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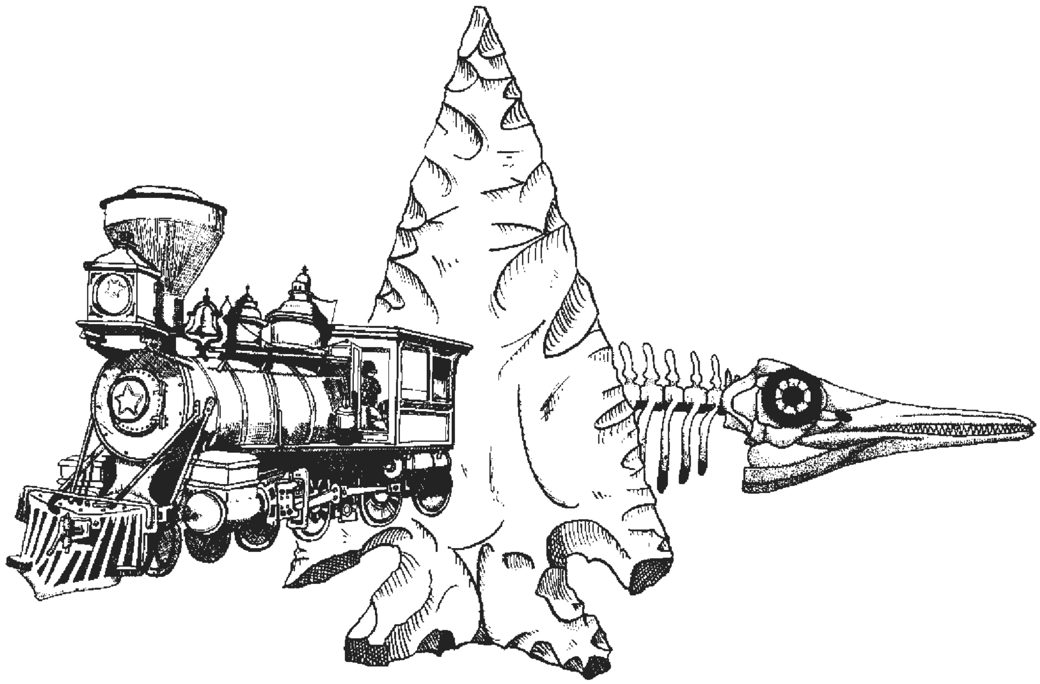

A Revised Research Context for the Prehistoric Archaeology of the Little Boulder Basin Area, North-Central Nevada

Edited by

Michael D. Cannon

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A REVISED RESEARCH CONTEXT FOR THE PREHISTORIC ARCHAEOLOGY OF THE LITTLE BOULDER BASIN AREA, NORTH-CENTRAL NEVADA

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ABSTRACT

Barrick Goldstrike Mines, Inc., (BGMI) as part of its ongoing efforts to manage cultural resources within its area of operations, has contracted SWCA Environmental Consultants to prepare this research context for the prehistoric archaeology of the Little Boulder Basin (LBB) and the surrounding area along a portion of the Carlin Trend in north-central Nevada. BGMI is supporting the preparation of this document at the request of and in consultation with the Bureau of Land Management, Elko District, Tuscarora Field Office (BLM-Elko). The purpose of this document is to assist BLM-Elko with its responsibilities under Section 106 of the National Historic Preservation Act by 1) synthesizing the extensive archaeological research that has been conducted in this part of the Great Basin over the past 25 or so years; 2) using the results of this synthesis to develop a comprehensive approach for evaluating, or re-evaluating, whether prehistoric archaeological sites in the area are eligible for the National Register of Historic Places (NRHP) under Criterion D; and 3) providing a basis for research designs to be implemented in any archaeological mitigation work that may be required in the future.

This document is proposed as an update of and a replacement for a historic context that was prepared for the LBB area in 1991. Due to the considerable amount of work that has taken place since it was written, some of the research questions outlined in the 1991 historic context have been answered, some have required revision, and new questions have arisen. Consequently, it is appropriate to reconsider NRHP eligibility determinations made under the 1991 historic context based on updated research priorities for the area. Defining a new set of research priorities for the LBB and surrounding area is the major purpose of this document.

The new research priorities developed in this document are based on a synthesis of the results of archaeological excavations conducted to date in the LBB and surrounding area and an evaluation of the current status of archaeological knowledge about the area. Over 50 sites in the area have been excavated. However, a comprehensive treatment of the knowledge gained through these excavations has never been produced; several separate reports describe excavations at individual sites or small groups of sites, but the bigger picture that might be painted by the cumulative information obtained from these sites has remained unclear. This document fills that gap by compiling the data from all excavated sites in the vicinity of the LBB and by applying the collective dataset to research questions from the 1991 historic context. The main substantive results of this research synthesis are as follows.

The distribution of radiocarbon dates from archaeological sites in the area suggests that sustained human occupation began around 1200 B.C. and continued without major interruption through the period of Euro-American settlement. Projectile points further provide evidence for at least sporadic use of the area prior to 1200 B.C. The lack of radiocarbon dates from before this time, and the more general paucity of evidence for substantial occupation prior to 1200 B.C., may be due to insufficient preservation of earlier materials and/or insufficient testing of deeply buried deposits, but at face value, the available data suggest that humans used the area only lightly until well into the late Holocene. Based on a synthesis of available chronological data, a slightly revised phase sequence for the area is presented. Revisions to the projectile point and obsidian hydration chronologies that have been used in the area are also suggested.

It has previously been well established that multicomponent deposits (i.e., deposits containing material from multiple time periods) are very common in the LBB area, and much work has focused on attempting to more successfully limit excavation efforts to single-component deposits, which enable change over time to be examined. Employing an explicit and consistent set of criteria for identifying assemblages as single-component, only a small proportion of the previously excavated assemblages from the study area—no more than about a third—can be identified as such. Geoarchaeological work that has been conducted suggests that, in most LBB area geomorphological settings, archaeological deposits are likely to be shallow and to lack stratigraphic distinctions, a fact that likely goes a long way towards explaining the

prevalence of multicomponent archaeological assemblages in the area. Another major reason why many previously excavated LBB area sites and site loci cannot be identified as single-component is that they lack sufficient dating information for evaluating their occupational history.

An analysis of potential predictor variables shows that there are no clear-cut ways to determine whether a site or site locus is single-component prior to excavation based either on environmental variables or on characteristics of surface archaeological assemblages. It is demonstrably not the case that sites or site loci with larger or denser surface artifact assemblages are more likely to be multicomponent, as some have previously suggested may be the case. On the other hand, the number of archaeological features found at a site or site locus does appear to substantially improve the ability to identify deposits as single-component, likely because features typically provide abundant dating information in the form of radiocarbon dates and associated artifacts. The most productive approach to identifying single-component deposits may therefore be simply to focus on locating archaeological features, and there fortunately are some variables that do seem to be able to predict whether a site or site locus will contain archaeological features. In particular, the presence of ground stone artifacts and/or ceramics, as well as site location in upland settings, appear to be indicative of the presence of features with better than random chances.

Turning to issues of subsistence, comprehensive analyses of faunal and floral remains from the LBB area support the previously made argument that large mammal encounter rates declined around A.D. 1300, leading to a reduction in overall foraging efficiency and an expansion of diet breadth. However, a new result also emerges from these analyses, which is that, prior to approximately A.D. 700, diets appear to have been about as broad, and foraging efficiency about as low, as was the case after A.D. 1300. Thus, the period between A.D. 700 and A.D. 1300 stands out in terms of diet breadth and foraging efficiency in comparison to both earlier and later times. An analysis of ground stone tools from the LBB area indicates greater investment in milling technology both before A.D. 700 and after A.D. 1300, a pattern that is consistent with the argument that has been previously made that people adjusted their investment in various forms of technology in response to changes in resource selection and foraging efficiency. Ceramic data from the LBB area also seem to be consistent with such a change in technological investment in that pottery from the area appears to date primarily after A.D. 1300 and may be associated with increased use of seeds at around this time; however, the fact that LBB area ceramics are only loosely dated presently limits the degree of confidence that can be placed in this conclusion. Finally, the frequency of small hearth features that lack rocks, relative to larger features with rocks, increases at around A.D. 1300, perhaps further indicating increased investment in technologies used to handle low-return resources.

A consideration of site structure and function leads to several important insights into settlement and mobility in the LBB area. For one, all sites, from all time periods, appear to represent the remains left by small groups of highly mobile hunters and gatherers who occupied sites for short periods of time. Overall, site structure is extremely simple. No residential structures have been identified on any sites of any time period in the LBB area, numbers of other types of features on sites are generally low and the features are relatively simple, and no secondary refuse areas have been identified. Variation among sites in potential indicators of site function is slight and centers on differences in densities of artifacts and faunal material. Although most sites are likely best characterized as small, generalized camps, two other site types may be present. One type, which is characterized by high densities of debitage and tools, may represent areas where stone tool production and repair were a particular focus. The second, which is characterized by higher densities of ground stone and high faunal richness, may represent areas where food collection and processing were emphasized to a relatively greater degree. It is notable that the distribution of these site types is not as patterned spatially as might be expected. General camps and tool processing sites appear to be located across a variety of settings, distances to water, and vegetation zones. Importantly, though, food processing sites appear restricted to particular ridge tops and the big sagebrush vegetation zone. Regarding temporal variation, the distinction between tool production and food processing sites seems to be clearest prior to A.D. 1300. This suggests that site functions may have been more varied before this time, whereas after this time use of the LBB area may have been much more homogenous.

Chipped stone artifacts comprise by far the most substantial portion of the LBB area archaeological record. A variety of analyses of such artifacts are presented in this document, and based on the cumulative results of these, in conjunction with the insights provided by the site structure and function analysis, a model of chipped stone assemblage variability and mobility is proposed. Chipped stone assemblages associated with pre–A.D. 700 occupations in the LBB area appear to represent debris from populations with a large annual range who were highly residentially mobile. Obsidian sourcing data indicate that they had access to sources from a large area. In addition, raw material selection favored high quality chert from the relatively close Tosawihi Quarries and the production of bifaces, as might be expected for groups with high levels of mobility. Between A.D. 700 and A.D. 1300, chipped stone assemblages, and undoubtedly the underlying mobility and economic strategies, changed radically. Data from obsidian sourcing indicates a great reduction in range size. Furthermore, use of non-Tosawihi materials increased, also suggesting a constriction in annual range requiring greater reliance on local materials. The frequency of residential moves, however, appears to have remained high, albeit within a greatly reduced range. After A.D. 1300, it appears that mobility patterns changed again. Evidence of obsidian procurement indicates that the overall foraging range was the greatest during this period. In addition, an increased investment in producing later-stage bifaces at the Tosawihi Quarries indicates that populations either expected to travel long distances or to be away from the quarry for long periods of time. The relative abundance of Tosawihi chert is highest after A.D. 1300, and it may be that the LBB area after this time was used only as a stopping point on trips between the Tosawihi Quarries and points to the south.

There are remarkable parallels between temporal patterns in subsistence-related data and temporal patterns in chipped stone data. Simply put, the period between about A.D. 700 and A.D. 1300 stands out in relation to both earlier and later times in exhibiting evidence for higher foraging efficiency and correspondingly narrower diets, as well as evidence for a greatly reduced overall range size. The explanation for the patterns in foraging efficiency and diet breadth that currently seems best supported is that favorable climatic conditions for artiodactyl prey between A.D. 700 and 1300 enabled higher foraging efficiency for human predators, which, in turn, predictably led to relatively narrow diet breadth, as well as associated changes in subsistence-related technologies. The reduced foraging ranges that people evidently traversed during this period may also be predictably related to climatic variability in one of several ways. First, it is possible that, if human population densities throughout the Upper Humboldt region were highest between A.D. 700 and 1300—something that may have resulted, at least in part, from the higher effective precipitation that characterized this span of time—then foraging ranges may have been somewhat constricted due to demographic packing. Another possibility is that climatic variability led to changes in the costs and benefits of residential mobility. Specifically, the higher foraging returns that hunter-gatherers in the LBB area were evidently able to obtain between A.D. 700 and 1300 may have made it economical to move residentially less often. Further evaluating such "big picture" hypotheses for major adaptive shifts in LBB area prehistory would be a very worthwhile goal for the next generation of archaeological research in the region.

Based on the just-described research results, an extensive series of research questions and data needs is proposed to guide future archaeological investigations in the LBB area. Many of these research questions would likley best be answered using either existing data from previously excavated sites or data from outside the LBB area. However, many can also be answered using data from as-of-yet unexcavated sites within the LBB area. The specific characteristics, or "eligibility factors", that would enable an LBB area site to provide data applicable to research questions outlined in this document, thereby making that site eligible for the NRHP under Criterion D, are described. It is also suggested that research potential be evaluated at the level of the intra-site locus or artifact concentration, rather than at the level of the site as a whole, and that loci or concentrations with high research potential be considered to be components that contribute to the eligibility of NRHP-eligible sites. Finally, a range of further management recommendations are made, covering issues such as strategies for mitigating adverse effects to NRHP-eligible sites, opportunities for academic research in the area, data submission and curation standards, and guidelines for future updates of this research context.

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1. INTRODUCTION

Michael D. Cannon

Barrick Goldstrike Mines, Inc. (BGMI), as part of its ongoing efforts to manage cultural resources within its area of operations, has contracted SWCA Environmental Consultants (SWCA) to prepare this research context for the prehistoric archaeology of the Little Boulder Basin (LBB) and the surrounding area along a portion of the Carlin Trend in north-central Nevada (Figure 1). BGMI is supporting the preparation of this document at the request of and in consultation with the Bureau of Land Management, Elko District, Tuscarora Field Office (BLM-Elko). The purpose of this document is to assist BLM-Elko with its responsibilities under Section 106 of the National Historic Preservation Act (NHPA) by 1) synthesizing the extensive archaeological research that has been conducted in this part of the Great Basin over the past 25 or so years; 2) using the results of this synthesis to develop a comprehensive approach for evaluating, or re-evaluating, whether prehistoric archaeological sites in the area are eligible for the National Register of Historic Places (NRHP); and 3) providing a basis for research designs to be implemented in any archaeological mitigation work that may be required in the future. As such, this document provides an important tool to be used in the management of cultural resources in and around the LBB, and it also presents archaeological research that should be of interest both to researchers and to the general public.

