10	7.0	(7.1)	1	1.0	(3.9)	11	5.0
Quarry Pit	35	25.0	(45.4)	35	45.0	(24.6)	70	32.0
Outcrop Quarry	14	10.0	(16.2)	11	14.0	(8.8)	25	11.0
Surface Cobble Quarry	10	7.0	(6.5)	0	-	(3.5)	10	5.0
Reduction Locality	39	27.0	(31.8)	10	13.0	(17.2)	49	22.0
Rockshelter	21	15.0	(22.7)	14	18.0	(12.3)	35	16.0
Lithic Scatter	7	5.0	(5.8)	2	3.0	(3.2)	9	4.0
Isolated Artifact	6	4.0	(6.5)	4	5.0	(3.5)	10	5.0
Total	142	65.0		77	35.0		219	

Within the priority zone, 69% of archaeological localities are quarry-related, but only 35% of localities outside the zone are quarry pits or outcrop quarries. This is due in large part to the more dissected geomorphology of the priority zone with its ridges, canyons, and ravines. More opalite bedrock outcrops are exposed in the terrain east of Tosawihi Ridge and colluvial fragments are rich in toolstone fragments.

Differences of lesser magnitude include lower proportions of open residential, surface cobble quarry, and reduction localities inside the priority zone compared to the remainder of the District; on the other hand, rockshelters are somewhat more abundant inside the priority zone. Again, these differences most likely are related to differences in geology and geomorphology. For instance, rockshelters tend to be found in bedrock outcrops of canyons and ravines typical of the priority zone, while open residential localities and surface cobble quarries are found in the flatter, alluvial areas that occur outside the priority zone.

The significance of differences between the two populations were tested statistically using the chi-square two sample test (Blalock 1979:279-292). The observed and expected frequencies given in Table 11 were used to construct a chi-square table with seven degrees of freedom. Since 25% of the cells in the table had low values (less than 5), the table was adjusted using the correction for continuity (Blalock 1979:290-291). The null hypothesis is that there is no difference between prehistoric locality populations inside and outside the priority zone. The chi-square value was 17.332, above the critical value of 14.067 for rejection of the null hypothesis at the 0.05 level. Therefore, the two populations are different.

As discussed in Chapter 6, the major types of prehistoric localities are divided further into subtypes. The proportions of these in the priority zone are given in Table 12.

Table 12. Frequency of Prehistoric Locality Subtypes in Priority Zone.

	Priority Zone (26% of Total)			
			N	%
Open Residential			1	1.0
Quarry Pit	35	45.0		
Isolated			8	10.0
Quarry Pit Complex			27	35.0
Outcrop Quarry	11	14.0		
Small Outcrop-Adit Quarry			5	6.0
Small Outcrop Quarry			2	3.0
Outcrop Quarry Complex			2	3.0
Adit			2	3.0
Surface Cobble Quarry			0	-
Reduction Locality	10	13.0		
Small Reduction Station			5	6.0
Reduction Station Complex			4	5.0
Others			1	1.0
Rockshelter	14	18.0		
Residential			3	4.0
Residential Complex			1	1.0
Reduction Station			6	8.0
Undetermined Type			3	3.0
Other			1	1.0
Undifferentiated Lithic Scatter	2	3.0		
Isolated Artifacts	4	5.0		
Total	77			

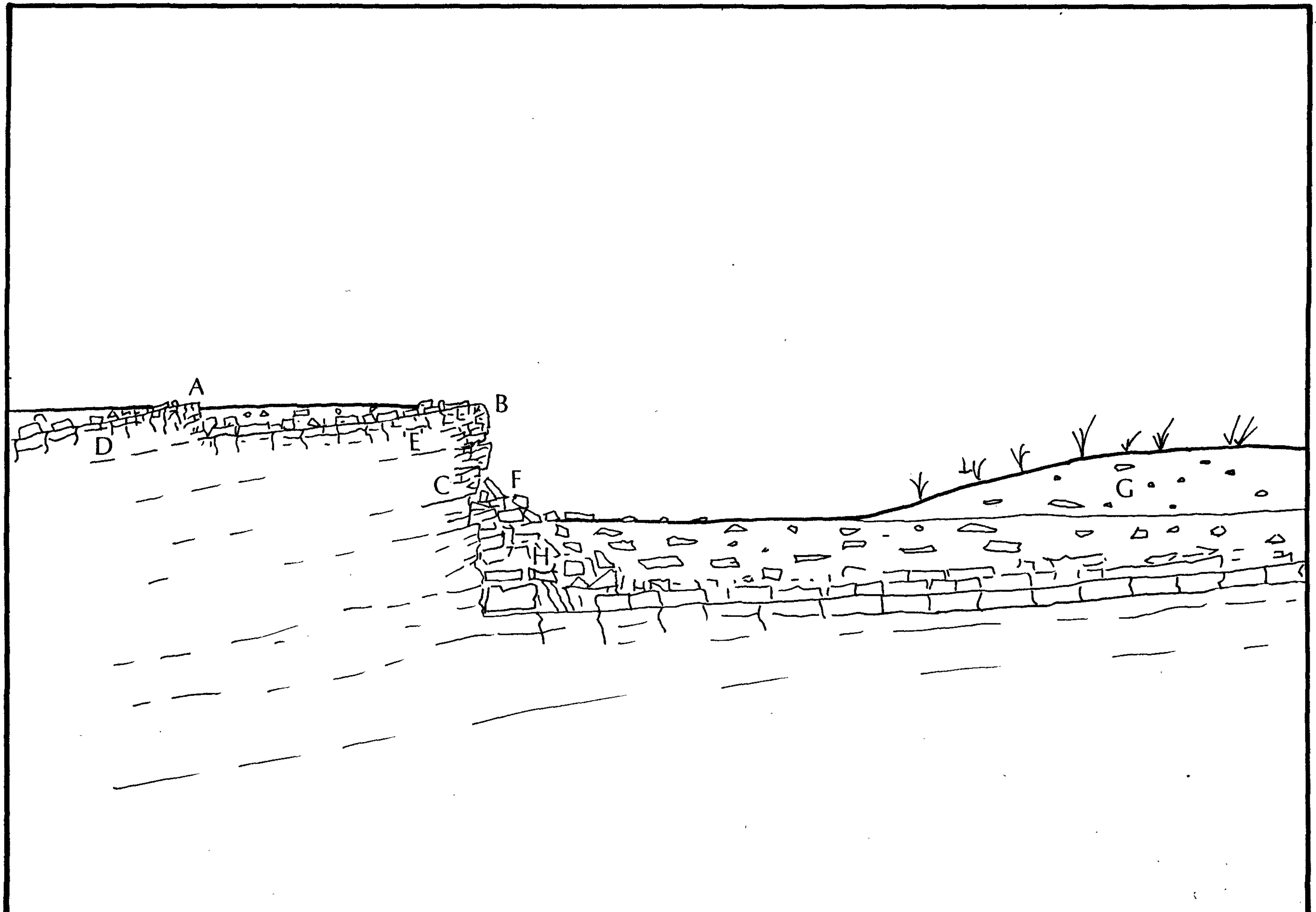
Raw Material Sources and Quarrying Strategies

It was as true in prehistoric times as it is now: the strategies used to extract and process any valuable mineral are determined by the available technology and the nature of the ore. In the quest for opalite toolstone, prehistoric technology involved simple tools such as wooden (or possibly antler) digging sticks, wedges and levers, stone hammers, basketry or hide containers powered only by human muscle. Fire was used to improve the workability of toolstone once extracted, and it may have been used to help break up rock at Tosawihi.

Ultimately, all the opalite raw material in the District is derived from bedrock. Sometimes the bedrock is exposed at the surface (Figure 11a, b), and one might suppose that the most productive sources of opalite would be surface outcrops. However, surface opalite is exposed constantly to chemical weathering, winter freeze-thaw cycles, summer heating and cooling, and wild fire so that surface material is flawed by extensive cracking and spalling, tending to break into small, irregular pieces. Thermal excursions build up mechanical stresses in these fragments, making controlled flaking difficult or impossible. Quarrying bedrock exposed at the surface requires removal of the cracked and stressed outer material to expose less weathered stone; then, some means of breaking up the tough, massive, inner rock is necessary. Thus, exploitation of surface bedrock outcrops is costly in terms of time and effort. One might expect intensive bedrock quarrying only under certain conditions which make the effort worthwhile: the quality of the toolstone must be high, and it is helpful if geologic processes work fast enough to remove the weathered rock as it is formed (running water is particularly effective), and/or the rock is somewhat protected from weathering on vertical faces or under slight overhangs (Figure 11c). Large cracks in the rock are helpful to the quarrying process; surfaces with myriad small cracks are useless.

Bedrock covered by colluvium is protected from weathering to various degrees. Generally, the rate of weathering decreases with depth, and eventually stops altogether. Colluvium is formed as bedrock weathers and breaks up into angular pieces and ultimately into sand, silt, and clay-sized particles usually thought of as soil (although much of the soil-sized material in the colluvium of the District probably has been deposited there by eolian processes). The largest fragments generally are found nearest the bedrock. Thus, the

Figure 11. Schematic cross-section showing toolstone sources.



A
B
D
E
C
F
H
G

closer bedrock is to the surface, the more abundant are cobble and boulder-sized opalite fragments suitable for manufacture of stone tools (Figure 11d, e).

In terms of prehistoric technology, extracting pieces of opalite from colluvium is much less difficult than mining massive surface outcrops; one need only dig up the already broken pieces. Some of these may be large and require further reduction, but this is a less difficult problem technically than opening adits or shafts into solid bedrock.

Talus is colluvium composed entirely of cobble-to-boulder-size particles. Talus often accumulates at the bases of cliffs (Figure 11f) and steep slopes, and in long streams or "stripes" on slopes perpendicular to contours. If the particles are relatively unweathered, talus may be a good source of easily extracted toolstone; one might even expect such talus to be the first source to be exploited in a given area.

Where bedrock is more deeply buried, and plants have trapped quantities of wind-blown sediments, opalite fragments are much less abundant and smaller in average size (Figure 11g). Unless the opalite is very good quality, it may not be worthwhile to extract it from such deposits.

The extraction of toolstone from loose, unconsolidated colluvium has its problems. Shoring apparently was not part of prehistoric quarrying technology, so pit walls were sloped to prevent slumping, resulting in conical quarry pits. When toolstone is concentrated at depth, a large amount of relatively unproductive overburden must be removed before "paydirt" is reached. At some point, a conical pit becomes uneconomical to work further and must be abandoned.

In order to minimize this problem, prehistoric miners are likely to have followed two strategies. One strategy would be to exploit colluvial deposits in a particular thickness range: not too shallow (avoiding highly weathered rock), but not too deep (avoiding removal of too much unproductive overburden). Another strategy would be to exploit colluvial deposits in which toolstone abundance varies little with depth. Such deposits often are found below vertical bedrock outcrops where the bedrock face contributes stone fragments at a constant rate (Figure 11h). Of course, none of these strategies should be thought of as mutually exclusive; as we shall see, toolstone sources and the means used to exploit them grade into one another.

Toolstone Quality

We assume that toolstone quality was an important factor in prehistoric decisions regarding whether or not to quarry a particular source of toolstone, and which extraction strategies to employ. By quality, we mean the combination of factors that contribute to the workability and durability of the material. Tool manufacture by flaking (knapping) requires non-crystalline or cryptocrystalline material that is without texture or grain, and is isotropic, or able to fracture in any direction. The presence of voids, crystals or fracture planes, or, as previously discussed, strains in the rock set up by mechanical or thermal stress, reduce control in flaking. Material with these defects usually is avoided in assay or initial reduction, but heat treatment (slowly heating and cooling the rock) often can improve the isotropic behavior of even very poor material. Toolstone should be brittle (in order for knapping to be possible), breaking with a sharp edge, and yet be durable or resistant to wear. Raw material size is a consideration; obviously, large tools cannot be made from pebbles.

It is not often that a particular lithic raw material meets all these criteria, but Tosawihi opalite comes close. Large pieces of it can be obtained, much of it perfectly free of voids and fracture planes. Some opalite contains embedded quartz grains ranging from less than 0.25 mm to 2.0 mm in diameter. These grains do not appear to affect the flaking qualities of the material at the level of quarrying and initial processing that employs hard hammer percussion, and they are likely to enhance durability of edges. The quartz grains might influence reduction at later stages employing soft hammer or pressure techniques. In any case, quartz grains give some Tosawihi opalite (perhaps 25%) a characteristic "glittery" surface.

Tosawihi opalite is not brittle, but tough and resistant to breakage. Consequently, great force must be used to detach flakes from opalite cores; one must use a massive hammerstone and swing it hard. The platform of virtually every primary or secondary reduction flake examined by the present study exhibits multiple ring cracks, indicating the knapper struck the platform several times before getting a flake to come off. This suggests that quarrying and initial reduction of Tosawihi opalite was laborious and possibly difficult to control.

Fortunately, heat treatment not only enhances isotropism, but greatly reduces the amount of force required for flaking. Heat treated Tosawihi opalite has excellent knapping properties. However, we have observed very little evidence that heat treatment was practiced at the quarry per se. The usual pattern seems to have been to take reduced pieces (flake blanks and bifaces) to open residential sites and residential rockshelters where they were heat treated and further reduced or "finished".

Most Tosawihi opalite in the priority zone is opaque white or cream in color. Some "white" material actually has a faint grayish yellow or grayish green hue. Most of this material does not appear to change color on exposure to light and air, but some turns a light to medium gray. On the other hand, the cream colored material often weathers to a pale orange or tan. It is most abundant on Upper Holmes Ridge, particularly at localities 47 and 44, but is also present on Lower Holmes Ridge at localities 25 and 35.

A salmon pink opalite occurs throughout the priority zone, always interbanded with white or cream colored opalite. Localities in which the pink material is present occur in a northwest-southeast trending band beginning at locality 87 in the Butte No. 2 Group at 5900 feet asl, including localities 86 and 81 on Bordes Ridge, through locality 78 in the Butte No. 2 Group and locality 77 on Rainbow Ridge, localities 65 and 67 on Crabtree Ridge, locality 60 in Lower Velvet Canyon, locality 91 on Upper Holmes Ridge, the entire Pink Pits area, and finally, locality 35 on Lower Holmes Knoll at 5750 feet asl. With the exception of the Pink Pits area where it predominates, the pink material is less abundant than the white or cream colored opalite.

Material ranging from yellow through orange, red, and brown occurs at locality 77 on Rainbow Ridge. Brown and purple opalite is found at locality 81 on Bordes Ridge, and purple and white opalite was quarried at locality 31 on Lower Holmes Ridge. Opalite cobbles in many colors were obtained from colluvial or alluvial deposits at locality 31 and locality 10 at Station R.

There presently is no evidence that colored opalite was valued less or more than white material. Certainly, no greater effort was made to obtain colored opalite.

Given the time and energy required to secure a quantity of toolstone at the Tosawihi Quarries, quality probably was the major factor in deciding where to expend effort. In fact, assaying for quality probably is responsible for a sizable fraction of the debitage littering the surface of the ground in the District.

Several anthropologists have reported assaying behavior at Australian Aborigine quarries (Tindale 1965; Hayden 1979; Binford and O'Connell 1984). Binford and O'Connell (1984:410) observed that the first thing people did on arriving at the quarry area was to walk around, pick up chunks of rock and remove one or two flakes. Most of these assayed surface rocks were discarded because they were used merely to judge where good, unweathered buried material was likely. When the place was located, a large boulder was dug up, cracked open using a large hammerstone and fire, and chunks used as cores to produce blades and flakes. The description of Aborigine quarry features is reminiscent of Tosawihi:

> Between each rock exposure and clump of trees was a dense scatter of flaked and modified stone... Undulating depressions encircled by high densities of flake debris alternated with clusters of large blocks from which only a few flakes had been struck. Away from these clusters of 'big stuff' ... were small half-moon scatters of large flakes and a few chunks and blocks (Binford and O'Connell 1984:409).