1.1. Management Background

Because BGMI operates under permit from BLM-Elko, BLM-Elko has responsibility under Section 106 of the NHPA, as well as under other statutes such as the National Environmental Policy Act (NEPA), for ensuring that impacts to cultural resources from BGMI's mining activities are taken into account and, when appropriate, mitigated, avoided, or minimized in accordance with applicable laws and regulations. BLM-Elko, BGMI, the Nevada State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (ACHP) are signatories to a Programmatic Agreement regarding the treatment of historic properties during mineral development associated with the Goldstrike mine. The present document, as noted, was prepared at the request of BLM-Elko, and the scope of this document was determined in consultation between BLM-Elko, BGMI, and SWCA, with the goal of meeting both the BLM's cultural resource management responsibilities and BGMI's cultural resource management needs.

Section 106 of the NHPA requires a federal agency, in this case BLM-Elko, to determine whether its undertakings, including permitting actions, have the potential to adversely affect properties that are listed on, or eligible for, the NRHP. Doing so first requires a determination of whether properties that may be affected are NRHP-listed or NRHP-eligible. Under federal regulation 36 CFR 60.4, a property—such as a building, an archaeological site, or a district—is eligible for the NRHP if it retains integrity and if it meets any of the following four criteria (National Park Service 1997:2):

A. It is associated with events that have made a significant contribution to the broad patterns of our history.

B. It is associated with the lives of persons significant in our past.

C. It embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose individual components may lack individual distinction.

D. It has yielded, or may be likely to yield, information important in prehistory or history.

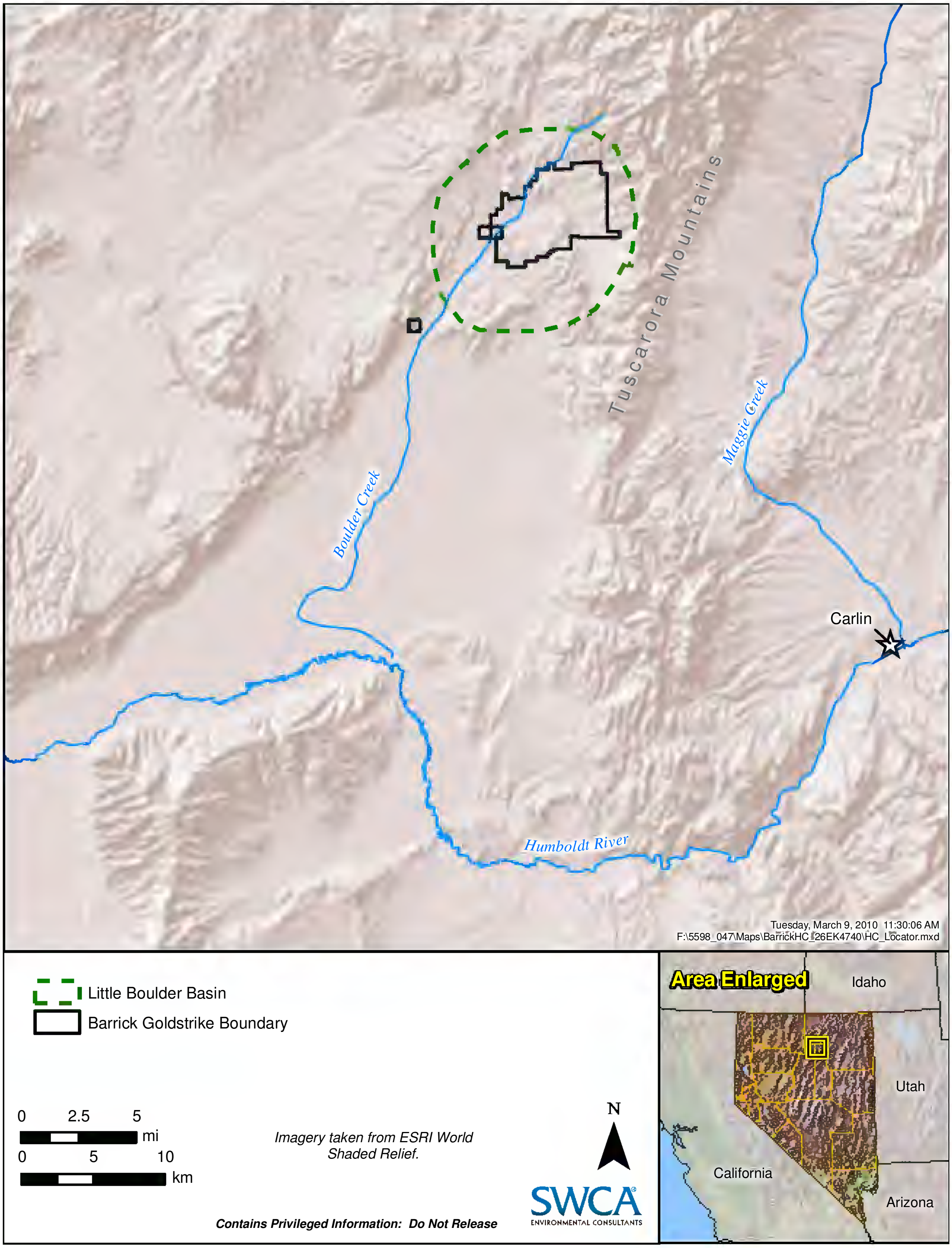

Figure 1. Location of the Little Boulder Basin and Barrick Goldstrike Mines in north-central Nevada.

Prehistoric archaeological sites, the subject of this document[1], may be eligible under any of these criteria. However, most, if not all, of those in the LBB that have previously been determined to be NRHP-eligible are eligible under Criterion D; that is, they have been judged to have the potential to help us learn about the prehistory of this part of northern Nevada. Accordingly, when impacts to NRHP-eligible prehistoric sites in the LBB have warranted mitigation, this has occurred through archaeological excavations designed to recover the knowledge about the past that those sites can provide. Because Criterion D has been the primary criterion under which prehistoric archaeological sites in the LBB have previously been determined eligible for the NRHP, and upon the guidance of BLM-Elko, this document focuses on research issues relevant to eligibility under Criterion D.

This is not to minimize value that archaeological sites may have for reasons other than research, such as traditional value to Native Americans. That subject is considered elsewhere, based on BLM consultation with Native American tribes, in the Draft Supplemental Environmental Impact Statement (DSEIS) for BGMI's planned Betze Pit Expansion (Bureau of Land Management 2008:Section 3.10) and in the DSEIS prepared for cumulative effects related to Newmont Mining Corporation's South Operations Area Project Amendment (Bureau of Land Management 2007:3-87–3-89). Though these documents were prepared as part of compliance with NEPA, they contain information that also pertains to BLM's tribal consultation responsibilities under the NHPA.

The bulk of the archaeological investigations that have been conducted in and around the LBB has occurred since the 1980s in association with the expansion of mining operations in the area. This work has produced a tremendous amount of information about the prehistory of the region, making it surely one of the most intensively studied parts of the Great Basin. Mining-related Section 106 compliance has led to the cultural resources inventory of large areas in and around the LBB, the identification of over 900 prehistoric archaeological sites along the Carlin Trend, and the excavation of more than 50 of these sites.

For the most part, this work has been guided by a document entitled, *A Treatment Plan for Prehistoric and Protohistoric Cultural Resources in the Little Boulder Basin Area*, prepared by P-III Associates, Inc., (P-III) in 1991 (Schroedl 1991). This document, hereafter referred to as the "1991 historic context", was prepared pursuant to the Programmatic Agreement between BGMI, BLM-Elko, the Nevada SHPO, and the ACHP that was also signed in 1991 (as documented by correspondence on file at BLM-Elko in cultural resources project file BLM 1-1582). The 1991 historic context has served multiple purposes. For one, it has functioned as a historic context in the general sense in which this term is used in the Secretary of the Interior's Standards and Guidelines for evaluation of historic properties (National Park Service 1995): it has provided a means of operationalizing National Register Criterion D for prehistoric sites in and around the LBB by outlining research questions and priorities specific to the archaeological record of this area. As such, the 1991 historic context has been an important tool used in evaluating whether sites in the area are eligible for the NRHP. Second, when archaeological excavations have been conducted as a mitigation measure, the 1991 historic context has served as a research design, at least at a general level, for those excavations.

Due in large part to the considerable amount of work that has taken place since it was written, some of the research questions outlined in the 1991 historic context have been answered, some have required revision, and new questions have arisen. Consequently, it is appropriate to reconsider NRHP-eligibility determinations made under the 1991 historic context, in many cases nearly 20 years ago, based on updated research priorities for the area: some sites may have originally been determined eligible because they were once judged to have potential for addressing research questions that have since been answered

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[1] The focus of this document is limited to prehistoric archaeological sites on the guidance of BLM-Elko. No NRHP-eligible historic sites are currently known within the LBB. Two historic mining sites located within the study area for this document have undergone data recovery and are no longer eligible for the NRHP (Jones 1994b; Schroedl 2007).

or that are no longer relevant, while other sites once determined not eligible may actually be very useful for research purposes in light of current knowledge about the archaeology of the region. A major purpose of this document—which is an update of the 1991 historic context and is proposed as a replacement for it—is to define a new set of research priorities for the LBB and surrounding area, based on the knowledge that has been gained since 1991, to be considered in future NRHP-eligibility evaluations or re-evaluations. These new research priorities also provide a foundation for any data recovery plans that may be required for future mitigation purposes, since site-specific research designs can be developed focusing on an appropriate subset of the research questions outlined in this revised context. The new research priorities are developed throughout the course of this document and are summarized in the final chapter.

As noted, this proposed update to the 1991 historic context is being prepared in consultation with and at the direction of BLM-Elko. Because its purpose is to provide a basis for future NRHP-eligibility evaluations or reevaluations, BLM-Elko is consulting with the Nevada SHPO regarding it, and the SHPO will review it. A copy will also be provided to the ACHP as a signatory to the BGMI Programmatic Agreement.

1.2. Research Background

The new research priorities developed in this document are based on a synthesis of the results of archaeological excavations conducted to date in the LBB and surrounding area and an evaluation of the current status of archaeological knowledge about the area. As mentioned, over 50 sites in the area have been excavated. However, a comprehensive treatment of the knowledge gained through these excavations has never been produced: several separate reports describe excavations at individual sites or small groups of sites, but the bigger picture that might be painted by the cumulative information obtained from these sites remains unclear. This document fills that gap by compiling the data from all excavated sites in the vicinity of the LBB (specifically, from a study area defined in Chapter 4 of this report) and by applying the collective dataset to research questions from the 1991 historic context (outlined in Chapter 3). This undertaking, together with a consideration of issues discussed in recent years in the peer-reviewed archaeological literature, enables an up-to-date assessment of the research themes outlined in the 1991 historic context, as well as the development of a revised historic context for the LBB.

1.3. Volume Organization

The next two chapters present background information for the research synthesis conducted in this document. Chapter 2 discusses the environment of the LBB and surrounding area, both past and present, and it also outlines the prehistoric cultural history of the area, based on a contemporary understanding of the archaeological record. In Chapter 3, the research topics laid out in the 1991 historic context are summarized and are then presented in a reorganized manner that corresponds to the way in which they are addressed subsequently in this document.

Chapter 4 defines the study area for this research context and presents basic information about the prehistoric archaeological sites that have been excavated within this area. Data from these excavated sites are applied in Chapters 5 through 9 to the research topics outlined in Chapter 3; any advances in our understanding of these topics that have occurred since 1991 are discussed in these chapters, and analyses of the cumulative datasets compiled for this document are conducted in order to evaluate previous conclusions about the prehistory of the area.

Chapter 5 discusses issues of site dating and the chronology of occupation of the study area. This chapter also addresses what has proved to be the greatest impediment to exploring change over time in the area, which is that assemblages from many sites are palimpsests resulting from repeated use of the same points on the landscape over the last few thousand years. Chapter 6 considers the limited amount of work that has been conducted in the study area to explore issues of site formation processes and paleoenvironment, whereas Chapter 7 discusses the large body of data relevant to issues of subsistence. In Chapter 8, the topic of site structure and function is explored, and in Chapter 9, the substantial chipped stone tool and debitage dataset from the study area is discussed and analyzed; the subject matter of both of these chapters bears on interrelated research questions about settlement systems and mobility patterns.

In each of Chapters 5 through 9, the current state of knowledge pertaining to the various research topics is assessed, and based on this evaluation, directions for future research are suggested. In Chapter 10, the research results and suggested future directions from those previous chapters are synthesized. This synthesis provides a new research context for the prehistoric archaeology of the LBB and surrounding area, which can be used as a basis both for future NRHP eligibility evaluations or reevaluations and for future excavation research designs. Chapter 10 concludes with recommendations for a comprehensive strategy, built on the new research context, for management of prehistoric cultural resources in the area.

2. ENVIRONMENTAL AND CULTURAL SETTING

Michael D. Cannon and Sarah Creer

As context for the research issues addressed in the remainder of this report, this chapter presents general overviews of both the environment and the prehistory of the Little Boulder Basin and surrounding area.

2.1. Environment

The Little Boulder Basin is located north of the Humboldt River in north-central Nevada (see Figure 1). In addition to the LBB itself, the study area for this research context (defined in detail in Chapter 4) also includes the northern tip of Boulder Valley, located to the southwest of the LBB, the upper reaches of the Boulder Creek watershed, located to the north of the LBB, and small portions of the Tuscarora Mountains and the Maggie Creek watershed, both located to the east of the LBB. This area is part of a region characterized by basin and range geomorphology, typified by rugged mountain ranges dissected by creeks and drainages. The LBB is a small valley located between two north-south-trending mountain ranges: the Tuscarora Mountains on the east and north and the Sheep Creek Range on the west. To the south, the LBB is flanked by the Tuscarora Spur, an elongated ridge that projects northwest from the Tuscarora Mountains into Boulder Valley.

2.1.1. Geology

The bedrock geology of north–central Nevada consists of rocks laid down from the late Proterozoic through the Triassic, with sporadic distributions of later Jurassic- and Cretaceous-age rocks (Coats 1987). The majority of these rocks were created from marine deposits that underwent numerous deformations over the millennia. One of the more significant tectonic events in the area was the movement of the Roberts Mountains thrust, which resulted in the eastward movement of silicic and volcanic rocks that were originally deposited on the ocean floor (Coats 1987).

Among the rock formations laid down in the area surrounding the LBB, several were important to prehistoric inhabitants as sources of raw lithic materials (see Figure 34 in Chapter 9). The Ordovician Vinini Formation makes up the primary bedrock of the Tuscarora Mountains around the LBB, and is composed of quartzite, limestone, calcareous sandstone, black shale, cherty shale, andesite lava, andesite tuff, interbedded chert, and siltstone (Schroedl 1995, 1996). Two named toolstones can be found in the Vinini Formation: Vinini Silicified Shale and Vinini Chert, both of which are found as tools and debitage at archaeological sites in the region and which outcrop at a single site (Site 26EU001851) located within the LBB (Schroedl 1995, 1996). The Valmy Formation is partly equivalent to the Vinini Formation and consists of vitreous quartzite interbedded with chert and shale (Roberts et al. 1967). Outcrops of the Valmy Formation nearest to the LBB are located in Whirlwind Valley, immediately south of Boulder Valley. Both these formations are remnants of the rocks moved eastward by the Roberts Mountains thrust (Roberts et al. 1967). The Roberts Mountain Formation, dating to the Silurian period, consists of dolomite, dolomitic limestone, and siliceous limestone interbedded with chert (Roberts et al. 1967). Outcrops of the formation are exposed in the Tuscarora Mountains (Roberts et al. 1967). This formation's cherts were also used for chipped stone tool production (Schroedl 1995, 1996).

Igneous rock formations in and around the LBB consist of Jurassic–, Cretaceous–, and Tertiary–aged volcanic episodes in the form of various lava flows and ash layers (Schroedl 1995, 1996). During the Miocene, volcanic deposits of rhyolitic ashes and tuff laid down to the north of the LBB eventually evolved into the group of cryptocrystalline rocks that includes Tosawihi chert, the toolstone quarried at the Tosawihi Quarries (Elston and Raven 1992). Tosawihi chert, also known as Tosawihi opalite, is the dominant toolstone observed in lithic assemblages from archaeological sites in the LBB (see Chapter 9 of this report). In addition to Tosawihi chert, volcanic activity near the Tosawihi Quarries also formed other potential toolstones. Basaltic andesite occurs along Basalt Canyon and forms the hills west of Tosawihi, while deposits of rhyolite are located to the east and southeast of Tosawihi (Elston 1992b). These lithic sources were used by prehistoric inhabitants for manufacturing grinding stones, hammerstones, and possibly flaked stone tools (Elston 1992b).

Other sources of cryptocrystalline rocks suitable for use as toolstone are located within the LBB as well as to the east and southeast of it. These toolstones are all described in detail by LaFond (1996a). The source for Sheep Creek Chert is found in the southern part of the LBB in the Sheep Creek drainage. This chert may come from outcrops of the geological formations that make up the Tuscarora Spur, such as the Roberts Mountain Formation, the Hanson Creek Formation, and the Vinini Formation. Schroeder Mountain Chert refers to several varieties of banded cherts that come from the Maggie Creek drainage in the Schroeder Mountain area on the east side of the Tuscarora Mountains. Hadley Chert is another toolstone that is found south and east of the LBB in the Maggie Creek drainage. In the Susie Creek area, located southeast of the LBB, two toolstones are present: Susie Creek Chalcedony and Susie Creek Chert. These materials can be found in the form of pebbles and small cobbles on the hills between Dry Gulch and Maggie Creek. These toolstones obtained from the Maggie Creek area are probably from the upper plate of the Roberts Mountain thrust.

Elko Hills Chalcedony, South Fork Quartzite, and South Fork/Elko Hills Chert are found in a source area further east of the LBB, between the Elko Hills and South Fork River. Elko Hills Chalcedony is found on the north flank of the Elko Hills and is subsumed within what Elston (1990a:171) describes as Elko Hills Chert. Sources of South Fork/Elko Hills Chert are found with Elko Hills Chalcedony on the north side of the Elko Hills and near the South Fork Reservoir. The chert obtained from the two locations cannot be differentiated, and it is probable that both sources are outcrops of the same geologic formation. This geologic formation may be an unnamed unit of Eocene cherty limestone known to contain large quantities of opaline chert (Coats 1987:55). South Fork Quartzite is found in primary geological deposits within the limestone that forms the cliff above South Fork Shelter at the confluence of the South Fork and Humboldt rivers.

Surficial deposits in the lower elevations of the LBB and surrounding area consist largely of Quaternary alluvium (Roberts et al. 1967). Holocene alluvial activity in the LBB transported material into the basin from the surrounding mountains in the form of cobbles and pebbles that may have been used by prehistoric inhabitants in hearths or as ground stone. Holocene volcanic episodes are also evident in deposits in the LBB, as represented by the ash layers from the Mount Mazama eruption that occurred around 6800 radiocarbon years before present (^{14}C yrs B.P.) (Schroedl 1995, 1996). Mazama ash is chemically distinct and distributed throughout northern Nevada, thus creating a temporal marker in the stratigraphy of the region (Elston and Raven 1992).

2.1.2. Hydrology

Water sources in the LBB and surrounding area are part of the Boulder Flat hydrographic area and are tributary to the Humboldt River (Maurer et al. 1996). Surface water sources consist of several drainages fed by discharge from springs and seeps, such as Sand Dune Spring, Knob Spring, Green Spring, and various other unnamed springs (Maurer et al. 1996). This system of creeks and drainages includes Rodeo Creek, Brush Creek, and Bell Creek, all of which flow into Boulder Creek, the main tributary of Rock Creek, itself a tributary of the Humboldt River. Though Boulder Creek is the largest stream flowing through the LBB, it is currently ephemeral over much of its length with the exception of a small section near its headwaters where streamflow is sustained (Maurer et al. 1996). Because water levels in the area are generally low, deposition of alluvial sediments in the area is minimal at present. However, many drainages show signs of past high–energy water flows, as evidenced by the depth of cut–banks (Schroedl 1995, 1996).

2.1.3. Flora

The LBB lies within the Big Sagebrush area of the Intermountain Sagebrush vegetation province (Bailey 1978). In riparian areas around the various creeks, drainages, springs, and seeps in the LBB region, native vegetation is composed of various willows (*Salix* spp.), bulrush (*Scirpus* spp.), cattails (*Typha latifolia*), and saltgrasses (*Distichlis* spp.). In other areas, native vegetation is dominated by big sagebrush (*Artemisia tridentata)* and rabbitbrush (*Chrysothamnus* spp.). Other native plants include pepperweed (*Lepidium* spp.), wildrye (*Elymus* spp.), wheatgrass (*Agropyron* spp.), Indian ricegrass (*Orysopsis hymenoides*), needle and thread grass (*Stipa* spp.), Idaho fescue (*Festuca idahoensis*), and galleta (*Hilaria jamesii*). Non–native invasive species that would not have occurred prehistorically are also present in the area and include Russian thistle (*Salsola kali*), cheatgrass (*Bromus tectorum*), and crested wheatgrass (*Agropyron cristatum*). An extensive list of the plant species present in north-central Nevada is contained in Appendix 3 of Schroedl (1995).

Plant communities in the valleys of the Great Basin can be grouped into four vegetation zones: the Creosote Bush, Shadscale, Sagebrush, and Pinyon-Juniper zones (Cronquist et al. 1986). The Creosote Bush Zone is present only in the extreme southern parts of the Great Basin, mostly outside of the Intermountain Region; therefore, it will not be discussed here. The remaining three zones are all present in north-central Nevada and are discussed separately.

Shadscale Zone

This zone, also known as the Saltbush Zone, is dominated by communities of shadscale or saltbush (*Atriplex* spp.). Shadscale is adapted to low moisture conditions and can tolerate somewhat saline valley soils. The shadscale community is well-developed in the valleys of western Nevada, where precipitation is low and salt concentrations in the soil are high. Communities of winterfat (*Eurotia lanata*) and greasewood (*Sarcobatus* spp.) are commonly encountered in the Shadscale Zone, as are scattered perennial and annual grasses.

Sagebrush Zone

Big sagebrush (*Artemesia tridentata*) replaces shadscale as the dominant vegetation at higher elevations where the annual precipitation is usually greater than seven inches. The LBB occurs within this Sagebrush Zone, which covers the broad valleys and lower foothills of the northern Great Basin. Big sagebrush communities thrive in well-drained valleys and at the bases of mountain ranges, especially on alluvial fans. Other shrubs commonly found in big sagebrush communities are little sagebrush (*Artenisia arbuscula*), rabbitbrush (*Chrysothamnus* sp.), Mormon tea (*Ephedra viridis*), spiny hopsage (*Grayia spinosa*), granite prickly phlox (*Linanthus pungens*), bitterbrush (*Pursia* sp.), gooseberry (*Ribes velutinum*), snowberry (*Symphoricarpos* spp.), and littleleaf horsebrush (*Tetradymia glabrata*). Grasses that are often co-dominant with sagebrush include wheatgrass (*Agropyron* sp.), Great Basin wildrye (*Elymus cinereus*), muttongrass (*Poa fendleriana*), and needle and thread grass (*Stipa comata*). In places, these bunchgrasses are abundant enough that the dominant vegetation is a sagebrush-grass community.

Pinyon-Juniper Zone

The Pinyon-Juniper Zone is sometimes treated as a montane zone, but in central and eastern Nevada, the valleys are high enough in elevation that pinyon-juniper can extend from mountain to mountain uninterrupted. This zone is usually found between 5,000 and 8,000 feet above sea level in areas where the annual precipitation is approximately 12 inches. This zone is dominated by the singleleaf pinyon (*Pinus* *monophylla*) and Utah juniper (*Juniperus osteosperma*). Some common understory shrubs and grasses associated with pinyon-juniper woodland are big sagebrush, rabbitbrush, bitterbrush, Mormon tea, Gambel's oak (*Quercus gambelii*), wheatgrass, needle and thread grass, and muttongrass.

Notably, the LBB lies to the north of the modern range of pinyon, and woodland communities in this part of the Great Basin are dominated solely by juniper. This is important because pinyon nuts, a staple resource elsewhere in the Great Basin both prehistorically and ethnographically, were not available in this region. There are ethnographic accounts of Shoshone groups residing along the Humboldt River from Elko to Palisade traveling south to the Ruby Mountains to gather pine nuts, but there is no indication that groups living further to the north along Maggie Creek did this (Elston and Budy 1990:15–16).

2.1.4. Fauna

The creeks, drainages, and springs within the LBB and surrounding area provide both a water source for fauna as well as a riparian habitat. A list of mammal species native to the area is provided in Table 1. Bird species of the area are listed in Bureau of Land Management (1992). Particularly relevant to prehistoric occupation in the area, the LBB is part of the mule deer (*Odocoileus hemionus*) migration corridors that run through the region (Bureau of Land Management 2007, 2008). Though migration patterns have been disrupted somewhat by mining activities in recent years, mule deer historically migrated both along Boulder Creek in the western LBB and along the Tuscarora Mountains to the east, moving between summer habitat in the higher reaches of the Tuscarora Mountains and winter habitat located on the east flanks of the Sheep Creek Range and along the Humboldt River. The LBB itself serves as an intermediate range staging ground, accommodating deer prior to their movements through the migration corridors. The western half of the LBB and adjacent portions of Boulder Valley and the Sheep Creek Range also provide crucial winter habitat for pronghorn (Bureau of Land Management 2007, 2008).

Table 1. Mammal Species of the Little Boulder Basin and Surrounding Area

Common Name	Scientific Name
Order Insectivora	
Family Soricidae	
Merriam's shrew	*Sorex merriami*
Vagrant shrew	*Sorex vagrans*
American water shrew	*Sorex palustris*
Order Carnivora	
Family Procyonidae	
Raccoon	*Procyon lotor*
Family Mustelidae	
Subfamily Lutrinae	
North American river otter	*Lontra canadensis*
Subfamily Mustelinae	
American mink	*Neovison vison*
American badger	*Taxidea taxus*
Long-tailed weasel	*Mustela frenata*
Ermine	*Mustela erminea*

Table 1. Mammal Species of the Little Boulder Basin and Surrounding Area

Common Name	**Scientific Name**
Family Mephitidae	
Western spotted skunk	*Spilogale gracilis*
Striped skunk	*Mephitis mephitis*
Family Canidae	
Coyote	*Canis latrans*
Wolf (extirpated)	*Canis lupus*
Kit fox (includes Swift fox [*V. macrotis*])	*Vulpes velox*
Red fox	*Vulpes vulpes*
Family Felidae	
Bobcat	*Lynx rufus*
Mountain lion/puma/cougar	*Puma concolor*
Order Rodentia	
Family Sciuridae	
Subfamily Xerinae	
Belding's ground squirrel	*Spermophilus beldingi*
Golden-mantled ground squirrel	*Spermophilus lateralis*
Least chipmunk	*Tamias minimus*
Merriam's ground squirrel	*Spermophilus canus*
Piute ground squirrel	*Spermophilus mollis*
Uinta chipmunk	*Tamias umbrinus*
White-tailed antelope ground squirrel	*Ammospermophilus leucurus*
Wyoming ground squirrel	*Spermophilus elegans*
Yellow-bellied marmot	*Marmota flaviventris*
Family Geomyidae	
Northern pocket gopher	*Thomomys talpoides*
Botta's pocket gopher	*Thomomys bottae*
Townsend’s pocket gopher	*Thomomys townsendii*
Family Heteromyidae	
Subfamily Perognathinae	
Great Basin pocket mouse	*Perognathus parvus*
Little pocket mouse	*Perognathus longimembris*
Subfamily Dipodomyinae	
Chisel-toothed kangaroo rat	*Dipodomys microps*
Dark Kangaroo mouse	*Microdipodops megacephalus*
Ord's Kangaroo rat	*Dipodomys ordii*
Family Castoridae	
American beaver	*Castor canadensis*

Table 1. Mammal Species of the Little Boulder Basin and Surrounding Area

Common Name	**Scientific Name**
Family Dipodidae	
Subfamily Zapodinae	
Western jumping mouse	*Zapus princeps*
Family Cricetidae	
Subfamily Neotominae	
Bushy-tailed woodrat (packrat)	*Neotoma cinerea*
Canyon deermouse	*Peromyscus crinitus*
North American deer mouse	*Peromyscus maniculatus*
Desert woodrat (packrat)	*Neotoma lepida*
Northern grasshopper mouse	*Onychomys leucogaster*
Pinyon deermouse	*Peromyscus truei*
Western harvest mouse	*Reithrodontomys megalotis*
Subfamily Arvicolinae	
Long-tailed vole	*Microtus longicaudus*
Montane vole	*Microtus montanus*
Muskrat	*Ondatra zibethicus*
Sagebrush vole	*Lemmiscus curtatus*
Family Erethizontidae	
North American porcupine	*Erethizon dorsatum*
Order Lagomorpha	
Family Ochontonidae	
American Pika	*Ochotona princeps*
Family Leporidae	
Black-tailed jackrabbit	*Lepus californicus*
Mountain cottontail	*Sylvilagus nuttalli*
Pygmy rabbit	*Brachylagus idahoensis*
White-tailed jackrabbit	*Lepus townsendii*
Order Artiodacyla	
Family Cervidae	
Elk	*Cervus elaphus*
Mule deer	*Odocoileus hemionus*
Family Antilocapridae	
Pronghorn antelope	*Antilocapra americana*
Family Bovidae	
American bison	*Bison bison*
Bighorn sheep	*Ovis canadensis*

Note: Table excludes bats. Compiled from range maps in Hall (1946). Scientific names follow Wilson and Reeder(2005). Common names follow Wilson and Cole (2000).