Lithic Scatters

Undifferentiated lithic scatters are represented by a veneer of sparse-to-heavy density debitage overlying land surfaces throughout the District. Generally, moderate-to-heavy debitage scatters are associated directly with places where lithic raw materials were assayed, extracted, and initially processed, such as quarry pits, outcrop quarries, and surface cobble quarries. In the project area, geologic (sheet wash, frost heaving) and biotic (animal burrowing) processes move colluvium rapidly downhill on slopes greater than about 5%, so that these processes contribute to the widespread distribution of cultural materials across the landscape.

These relationships are perhaps clearest with regard to outcrop quarries and quarry pits. Typically, debitage density is highest along the foot of the outcrop or on the quarry pit berm, and perhaps the immediately surrounding area, but falls off with distance from source. Along outcrops and in complexes of closely adjacent quarry pits, debitage density may decrease significantly only outside the entire complex. Since material tends to move down hill, slope often has a strong influence on the shape and size of the debitage scatter surrounding pits and pit complexes. In this regard, consider the lobate (downslope) distribution of debitage at several localities shown in Figure 9.

An elongate, moderate density scatter associated with locality 47 (Upper Holmes Ridge) is also oriented downslope, but the processes just discussed are not primarily responsible. Instead, the moderate density scatter occurs among surface opalite boulders and cobbles in colluvium thinly covering a strip of bedrock. Here, much of the moderate density scatter has been generated by surface material assay.

The density plots from transect survey showed several small, isolated patches of moderate density scatter surrounded by areas of sparse-to-light density scatter, four of which were selected for intensive survey at 10 m intervals or less (see Figure 10).

Area M1 lies just outside the east boundary of the priority zone in Middle Little Antelope Canyon. Intensive survey showed that area M1 is actually a small outcrop-assay quarry on a narrow bench on the steep slope along the canyon. It was designated locality 98. Area M3 on Sagehen Ridge and area M5 on Rainbow Ridge were found to contain isolated quarry pit features, designated localities 100 and 105, respectively. Area M4 was found to be part of the moderate density scatter surrounding the quarry pit complexes on Crabtree Ridge.

Five areas in relatively flat terrain where density is sparse-to-light were examined (see Figure 10). Area L1 is a saddle in the Butte No. 2 Group above South Tosawihi Spring, containing an undifferentiated light-to-moderate density flake scatter representing many kinds and colors of opalite. Bifaces are abundant; they and the debitage reflect all stages of reduction, and by these features alone, the area, designated locality 107, resembles the large open residential sites around Tosawihi Springs to the north. Locality 107 also contained a feature comprised of seven biface fragments and an Elko Series projectile point.

Area L2, on a broad, open north slope of Crabtree Ridge, was found to contain no discrete archaeological features. However, an area just north on the crest of Rainbow Ridge, not purposely selected for study, was found to contain several discrete flaking stations. The group of features was designated locality 106.

Area L3 is a broad saddle on Upper Holmes Ridge. It was found to contain at least three discrete flaking stations, all associated with stands of big sage. Several obsidian flakes were noted in this area.

Area L4 is a small saddle north of Station R. It appears to have contained a discrete lithic scatter at one time, but this mostly was destroyed by historic mining.

These additional studies demonstrate a significant point: the transect survey density plots were made with data obtained at a resolution of 100 feet. While this level of observation serves to reveal large scale prehistoric patterns, there is more complexity than is indicated by the density map. Numerous areas plotted as moderate density contain "holes" of light or sparse density, while other areas plotted as sparse or light density may contain small artifact concentrations or quarry features.

Outcrop Quarries

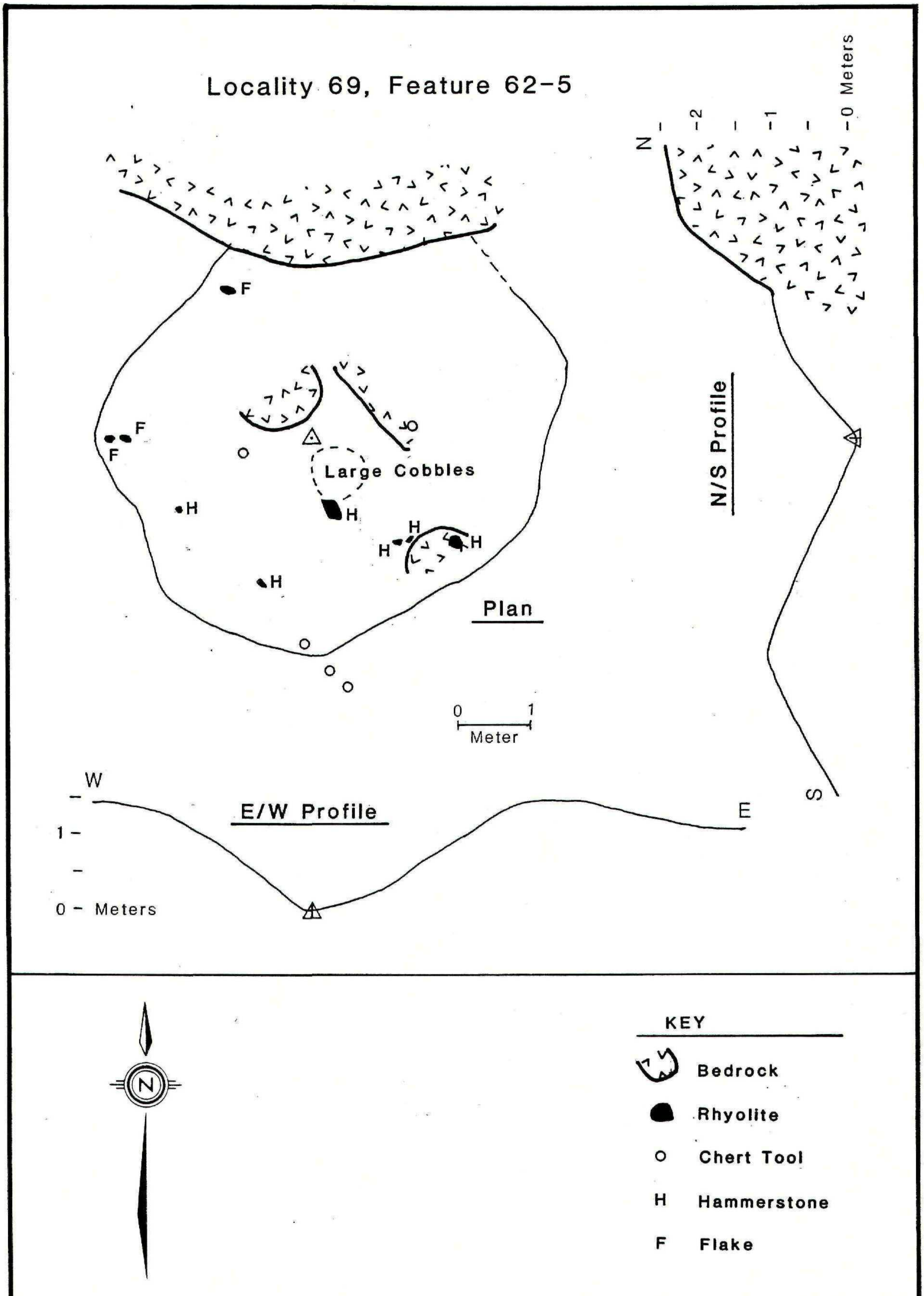
Outcrop quarries, places where the surface outcrop of toolstone was the major focus of prehistoric attention, account for only 11% of prehistoric localities in the District overall, and for 14% of prehistoric localities in the priority zone (see tables 11, 12). Five of the latter are small outcrop quarry/assay locations (localities 12, 50, 71, 98, and 113) and two each are small outcrop quarries (localities 13 and 59), outcrop quarry complexes (localities 68 and 69), and adits (localities 58 and 61).

Of all these, locality 69 was transit-mapped and feature 62-5 recorded in detail (Figure 12). Locality 69 is a component of a very large complex of outcrop quarries and quarry pits arrayed along the north side of Ledge Ravine and the south side of Crabtree Ridge, and feature 62-5 is a good example of blended extraction strategies. A talus of cultural and non-cultural lithic debris has accumulated at the base of a bedrock ledge, now about 1.3 m high. Much of this material appears to be debris from quarrying on the outcrop itself.

Feature 62-5 is a circular quarry pit 5.6 m in diameter and 1.5 m deep excavated into the colluvium at the base of the outcrop; a sizable berm of debitage and waste material has formed on the outside or down-slope side of the pit. The interior of the pit and the berm are littered with rhyolite hammerstones and hammerstone spalls.

The bottom of the pit contains an accumulation of what we termed "cobbles" as we were working in the field. However, while these are cobble-sized (between 8 and 15 cm) objects, most are artifacts: assayed cobbles, cores, flakes, biface fragments, and bifaces. "Cobble accumulations" occur in pits; "cobble patches" are found outside pits, usually at the base

Figure 12. Plan view and profiles, locality 69, feature 62-5.


Locality 69, Feature 62-5
F
F
F
Large Cobbles
H
H
H
H
H
H
Plan
0
1
Meter
N
2
1
0 Meters
N/S Profile
S
W
1
0 Meters
E/W Profile
E
KEY
Bedrock
Rhyolite
Chert Tool
H Hammerstone
F Flake

of berm slopes. Cobble patches and accumulations thus seem to be discarded material extracted and processed from an adjacent pit or outcrop. Sometimes cobble accumulations nearly fill pits.

A cobble accumulation in the bottom of feature 62-5 partially obscures the bedrock contact exposed there, but it appears possible that the bottom of the pit actually penetrated the bedrock, perhaps along a large crack. We have no clues as to how the bedrock was broken up or how deep the pit might actually be.

Quarry Pits

Quarry pits are places where toolstone in colluvium was the major focus of attention. Quarry pits are sometimes isolated features, but more often occur in complexes of 2 to more than 50. Two different kinds of place form the extremes of quarry pit location: in colluvium below bedrock outcrops (much like feature 62-5 in locality 69 described above), and in colluvium on open slopes. In the discussion below, quarry pits below bedrock outcrops are given more attention because they contain more structural complexity.

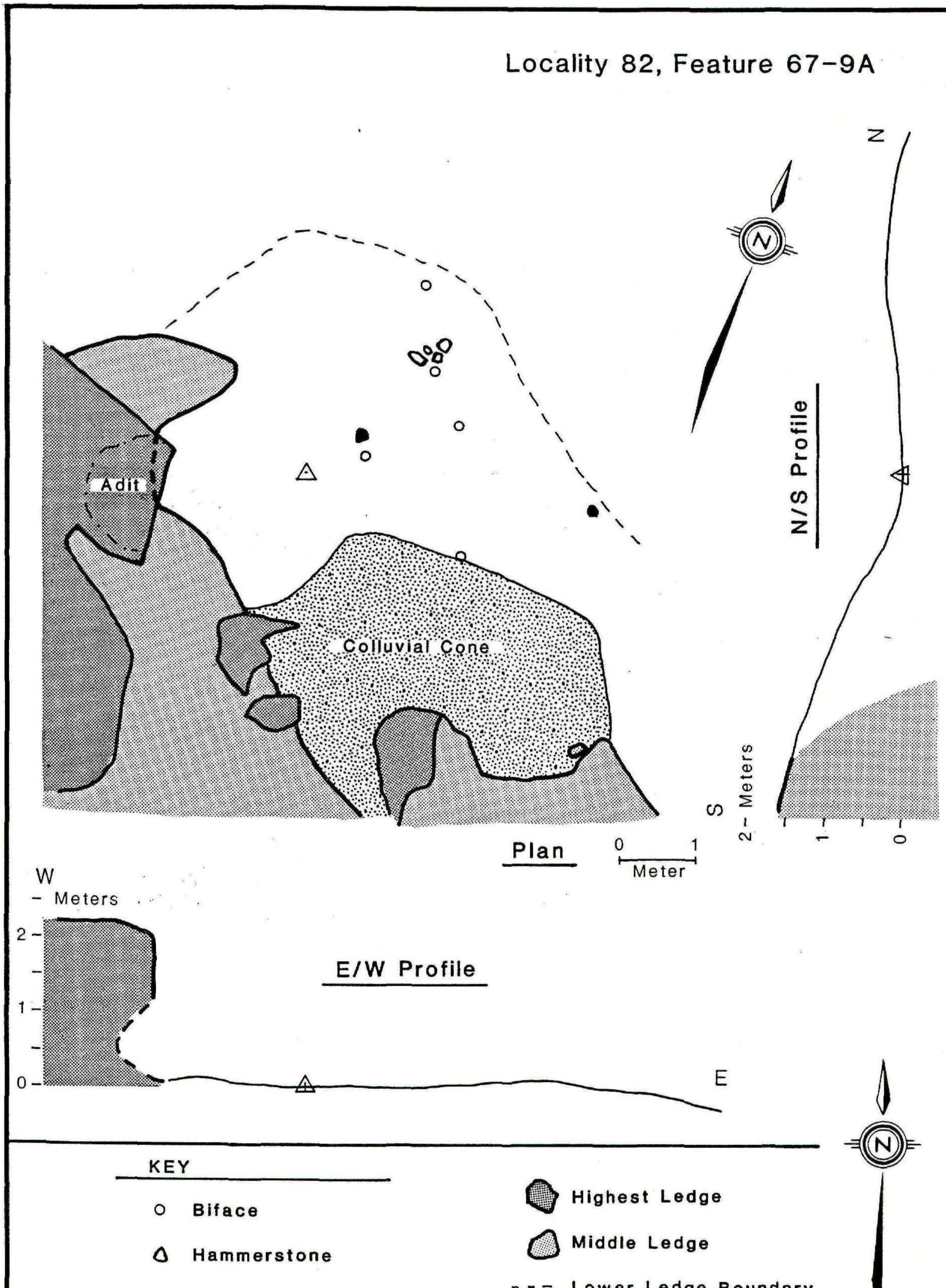
Quarry Pits Below Bedrock Outcrops

Of the localities with quarry pit features studied in the priority zone, only locality 69 seems to have been the focus of exploitation of the bedrock outcrop. However, several other localities have quarry pits in geomorphically similar situations at the base of bedrock outcrops.

Locality 82 is a complex of quarry pits in patches of colluvium in a bedrock outcrop about 20 meters above Velvet Creek in Upper Velvet Canyon. In most places, the bedrock is poor quality material that was not quarried; thus, the locality was classified as a quarry pit complex. However, one pit (feature 67-9a) has been excavated 85 cm into colluvium at the foot of a 2 m bedrock outcrop where toolstone quality was good (Figure 13). The pit, 6.5 m in diameter, is surrounded by a berm of debitage and waste rock and partially filled with colluvium washing down from above the outcrop. Opalite bifaces, along with rhyolite and tuff sandstone hammerstones were observed inside the pit.

In addition, a small adit, about 1 m wide and 1.5 m deep, has been excavated into the base of the bedrock. Flake scars are present on the opalite of the adit walls, so we assume

Figure 13. Plan view and profiles, locality 82, feature 67-9a.



Locality 82, Feature 67-9A
Adit
Colluvial Cone
N
S
N/S Profile
2 - Meters
1
0
Plan
0
1
Meter
W
- Meters
2
1
0
E/W Profile
E
KEY
Biface
Hammerstone
Rhyolite Hammerstone
Highest Ledge
Middle Ledge
Lower Ledge Boundary

that hammerstones were used in its excavation. Evidence of other extraction techniques, such as fire, is not apparent.

Locality 42 is a complex of four pits excavated into colluvium below a bedrock outcrop of partially silicified tuff, a very poor toolstone material. One of the four pits, feature 54-14, is 7.8 m in diameter and 60 cm deep (Figure 14) with a ledge of poor quality bedrock exposed in the bottom of the pit. A berm of debitage and waste rock rings the pit on the downslope side; concentrations of debitage were found on the crest of the berm in two places. Rhyolite and basalt hammerstones and hammerstone spalls lie on the outside slope of the berm.