2.1.5. Paleoenvironment

During the late Pleistocene, the period to which the earliest evidence of a human presence dates, the landscape of much of the Great Basin was dominated by large pluvial lakes; however, no pluvial lakes were present in the LBB or its immediate vicinity. Lake Bonneville, the largest Great Basin pluvial lake, was located to the east, covering much of the eastern Great Basin from approximately the present-day Utah-Nevada border eastward. Lake Lahontan, the second largest Great Basin pluvial lake, sprawled across much of what is currently western Nevada, reaching into central Nevada to the west of the LBB. Closer to the LBB, a series of smaller pluvial lakes were present in valleys located south of the Humboldt River, ranging from Goshute, Independence, Clover, Ruby and Diamond Valleys to the southeast of the LBB, to Crescent and Grass Valleys to the south, to Buffalo Valley to the southwest. Additional pluvial lakes were located in valleys even further south and particularly to the southeast. As is clear in data collected from both Lake Bonneville and Lake Lahontan, pluvial lake levels fluctuated considerably during the Pleistocene (e.g., Benson et al. 1992; Madsen 2000). Vegetation in much of the Great Basin at this time consisted mostly of subalpine conifers and sagebrush steppe in the valley bottoms (Grayson 1993; Louderback and Rhode 2009). Pleistocene mammals in the Great Basin included ground sloths, horses, camels, mastodons, and mammoths. These, and other species, went extinct as part of the mass extinction that occurred before the onset of the Holocene (Grayson 1993).

The Holocene saw significant climate changes that divide it into three general periods. Though different names and date ranges have been proposed for these periods (see Antevs 1955; Currey and James 1982), for the purposes of this discussion the Holocene will be divided into three periods following Grayson (1993): early (10,000–7500 ^{14}C yrs B.P.), middle (7500–4500 ^{14}C yrs B.P.), and late (4500 ^{14}C yrs B.P.–present). These divisions are somewhat arbitrary, and dates of major paleoenvironmental changes differ somewhat among different parts of the Great Basin.

The early Holocene is generally characterized by a cooler and moister climate than is present today. The pluvial lakes and large marshes of the late Pleistocene had diminished considerably in size in the early Holocene, but shallow lakes and marshes were still present in many valleys. Pollen data from the early Holocene show a dominance of sagebrush in areas that are currently dominated by plants in the Cheno–am group (Grayson 1993), as well as an expansion of xerophytic shrubs such as shadscale into areas that had been dominated by pine and sagebrush during the late Pleistocene (Louderback and Rhode 2009). Faunal data from early Holocene sites, such as Homestead Cave, suggest that mammals currently only found at higher elevations—pikas (*Ochotona* sp.), yellow-bellied marmots (*Marmota flaviventris*), northern pocket gophers (*Thomomys talpoides*), bushy-tailed woodrats (*Neotoma cinerea*), and voles (*Microtus* sp.), for example—were present at much lower elevations, indicating a cooler climate (Grayson 1993; Madsen 2000). Data from Ruby Valley and Alkali Lake Basin indicate that at the end of the early Holocene, sometime between 8000 and 7000 ^{14}C yrs B.P., conditions became much drier, causing lakes to shrink and marshes to retreat (Grayson 1993).

The middle Holocene is characterized by generally hotter and drier conditions throughout the Great Basin (Grayson 1993). Many shallow lakes and marshes in the Great Basin significantly diminished or dried up altogether. Evidence of this drier climate can be seen in data indicating the desiccation of Owens Lake and lowered sedimentation rates in the Ruby Marshes (Benson et al. 2002). Data from tree stumps submerged in Lake Tahoe indicate that the lake remained below its overflow level during much of the middle Holocene (Benson et al. 2002). Even the Great Salt Lake may have almost completely dried up during this period (Madsen 2000). The warmer temperatures of the middle Holocene facilitated the spread of pinyon pine throughout the eastern Great Basin and prompted further expansion of Cheno-am plants, such as shadscale, into areas previously dominated by sagebrush (Grayson 1993; Louderback and Rhode 2009).

The climate change that occurred at the end of the early Holocene was also marked by a dramatic reduction in mammalian taxonomic richness (Grayson 2000). Some mammals that had survived in the cooler and moister conditions of the early Holocene diminished dramatically in certain areas of the Great Basin. These mammals include yellow-bellied marmots, pygmy rabbits (*Brachylagis idahoensis*), bushy-tailed woodrats, Ord's kangaroo rats (*Dipodomys ordii*), and Great Basin pocket mice (*Perognathus parvus*) (Grayson 2000; Madsen 2000). The pikas that were present in lower elevations in the early Holocene were compelled to move to the cooler climate of higher elevations (Grayson 1993). Moreover, the rarity of middle Holocene archaeological sites in the Great Basin suggests that human populations may also have declined in the region, possibly as a result of decreased surface water sources (Grayson 1993). However, it must be noted that the middle Holocene was not always dry everywhere. Evidence for wet periods in the midst of the middle Holocene exists in the Lahontan Basin, the Mono Lake Basin, and Diamond Pond (Benson et al. 2002).

The late Holocene, dating from around 4500 ^{14}C yrs B.P. to the present day, is characterized by moister, cooler conditions than the middle Holocene, but not as moist and cool as the early Holocene (Grayson 1993). According to data recovered from James Creek Shelter, located just to the southeast of the LBB, increased precipitation began in the middle Holocene and continued to 3200 ^{14}C yrs B.P. (Elston and Budy 1990). There was then a decrease in precipitation from 3200 to 2800 ^{14}C yrs B.P., followed by a short period of flooding activity and leveling out to essentially modern climate conditions a little before 2300 ^{14}C yrs B.P. (Elston and Budy 1990). As conditions became cooler and moister in the late Holocene, more sagebrush appeared in areas that had been dominated by Cheno–am plants in the middle Holocene (Grayson 1993; Louderback and Rhode 2009).

Some mammals that had diminished in areas during the middle Holocene rebounded in the late Holocene. At Homestead Cave, species such as Ord's kangaroo rats and Great Basin pocket mice both increased in abundance in the late Holocene and remain to the modern day (Madsen 2000). Some species that no longer reside in the Great Basin were also present at times during the late Holocene. There is evidence that bison were widespread in the eastern and northern parts of the Great Basin, including the LBB, in the very late Holocene (Grayson 2006). Bison were also likely present in parts of the Great Basin during the early and middle Holocene periods, but the available data are insufficient to indicate the extent or density of their distribution (Grayson 2006). In contrast to the early and middle Holocene, there is ample evidence of significant human populations throughout the Great Basin during the late Holocene.

2.2. Culture History

Most of the archaeological investigations that have been conducted to date in the LBB and surrounding area were performed by P-III, who used the prehistoric culture history framework presented in Table 2. This framework was derived with only minor modification from the phase sequence for the Upper Humboldt River area that was originally developed based on the excavation of James Creek Shelter (Elston and Budy 1990; also see McGuire et al. 2004). P-III's culture history sequence is evaluated elsewhere in this document, particularly in Chapter 5, but it is presented and discussed here in close to its original form for historical purposes because this is the chronological framework used in the majority of the work conducted under the 1991 historic context. The discussion presented here summarizes descriptions given by Schroedl (1995) for all periods except the Paleoarchaic and Early Archaic, knowledge of which has advanced considerably since the time of Schroedl's synthesis. In addition, for the Middle Archaic through Late Prehistoric periods, Schroedl's descriptions are supplemented with the results of more recent research.

Ethnographic information is not considered here because a very detailed summary of such information from the Upper Humboldt region as it pertains to the period of Euro-American colonization is provided by Elston and Budy (1990). More recent information derived from BLM tribal consultation, which is ongoing, is presented in the sources mentioned above in Section 1.1.

Table 2. Prehistoric Culture History Sequence for the Little Boulder Basin, after Schroedl (1995:Table 9)

Period[a]	Phase	Dates (calibrated B.C./A.D.)
Late Prehistoric	Eagle Rock	A.D. 1300–late 1800s[b]
Late Archaic	Maggie Creek	A.D. 700–1300
Middle Archaic	James Creek	850 B.C.–A.D. 700
Middle Archaic	South Fork	4600–850 B.C.
Early Archaic		8000–4600 B.C.
Paleoarchaic		12,250–8000 B.C.

a. The period designations used here do not follow Schroedl (1995:Table 9). Rather, the term Late Archaic is used, after Hockett and Morgenstern (2003), to refer to the period that begins roughly with the introduction of the bow and arrow, and Late Prehistoric is used, after Janetski and Smith (2007), to refer to the eastern Great Basin post-Fremont, presumably Numic, period. The term Middle Archaic is accordingly used as the designation for the pre–bow and arrow, late Holocene occupations of the LBB and surrounding area. Finally, the term Paleoarchaic is used here, rather than Schroedl's term Paleoindian, for reasons discussed in the text.

b. Schroedl (1995:Table 9) gives a terminal date of A.D. 1850 for the Eagle Rock Phase, but subsequent work (e.g., Schroedl and Kenzle 1997) suggests continuity in Eagle Rock material culture into at least the late 1800s, well after Euroamerican settlement of northern Nevada.

2.2.1. Paleoarchaic Period

Recently discovered evidence from the western Great Basin suggests that humans were present in this region prior to 12,000 ^{14}C yrs B.P. (Gilbert et al. 2008); this is, in fact, the earliest convincing evidence of people anywhere in North America. Evidence of human occupation of the Great Basin becomes somewhat more common after about 11,000 ^{14}C yrs B.P. (Beck and Jones 1997; Graf and Schmitt 2007). A majority of Great Basin archaeologists who study the period from this time through the early Holocene refer to this period as the Paleoarchaic. This contrasts with usage elsewhere in the Americas, where the period of initial human occupation is termed Paleoindian; the difference is warranted by an absence in the Great Basin of evidence for a subsistence focus on the hunting of megafauna, which the term Paleoindian implies (Beck and Jones 1997).

Madsen et al. (2005) divide the Great Basin Paleoarchaic into early and late sub-periods at approximately the beginning of the Holocene. Diagnostic artifacts of the Early Paleoarchaic period include both fluted and stemmed projectile point varieties, the precise chronological relationship between which is unclear (e.g., Beck and Jones 1997; Beck and Jones 2007; Grayson 1993). Late Paleoarchaic diagnostic artifacts include stemmed points and, after about 9000 ^{14}C yrs B.P., Pinto points (e.g., Hockett 1995). Elston and Katzer (1990:267) refer to the Late Paleoarchaic period in the Upper Humboldt River region as the Dry Gulch phase.

By far the majority of known Great Basin Paleoarchaic sites are situated in places that would have been adjacent to pluvial lakes or near other wetland settings, suggesting that the types of resources that could be found in such areas were the main focus of subsistence (e.g., Beck and Jones 1997; D. G. Duke and Young 2007; Schmitt and Madsen 2005). Faunal remains and human coprolites indicate that small mammals, birds such as waterfowl and sage grouse (*Centrocercus urophasianus*), and wetland plants were important food resources across the Great Basin throughout the Paleoarchaic (e.g., Broughton et al. 2008; Hockett 2007; Madsen et al. 2005; Pinson 2007).

Paleoarchaic materials are rare in the LBB and surrounding region. Great Basin Stemmed points are reported to occur only as "scattered" isolates in the area (Schroedl 1995:55). Outside of the area, stemmed points have been found, also in small numbers, at the Tosawihi Quarries (Ataman and Drews 1992:185; Hockett 2006b:Table 2) and along Susie Creek and Maggie Creek (Armentrout and Hanes 1986). Other reports of stemmed points from northeastern Nevada for which provenience information is available (Hockett 1995) are from areas far to the south or east of the Humboldt River. Fluted points are even rarer than stemmed points in the area north of the Humboldt: an artifact described as a Clovis preform is reported from the Tosawihi Quarries (Ataman and Drews 1992:183–185), and a Clovis point is reported from the Izzenhood Valley (McGuire et al. 2004:15). The rarity of Paleoarchaic materials in the LBB and surrounding region, which suggests only a transient human presence in the area during this period (Schroedl 1995), may be due to the absence, noted above, of terminal Pleistocene/early Holocene pluvial lakes in the region to the north of the Humboldt River and between the Lahontan and Bonneville Basins. Given the clear focus of Paleoarchaic settlement on wetland habitats, the absence of a substantial Paleoarchaic presence in this part of the Great Basin is perhaps not surprising.

2.2.2. Early Archaic Period

The shift from the Paleoarchaic to the Early Archaic period corresponds roughly to the onset of the middle Holocene period of generally warm and dry climate, one of the most dramatic environmental changes evident in the climatic record of the region. Much remains unknown about the Early Archaic in the LBB due to a lack of well-dated sites or artifact assemblages from this period (Schroedl 1995:55). Accordingly, Schroedl (1995) defined no phases within this period in the LBB. Elston and Katzer (1990:267) tentatively proposed an Early Archaic "No Name phase" for the Upper Humboldt area, based on admittedly scant evidence for human occupation of the region during this period. The sparseness of such evidence is consistent with an apparent Great Basin-wide pattern of low human population densities during the middle Holocene (Grayson 2000). Based on findings from outside of the LBB area, Early Archaic occupations would likely be characterized by Pinto series projectile points (e.g., Hockett 1995).

2.2.3. Middle Archaic Period: Pie Creek, South Fork, and James Creek Phases

The beginning of the Middle Archaic period corresponds roughly to the climatic amelioration that occurred throughout the Great Basin at the transition from the middle to the late Holocene. In the LBB area, the first Middle Archaic phase that Schroedl (1995) recognized is the South Fork phase[2]. Aside from the few isolated Paleoarchaic artifacts noted above, the South Fork Phase represents the earliest archaeologically visible human presence in the LBB. However, deposits at Pie Creek Shelter, located approximately 35 miles to the northeast of the LBB, enabled McGuire et al. (2004) to identify a Pie Creek phase for the Upper Humboldt River region, dating to the period of transition from the middle to the late Holocene and immediately pre-dating the South Fork phase. At this site, stratigraphic units assigned to the Pie Creek Phase produced three Humboldt Concave Base projectile points and one specimen each of the Northern Side-notched, Gatecliff series, and Elko series point types. Faunal remains from the shelter are dominated by small-bodied prey during this period, and the ground stone and botanical assemblages indicate extensive plant exploitation; this is consistent with a broader Great Basin–wide increase in the use of small seed resources and grinding tools that began during the early to middle Holocene transition (e.g., Grayson 1993; Rhode et al. 2006). Overall, McGuire et al. (2004:123–125) suggest that, during the Pie Creek phase, Pie Creek Shelter was occupied by highly mobile foragers who focused on wetland resources that would have been available in the vicinity of the shelter.

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[2] Schroedl (1995) uses a beginning date for the South Fork phase of 4600 B.C., which falls well before the beginning of the late Holocene (the beginning date for the late Holocene that is used here, 4500 ^{14}C yrs. B.P., calibrates to approximately 3200 B.C.). However, as is discussed in Chapter 5, a beginning date for the South Fork phase of perhaps 2600 B.C. is better supported by radiocarbon dates from James Creek and Pie Creek shelters.

Sustained human occupation of the LBB area appears not to have begun until the South Fork phase. Schroedl (1995) considers Humboldt Concave Base projectile points to be diagnostic of this phase, though, as noted above, work at Pie Creek Shelter indicates that they were likely also used earlier in the Upper Humboldt region. Schroedl also suggests that Gatecliff Split Stem, Gypsum (or Gatecliff Contracting Stem), and Elko Eared points date primarily to the latter portion of the phase. Beyond this, Schroedl (1995:56) describes the South Fork phase in the LBB as "poorly understood". Based on their more recent work at Pie Creek Shelter, McGuire et al. (2004) suggest that subsistence practices were reorganized around the acquisition of large game during this phase, and that settlement systems may have been restructured, with a greater degree of logistical (sensu Binford 1980) resource harvesting.

The James Creek phase is the latest Middle Archaic phase defined for the LBB area. Schroedl (1995) notes that Elko Corner-notched and Side-notched projectile points appear to have been most common during this phase, though because these point types were likely also used both before and after this time, they cannot be considered truly diagnostic of it. At Pie Creek Shelter, McGuire et al. (2004) suggest that there was a continued focus on large game during the James Creek phase, and that settlement continued to be logistically organized. Further, there is a reduction in the quantity of exotic lithic material types in the shelter during this time, which McGuire et al. (2004:128) interpret as indicating a reduction in overall foraging territory size. Notably, larger residential camps dating to this phase are known from the Upper Humboldt region, including a site along Dry Susie Creek, just to the southeast of the LBB, at which evidence of pit structures was found (Reust et al. 1994; Smith and Reust 1995).

2.2.4. Late Archaic Period: Maggie Creek Phase

The Late Archaic period, represented in the LBB area by the Maggie Creek phase, is associated with the appearance of bow-and-arrow technology in the region. Arrow point types such as Eastgate Expanding Stem, Rose Spring Corner-notched, and Rye Patch Miniature are diagnostic of this phase (Hockett and Morgenstein 2003; Schroedl 1995). At both James Creek and Pie Creek Shelters, occupations appear to have been the most intensive during this phase (McGuire et al. 2004:16–17, 129–130). At Pie Creek Shelter, exotic tool stone continues to decline during the Maggie Creek phase, suggesting further contraction of foraging ranges, and use of plant resources may also have intensified (McGuire et al. 2004:129–130). Throughout northeastern Nevada more broadly, characteristics of Fremont assemblages—such as Fremont-like ceramics, Fremont-style side-notched projectile points, and corn remains—are present in sites or components that date to the Maggie Creek phase (Hockett and Morgenstein 2003). Most such sites are located some distance to the east and southeast of the LBB, though maize pollen may be present in samples from James Creek Shelter (Madsen 1990:109).

2.2.5. Late Prehistoric Period: Eagle Rock Phase

During the Eagle Rock phase, the single phase of the Late Prehistoric period in the region, new types of projectile points and new types of pottery appear. Schroedl (1995) considers the small Desert Side-notched and Cottonwood Triangular arrow point types to be diagnostic of this phase, as well as irregular brownware pottery (i.e., Intermountain Brownware). The Eagle Rock phase and its characteristic artifacts may represent an expansion of Numic-speaking peoples out of the Mojave Desert (e.g., Bettinger and Baumhoff 1982; Kaestle and Smith 2001; Rhode 1994). Whatever the cause, however, significant changes are evident in the archaeological record of the region around the beginning of the Eagle Rock phase, and the overall pattern appears to represent significant intensification of the use of small game and plant resources relative to earlier periods (Bright et al. 2002; Ugan and Bright 2001).

3. RESEARCH SETTING

Michael D. Cannon

The 1991 historic context for the LBB (Schroedl 1991) grouped research topics into six "domains". This chapter begins with a brief overview of these research domains. Following this, research topics are organized in a slightly different manner, corresponding to the way in which they are addressed in this revised research context, and the scope of the analyses presented for each research topic in subsequent chapters is summarized.

3.1. Research Domains in the 1991 Historic Context

The 1991 historic context discussed many areas in which research was needed, as of the date of its development, in order to better understand the prehistory of the LBB and surrounding area. Topics for research were grouped into these six domains:

1. Site Structure and Function
2. Settlement and Subsistence Patterns
3. Paleoenvironmental Analysis
4. Site Formation Processes
5. Chronology
6. Lithic Technology and Abiotic Resource Procurement

Since the time it was written, the questions and issues discussed within the context of these research domains in the 1991 document have guided virtually all NRHP-eligibility evaluations and all archaeological data recovery excavations in the LBB and surrounding area (cf. Cannon et al. 2008:18-24). Knowledge within some of the research domains has advanced since 1991, to be sure, but the basic kinds of questions asked of the LBB archaeological record have not changed in a substantive way since then. Moreover, because, as Schroedl (1991:41) explicitly states, the research domains in the 1991 historic context were derived from a context for the Upper Humboldt River region prepared almost a decade earlier by Rusco (1982a), it can be argued that much of the research approach employed in the area dates back nearly 30 years.

In the 1991 historic context, specific research questions were posed for some of the research domains, while for other domains only general research needs were mentioned. What follows briefly summarizes the questions and issues laid out in that document that are relevant to each of the research domains, as well as the work that has been conducted since 1991 within each domain; more detailed discussions of the history of research conducted within each domain are presented in subsequent chapters of this document. The 1991 historic context presented a few research questions outside of the discussion of research domains that are clearly related to the research domains; for simplicity of presentation, these questions are addressed here within the context of their respective research domains.

3.1.1. Site Structure and Function

The 1991 historic context proposed that analyses of site structure and function could be used to determine where groups in the LBB fell along Binford's (1980) forager-collector continuum of settlement systems and how this might have changed over time (Schroedl 1991:45–66). Application of Binford's forager-collector rubric, in fact, has a history in the LBB and surrounding area that can be traced back almost to the time when Binford published it (Rusco 1982a), and it is not unfair to say that it has provided the central organizing principle for most of the archaeological research that has been conducted in this region (see also Elston and Budy 1990:11–19).

A clear statement of how Binford's forager-collector continuum would be operationalized was not presented in the 1991 historic context, but it can be inferred from this document that methods should involve classification of sites into functional categories that derive from Binford's analysis (e.g., short-term residential base camp, field camp, etc.), based on interpretations of site structure informed by ethnoarchaeological research (e.g., Bartram et al. 1991; Binford 1978b; O'Connell 1987; O'Connell et al. 1991; Simms 1988). Later data recovery plans prepared in order to implement the 1991 historic context at specific sites (e.g., Kice et al. 1993) provided greater methodological guidance for site classification based on both site structure and artifact assemblage composition.

Developments over time in the study of site structure and function in the LBB and surrounding area are explored in greater detail in Chapter 8 of this document. Here, it suffices to say that, since the implementation of the 1991 historic context, it has been common practice to classify investigated sites into functional categories, but the basis for doing so has not always been clear or consistent. In addition, despite the ubiquity of site classification, little attempt has been made to synthesize the results of exercises in site classification into a coherent statement about settlement systems. Only recently has any synthetic argument about the nature of settlement systems in the region been advanced, and this argument does not actually rely to any great degree on data from north-central Nevada. Specifically, McGuire and colleagues (McGuire and Hildebrandt 2005; McGuire et al. 2004) have suggested, based on evidence generalized from across the Great Basin, that the groups who occupied northern Nevada during the late Holocene adopted logistically organized settlement systems (sensu Binford 1980). However, whether such logistical organization was actually practiced in the LBB and surrounding area remains to be demonstrated with data from this region. To the extent that it is possible to do so, data from the region pertaining to site structure and function are used in Chapter 8 to classify sites in a consistent manner and to draw conclusions about settlement organization. To the extent that it is not possible to do these things using existing data, research methods that might fill in the gaps in the future are described, as are alternative perspectives on the issue.

Outside of the general discussion of site structure and function and the forager-collector continuum, the 1991 historic context also outlined additional questions and issues related to the functional classification of sites or activity loci (i.e., individual areas within sites). These are considered next.

Classes of Cultural Properties

It was proposed that sites be classified according to their degree of complexity, measured in terms of artifact and feature diversity, and it was argued that this should reflect behavioral variability (Schroedl 1991:35-38). Since then, it has become apparent that sites or activity loci that might be classified as complex under the scheme proposed in the 1991 historic context may be complex primarily because they are multicomponent: i.e., they have palimpsest assemblages produced by repeated occupation. It has also been suggested that less dense and "simpler" surface assemblages are more likely to be associated with buried single-component deposits than are denser and more "complex" surface assemblages (e.g., LaFond et al. 1995). Likely for these reasons, classification of sites into categories of "simple" and "complex" has not generally been pursued in archaeological research in the area. It is likewise not pursued in the analyses presented in this document; rather, to the extent that it is possible to do so, single-component sites or site loci are classified into functional types based on assemblage composition and site structure.

Activity Locus Type Frequencies

The 1991 historic context asked how common different types of activity loci are in the LBB (Schroedl 1991:43–44), information that could be applied to more general research questions about settlement systems. As noted above, in virtually every inventory and excavation project conducted after the development of the 1991 historic context, sites were classified into various functional categories, but not in a particularly systematic manner. In addition, as also noted above, many excavated deposits have proven to be multicomponent and thus difficult to classify. An attempt at classifying loci into functional categories in a consistent manner, taking palimpsest deposits into account, is presented in Chapter 8. In doing so, the basic questions of how abundant loci of different types are and whether temporal changes in locus type frequencies are evident are addressed.

Spatial Distribution of Locus Types

The 1991 historic context also proposed that spatial relationships among locus types should be examined, as should the distribution of locus types in relation to environmental factors such as vegetation type, topography, distance to water, and distance to raw materials (Schroedl 1991:44). An overall analysis of the distribution of locus types has never been conducted, likely due, at least in part, to the "multicomponent problem" discussed above. More limited aspects of this topic, however, have been examined: for example, a relationship between hunting/processing sites and springs has been demonstrated to some degree (Tipps 1997a; Tipps and Miller 1998). Spatial distributions of locus types are analyzed further in Chapter 8 of this document, and directions for future research that might result in a better understanding of the spatial dimension of settlement systems are also discussed.

3.1.2. Settlement and Subsistence Patterns

It was argued in the 1991 historic context that models from evolutionary ecology, and from foraging theory in particular (e.g., Cannon and Broughton 2010; Stephens and Krebs 1986), could be used to help understand subsistence and settlement patterns (Schroedl 1991:66–72). The sole method that the 1991 historic context proposed for applying foraging theory models to the LBB archaeological record was to conduct a "range site" analysis, involving the use of soil types to reconstruct patch return rates (i.e., the amount of calories that could be obtained per unit time from a given area). A range site analysis has not been pursued for the LBB area since 1991. This approach has proven useful in other Great Basin contexts (e.g., Zeanah 2004; Zeanah et al. 2004), but given the extraordinary data requirements of the approach (see Grayson and Cannon 1999), it is perhaps understandable that it was never attempted for this area.

On the other hand, syntheses of subsistence data from the numerous excavated sites in and around the LBB—including faunal, floral, ground stone, and thermal feature data—have been completed and have revealed patterns that are argued to be understandable in terms of foraging theory, largely employing methods not considered in the 1991 historic context (e.g., Birnie 1996b; Bright 1998d; Corbeil 1996; Coulam 1996; Ugan and Bright 2001). In particular, it has been proposed that there is evidence for a substantial increase in diet breadth in the LBB at about A.D. 1300 (i.e., around the beginning of the Eagle Rock phase). Subsistence-related data from the LBB have even inspired the development of a novel evolutionary ecology model designed to explore the relationship between subsistence change and technological change, and based on this model it has been suggested that the post–A.D. 1300 expansion of diet breadth led to changes in ground stone, chipped stone, and ceramic technologies (Bright et al. 2002).

In Chapter 7 of this revised context, cumulative data from the study area are used to evaluate whether changes in diet breadth and resulting changes in technology are, in fact, supported by the available evidence. The results are then considered in light of recent debates over subsistence change in the region (Broughton et al. 2008; Byers and Broughton 2004; Hockett 2005; McGuire and Hildebrandt 2005), and directions for future research related to the topic of subsistence are explored.

3.1.3. Paleoenvironmental Analysis

The 1991 historic context described a general need for understanding environmental change in the LBB and surrounding area during the course of human occupation, but it provided little methodological detail regarding how this might be accomplished (Schroedl 1991:72–75). Moreover, since 1991, only very limited paleoenvironmental research has been conducted in the LBB area. This is understandable given that most cultural resources work has focused on archaeological sites and given that the most useful types of paleoenvironmental data (e.g., the data provided by packrat middens or by cores from wetland sediments) generally do not come from archaeological sites. However, the collection of additional paleoenvironmental evidence remains an important need if the human prehistory of the LBB area is to be fully understood. The limited paleoenvironmental information that is available from the LBB is summarized in Chapter 6 of this document, and recommendations are also offered there regarding paleoenvironmental research that might be carried out as a supplement to work conducted in the context of compliance with cultural resource regulations.