In locality 65, feature 51-6 is one of five quarry pits excavated along a bedrock ledge. The feature is 6 m in diameter and 50 cm deep, but it (along with the other four pits in the group) is filled partially with an accumulation of cobbles (Figure 15). Cobble patches are found in the intervening spaces between pits. Basalt and rhyolite hammerstones and spalls are on the berm surrounding the pit; a rhyolite hammerstone spall rests on a boulder of the bedrock outcrop.

Other similar features are the isolated pit (no feature number assigned) in locality 41, feature 58-6 in locality 68, and feature 67-1 in locality 85.

Quarry Pits on Colluvial Slopes

Quarry pits on colluvial slopes are circular to oval in outline and basin-shaped to conical in profile. Isolated pits and pit complexes frequently are surrounded entirely by berms of soil, waste rock, and debitage. When pits are on slopes, the berms usually are higher on the downslope side.

Two isolated quarry pits were mapped in detail. Feature 63-5 in locality 38 is a shallow, basin-shaped depression 4.6 m in diameter and 25 cm deep, surrounded by a low berm (Figure 16). It was excavated in thin colluvium over bedrock, where good quality pink and cream-colored opalite was obtained. The pink flakes and waste rock in the pit, on the berm and surrounding area provide a striking contrast to the tan soil of the quarry area. Aside from the pink toolstone, this locality is interesting by the presence of two bifaces and a concentration of debitage made of material exotic to the material obtained from the pit. In addition, a possible rhyolite groundstone fragment is present just outside the

Figure 14. Plan view and profiles, locality 42, feature 54-14.

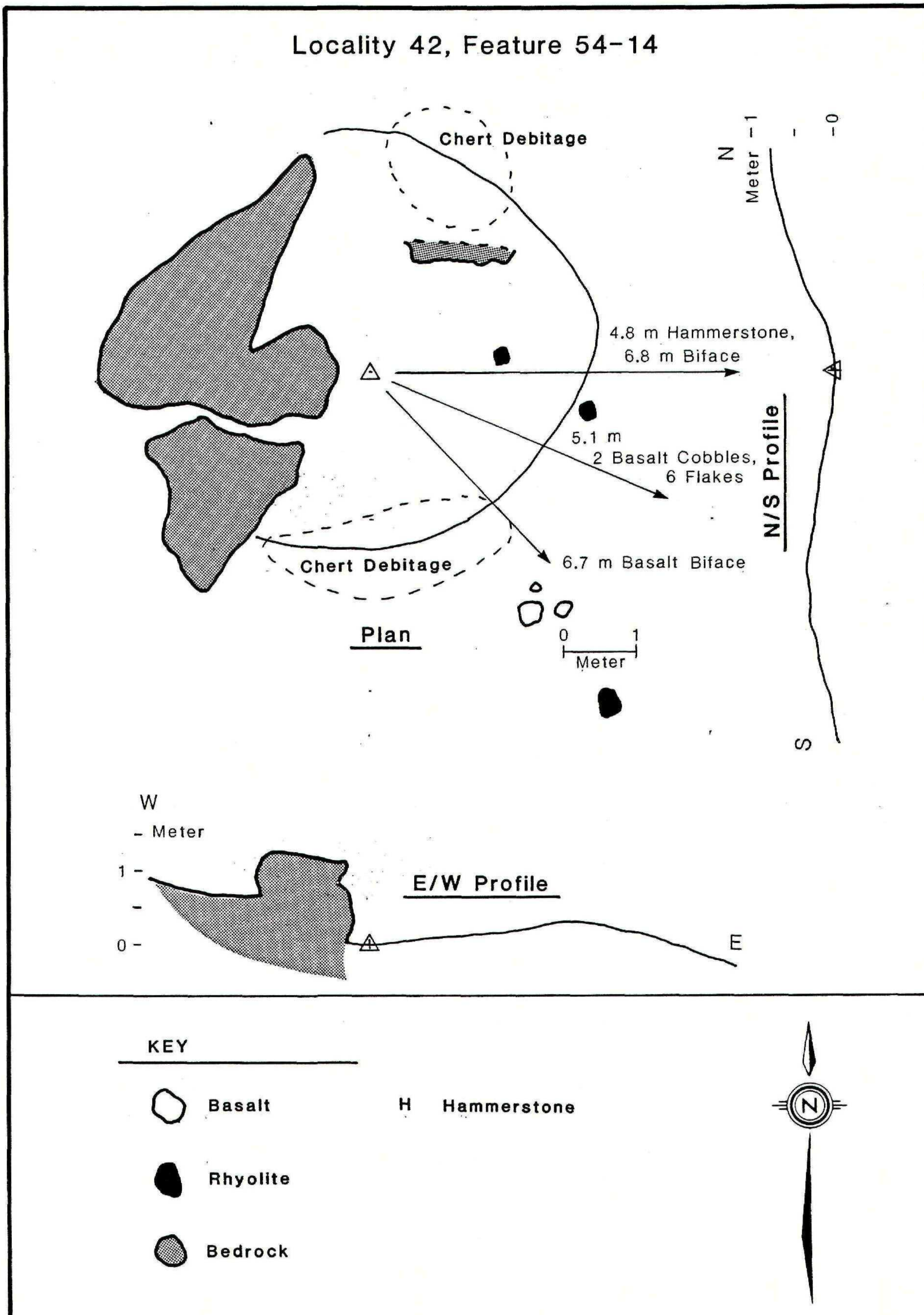

Locality 42, Feature 54-14
Chert Debitage
4.8 m Hammerstone,
6.8 m Biface
5.1 m
2 Basalt Cobbles,
6 Flakes
6.7 m Basalt Biface
Chert Debitage
Plan
0 1
Meter
N
Meter
1
0
N/S Profile
S
W
Meter
1
0
E/W Profile
E
KEY
Basalt
Rhyolite
Bedrock
H Hammerstone
N

Figure 15. Plan view and profiles, locality 65, feature 51-6.

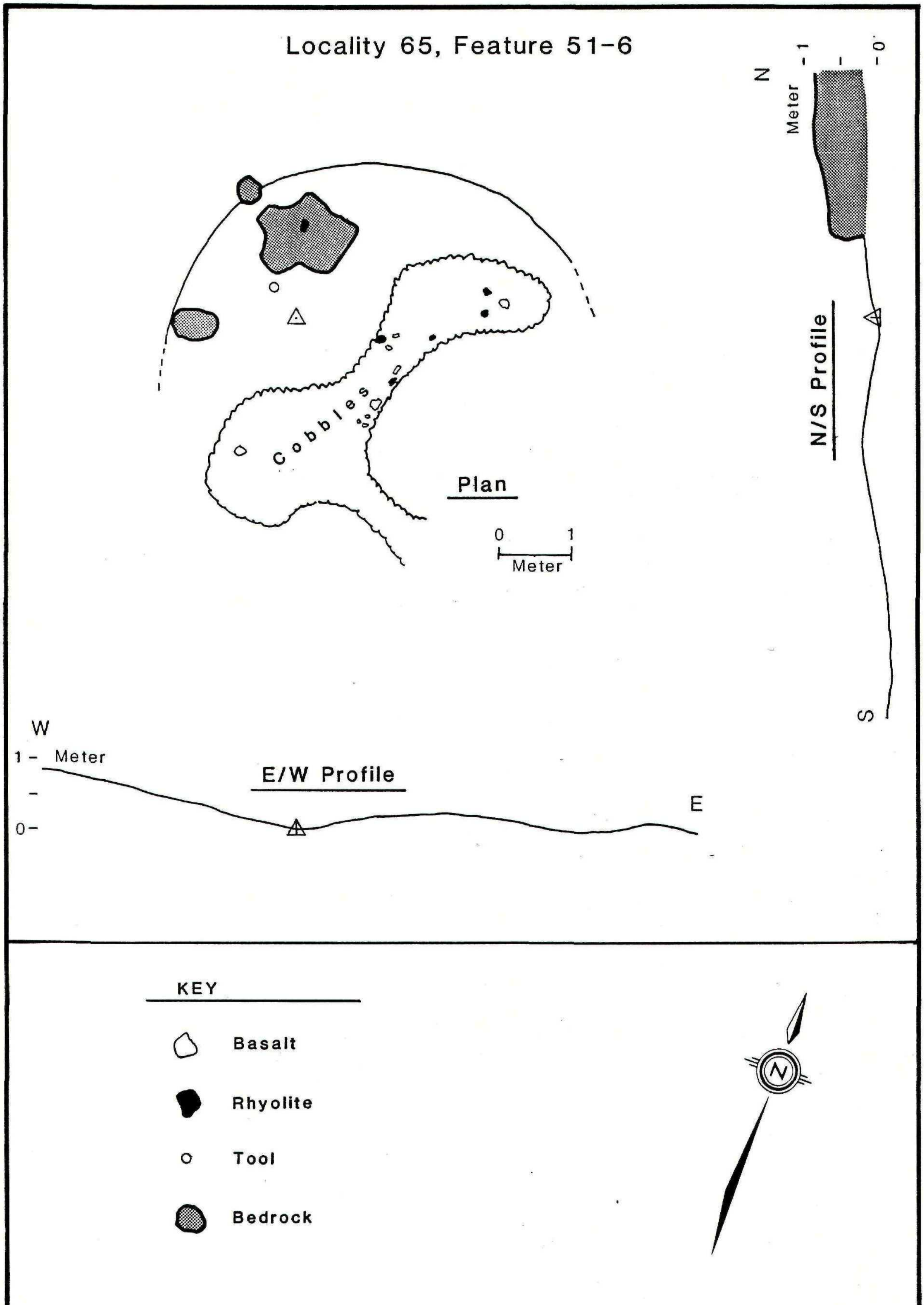
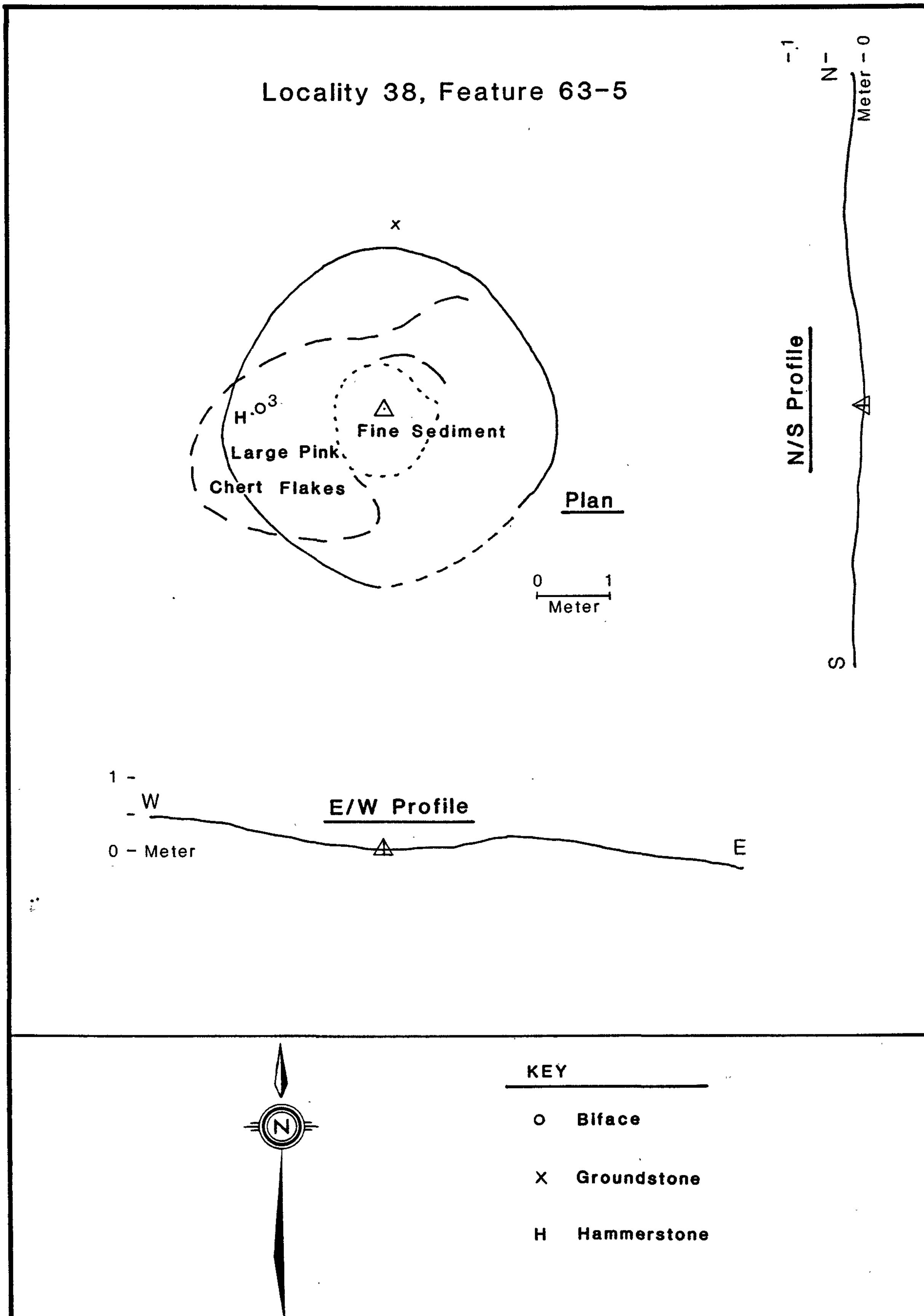

Locality 65, Feature 51-6
Cobbles
Plan
0 1
Meter
N
Meter
1
0
N/S Profile
S
W
1 - Meter
0 -
E/W Profile
E
KEY
Basalt
Rhyolite
Tool
Bedrock
N

Figure 16. Plan view and profiles, location 38, feature 63-5.



Locality 38, Feature 63-5
x
H
3
Large Pink
Chert Flakes
Fine Sediment
Plan
0
1
Meter
N/S Profile
N
S
1
0
Meter
E/W Profile
W
E
1
0 - Meter
KEY
o Biface
X Groundstone
H Hammerstone
N

berm, making locality 38 one of the few quarry features in the District where a non-quarry related tool was found.

Feature 51-4 at locality 64 is an elongated pit 5.5 x 4.0 m, and 55 cm deep, with a low berm on the downslope side only. It was excavated into shallow colluvium upslope from a bedrock outcrop in order to obtain moderate-to-poor quality white and gray variegated opalite. The pit is filled partially by two cobble accumulations; two bifaces and a rhyolite hammerstone were observed inside the pit.