3.1.4. Site Formation Processes

A general discussion of the various natural and cultural factors that can affect the composition of archaeological assemblages and the spatial distribution of archaeological materials was presented in the 1991 historic context, and it was stated that analyses would be conducted to address such factors in subsequent excavations (Schroedl 1991:75–78). However, since 1991, the only efforts that have been made in the LBB area within this research domain have been a few attempts to explore the effects of geomorphological processes on archaeological deposits. This work has shown, for example, that post-depositional processes have likely contributed to the formation of multicomponent deposits (Schroedl 1997:55–56). It has also become clear that rates of deposition have been very low throughout the late Holocene in many LBB contexts, further adding to the problem of palimpsest assemblages (e.g., Cannon et al. 2008:172–181). These important points aside, a synthetic understanding of site formation processes has not yet been developed for the area, even though sufficient information is now available from excavations conducted throughout the area to draw some general conclusions. Such conclusions are discussed in Chapter 6 of this revised context, with specific reference to the issue of multicomponent deposits.

Outside of its discussion of the site formation process research domain, but clearly relevant to this domain, the 1991 historic context raised two additional issues that are discussed next.

The Effect of Artifact Collecting on Surface Assemblages

The question of whether artifact collecting has biased surface artifact assemblages was considered in the 1991 historic context (Schroedl 1991:34–35) and has since been addressed in several studies (Cannon et al. 2008:296–299; LaFond and Jones 1995; Schroedl 1995, 1996). The results of these studies have been mixed, in some cases suggesting that biases due to artifact collecting are present and in other cases suggesting that they are not. To provide a more complete answer to the question than these earlier studies, each of which was based only on assemblages from individual sites or small groups of sites, the cumulative dataset from all excavated sites in the area compiled for this document is applied to the question in Chapter 6.

Early Archaeological Deposits in the Little Boulder Basin

The 1991 historic context noted that archaeological materials might be buried in alluvial deposits along the major creeks in the LBB and suggested that this may have biased the sample of known archaeological sites with respect to site function; that is, it was proposed that some types of sites might be underrepresented because they are deeply buried (Schroedl 1991:34). After 1991, the focus turned to the question of whether burial in alluvium could have produced a bias with respect to site age; that is, whether it might account for the low numbers of known pre–Maggie Creek phase occupations and the complete lack of archaeological deposits dating to the middle Holocene (e.g., Tipps 1996). Two studies have been conducted to address this issue (Birnie 1996a; LaFond and Jones 1995), and they suggest that early deposits have eroded out of the LBB and are thus unlikely to be preserved. However, these studies are not exhaustive with respect to the full range of geomorphological settings in the area. Moreover, exposures of Mazama tephra along Rodeo Creek suggest that early Holocene sediments are present in at least some places, and there is a corresponding likelihood that early Holocene archaeological materials may be present as well. There thus remains a need for systematic geoarchaeological work designed to evaluate whether buried pre–Maggie Creek phase deposits are in fact present in the LBB and surrounding area. As with paleoenvironmental research, this geoarchaeological research would likely require work—specifically, deep testing—conducted outside of known archaeological sites, and recommendations are made in Chapter 6 regarding how such research that might be carried out.

3.1.5. Chronology

The very brief discussion of the chronology research domain in the 1991 historic context mentioned a need for a refined chronology of projectile point types for the LBB area and a need for greater use of obsidian hydration dating (Schroedl 1991:78–79). Both of these needs were soon addressed, as Schroedl (1995) evaluated and updated the projectile point chronology for the area and also developed a hydration chronology for obsidian from the Paradise Valley source, the most commonly represented obsidian source in the LBB. Schroedl's projectile point and obsidian hydration chronologies have since been used during virtually all of the work conducted in the area. More recently, further refinements to the culture history of the region have been made (e.g., Hockett and Morgenstein 2003; McGuire et al. 2004). The current status of knowledge about projectile point chronology, obsidian hydration chronology, and the overall culture history sequence for the area is evaluated in Chapter 5.

Temporal Change

The 1991 historic context asked a seemingly innocuous question outside of the discussion of the chronology research domain, though it was noted that this question is very much related to that domain: "what temporal changes occur through time in settlement patterns, artifact classes, raw material, and reduction stages in the Little Boulder Basin Area?" (Schroedl 1991:45). This is, of course, the most basic type of question that can be asked of the archaeological record, but, to date, temporal changes have been explored only to a limited degree in the LBB and surrounding area. This is due in part to the lack, noted above, of synthetic analyses of data from multiple sites that might allow patterns of change over time to emerge. However, to perhaps a greater extent, it is also due to the fact that a substantial proportion of the deposits that have been excavated in the LBB are multicomponent. When sites or site loci contain evidence of occupation during multiple time periods, it becomes difficult to assign them to individual periods, and the ability to make comparisons among time periods is reduced accordingly.

The 1991 historic context did not foresee that multicomponent deposits would be a significant problem in the LBB area. However, soon after implementation of the 1991 historic context, researchers began to consider multicomponent deposits to be a major impediment to archaeological interpretation (e.g., Schroedl 1995:Chapters 10 and 11), and field methods began to be modified accordingly (e.g., J. B. Jones

1996b:62). It also began to be thought that large sites with dense surface artifact assemblages might be more likely to be the result of repeated occupation, and thus of lesser interpretive value, than smaller, less dense sites (e.g., LaFond et al. 1995). Despite efforts made to improve the situation over the years, though, many excavated site loci continued to produce palimpsest assemblages (e.g., Birnie 2001), to the extent that the most recent large-scale excavation project conducted in the area (Cannon et al. 2008) had as a central focus the development of methods for more efficiently and more effectively identify single-component deposits.

Although the issues considered in the brief section on the chronology research domain in the 1991 historic context are fairly straightforward, the largely unanticipated "multicomponent problem" continues to present unresolved challenges. Because of the importance of being able to extract temporal change from the archaeological record, a very high priority for future research in the LBB area should be to find ways to resolve these challenges. Initial steps towards doing so are presented in Chapter 5 of this revised context, which takes a comprehensive look at the chronological data from individual sites and site loci in order to reevaluate which might be single-component, and which also suggests some methods that might help to better identify single-component deposits in the future.

3.1.6. Lithic Technology and Abiotic Resource Procurement

Three distinct sub-domains were considered in the lithic technology and abiotic resource procurement research domain of the 1991 historic context, and an additional question related to lithic technology was asked outside of the discussion of this domain.

Lithics and Activity Locus Function

It was proposed in the 1991 historic context that lithic analysis could be used to address the issue discussed above of site function and its relationship to settlement systems (Schroedl 1991:80–83). In particular, it was suggested that site or locus function could be inferred from an analysis of the relationship between lithic assemblage diversity and assemblage size, with more diverse assemblages, controlling for size, indicating a wider variety of activities. At least one study has used a variant of the method outlined in the 1991 historic context with some degree of apparent success (Cannon et al. 2008:271–274). In Chapter 8 of this revised context, a slightly different approach—but one that still takes overall assemblage diversity into account—is applied to the cumulative dataset from the study area as part of the larger effort to classify sites into functional categories in a consistent and useful manner.

Toolstone Procurement Strategies

In its discussion of lithic resource procurement strategies (Schroedl 1991:83–86), the 1991 historic context primarily considered use of material from the Tosawihi Quarries chert source, which, as noted in Chapter 2, is by far the dominant toolstone type at archaeological sites in the LBB and surrounding area. Discussion of the use of this material was largely couched in terms of Elston's economic model of Tosawihi lithic material type procurement (e.g. Elston 1990b, 1992c). Work conducted in the area since 1991 has suggested that, contrary to a key assumption of Elston's model, not all material obtained from Tosawihi was transported from the quarries in the form of bifaces; rather, it is clear that some was taken away in the form of more costly-to-transport non-bifacial cores (Cannon et al. 2008; Hockett 2006b; LaFond 1996b; Schroedl 1997). Recognition that this assumption is problematic (made possible only by application of Elston's very productive model) leads to new questions about how and why toolstone reduction and transport strategies varied over time and space. Chapter 9 of this revised context presents a comprehensive analysis of such issues for the study area and discusses the new questions that are raised.

Lithic Technology and Mobility

The 1991 historic context presented an insightful discussion, related to issues of settlement systems discussed above, of how lithic technology might be influenced by mobility patterns (Schroedl 1991:86–89). LaFond (1996b) subsequently presented a far-ranging treatment of such issues using data from the first few years of excavation following implementation of the 1991 historic context. More recently, McGuire and colleagues (McGuire and Hildebrandt 2005; McGuire et al. 2004) have presented a more focused argument, suggesting that mobility became increasingly logistical between the middle and the late Holocene, not only in northern Nevada but throughout the Great Basin, and noting that such changes in settlement should be reflected in lithic assemblages (e.g., Kelly 1988; Parry and Kelly 1987). However, as noted above, the increase in logistical organization that McGuire et al. (2004) suggest occurred has yet to be demonstrated using data specific to the LBB area. Moreover, it is becoming clear that the relationship between lithic technology and mobility is more complex than previously thought (e.g., Prasciunas 2007). An updated analysis of the comprehensive chipped stone dataset from the LBB area, which incorporates recent insights into the relationship between lithic technology and mobility, is presented in Chapter 9.

Variability in the Use of Lithic Raw Materials

Finally, related to the issue of toolstone procurement discussed above but in another section of the document, the 1991 historic context noted a need to understand variability in the use of lithic materials from sources in addition to the Tosawihi Quarries (Schroedl 1991:44–45). Though Tosawihi chert overwhelmingly dominates most lithic assemblages in the LBB, other types of cryptocrystalline silicates also occur in small amounts at many sites, as does obsidian from a variety of sources. Changes in the proportion of different material types in lithic assemblages may be related to larger-scale changes in land-use across northern Nevada (e.g., Hockett 2006b), though this has yet to be explored in detail using data from the LBB. This is done in Chapter 9 of this revised context as part of a larger set of lithic analyses directed at issues of settlement and mobility.

3.2. Organization of Research Topics for This Revised Context

In this revised research context for the LBB and surrounding area, all of the basic research issues outlined in the 1991 historic context are addressed, but they are approached in a different order. Chronological issues are considered first since they are fundamental to all other research topics: the basic temporal framework for the study area must be evaluated, and attempts to deal with the "multicomponent problem" made, before progress on any of the remaining, higher-order domains can be achieved. Issues within the site formation process and paleoenvironment domains are also fundamental to higher-order research topics, and these two domains are best addressed using somewhat similar approaches, so they are considered together after chronology. The higher-order domains of subsistence, site structure and function, and lithic technology are addressed last. Because research within each of these higher-order domains can help us understand prehistoric landscape use, settlement and mobility systems are a thread that runs through the discussion of all of them.

The following chapters address each of these topics in order. The scope of the analyses presented within each chapter is briefly described here.

3.2.1. Chronology and the "Multicomponent" Problem

Issues of chronology are addressed by first examining the radiocarbon record from the LBB area and evaluating projectile point and obsidian hydration chronologies. Then, all data from individual sites or site loci that bear on age of occupation are compiled. The lines of evidence that are relevant to this are radiocarbon dates, temporally diagnostic artifacts—specifically, projectile points and ceramics—and obsidian hydration measurements. This allows a case-by-case reassessment of whether individual sites or site loci are single-component and, if so, to which time period they date. In the course of evaluating whether sites or site loci are single-component, a method for more consistently identifying single-component assemblages based on available dating information is discussed.

As noted above, excavation efforts in the LBB have become more focused over the years on specifically targeting areas that are likely to be single-component (e.g., Cannon et al. 2008). Central to these efforts have been attempts to more efficiently locate subsurface features so that potential activity areas can be quickly tested and evaluated as to whether they are single-component before initiating more extensive, and more expensive, excavations. To advance these efforts, a statistical modeling exercise geared towards helping to predict which sites in the LBB area are likely to have subsurface features is discussed in the chapter on chronology. Though it may seem at first glance to have little to do with chronological issues, the purpose of the predicting feature locations is to improve the chances of selecting deposits for excavation that are single-component and thus more useful for addressing larger research questions involving temporal change.

3.2.2. Site Formation Processes and Paleoenvironment

In the chapter on site formation processes and paleoenvironment, the results of previous geoarchaeological investigations in the LBB and surrounding area are synthesized in order to improve our understanding of geomorphological site formation processes. This is done with a particular focus on identifying the types of settings, if any, that are likely to preserve single-component deposits and/or deposits dating to time periods that are relatively underrepresented or missing altogether in the currently known archaeological record of the area. Previous geoarchaeological research is also used to summarize what is currently known about past environments in the study area. Based on these summaries of previous research, recommendations are made for future geoarchaeological and paleoenvironmental research so that current gaps in knowledge can be filled in. Recommendations are also made regarding the potential future use of geophysical remote sensing techniques based on the results of previous efforts (e.g., Cannon et al. 2008).

A final issue considered within the realm of site formation processes is whether illegal artifact collection has had a measurable effect on surface artifact assemblages. This issue is addressed using the comprehensive chipped stone tool and debitage dataset compiled for this document.

3.2.3. Subsistence

Compared to the relatively limited amount of research into site formation processes and paleoenvironment that has been conducted in the study area, a great deal more work has been done that is relevant to understanding subsistence. Accordingly, the chapter of this revised context that is devoted to issues of subsistence includes detailed overviews of past approaches to research into such issues and of previous results. New analyses of the comprehensive archaeofaunal, macrobotanical, ground stone, ceramic, and thermal feature datasets from the study area are also presented in order to evaluate previous conclusions about prehistoric subsistence.

3.2.4. Site Structure and Function

Building on the examination of the age of occupational events presented in the chapter on chronology, the site structure and function chapter presents an analysis of site structure for single-component sites or loci, and then classifies those sites or loci into functional types based on artifact assemblage composition. In doing so, an example is provided of how sites or loci investigated in the future might be classified in a manner that is both consistent and relevant to larger research questions about settlement systems. Spatial relationships among sites or loci of different types, and in relation to environmental features, are also considered.

3.2.5. Lithic Source Use, Technology, and Mobility Patterns

In Chapter 9, the final chapter of this document in which previously collected data are analyzed, the comprehensive chipped stone tool and debitage dataset compiled for the study area is applied to questions about the interrelated issues of raw material source use, technological organization, and settlement systems. Analysis of source use focuses both on the contribution of Tosawihi chert relative to other lithic sources and on the relative use of different obsidian sources; changes in source use over time are also explored. In the realm of technological organization, lithic data are used to draw inferences about reduction and transport strategies, and results are evaluated with respect to Elston's model for use of the Tosawihi Quarries. Finally, the results of these analyses are used, in conjunction with the results regarding site structure and from the previous chapter, to develop a model of regional settlement systems and of changes over time therein. This model provides the basis for a new phase of research into issues of settlement and mobility in the LBB area.

4. THE DATASET: EXCAVATED SITES IN THE LITTLE BOULDER BASIN AREA

Michael D. Cannon and Amber Tews

This chapter describes the study area considered in this document, as well as the excavation projects and excavated sites within the study area that provide the data analyzed in subsequent chapters.

4.1. Study Area

The study area for this research context is shown in Figure 2 and Figure 3; also shown in Figure 2 are the boundaries of mining operations areas within the study area, after the Newmont South Operations Area Project Amendment (SOAPA) DSEIS (Bureau of Land Management 2007:2-24–2-25) (see Table 3). The study area is centered on the LBB and the BGMI operations area, but it also incorporates areas to the north and south where archaeological excavation projects have occurred. The boundaries of this area were determined in consultation with Bill Fawcett, BLM-Elko archaeologist, and are based in part on the cultural resources cumulative effects analysis area used in the SOAPA DSEIS (Bureau of Land Management 2007:3-83–3-85). The southern portion of the SOAPA cultural resources cumulative effects analysis area is not included in the study area for this project because of its distance from the BGMI operations area. Conversely, the northern portion of the study area for this project is not included in the SOAPA cultural resources cumulative effects analysis area, but it was added to the study area for this project because it encompasses other mines in which Barrick Gold Corporation has an interest.

In addition to serving the cultural resource management needs of BGMI, the study area for this research context forms a useful research unit in that it comprises a north-south transect from the crest of the Tuscarora Mountains to the floor of Boulder Valley and an east-west transect from Boulder Creek to Maggie Creek. As such, it incorporates the full range of environmental variability that occurs in the immediate vicinity of the LBB. Elevation in the study area ranges from about 4,780 feet in Boulder Valley to about 8,450 feet in the Tuscarora Mountains. The study area includes major tributaries of both Boulder and Maggie Creeks, including Brush, Bell and Rodeo Creeks, all located in the LBB proper and tributary to Boulder Creek, and portions of Indian, Lynn and Simon Creeks, all tributary to Maggie Creek and located on the east slope of the Tuscarora Mountains.

The southwest corner of the study area lies at a point along Boulder Creek near the northern tip of Boulder Valley. From this point, the study area boundary proceeds in a northeasterly direction up Boulder Creek to an unnamed tributary that runs northwards into the Sheep Creek Range, and then over the crest of the Sheep Creek Range and down an unnamed tributary of Antelope Creek. From here, the boundary runs east and then north up Antelope Creek to its confluence with Little Coyote Creek, then east up Little Coyote Creek to its head, and then east along a ridge (following a jeep road for part of the way) to the crest of the Tuscarora Mountains. The boundary then runs south along the crest of the Tuscarora Mountains to the head of Indian Creek, then southeast down Indian Creek to its confluence with Maggie Creek, and then south down Maggie Creek to its confluence with Simon Creek. From this point the boundary runs west to a point near Richmond Summit in the Tuscarora Mountains, and then across the northern end of Boulder Valley to the starting point.

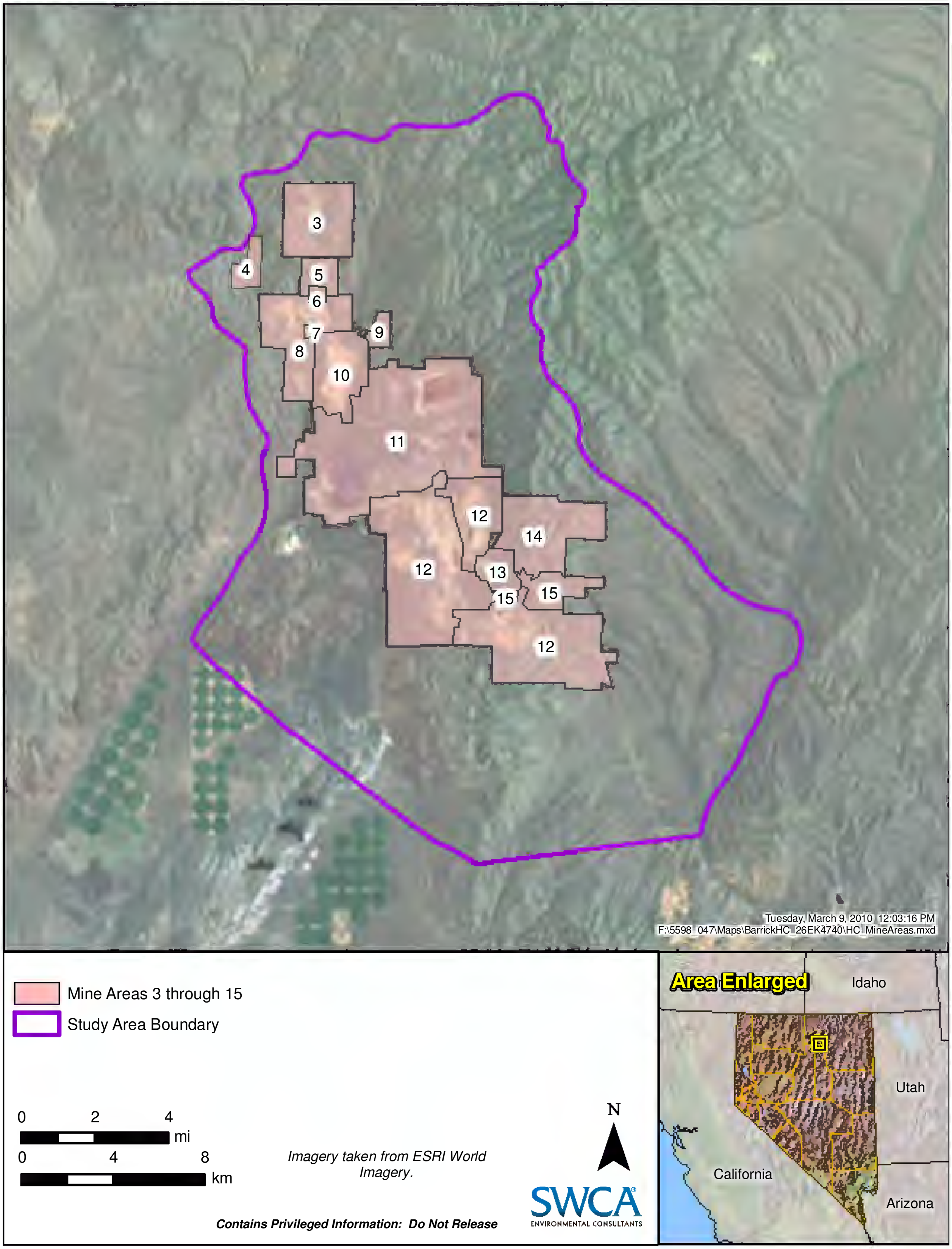

Figure 2. Location of the Little Boulder Basin archaeological study area and mining operation areas.

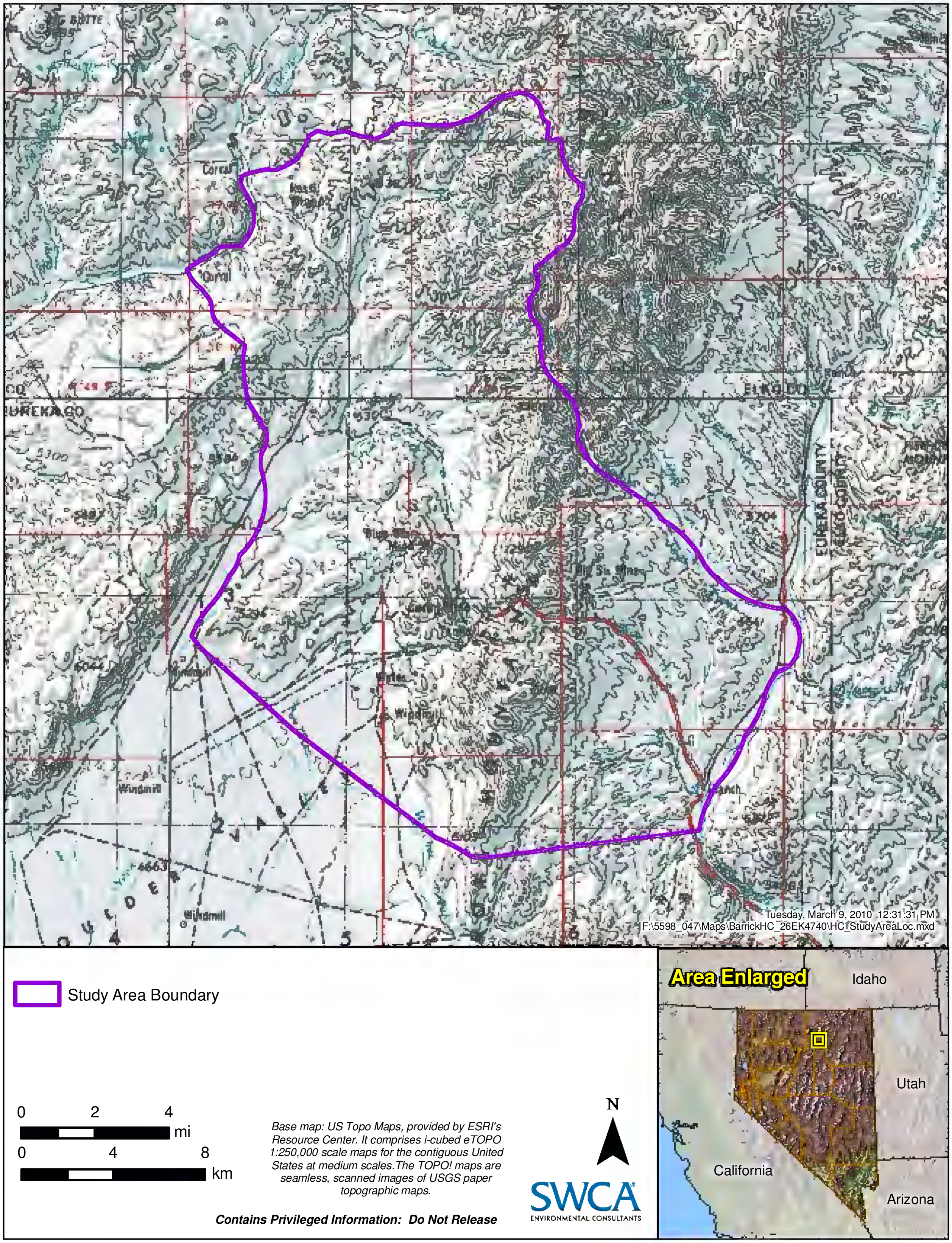

Figure 3. Location of the Little Boulder Basin archaeological study area in relation to topographic features.

Table 3. Carlin Trend Mining Operation Areas (see Figure 2) (from Bureau of Land Management 2007:2-24–2-25)

Map Reference Number	Facility
1*	Newmont/Great Basin Gold-Hollister/Ivanhoe
2*	Hecla-Hollister Development Block
3	Halliburton-Rossi
4	Trio Gold Corp-Rodeo Creek
5	Barrick-Meridian JV-Rossi
6	Barrick-Storm Underground
7	Barrick-Arturo
8	Marigold-Dee Mine
9	Centerra-Ren
10	Newmont-Bootstrap
11	Barrick-Betze/Post, Meikle, Rodeo, Goldbug (Barrick Goldstrike)
12	Newmont-Blue Star/Genesis and others
13	Newmont-Leeville
14	Newmont-Chevas
15	Newmont-High Desert
16*	Newmont-Mike
17*	Newmont-Gold Quarry/SOAP, MC Reservoir, N-S Haul Road
18*	Newmont-Woodruff Creek
19*	Newmont-Rain
20*	Newmont-Emigrant Springs

*Located outside of LBB archaeological study area and not shown in Figure 2.

4.2. Excavated Prehistoric Sites

The data analyzed in this document come from 53 prehistoric archaeological sites located within the study area that have been excavated in some manner—ranging from limited test excavation to extensive block excavation—and subsequently reported. This sample of sites comes from a list provided by Bill Fawcett of BLM-Elko, which was based on the cultural resources cumulative effects analysis conducted for the SOAPA DSEIS, with the addition of four sites (reported in Rusco 1982b) located in the portion of the study area that lies to the north of the SOAPA DSEIS cultural resources cumulative effects analysis area[3]. These sites are listed in Table 4, and excavation reports for these sites are listed in Table 5. The locations of thes sites are shown in Appendix A. Detailed maps of each individual site, showing the locations of such things as excavation blocks and archaeological features, are also provided in Appendix A.

The previous work conducted at each site is summarized below. First, however, the history of archaeological investigations in the study area is briefly discussed, and the usefulness of the sample of excavated sites for research and management purposes is also considered.

Table 4. Excavated Prehistoric Sites in the Little Boulder Basin Archaeological Study Area

Smithsonian Site Number	BLM Site Number	Mine	Report Code
26EK002304	CRNV-01-1793	Haliburton Rossi	1
26EK002305	CRNV-01-1794	Haliburton Rossi	1
26EK002307	CRNV-01-1796	Haliburton Rossi	1
26EK002309	CRNV-01-1805	Haliburton Rossi	1
26EK004687	CRNV-12-7400	Barrick Goldstrike	5
26EK004688	CRNV-12-7228	Barrick Goldstrike	18
26EK004690	CRNV-12-7229	Barrick Goldstrike	5
26EK004695	CRNV-12-7401	Barrick Goldstrike	5
26EK004696	CRNV-12-7402	Barrick Goldstrike	5
26EK004749	CRNV-12-7940	Newmont Bootstrap Area	16
26EK004755	CRNV-12-7946	Newmont Bootstrap Area	16
26EK005200	CRNV-12-8928	Barrick Goldstrike	4
26EK005270	CRNV-12-10440	Dee Gold	8
26EK005271	CRNV-12-10441	Dee Gold	8
26EK005274	CRNV-12-10444	Dee Gold	8
26EK005278	CRNV-12-10448	Newmont Genesis/Blue Star Area	14
26EK005374	CRNV-12-10545	Barrick Goldstrike	5
26EK006231	CRNV-12-12026	Newmont Genesis/Blue Star Area	15
26EK006232	CRNV-12-12027	Newmont Genesis/Blue Star Area	13
26EK006487	CRNV-12-9196	Barrick Goldstrike	17
26EU001319	CRNV-12-5588	Barrick Goldstrike	2

[3] A few prehistoric sites within the study area that have undergone limited test excavation are not included in the sample of sites used here; these include sites reported in Schroedl and Tipps (1991b) and sites reported in a document by Seddon et al. (2009) that is currently in preparation.