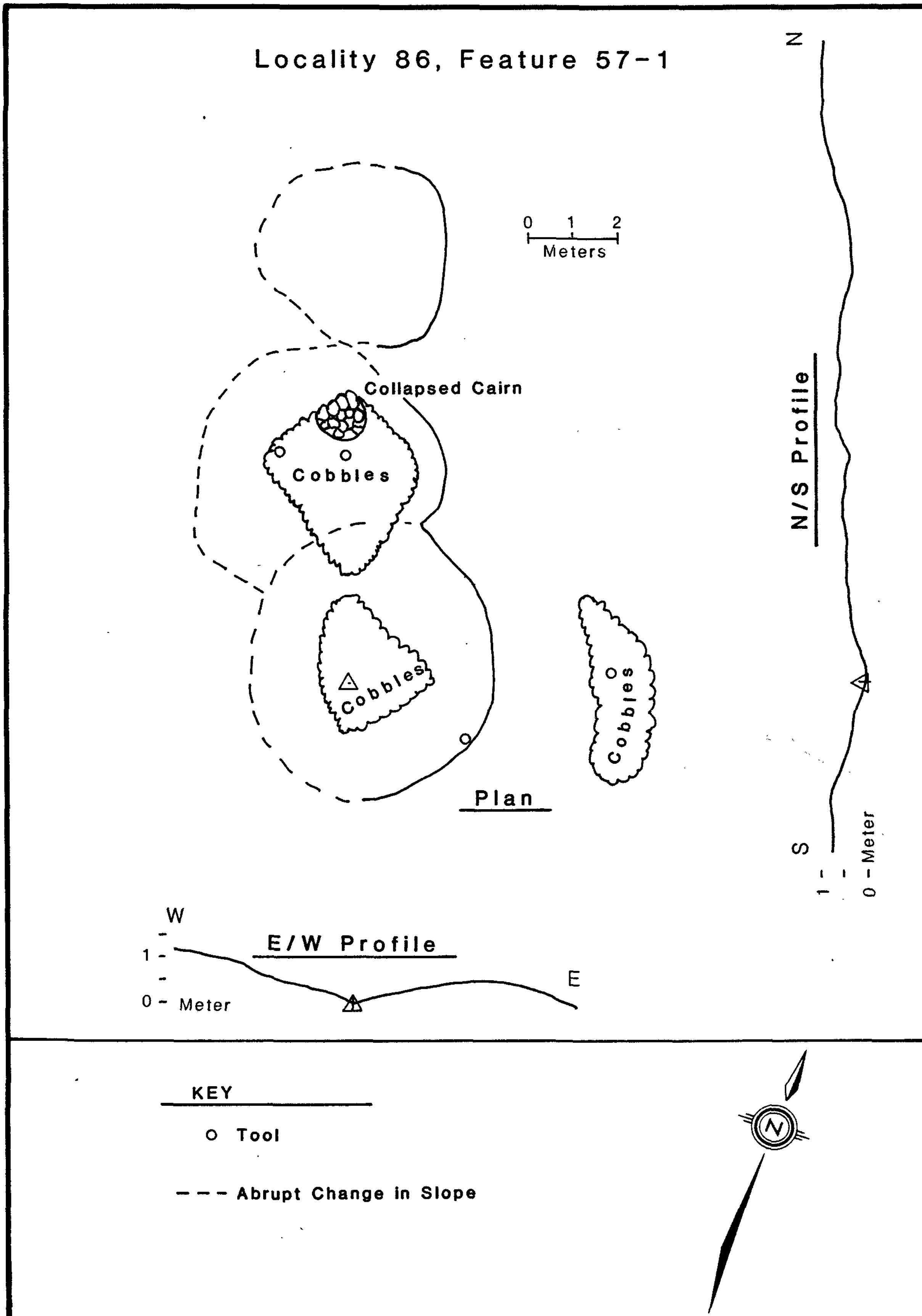
Other isolated quarry pits within the priority zone are feature 70-6 in locality 11 (where a distinctive blood-red toolstone was obtained), pit 1 in locality 206, the unnamed pit in locality 41 mentioned above, feature 57-5 in locality 101, feature 51-5 in locality 64, pit M3 in locality 100, feature 59-7 in locality 104, and feature 62-4A in locality 105.

There are few differences between isolated quarry pits and individual pits in quarry pit complexes. The closer pits are to each other, the more difficult it is to distinguish individual pit boundaries. This is due to the tendency for older pits to be filled with cobble accumulations and slope wash, and because of subsequent pit excavation in berms and pit floors. In places such as locality 36, with its complex of over 50 shallow pits in a relatively small area, the impression is of "lumpy" rather than "pitted" terrain.

In several instances, closely adjacent pits are arranged in a line, creating an elongated pit with low "compartments" formed by internal berms. These features suggest that toolstone was being obtained along a linear subsurface outcrop. They also suggest that at some point it became easier to excavate a new pit than to enlarge an old one. As with feature 57-1 in locality 86 (Figure 17), one sometimes can work out the order in which such pits were excavated by the ways berms overlap, and by the presence or absence of cobble accumulations in pit bottoms. Elongated pits and linear clusters of pits are present at localities 10, 36, 43, 47, 77, and 65.

Feature 66-23 in locality 10 is worth special mention. This is a very large (16 x 12 meters), shallow (50 cm) pit, excavated into sediments near the top of Station R hill on Holmes Ridge. The sediment is colluvium as we have defined it, but remarkable for the wide range of colors in the cobbles of opalite it contains. Relatively large amounts of tuff waste rock are present, and we suspect the underlying bedrock may be a tuff-opalite breccia.

Figure 17. Plan view and profiles, locality 86, feature 57-1.


Locality 86, Feature 57-1
0 1 2
Meters
Collapsed Cairn
Cobbles
Cobbles
Cobbles
Plan
N
N/S Profile
S
1 -
0 - Meter
W
1 -
0 - Meter
E/W Profile
E
KEY
o Tool
- - - Abrupt Change in Slope

Feature 66-23 is the largest pit recorded, but it probably is comprised of several closely adjacent pits without intervening berms. The low berm around the outside of the feature is composed mostly of tuff waste rock with opalite debitage. We assume that raw material size was small and concentrated in the upper half meter of colluvium. The feature lacks cobble patches or accumulations, hammerstones, bifaces, or obvious cores.

Variability in Quarry Pit Size and Depth

The length, width, and overall depth of mapped quarry pits in the priority zone is given in Table 13, and frequency distributions are shown in Figure 18. It occurred to us there might be some relationship between quarry pit size and depth, reflecting the optimum effort for the maximum return of toolstone. In order to test this hypothesis, the values for maximum pit dimension and depth in centimeters were log transformed and plotted (Figure 19). The plots are scattered and the correlation coefficient (using Pearson's r) is 0.09, about as uncorrelated as it is possible to get.

One alternative is that the relationship between pit size and depth is completely random. Another alternative is that the relationship is not simple; other factors (perhaps usable toolstone per unit volume of colluvium) are important, but we do not know what they are.

Variability in Basalt Hammerstone Distribution

Heavy, dense hammerstones were required to quarry and process the tough Tosawihi opalite. Quartzite and rhyolite are available throughout the District, both as colluvial cobbles and in the beds of Velvet Canyon, Little Antelope Canyon and other stream courses, and tuff sandstone is present in smaller quantities. None of these rocks is particularly hard compared to opalite, although the hardness of rhyolite and sandstone sometimes is enhanced by partial silicification. Opalite is both hard and dense, but striking opalite against opalite is dangerous since one or both stones may shatter into shrapnel-like fragments. Basalt is hard, dense, and less shatter-prone than opalite, and seems to have been the hammerstone of choice.

Table 13. Dimensions of Quarry Pit Features

Locality No.	Feature No.	Max. Length (m)	Max. Width (m)	Max. Depth (cm)		Locality Type
10	66-23	16.0	12.0	50		Quarry Pit Complex
24	67-16	4.5	5.1	25		Quarry Pit Complex
31	71-9	4.9	4.4	40		Quarry Pit Complex
35	64-9	8.4	7.5	30		Quarry Pit Complex
36a	60-4	18.0	9.5	60		Quarry Pit Complex
36b	60-5	5.1	4.1	40		Quarry Pit Complex
36c	61-4	5.0	4.0	30		Quarry Pit Complex
38	63-5	4.6	4.5	25		Isolated Quarry Pit
39	59-11	7.5	5.5	25		Quarry Pit Complex
42a	54-14	7.8	4.6	60		Quarry Pit Complex
42b	54-15	8.1	8.0	50		Quarry Pit Complex
43a	48-5	8.3	5.4	70		Quarry Pit Complex
43b	49-5	11.6	5.6	40		Quarry Pit Complex
44a	44-3	5.6	4.0	100		Quarry Pit Complex
44b	46-6A	6.2	5.4	50		Quarry Pit Complex
47	50-7	11.5	3.6	30		Quarry Pit Complex
48	59-4	8.7	6.9	50		Quarry Pit Complex
60	69-7	5.2	4.8	90		Quarry Pit Complex
62	66-17	5.7	4.9	30		Quarry Pit Complex
63	56-2	6.2	3.9	40		Quarry Pit Complex
64	51-5	5.5	4.0	55		Isolated Quarry Pit
65a	51-6	6.0	3.0	50		Quarry Pit Complex
65b	54-11	12.0	10.0	65	3 pits	Quarry Pit Complex
67	57-7	6.7	5.0	50	4 pits	Quarry Pit Complex
69	62-5	6.4	5.4	150		Outcrop Quarry Complex
75	64-5	5.6	5.6	50		Quarry Pit Complex
77	58-7	10.9	6.8	40		Quarry Pit Complex
78	53-4	8.5	4.6	25		Quarry Pit Complex
79	54-7	8.6	6.8	95		Quarry Pit Complex
81	59-8	6.7	5.2	60		Quarry Pit Complex
82	67-9a	6.5	6.0	85		Quarry Pit Complex
86	57-1	14.2	6.0	80	3 pits	Quarry Pit Complex
87	51-2	8.0	7.0	115		Quarry Pit Complex
91	55-3	6.0	4.7	60		Quarry Pit Complex
N=34		$\bar{x} = 8.0$	$\bar{x} = 5.7$	$\bar{x} = 56$		
		s = 3.3	s = 1.9	s = 28		

Figure 18. Frequency distributions of quarry pit dimensions.

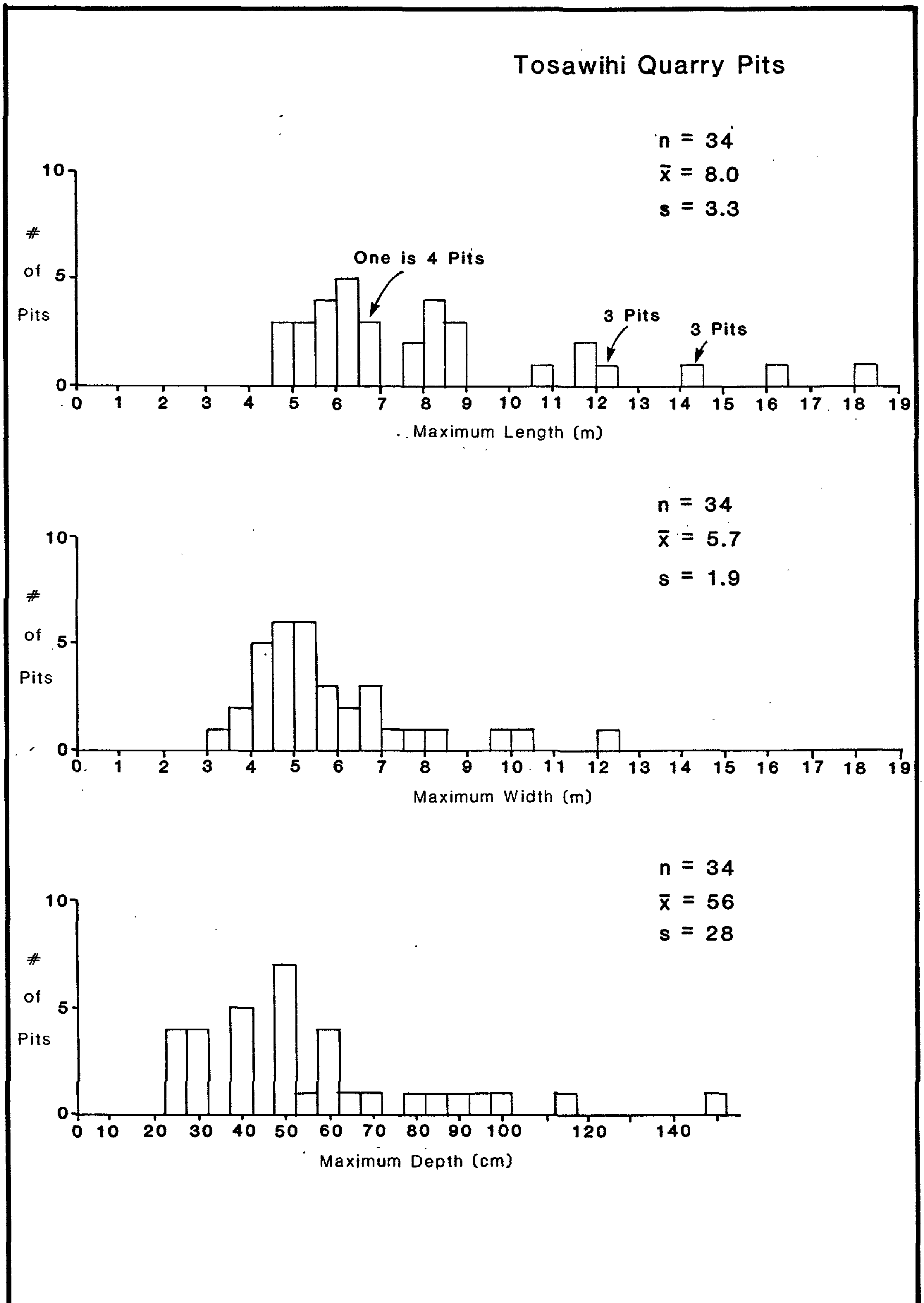
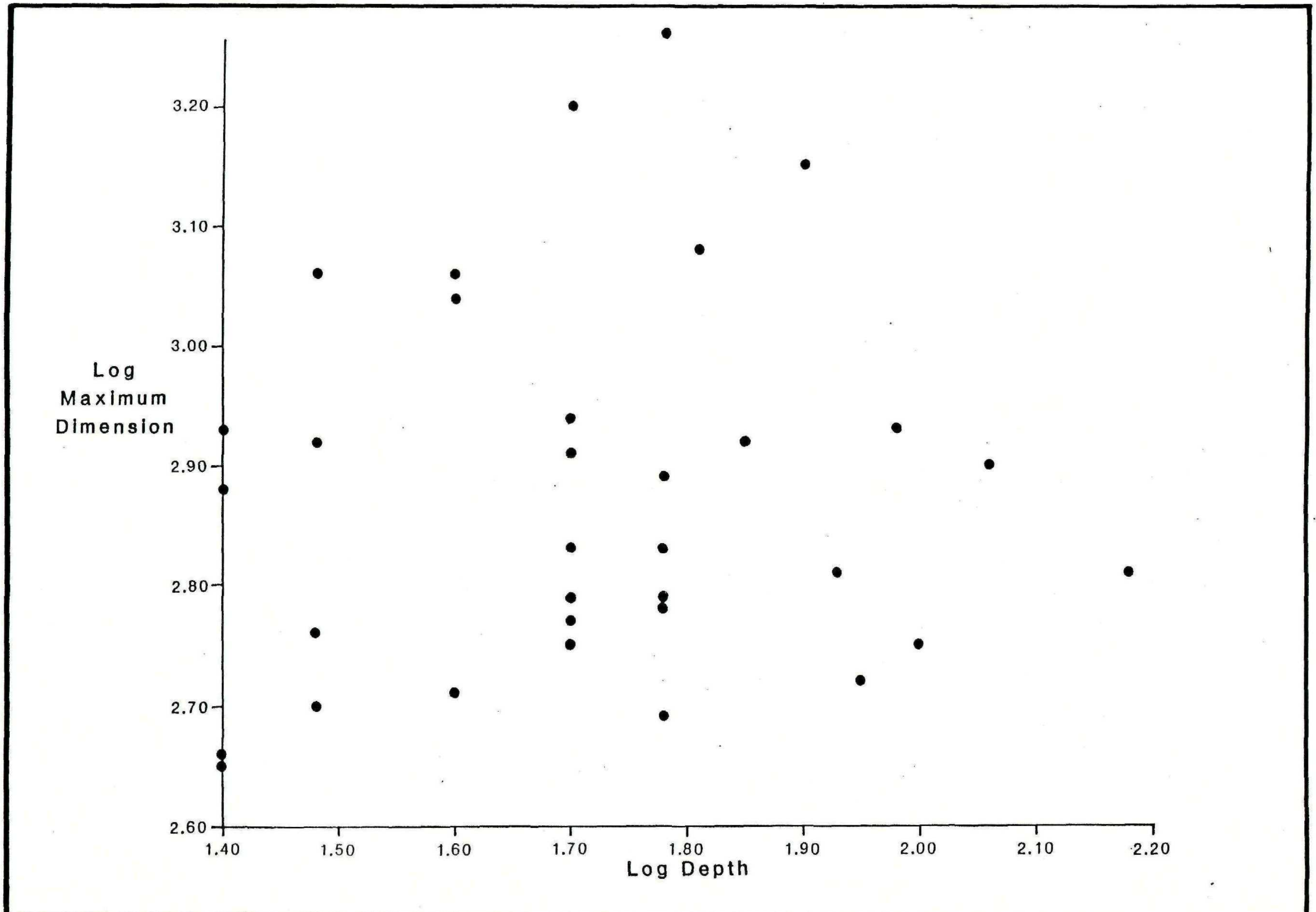

Tosawihi Quarry Pits
n = 34
x̄ = 8.0
s = 3.3
# of Pits
One is 4 Pits
3 Pits
3 Pits
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Maximum Length (m)
n = 34
x̄ = 5.7
s = 1.9
# of Pits
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Maximum Width (m)
n = 34
x̄ = 56
s = 28
# of Pits
0 10 20 30 40 50 60 70 80 90 100 120 140
Maximum Depth (cm)

Figure 19. Plots of log transformed Quarry Pit depth and maximum dimensions.


Log
Maximum
Dimension
3.20
3.10
3.00
2.90
2.80
2.70
2.60
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
2.20
Log Depth

Basalt, however, is available only from talus and stream deposits in Basalt Canyon on the western margin of the Tosawihi District. Prehistoric people seem to have been willing to transport the material over rather long distances, since basalt hammerstones are found in quarry localities adjacent to Velvet Canyon, close to ample supplies of rhyolite and quartzite rock. Even so, there seemed to be an inverse relationship between the amounts and sizes of basalt hammers at quarry localities and the distance to the nearest source in Basalt Canyon. That is, basalt hammerstones become fewer and smaller the farther from Basalt Canyon they occur.

We measured the dimensions in centimeters of all basalt hammerstones observed during locality mapping in the priority zone. The frequency distributions of these data are graphed in Figure 20. A crude estimate of each hammerstone volume was obtained by multiplying length, times width, times thickness. The mean hammerstone volume for each locality then was calculated. The distance from Basalt Canyon to each locality was measured on the 1:6000 map in feet. The values for both mean volume and distance were log transformed.

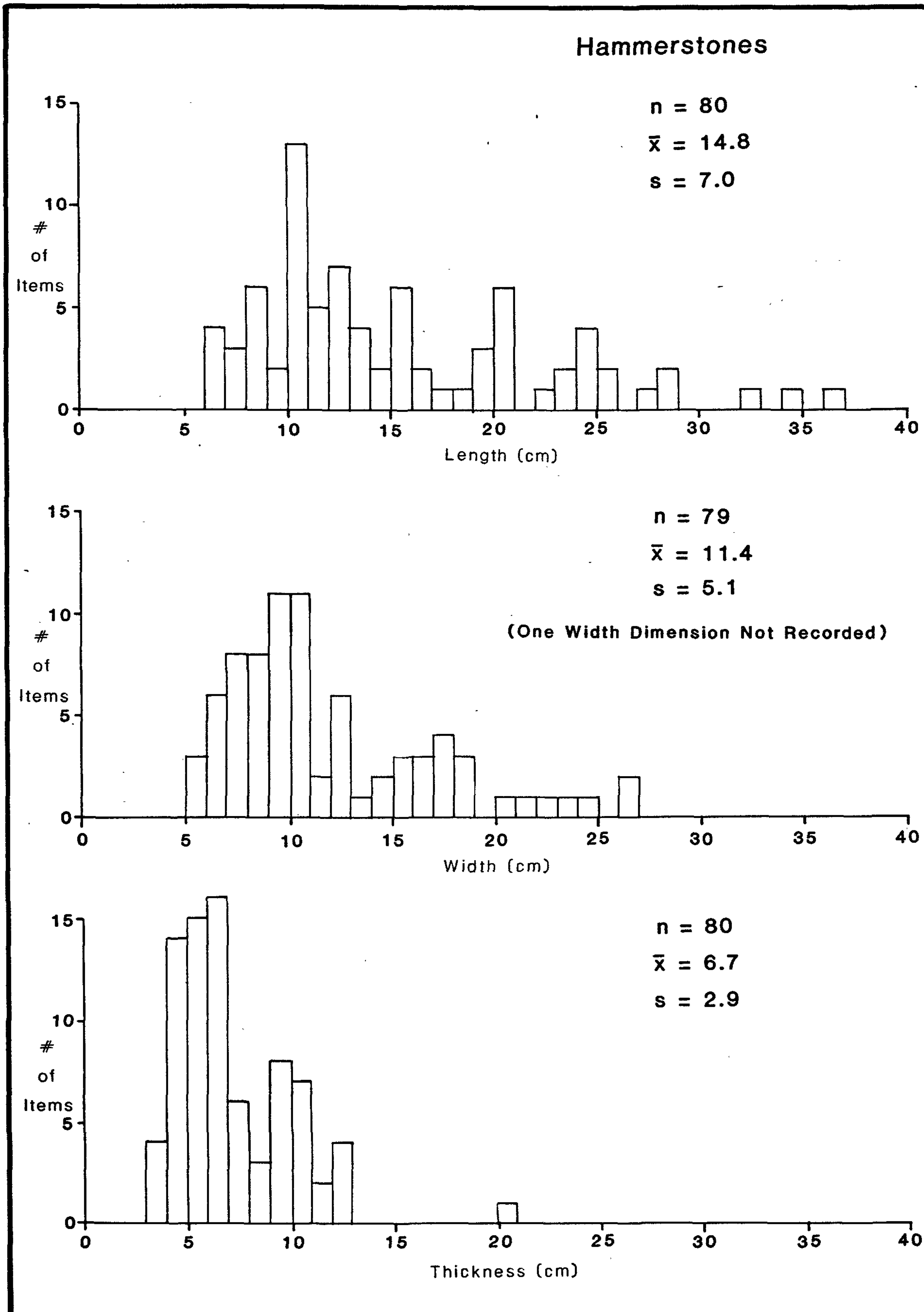
The plot of these values shown in Figure 21 demonstrates the expected inverse relationship: mean basalt volume decreases with distance from source. However, the correlation coefficient calculated with these data is only 0.56, due in part to the vertical spread of the paired values. Notice that none of the 15 values lies on the regression line; 8 are well above it and 7 are below.

Field judgements of toolstone quality accompany the plot for each locality. Notice also that most plots above the line are localities at which toolstone is "good" or better, while most plots below the line are localities at which toolstone quality is less than "good", suggesting the possibility that people were willing to transport larger chunks of basalt to localities where toolstone quality made the effort worthwhile. Alternatively, this distribution may mean that extraction and processing of poorer quality opalite was harder on hammerstones, causing them to break into smaller pieces.

Biface Size

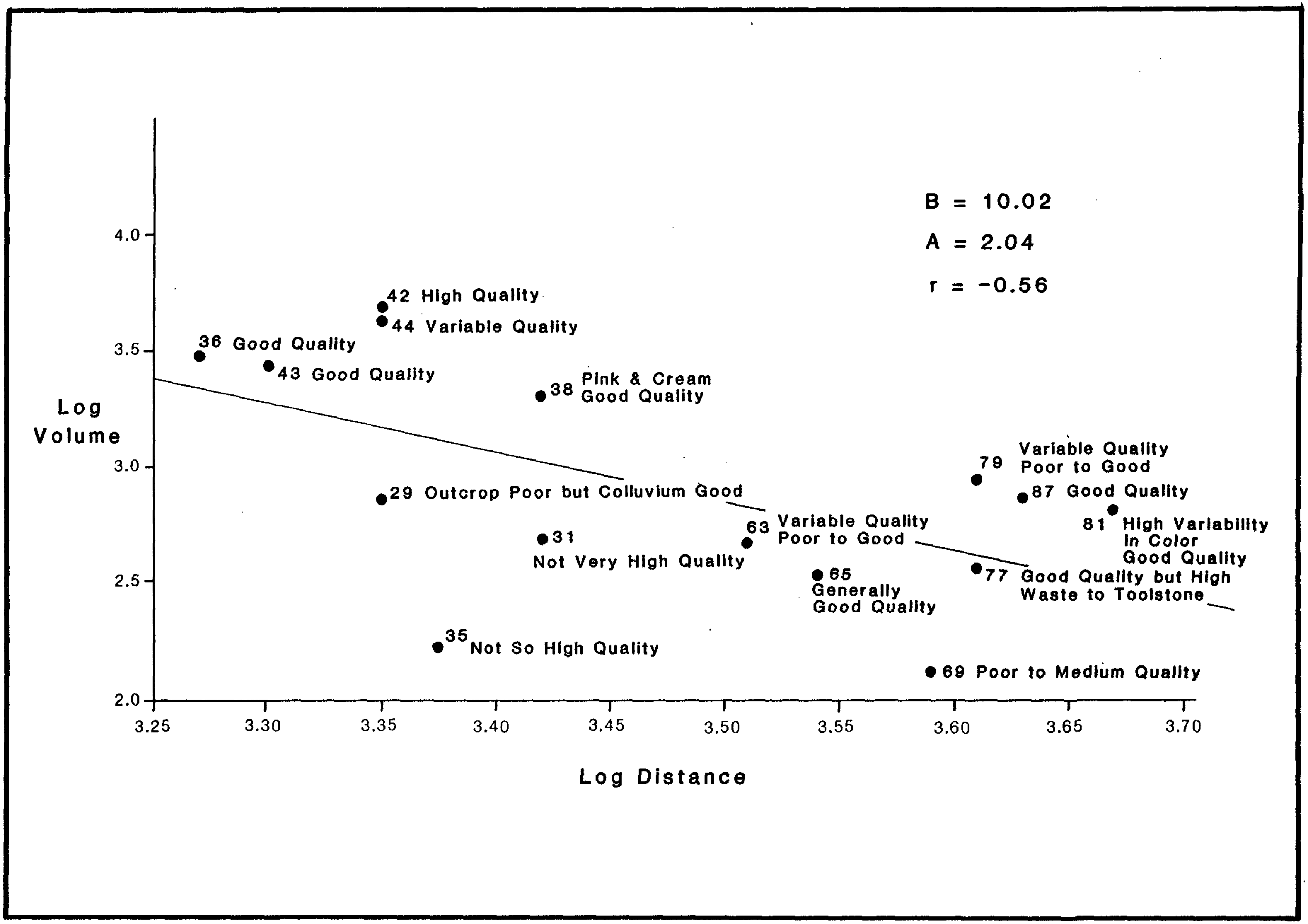
Bifaces were collected only when they seemed to represent reduction stages or processes outside the usual range for quarry areas. Dimensions and observations concerning collected bifaces are presented in Appendix B. Otherwise, bifaces observed during mapping of quarry features were

Figure 20. Frequency distributions of basalt hammerstone dimensions (in cm).



Hammerstones
n = 80
x̄ = 14.8
s = 7.0
# of Items
Length (cm)
n = 79
x̄ = 11.4
s = 5.1
(One Width Dimension Not Recorded)
# of Items
Width (cm)
n = 80
x̄ = 6.7
s = 2.9
# of Items
Thickness (cm)

Figure 21. Basalt hammerstones: plots of log transformed mean volume (in cubic cm) by log transformed distance to source in feet. Comments are field observations of toolstone quality.



B = 10.02
A = 2.04
r = -0.56
Log Volume
Log Distance
4.0
3.5
3.0
2.5
2.0
3.25
3.30
3.35
3.40
3.45
3.50
3.55
3.60
3.65
3.70
42 High Quality
44 Variable Quality
36 Good Quality
43 Good Quality
38 Pink & Cream Good Quality
79 Variable Quality Poor to Good
87 Good Quality
81 High Variability In Color Good Quality
29 Outcrop Poor but Colluvium Good
63 Variable Quality Poor to Good
31 Not Very High Quality
65 Generally Good Quality
77 Good Quality but High Waste to Toolstone
35 Not So High Quality
69 Poor to Medium Quality

measured in the field and recorded. The frequency distributions of these measurements (in centimeters) are given in figures 22 and 23 (which also give mean and standard deviations).

Before continuing with the analysis of these data, let us consider the manufacture and maintenance of bifaces. First, the production of a flake blank and its bifacial reduction thoroughly tests the raw material and reduces unnecessary weight for transport away from the quarry. It also produces a symmetrical implement with sharp but relatively strong edges that can be used as is for a variety of cutting and scraping tasks. This symmetry also facilitates maintenance (resharpening) and further reduction of the tool. Indeed, the thin, sharp flakes typically produced from such maintenance ("biface thinning") are themselves useful as general purpose tools.

The optimizing strategy for biface thinning is to detach very thin, expanding flakes that cross the midline of the piece from narrow platforms. This results in least decrease in biface width while recreating a sharp edge and making the tool thinner.

While thinning can occur in any stage of manufacture, it is emphasized in Stage II and later stages of reduction. However, successful (optimal) thinning in later stages requires that the proper core geometry be achieved in the earliest stage; particularly important is the thickness to width ratio. If this is too high, the curvature of one or both faces may be too great for flakes to cross the midline. In this case, each flake removal decreases the width of the piece but not its thickness, exacerbating the problem. Thus, early stage bifaces with high thickness to width ratios tend to be discarded.

Returning now to measurements of bifaces observed at quarry features, the mean complete biface is 11.5 cm long, 7.1 cm wide, and 2.9 cm thick; the largest complete biface was 15.5 cm long. The mean width to thickness ratio of complete bifaces is .41. It is obvious that virtually all these artifacts were discarded because this value was too high and they could not be thinned any further.

The mean biface fragment was 9.9 cm long, 7.6 cm wide, and 2.8 cm thick. The mean width to thickness ratio for biface fragments is .37, and the largest biface fragment was 16.5 cm long. These artifacts broke while they were are being thinned, and thinning was progressing successfully until the break. This suggests that biface fragments were discarded

Figure 22. Frequency distributions of complete biface dimensions.

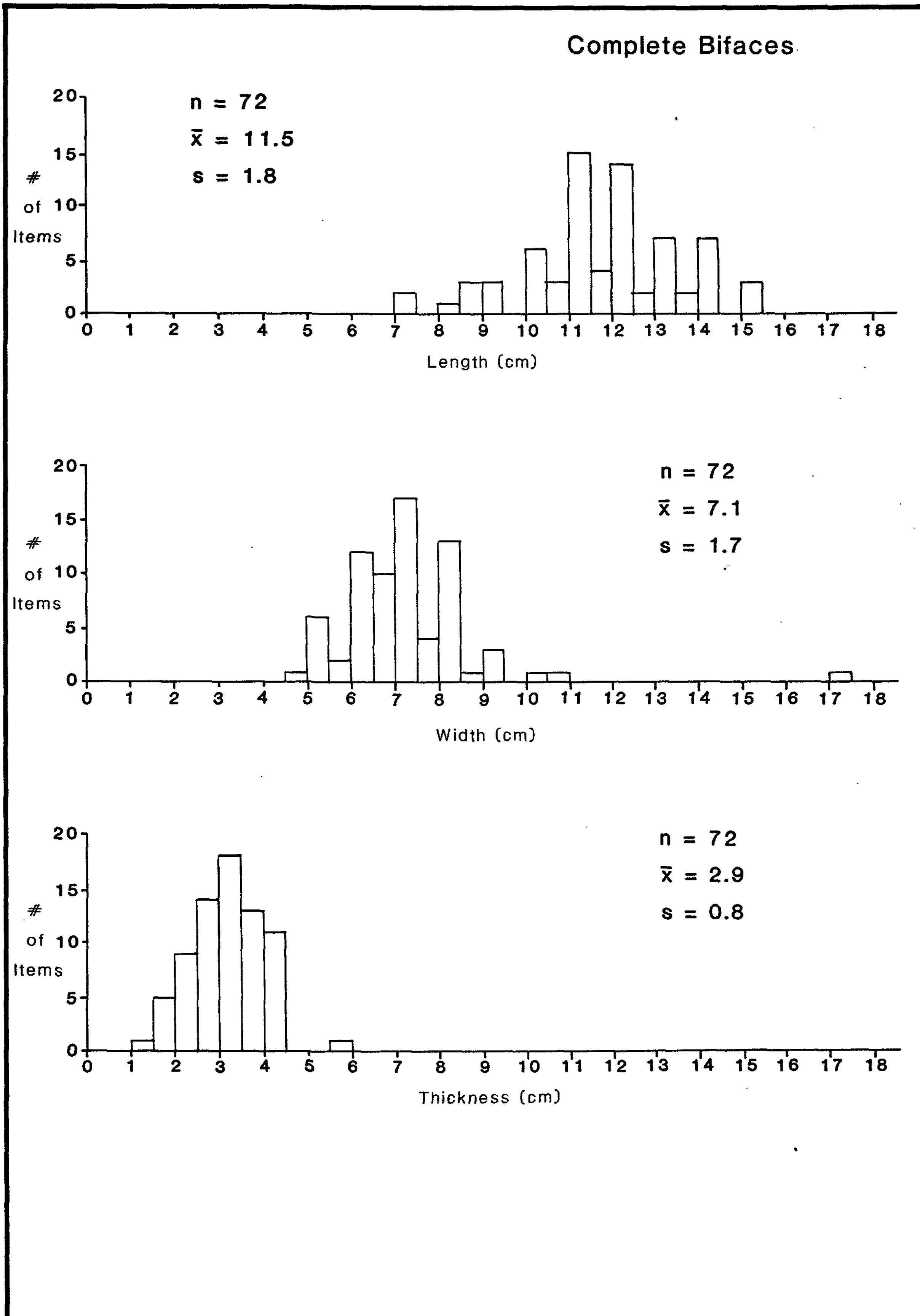
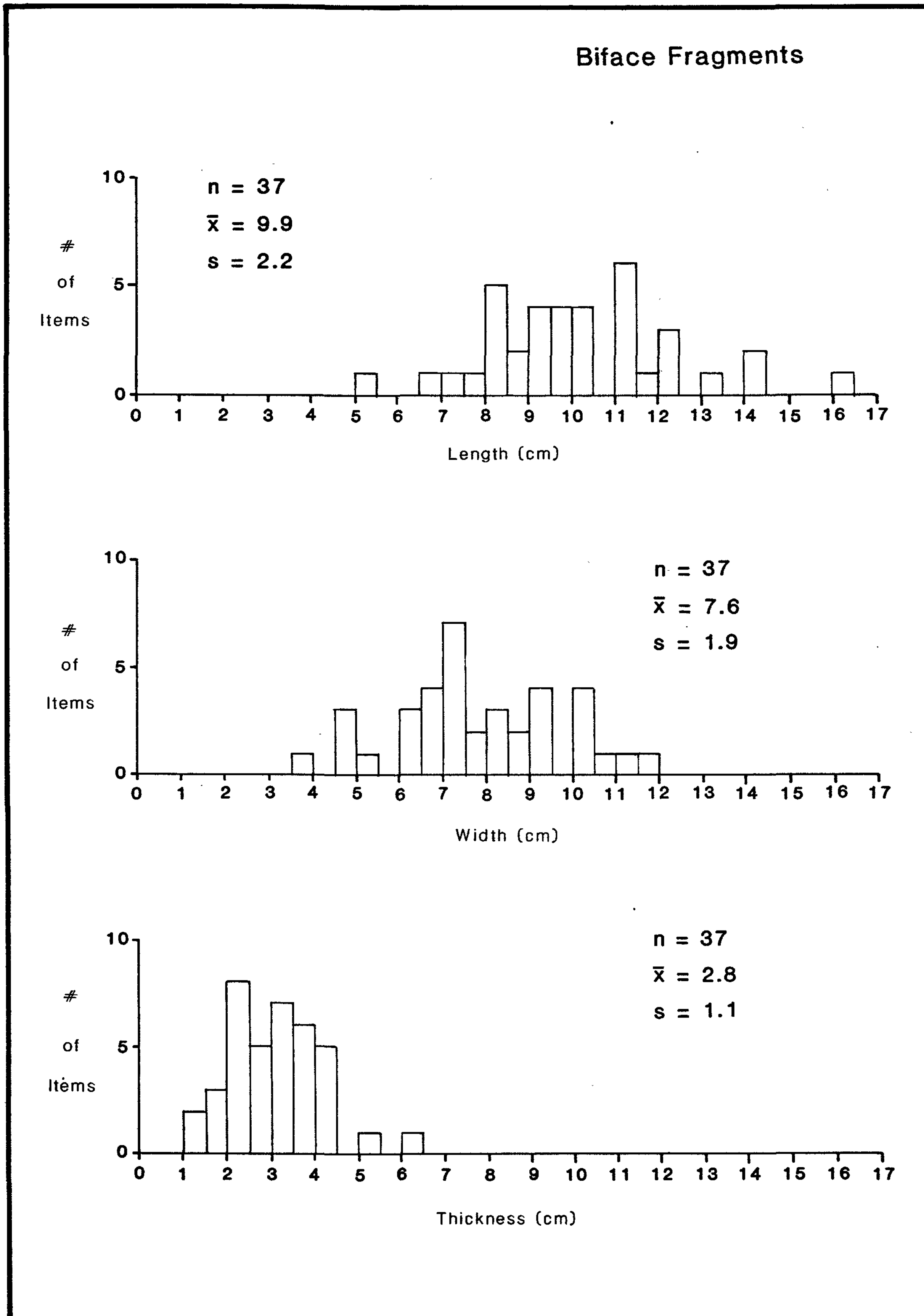

Complete Bifaces
n = 72
x̄ = 11.5
s = 1.8
# of Items
Length (cm)
n = 72
x̄ = 7.1
s = 1.7
# of Items
Width (cm)
n = 72
x̄ = 2.9
s = 0.8
# of Items
Thickness (cm)

Figure 23. Frequency distributions of biface fragment dimensions.



Biface Fragments
n = 37
x̄ = 9.9
s = 2.2
# of Items
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Length (cm)
n = 37
x̄ = 7.6
s = 1.9
# of Items
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Width (cm)
n = 37
x̄ = 2.8
s = 1.1
# of Items
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Thickness (cm)

precisely because they were too short to consider working further. Consider that the mean width of biface fragments is actually larger than the mean width of complete bifaces. The limiting factor appears to have been length: pieces 10 cm long or shorter tended to be discarded. Of course, longer pieces were discarded also (the longest biface fragment is longer than the longest complete biface), but they may have been flawed in other ways (we did not record such information).

What were the target dimensions of bifaces produced in the District? This can be estimated from discarded bifaces and biface fragment data: probably about 7.5 cm wide, longer than 11.5 cm, and thinner than 2.8 cm. To test this hypothesis, we have the six bifaces from a "cache" discovered in the District several years ago by Mary Rusco and her associates (figures 24-26). Unlike the bifaces we observed at the quarry features, most of which were discarded in Stage I or early Stage II because of major flaws and poor thickness to width ratios, the Rusco artifacts are "finished" stage two bifaces; that is, they have been shaped and thinned to a point at which they normally would have been transported from the quarry to another location for heat treatment and further thinning. However, each of these artifacts has a minor flaw or two, and they probably are also discards. Imagine the knapper sorting through a pile of bifaces after a day's work and taking only the perfect ones with him, leaving these six behind.

In any case, the Rusco artifacts probably reflect the target dimensions (Table 14) for bifaces produced in the quarry: the mean dimensions are 16.0 cm by 7.4cm by 1.8 cm, and the mean width/thickness ration is .24. Using Student's $\underline{t}$ distribution (Blalock 1979:190-195), the Rusco bifaces are significantly longer and thinner than the sample of observed bifaces, at the 0.05 level.

Table 14. Dimensions of Artifacts in Rusco's Biface Cache.

Item	Length (cm)	Width (cm)	Thickness (cm)
1	16.6	8.23	1.89
2	16.3	8.61	1.92
3	16.5	7.57	1.74
4	15.9	7.72	1.65
5	16.2	6.58	2.06
6	14.8	5.95	1.79

Figure 24a, b. Bifaces from the Rusco Cache.

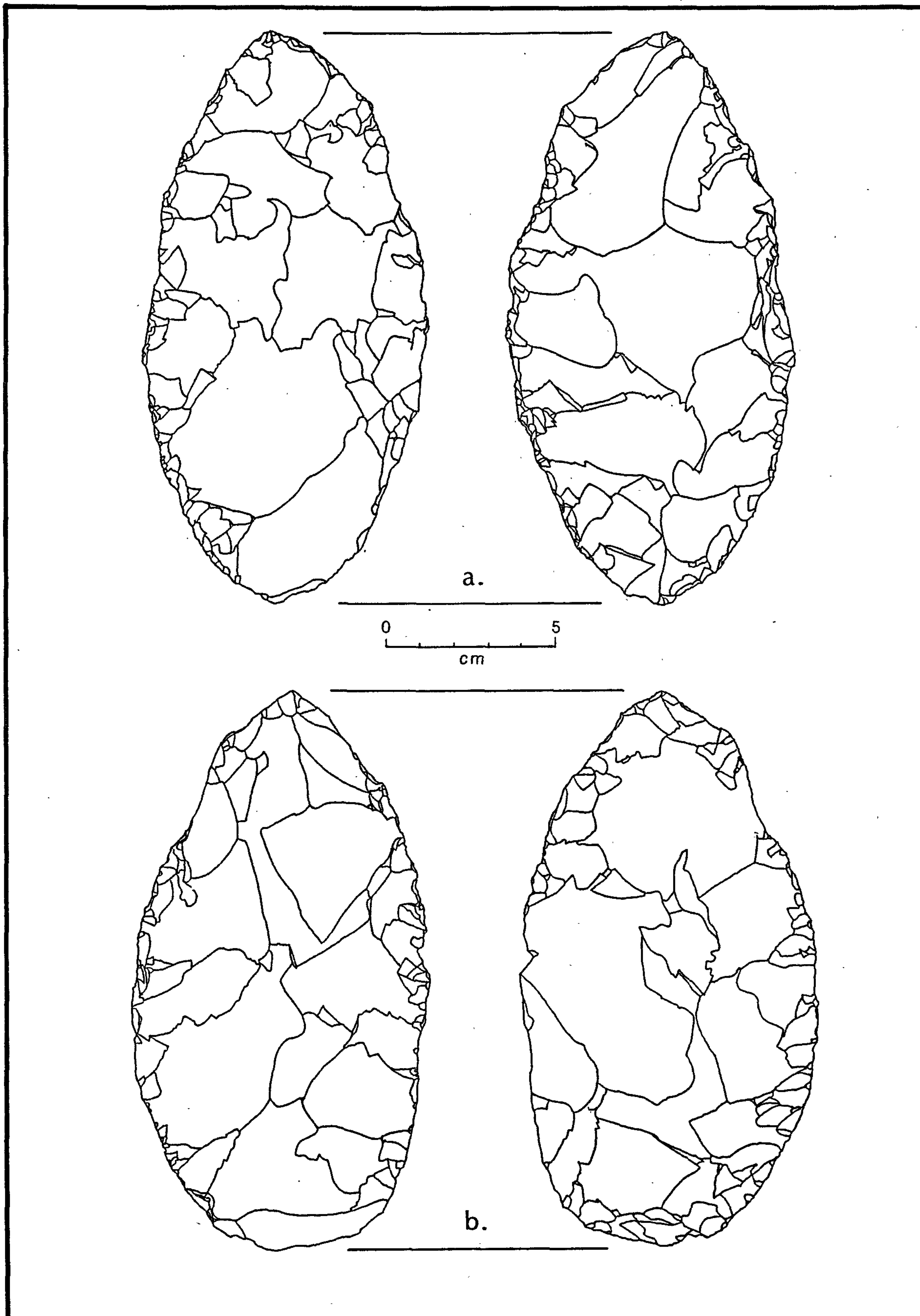

a.
0 5
cm
b.

Figure 25a, b. Bifaces from the Rusco Cache.

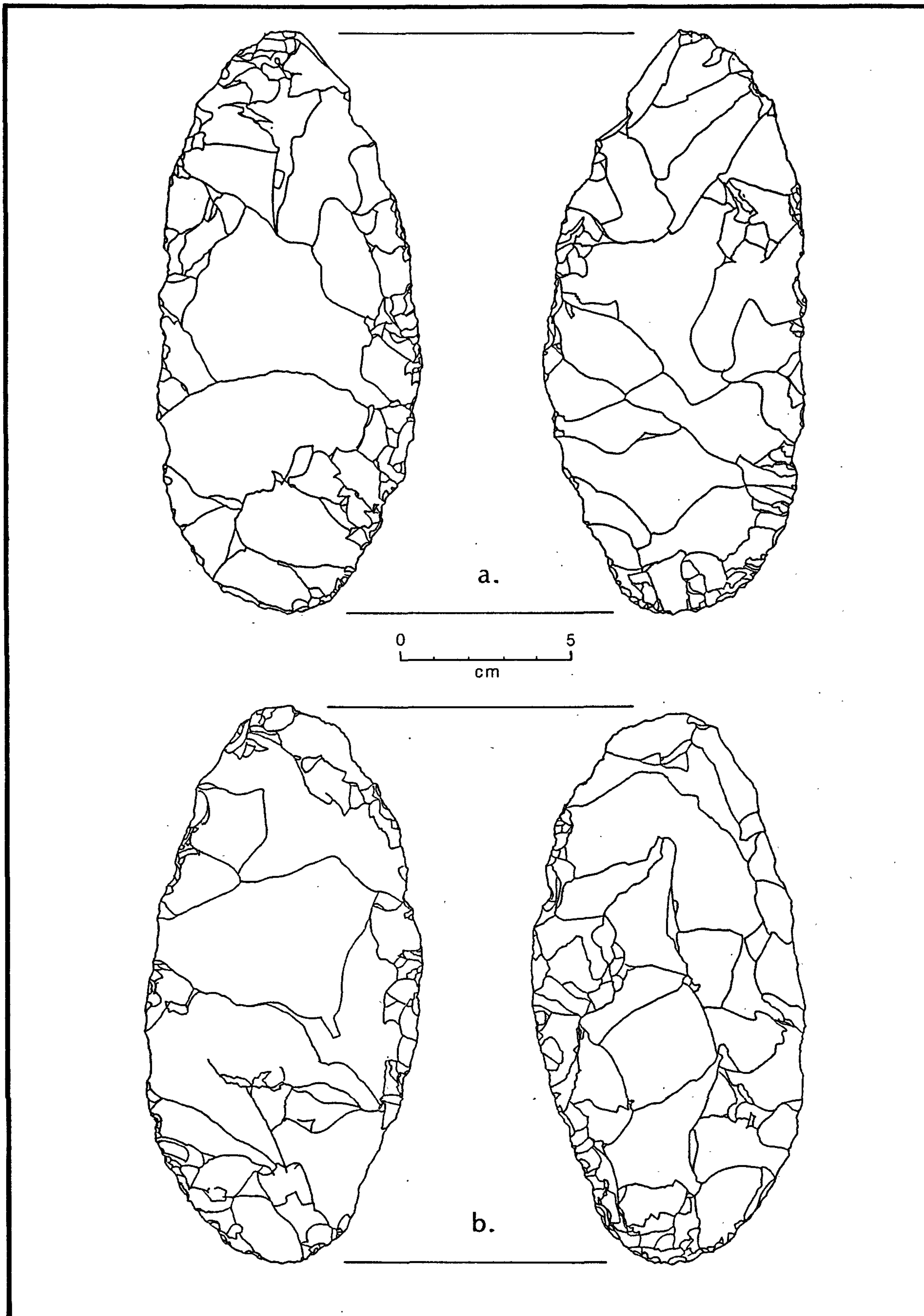
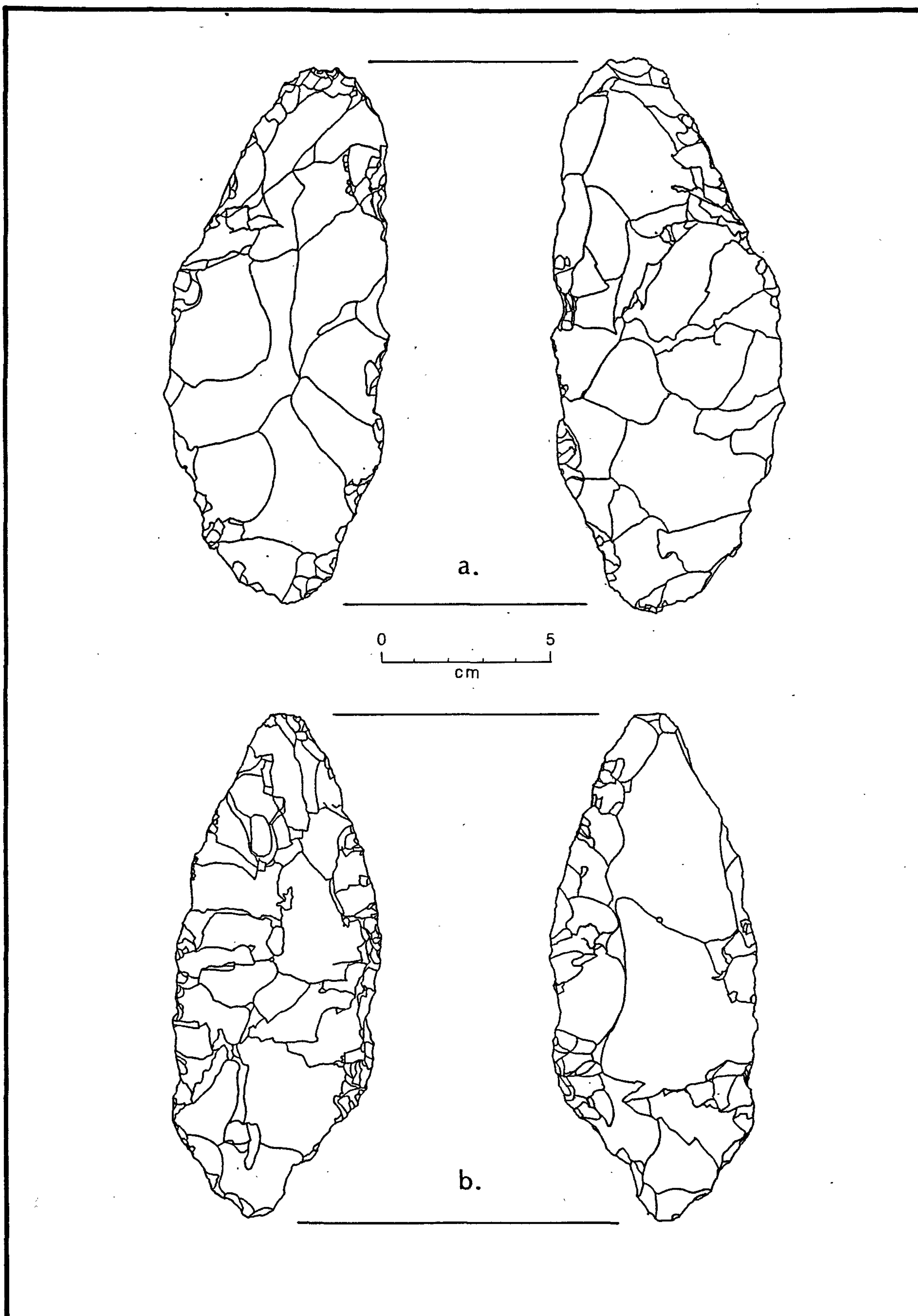

a.
0
5
cm
b.

Figure 26a, b. Bifaces from the Rusco Cache.


a.
0
5
cm
b.

Finally, the dimensions or early stage complete bifaces and biface fragments seem related to the size of objects in the cobble accumulations and cobble patches of discarded material in and around quarry pits. Cobble objects are well sorted in size, with most ranging between about 8 and 15 cm in maximum dimension. Consider that this is the size range at which pieces of tool stone are discarded. It appears that cores were discarded when they were too small to produce flake blanks of the correct size for large biface production. Little or no effort was expended on a piece of toolstone once it reached that size range. Consequently, there are few, if any (we observed none), well-developed cores in the quarry areas. The strategy was to handle the raw material as little as possible. Large pieces apparently were reduced to the size that one or two large flakes could be struck off the sides or ends, and then discarded.

Projectile Point Chronology

As previously mentioned, artifacts not directly related to opalite quarrying and processing are rare in quarry-related localities, and this includes temporally diagnostic projectile points. We observed only ten projectile points or projectile points preforms during the project; two of these were found, not in the Tosawihi District, but near our field camp at Hunting Blind Spring about two miles east of the project area in southeastern Big Butte Valley.

With one exception, points representative of all major periods in western Great Basin prehistory are present, from the Pre-Archaic between 6000 and 8000 B.C., through the Late Archaic between A.D. 500 and A.D. 1850 (Elston 1986). The exception is that no points key to the Rosegate Series, Late Archaic points used between A.D. 500 and A.D. 1100, although one specimen rejected by the Thomas (1979) key may well be a reworked Rosegate point. Projectile point observations appear in Appendix B.

Chapter 8. SUMMARY AND CONCLUSIONS

by Robert G. Elston

The Tosawihi Quarries are quite different from most Great Basin archaeological sites. The great extent of the quarry area, the density of surface artifacts, the complexes of quarry pits, outcrop quarries, rockshelters, and other cultural loci at first are bewildering. Underlying patterns are masked by the sheer abundance of archaeological material which, when viewed outside any frame of reference, suggest chaos.

Systematic survey of the Tosawihi District, followed by more intensive observation of quarry-related features and lithic scatters in the priority zone, was intended to provide such a framework, through description of the landscape and variation in the kinds and distribution of prehistoric localities across it. Data gathered thus will suggest where further evaluative studies are needed and provide a point of departure for planning and management of the District.

Certain findings and conclusions of the present study are summarized in the following discussions. Rather than statements of fact, many of these interpretations should be regarded as hypotheses to be tested in subsequent investigations.

Surface Debitage

Debitage scatters are most extensive and most dense in areas where opalite forms the bedrock; these scatters are related directly to toolstone procurement and initial processing at or adjacent to sources. Surface debitage density is highest at the source and tends to fall off with distance, although density also is affected by slope. Thus, areas of heavy-to-moderate density debitage (nearly always associated with quarry features) tend to be surrounded by areas of light density, with sparse density intervening. However, surface debitage scatters have more fine-grained structure than suggested by the 100 foot surface density plots presented in Figure 9. For instance, moderate density areas may contain smaller patches of heavy, light, or sparse density, and light density areas may contain patches of moderate density.

In areas where the bedrock is rhyolite or basalt (Owl Ridge, Red Hill Ridge), debitage is less extensive and dense; islands of sparse density, tending to occur on ridgetops and in saddles, are surrounded by expanses on slopes and drainage bottoms in which there are no cultural materials.

Discrete, light-to-moderate density flaking stations occur here and there throughout the District. These tend to occur on benches and saddles or overlooking drainages, are often associated with stands of big sage, and many probably are related to hunting. In opalite areas, such discrete scatters are masked by heavy-to-moderate density debitage in and around quarries, but can be distinguished where debitage is light-to-sparse.

Quarry-Related Localities

Prehistoric activities in quarry localities seem narrowly focused on just a few quarrying and processing activities; "residential" artifacts are rare at quarries. Still, some evidence of non-quarry-related land use exists within the quarry area, mainly in certain of the discrete debitage scatters recorded as flaking stations which, from their position in the landscape, appear related to hunting.

Most of the basic variation in quarry-related localities is a function of the nature of the opalite raw material: outcrop quarries and adits are found in surface exposures of bedrock; cobble quarries are associated with surface concentrations of opalite cobbles and boulders; quarry pits are excavated into colluvial deposits. Whether or not opalite was exploited at a particular spot in the landscape is likely a function of the interaction between raw material accessibility (given prehistoric technology) and quality.

There seems to be little technological variability among quarry pit features. Although pit size and depth do apparently not correlate, pits occur in a narrow range of sizes and depths. They usually are surrounded by berms of soil, waste rock, and the by-products of lithic assay and processing: flakes, shatter, assayed cobbles, cores, broken and rejected bifaces, and hammerstones.

These by-products tend to accumulate in pit bottoms and on pit berms. Size sorting in such accumulations appears to reflect a preferred size threshold for lithic products; material falling below that threshold was discarded.

Size sorting and lack of developed cores suggests an approach to toolstone procurement that minimized the time spent in processing and optimized the amount of toolstone processed. This apparently involved initial selection of pieces larger than a certain threshold; except to assay quality, smaller fragments were ignored. Boulders were broken into pieces within a size range such that removal of one to a few large flakes (suitable as biface blanks) reduced the core below the critical threshold and it then was discarded. This allowed a large amount of toolstone to be examined and the best material selected in the least amount of time. Such a strategy can pay off only when toolstone is as abundant as it is in the Tosawihi District.

Toolstone Diversity

Toolstone diversity (number of discrete toolstone sources represented) is least at quarries, where most toolstone is derived from the particular source. The occasional presence of color varieties of opalite at a source where they obviously had not been extracted suggests sequential exploitation of more than one source during a single visit to the quarry area.

Toolstone diversity is highest at residential sites (both open and in rockshelters), suggesting that material from numerous different sources was brought to such localities. Sources closest to a particular residential base were most likely to be exploited from that locality. While toolstone diversity is also high at localities 10, 31, and certain cobble quarries, this is due to variation in the raw material available at these localities and is not a cultural factor.

The incidence of exotic toolstone, such as obsidian, is highest in those small reduction stations that appear hunting related; such debitage probably is generated from maintenance of tools brought to the Tosawihi District from other areas.

Residential Sites

How people choose among quarry localities at any one time is not understood, but probably had something to do with the location of the residential base camp and duration of stay in the District vicinity. Our data suggest segmentation of toolstone procurement. Quarrying and initial processing were performed at or adjacent to the source, while subsequent processing took place at the residential base, most often located in relatively flat terrain near water.

The excavation of quarry pits and adits suggests a greater time investment and a longer duration of stay in the District vicinity than exploitation of surface cobbles, which could be accomplished by people who were merely passing through.

In turn, duration of stay probably was a function of scheduling demands, along with availability of local food resources and surface water. Seasonality of visits to the District, and the ways people supported themselves while there, are significant research problems. Fortunately, residential localities and discrete flaking stations associated with hunting have the potential to inform regarding subsistence, duration of occupation, seasonality, group size and composition, and a variety of other problem domains. The rockshelters containing dry deposits may contain well-preserved organic materials including bedding, cordage, and basketry, as well as wood, bone, and antler tools and weapons.

Technological Change and Cultural Chronology

Time diagnostic projectile points in the District suggest use of the area through 8,000 years or more. Whether or not the importance of opalite toolstone procurement has remained at the same level through that time is unknown, nor is it known if technological change in toolstone extraction and processing has occurred. It seems reasonable to expect that the first people to obtain toolstone from the District would have used the most cost-effective methods; high quality surface or near-surface material may have been "used up" before it became necessary to employ more intensive means of extraction.

Relative dates for quarry-related features may be obtained through stratigraphic superposition. Lichens are common on bedrock outcrops, debitage, and cobble objects throughout the District, and if basalt hammerstones have acquired desert varnish since their last use, cation dating may be possible. Whether or not lichenometry or cation analysis can provide relative dates will depend on a variety of technical factors not considered in the present study.

Absolute dates for quarry features are only possible if fire has been used in the quarrying process. Charcoal from campfires and heat treating ovens are likely to be present in both open residential localities and residential rockshelters. It may be possible to indirectly monitor changes in quarry technology, and directly monitor changes in later stages of lithic reduction technology at these localities if stratified deposits are present.

Redundancy and Significance of Cultural Resources

As components of an archaeological district eligible for inclusion in the National Register of Historic Places, some cultural phenomena are absolutely essential to the significance of the District, while others are contributory to District significance to one degree or another. Greater redundancy does not equate with lesser significance. For instance, the Tosawihi District is significant precisely because it contains so many similar examples of quarry-related features and a vast multitude of artifacts representing relatively few categories.

In the same light, significance does not vary with artifact abundance. Thus, the debitage density map presented in Figure 9 is not in itself a map of archaeological significance as much as it is a planning aid and a qualitative indicator of potential significance.

Redundancy may vary with the level or intensity of investigation. Concentrating on gross distribution of surface debitage and variety in quarry pit features, there appears to be a great deal of technological uniformity and redundancy in the District. Whether this will hold at the level of lithic assemblages (the contents of localities), or through time, is not known.

What the demonstration and understanding of redundancy among cultural resources allows is their informed management and choice of representative samples for study and/or preservation. Redundancy may exist at every level throughout the District, yet be difficult to demonstrate because of the problem of adequately sampling the variety in a very large population with unknown parameters.

BIBLIOGRAPHY

Armentrout, Lynda and Richard C. Hanes
1986 Archaeological Survey of the Susie Creek Area, Elko County, Nevada. Bureau of Land Management. Ms. in preparation.

Bailey, E.H. and D.A. Phoenix
1944 Quicksilver Deposits in Nevada. Nevada State Bureau of Mines and Mackay School of Mines, Geology and Mining Series No. 41. Reno.

Bard, James C.
1980 A Class III Cultural Resources Inventory of Sierra Pacific Power Company's North Valmy Power Plant Project: Valmy Unit #2 Well Field, Nevada. Basin Research Associates.

Bedwell, Stephen F.
1973 Fort Rock Basin Prehistory and Environment. University of Oregon Books, Eugene, Oregon.

Billings, W.D.
1951 Vegetational Zonation in the Great Basin of Western North America. In Les Bases Ecologiques de la Regeneration de la Vegetation des Zones Arides. IUBS, Series B, pp. 101-122. Paris.

Binford, L.R.
1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. American Antiquity. 45:4-20.

Binford, Lewis R., and James F. O'Connell
1984 An Alyawara Day: The Stone Quarry. Journal of Anthropological Research 40:406-443.

Blalock, Hubert M., Jr.
1979 Social Statistics (second edition). McGraw-Hill, Inc., New York.

Botti, N.
1985 Archaeological Investigations of Rock creek Dam and Reservoir, Lander County, Nevada. Archaeological Research Services, Inc., Virginia City, Nevada.

Busby, Colin I., and James C. Bard
1979 A Class III Cultural Resources Inventory of the Sierra Pacific Power Company's Transmission Line Corridor: Valmy to Mira Loma, Nevada. Basin Research Associates.

Clay, Vickie L., and Martha L. Hemphill
1986 An Evaluation of Five Sites in the Proposed Rock Creek Dam and Reservoir Project Area, Lander County, Nevada. A.R.S., Virginia City. Submitted to SEA Engineers, Reno, and Lander County Board of Commissioners, Battle Mountain, Nevada.

Cronquist, A., A.H. Holmgren, and J.L. Reveal
1972 Plant Geography of the Intermountain Region. In Intermountain Flora, 1:72-161. Hafner Publishing Co., New York.

Davis, Jonathan O., Don D. Fowler, and Mary K. Rusco
1976 Archaeological Investigations Near Treaty Hill, Humboldt County, Nevada. Desert Research Institute, Social Science Center, Technical Report No. 2. Reno.

Duffe', L.D.
1976a "Tosawi Chert" Project Progress Report. Draft manuscript in author's possession.

1976b Tosawi Chert Project. Paper delivered to the biannual meeting of the Great Basin Anthropological Conference. Las Vegas.

Elston, Robert G.
1982 Good Times, Hard Times: Prehistoric Culture Change in the Western Great Basin. In Man and Environment in the Great Basin, ed. David B. Madsen and James F. O'Connell, pp. 186-206. SAA Papers No. 2. Society for American Archaeology, Washington, D.C.

1986 Prehistory of the Western Area. In Great Basin, ed. Warren L. D'Azevedo, pp. 135-148. Handbook of North American Indians, vol. 11. William G. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Elston, Robert G., and Elizabeth E. Budy
1987 The Archaeology of James Creek Shelter. University of Utah Anthropological Papers. Salt Lake City, in press.

Elston, Robert G., Jonathan O. Davis, Sheryl Clerico, Robert Clerico, and Alice Becker
1981 Archaeology of Section 20, North Valmy Power Plant, Humboldt County, Nevada. University of Nevada, Desert Research Institute, Social Sciences Technical Report 19. Reno.

Hall, E. Raymond
1946 Mammals of Nevada. University of California Press. Berkeley.

Harris, Jack S.
1940 The White Knife Shoshoni of Nevada. In Acculturation in Seven American Indian Tribes, ed. Ralph Linton, pp. 39-116. Appleton-Century, New York.

Hayden, Bryan
1979 Paleolithic Reflections: Lithic Technology and Ethnographic Excavations Among Australian Aborigines. Humanities Press. Atlantic Highlands, New Jersey.

Heizer, R.F., M.A. Baumhoff, and C.W. Clewlow, Jr.
1968 Archeology of South Fork Shelter (NV-EL-11), Elko County, Nevada. University of California Archaeological Survey Reports 71:1-58. Berkeley.

Heizer, Robert F., and Thomas R. Hester
1973 Review and Discussion of Great Basin Projectile Points: Forms and Chronology. University of California Archaeological Research Facility. Berkeley.

James, Steven R. (ed.)
1981 Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Prepared by University of Utah Archaeological Center. Ms. on file, BLM Ely District Office, Ely, Nevada. Published as: Bureau of Land Management, Nevada, Cultural Resources Series No. 3.

LaRivers, Ira
1962 Fish and Fisheries of Nevada. Nevada State Fish and Game Commission, Biological Society of Nevada Memoirs 1. Carson City.

Linsdale, Jean M.
1936 The Birds of Nevada. Cooper Ornithological Club Pacific Coast Avifauna 23.

Merriam, C. Hart
1898 Life Zones and Crop Zones of the United States. Bulletin of the United States Biological Survey 10. Washington.

Muto, Guy R.
1971 A Technological Analysis of the Early Stages in the Manufacture of Lithic Artifacts. Unpublished Master's thesis, Idaho State University, Pocatello.

O'Connell, J.F.
1967 Elko Eared/Elko Corner-notched Projectile Points as Time Markers in the Great Basin. University of California, Archaeological Survey 70:129-140. Berkeley.

Powell, J.W., and G.W. Ingalls
1874 Report on the Condition of the Ute Indians of Utah; the Pi-Utes of Utah, Northern Arizona, Southern Nevada, and Southeastern California; the Go-Si Utes of Utah and Nevada; the Northwestern Shoshones of Idaho and Utah; and the Western Shoshones of Nevada. Washington.

Rusco, Mary
1976a Humboldt River Archaeological Project: Tosawi Chert Quarry. Draft manuscript in author's possession.

1976b Progress Report on Tosawi Opalite (Battle Mountain Chert) Quarry Project. Paper presented at biannual meeting of the Great Basin Anthropological Conference. Las Vegas.

1978 Distribution of Stone from the Tosawihi Quarries in Archaeological Sites along the AT&T Right-of-Way across Northern Nevada. Draft manuscript in author's possession.

1979 The Tosawihi or White Knife Quarries North of Battle Mountain, Nevada. Draft manuscript in author's possession.

1982 Archaeological Investigations at the Rossi Mine Sites, Elko County, Nevada. Archaeological Services Report, Nevada State Museum.

1983 Tosawihi (White Knife) Quarry. Draft nomination to National Register of Historic Places, on file BLM Elko District office, Elko Nevada.

Rusco, Mary K., and Jonathan O. Davis
1979 Archaeological Investigations Near Treaty Hill, Humboldt County, Nevada: Section 29. Archaeological Services Report, Nevada State Museum. Submitted to Westinghouse Corporation, Environmental Services Division.

1982 The Humboldt Project Rye Patch Reservoir: Phase IV Archaeological Data Synthesis Final Report. Archaeological Services Report, Nevada State Museum, Carson City. Submitted to Interagency Archaeological Services Division, National Park Service, Contract No. C2527.

Rusco, Mary, Jonathan O. Davis, and Andrew Jensen
1979 Archaeological Investigations Near Carlin, Elko County, Nevada. Ms. on file. Nevada State Museum.

Rusco, Mary and Evelyn Seelinger
1974 Report of Archeological Reconnaissance Along Proposed 230 kv Transmission Line Right-of-Way of Sierra Pacific Power Company, Part II, Valmy to Jackpot, Nevada. Nevada State Museum Project 18-9.

Smith, Regina C., Peggy Jones, John R. Roney and Kathryn Pedrick
1983 Prehistory and History of the Winnemucca District. Bureau of Land Management, Nevada, Cultural Resource Series No. 6. Reno.

Stebbins, Robert C.
1966 A Field Guide to Western Reptiles and Amphibians. National Audubon Society and National Wildlife Federation. Houghton-Mifflin Co., Boston.

Stephenson, Robert L. and Kent Wilkinson
1969 Archeological Reconnaissance of the Winnemucca-Battle Mountain Area of Nevada. Nevada Archeological Survey Research Paper No. 1, pp. 66. University of Nevada, Reno.

Steward, Julian H.
1937 Linguistic Distributions and Political Groups of the Great Basin Shoshoneans. American Anthropologist 39(4):625-634.

1938 Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120. Washington.

1939 Some Observations on Shoshonean Distributions. American Anthropologist 41(2):261-265.

1941 Culture Element Distributions: XIII, Nevada Shoshone. Anthropological Records 4(2):209-359. University of California, Berkeley.

Stewart, Omer C.
1939 The Northern Paiute Bands. Anthropological Records 2(3):127-149. University of California, Berkeley.

1941 Culture Element Distributions: XIV, Northern Paiute. Anthropological Records 4:361-446. University of California, Berkeley.

Tadlock, W.L.
1966 Certain Crescentic Stone Objects as a Time Marker in the Western United States. American Antiquity 31(5):662-675.

Thomas, David H.
1981 How to Classify the Projectile Points from Monitor Valley, Nevada. Journal of California and Great Basin Anthropology 3:7-43.

1983 The Archaeology of Monitor Valley 2. Gatecliff Shelter. Anthropological Papers of the American Museum of Natural History 59:Part 2. New York.

Thomas, David H., Lorann S.A. Pendleton, and Stephen C. Cappannari
1986 Western Shoshone. In Great Basin, ed. Warren L. d'Azevedo, pp. 262-283. Handbook of North American Indians, vol. 11. William G. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Tindale, N.
1965 Stone Implement Making Among the Nakako, Ngadadjara and Pitjandara of the Great Western Desert. South Australian Museum Records. 15(1):131-164.

APPENDIX A
(bound separately)

This appendix is comprised of an Intermountain Antiquities Computer System Site Form for site 26Ek3032, the Tosawihi Quarries Archaeological District. Included with the site form are descriptions and USGS topographic map plots for each of 219 prehistoric localities observed in June-July, 1987.

APPENDIX B

Table 1. Projectile Point Attribute List.

Table 2. Measurements and Observations on Collected Bifaces.

Table 1. Projectile Point Attribute List.

* Collected from Hunting Blind Spring

Catalog No.	Type	Material	LS	LT	LA	LM	WM	WB	NW	TH	Wt.	Est. Wt.	DSA	PSA	NOI	(BIR)	LT/WM	WB/WM	LM/LT	Comments
35-4	DSN	Obsidian	17.0	(21.5)	(20.5)	-	10.9	7.9	5.4	2.2	.4	.4	192	170	22	.95	1.97	.72	-	Complete point, tip broken but re-worked. Minimal reduction of lateral margins, minimal thinning.
*HBS-LOC R	CWT	Obsidian	17.2	17.2	16.4	16.7	9.7	9.7	-	2.7	.4	.4	-	-	-	.95	1.77	1.00	.97	Complete, fully reduced.
219-1	ECN	Obsidian	27.3	27.3	26.9	-	15.6	14.0	9.1	4.4	1.5	1.5	179	145	34	.99	1.75	.90	-	One tang broken, base too large for Rosegate, may be re-worked Elko Eared.
107-1A-1	ECN	White/Tan Opalite	25.4	(40.3)	(38.8)	-	19.9	16.5	11.4	4.4	2.5	4.5	154	143	11	.96	2.02	.83	-	Tip missing, one lateral margin re-sharpened.
	ECN	White Opalite	52.3	(91.8)	(91.8)	-	29.0	22.5	14.9	8.3	15.4	22.5	203	140	63	1.00	3.17	.78	-	Tip broken, poorly reduced, re-sharpened, keys to ECN, but very large, PSA too small for large Side-notched.
53-1A	EE	Basalt	19.9	(40.6)	(37.8)	-	19.4	14.6	12.7	6.1	2.6	5.0	221	113	108	.93	2.09	.75	-	Tip broken, margins re-sharpened.
81-1A	BSS	White Opalite	21.1	(53.1)	(50.0)	-	36.0	14.6	15.0	5.9	3.6	7.2	168	95	73	.94	1.48	.41	-	Tip broken, one lateral margin re-sharpened. PSA variable, 110o-95o. Could also key to Elko Eared.
*HBS-mapped	GBS	Basalt	31.0	(70.0)	(70.0)	(46.2)	23.5	16.4	15.6	6.2	4.8	9.0	216	92	124	1.00	2.98	.70	.66	Blade broken above shoulders. Stem is edge ground. Not keyed by Thomas 1981.
130-53-1B	GBS	Obsidian	35.9	-	-	-	-	18.5	-	(7.7)	7.5	15.0	-	-	-	-	-	-	-	Stem only, broken below shoulders. Heavily edge ground. Made on brown obsidian. Not complete enough for measurement of all attributes.
40-56-3	Out of Key	Obsidian	22.6	22.6	22.6	-	17.9	5.1	7.3	3.7	1.3	1.4	160	95	65	1.0	1.26	.28	-	Complete, tip and base re-worked. Extensively re-sharpened. Remnant notching suggests it originally keyed to Rosegate Series.
4-69-12	Preform	Obsidian	33.2	(34.9)	(34.9)	(34.1)	18.1	18.1	-	3.2	1.7	1.7	-	-	-	1.0	1.93	1.00	3.84	Small portion of tip missing. Too large (wt.) 1.5 gr.) for Cottonwood Triangular.

Measurements are in millimeters and grams; numbers in parentheses are estimated.

Abbreviations:

CWT - Cottonwood Triangular
DSN - Desert Side-notched
ECN - Elko Corner-notched
EE - Elko Eared
GBS - Great Basin Stemmed
GSS - Gatecliff Split Stem

LS - Actual Length
LT - Total Length
LA - Length of Longitudinal Axis
LM - Length from Proximal End of Point of the Maximum Width
WM - Maximum Width
NW - Neck Width
WB - Basal Width
TH - Thickness

Wt. - Weight in Grams
DSA - Distal Shoulder Angle, between 90o-270o
PSA - Proximal Shoulder Angle, between 0o-270o
NOI - Notch Opening Index
BIR - Basal Indentation Ratio, LA/LT

Table 2. Measurements and Observations on Collected Bifaces

Catalog Number	Type	Material	Length	Width	Thickness	Comments
188-12	Stage II	Slightly waxy surface, translucent, "butterscotch" opalite; dusky yellow (5Y 6/4) by reflected light; dark yellowish-orange (10YR 6/6) by transmitted light; with opaque, very pale orange (10YR 8/2) angular inclusions 6 mm max. dimension - these do not appear to affect workability, which appears to be very good.	8.96	5.16	1.24	This artifact is intact but appears to be a reworked fragment of a larger biface. It may have been discarded because of its relatively small size in combination with hinge terminated flake scars at either end. It was probably not heat treated.
44-01	Stage II	Matte surface, opaque, very light gray opalite (N8) with opaque white (N9), slightly grainy banding; internal fracture planes interfere with flaking and quality is medium.	8.54	5.89	1.54	This artifact is intact but appears to be a reworked fragment of a larger biface. It may have been discarded because of its size and the presence of fracture planes. It apparently has not been heat treated.
102-01	Early Stage III	"Opaque white (N9) opalite with opaque light gray (N7) inclusion; quality is good.	5.34	3.15	0.99	This artifact is a fragment, apparently truncated by end shock. The edges of the piece taper from the truncation to an irregularly blunt "base". Flaking tends toward collateral but is marred by many terminations; platforms on margins are created by unifacial scrubbing. This could be a Great Basin Stemmed point preform. It apparently has not been heat treated.

Table 2. Measurements and Observations on Collected Bifaces, continued.

Catalog Number	Type	Material	Length	Width	Thickness	Comments
107-L1A-02	Stage I	Waxy, opaque with translucent edges bluish-white (5B 9/1) opalite with faint opaque white banding; contains a few small (to 1 mm) crystal-filled vugs; quality is good.	8.67	6.05	1.48	This artifact is an end fragment. It was made on a flake with longitudinal curvature; one edge has not been fully reduced. The artifact was apparently heat treated as a flake blank and seems to have been smash truncated. It is one of 7 bifaces found together.
107-L1A-03	Stage III	Waxy, opaque, pinkish-gray (5YR 8/1) opalite with quartz grain inclusions and small vugs, both to 1 mm. Quality is medium.	5.68	2.99	0.86	This artifact is leaf-shaped with truncations at both tip and base. The basal truncation has not been reduced and a small graver-like projection created. The edges have been retouched and the margins are crushed. It is one of 7 bifaces found together.
107-L1A-04	Stage III	Waxy, opaque but translucent on edges, very pale orange (10YR 8/2) with waxy, opaque white and matte moderate orange-pink (5YR 8/4) banding; quality is very good.	5.68	2.70	0.85	This artifact is a fragment, truncated on both ends. The margins taper from one end to the other; the artifact was heat treated as a flake blank or early stage biface and reduced to its present form. The edges have been retouched and the edges are crushed; a red mineral (ochre ?) is embedded in cracks and flake scars. It is one of 7 bifaces found together.
107-L1A-05	Stage I	Waxy, opaque, yellowish-gray (5Y 7/2) on flake scars; some surfaces are matte; vugs to 3 mm and some quartz inclusions. Quality is poor to medium.	8.94	5.05	1.02	This artifact is a fragment, with end shock truncation. It was apparently heat treated as an earlier Stage 1 biface: most flake scar surfaces have a waxy texture, a few flake scars and one unreduced margin have matte surfaces. It is one of 7 bifaces found together.

Table 2. Measurements and Observations on Collected Bifaces, continued.

Catalog Number	Type	Material	Length	Width	Thickness	Comments
107-L1A-06	Stage II	Waxy, opaque, yellowish-gray (5Y 8/1) opalite with fine gray bands; some flake scar surfaces are matte; open vugs to 3 mm and some fracture planes; quality is poor to medium.	8.37	4.74	2.05	This artifact is a fragment, truncated on both ends; the truncation on one end has been partially reduced unifacially. This piece was apparently heat treated as an early Stage I biface. This is one of 7 bifaces found together.
107-L1A-07	Stage II	Waxy, opaque, bluish-white (5B 9/1) opalite with faint gray bands and large (to 8 mm open vugs); quality is poor to good.	8.04	5.34	1.21	This artifact is a fragment with one end truncated. It was apparently heat treated as a Stage I biface. This is one of 7 bifaces found together.
107-L1A-08	Late Stage I	Matte, opaque, pinkish-gray (5YR 8/1) opalite with open vugs to 4 mm. Quality is poor to medium.	8.12	5.45	1.32	This artifact is a fragment, with one end truncated. The piece has apparently been heat treated; recent flake scars from trampling have a waxy texture. The truncation has a matte surface and must have occurred prior to or during heat treatment.