Table 4. Excavated Prehistoric Sites in the Little Boulder Basin Archaeological Study Area

Smithsonian Site Number	**BLM Site Number**	**Mine**	**Report Code**
26EU001320	CRNV-12-5682	Barrick Goldstrike	4
26EU001482	CRNV-12-7408	Barrick Goldstrike	5
26EU001483	CRNV-12-7421	Barrick Goldstrike	5
26EU001487	CRNV-12-7345	Newmont Bootstrap Area	16
26EU001492	CRNV-12-7440	Newmont Bootstrap Area	16
26EU001494	CRNV-12-7303	Barrick Goldstrike	7
26EU001505	CRNV-12-7324	Newmont Genesis/Blue Star Area	11
26EU001520	CRNV-12-7364	Newmont Bootstrap Area	16
26EU001522	CRNV-12-7368	Newmont Bootstrap Area	16
26EU001524	CRNV-12-7382	Barrick Goldstrike	4
26EU001529	CRNV-12-7404	Barrick Goldstrike	4
26EU001530	CRNV-12-7240	Barrick Goldstrike	5
26EU001531	CRNV-12-7407	Barrick Goldstrike	5
26EU001533	CRNV-12-7420	Barrick Goldstrike	20
26EU001534	CRNV-12-7422	Barrick Goldstrike	5
26EU001539	CRNV-12-7426	Barrick Goldstrike	20
26EU001548	CRNV-12-7446	Barrick Goldstrike	20
26EU001595	CRNV-12-8185	Barrick Goldstrike	3
26EU001667	CRNV-12-7146	Barrick Goldstrike	5
26EU001734	CRNV-12-5681	Barrick Goldstrike	4
26EU001851	CRNV-12-8929	Barrick Goldstrike	4
26EU001904	CRNV-12-8926	Barrick Goldstrike	5
26EU001906	CRNV-12-8249	Barrick Goldstrike	5
26EU001997	CRNV-12-11148	Barrick Goldstrike	6
26EU002064	CRNV-12-10507	Barrick Goldstrike	20
26EU002079	CRNV-12-10801	Newmont Genesis/Blue Star Area	19
26EU002124	CRNV-12-11122	Newmont Genesis/Blue Star Area	12
26EU002126	CRNV-12-11124	Barrick Goldstrike	20
26EU002181	CRNV-12-11421	Newmont South Operations Area	10
26EU002182	CRNV-12-11422	Newmont South Operations Area	10
26EU002183	CRNV-12-11725	Newmont South Operations Area	10
26EU002184	CRNV-12-11428	Newmont South Operations Area	9

Table 5. Excavation Reports for Sites in Table 4

Report Code	Author and Year	Title	BLM Report Number
1	Rusco, M. K. (1982)	Archaeological Investigations at the Rossi Mine Sites, Elko County, Nevada	BLM1-0361(P)
2	Tipps, B. L. (1988)	Archaic and Numic Encampment in the Little Boulder Basin, Eureka County, Nevada	BLM1-1188(P)
3	Schroedl, A. R. (1994)	Data Recovery Excavation at the Santa Fe Site, Eureka County, Nevada	BLM1-2450(P)
4	Schroedl, A. R. (1995)	Open Site Archeology in Little Boulder Basin: 1992 Data Recovery Excavations in the North Block Heap Leach Facility Area, North-Central Nevada	BLM1-2021(P)
5	Schroedl, A. R. (1996)	Open Site Archeology in Little Boulder Basin: 1993-1994 Data Recovery Excavations in the North Block Tailings Impoundment Area, North-Central Nevada	BLM1-1614(P)
6	LaFond, A. D., and J. B. Jones (1995)	Data Recovery Investigations at the *Yaha* Site: An Open Prehistoric Camp Site Along Rodeo Creek, Northern Eureka County, Nevada	BLM1-1683(P)
7	LaFond, A. D., B. L. Tipps, and M. K. Stratford (1995)	Data Recovery Excavations at Site 26EU1494	BLM1-2020(P)
8	Tipps, B. L. (1996)	Open Site Archeology Near Upper Boulder Creek: Data Recovery Excavations at Site 26EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area, Elko County, Nevada	BLM1-1753(P)
9	Tipps, B. L. (1997)	Data Recovery Excavations at Site 26EU2184: A Mulitcomponent Spring Site in the Lower Maggie Creek Area, North-Central Nevada	BLM1-1756(P)
10	Tipps, B. L., and G. H. Miller (1998)	Spring-Site Archeology in the Lower Maggie Creek Area: Data Recovery Excavations at Three Prehistoric Sites Along Simon Creek, North-Central Nevada	BLM1-1773(P)
11	Tipps, B. L., and M. K. Stratford (1996)	Data Recovery Excavations at Site 26EU1505, Eureka County, Nevada	BLM1-1574(P)
12	Stratford, M. K., and A. D. LaFond (1995)	Data Recovery Excavation at Site 26EU2124	BLM1-2446(P)
13	Schroedl, A. R. (1997)	Data Recovery Excavations at Site 26EK6232 Eureka County, Nevada	BLM1-2447(P)
14	Schroedl, A. R., and D. E. Tallman (1997)	Surface Collection, Mapping, and Testing of Site 26EK5278, Eureka County, Nevada	BLM1-2448(P)
15	Schroedl, A. R., and S. C. Kenzle (1997)	Two Penny Ridge: Numic Occupation Along Boulder Creek, North-Central Nevada	BLM1-2449(P)
16	Schroedl, A. R. (1998)	Open-Site Archeology: 1996 Bootstrap Data Recovery Excavations, North-Central Nevada	BLM1-1897(P)
17	Birnie, R. I., and B. L. Tipps (2000)	Data Recovery Excavations at Site 26EK6487, Elko County, North-Central Nevada	BLM1-2052(P)
18	Birnie, R. I. (2001)	Data Recovery Excavations at Site 26EK4688, Elko County, North-Central Nevada	BLM1-2159(P)
19	Hockett, B. (2006)	Reassessment of Site Significance for CRNV-12-10801	BLM1-2555(P)
20	Cannon, M. D. (2008)	Data Recovery Excavations at Five Prehistoric Archaeological Sites in the Little Boulder Basin, Eureka County, Nevada	BLM1-2595(P)

4.2.1. Archaeological Investigations in the Study Area

Of the sites included in the sample used in this document, the first four to have been investigated underwent surface artifact collection and test excavation during a project conducted by personnel from BLM-Elko and the Nevada State Museum at the Rossi Mine in 1982 (Rusco 1982b). Shortly after this, in the mid- to late-1980s, cultural resource inventories undertaken on behalf of mining interests began to occur with regularity in and around the LBB, including projects conducted by P-III (Russell et al. 1986; Schroedl 1986; Tipps 1989) and the Desert Research Institute (DRI) (Hicks 1989), among others (e.g., McLane 1988; Price 1988, 1989). Around the time that the 1991 historic context was prepared, and coincident with the signing of BGMI's initial Programmatic Agreement with the BLM, P-III began an extensive inventory and reevaluation program on behalf of BGMI, in which the NRHP-eligibility of both newly recorded and previously recorded sites was evaluated or reevaluated based on the 1991 historic context (e.g., Newsome, Popek et al. 1992; Newsome et al. 1993a; Newsome, Heath et al. 1992; Schroedl 1990, 1993; Schroedl and Tipps 1991a; Schroedl and Tipps 1991b; Tipps and Popek 1991a). During the same period of the early- to mid-1990s, P-III also conducted several inventories on behalf of other mining companies, likewise basing NRHP-eligibility evaluations on the 1991 historic context (e.g., J. B. Jones 1994c; Kenzle 1993; Newsome 1992, 1993, 1995; Tipps and Popek 1991b, 1992; Tipps et al. 1991). Inventory projects performed on behalf of both BGMI and other companies have continued to occur in the area since the mid-1990s, though at a much slower pace and involving a wider variety of cultural resource consultants, with NRHP-eligibility evaluations still generally being based on the 1991 historic context (e.g., Crosland 1997; Johnson 1996; Newsome 1997a, 1997b; Stettler et al. 2006).

Testing and excavation projects continued after the 1982 Rossi Mine project with P-III's 1987 excavation of one site and testing of another on behalf of BGMI (Tipps 1988). Three years later, P-III excavated a third site on the Barrick Goldstrike mine, though the report on this excavation was never formally submitted to BLM-Elko (Schroedl 1994). Then, as their early- to mid-1990s inventory and reevaluation program for BGMI was occurring, P-III conducted data recovery excavations on behalf of BGMI at 21 prehistoric sites (including the one tested in 1987) (LaFond and Jones 1995; LaFond et al. 1995; Schroedl 1995, 1996) and one historic site (J. B. Jones 1994a); in addition, P-III performed testing at eight other sites during this period for purposes of reevaluating their NRHP eligibility (Schroedl and Tipps 1991a). Close on the heels of these projects conducted for BGMI, P-III excavated an additional 18 prehistoric sites in the LBB area on behalf of other mining operations (Schroedl 1997, 1998; Schroedl and Kenzle 1997; Schroedl and Tallman 1997; Stratford and LaFond 1995; Tipps 1996, 1997a; Tipps and Stratford 1996; Tipps and Miller 1998). P-III's excavation efforts in the area wrapped up with work at two prehistoric sites on behalf of BGMI in the late 1990s (Birnie 2001; Birnie and Tipps 2000) and one historic site on behalf of Newmont in 2007 (Schroedl 2007). The most recent testing and excavation work that has been completed at prehistoric sites in the study area consists of a small testing project performed by BLM-Elko at a site on a Newmont mine in 2006 (Hockett 2006a), SWCA's probing of several sites at Barrick Goldstrike in 2005 and 2006 (Cannon et al. 2010), and SWCA's data recovery excavations at five sites on Goldstrike in 2007 (Cannon et al. 2008). All of the data recovery excavations that have occurred at prehistoric sites within the study area since 1991 have been guided by the 1991 historic context.

Two other excavation projects conducted in the Upper Humboldt River region but outside of the study area for this research context merit brief mention. Located just to the south of the study area along a tributary of Maggie Creek is James Creek Shelter, which was excavated in 1984 and reported in monograph form in 1990 (Elston and Budy 1990). The work that was performed at this site, completed just prior to the development of the 1991 historic context, provided much of the paleoenvironmental and chronological background for the 1991 historic context. The more recent 1999–2000 excavation of Pie Creek Shelter—located to the northeast of the LBB, just over the Independence Mountains from the Maggie Creek watershed—has enabled further refinement of the chronological framework for the Upper Humboldt area and has also inspired McGuire and colleagues' novel arguments about subsistence and settlement changes in the region, mentioned previously in Chapter 2 (McGuire and Hildebrandt 2005; McGuire et al. 2004). Though data from these sites located outside of the study area are not included in the new analyses presented in this document, analysis results are considered in light of the important work conducted at them.

4.2.2. Usefulness of the Excavated Site Sample

As in any case in which archaeological investigations are conducted in a cultural resource management context, the sample of excavated sites available for use in this document is dictated by management needs as much as by research needs. With the exception of a few sites that were only tested so that their NRHP eligibility could be evaluated (26EK002304, 26EK002305, 26EK002307, 26EK002309, 26EK005278, 26EU002079), all of the sites in the sample were at one point determined to be NRHP-eligible and were excavated because impacts to them from mining activities were planned; these sites were not chosen specifically for purposes of producing a random sample of all prehistoric sites, or even of all NRHP-eligible prehistoric sites, within the study area.

Nonetheless, though not a random sample, the sites in the sample are located in a variety of settings (see maps in Appendix A), ranging in elevation from about 5,150 to 5,870 feet, and they do encompass some variability in site type, as discussed in subsequent chapters. Most of the excavated sites occur along streams; however, this may just reflect the fact that most sites in the area—excavated or not and NRHP-eligible or not—are located along streams, and there are some sites in the sample from ridge top (e.g., 26EU001492) and alluvial fan (e.g., 26EU002184) settings. Thus, the large sample of over 50 sites used here should be informative about the general range of prehistoric activities conducted in the area, even if some biases in site type or setting exist. At the very least, to the extent that future mining activities will occur in the same kinds of places as have past mining activities—and therefore likely impact the same kinds of archaeological sites—the research priorities that are developed in this document based on this sample of sites should be useful for future management purposes.

4.2.3. Site Research Histories

The previous work conducted at each site in the sample is briefly described here as background for subsequent chapters, which discuss findings and analyze data from these sites in much greater detail.

26EK002304

Site 26EK002304 was first recorded by the BLM in 1981 as an open lithic scatter with three flake concentrations, several bifaces, an Elko-eared projectile point, two metates, and a mano (Rusco 1982b). In conjunction with the BLM, the Nevada State Museum conducted testing at the site in the same year (Rusco 1982b). Surface collection and 14 test excavation units were investigated at the site during data recovery.

26EK002305

In 1981, Site 26EK002305 was recorded by the BLM as a lithic scatter with a biface; two possible rockshelters were also noted nearby (Rusco 1982b). In conjunction with the BLM, the Nevada State Museum conducted testing at the site in the same year (Rusco 1982b). Surface collection and two test excavation units were investigated. Fowler revisited the site in 1992 but did not update the site form (Fowler 1992). In 1996, Frank W. Johnson Archaeological Consultants (FWJ) revisited the site and found it to be more extensive than the 1981 recording (Johnson 1996). FWJ observed two bifaces and extended the boundary (Johnson 1996). JBR Environmental Consultants (JBR) revisited the site in 1997 and updated the site form (Crosland 1997). JBR extended the boundary to the east, identified four artifact concentrations, four other areas of light flake scatters, an additional three bifaces, a scraper, a chopper, an

Eastgate projectile point, and two Elko Side-notched projectile points (Crosland 1997). JBR also identified a historic component to the site, dating between 1915 and 1969. The historic component consists of historic glass, ceramics, cans, and crate fragments (Crosland 1997).

26EK002307

The BLM documented Site 26EK002305 in 1981 as an open lithic scatter with a possible rockshelter noted nearby (Rusco 1982b). Testing was conducted at the site in the same year by Nevada State Museum in conjunction with the BLM (Rusco 1982b). This consisted of excavation of a single test unit and surface collection (Rusco 1982b).

26EK002309

In 1981, the BLM recorded site 26EK002309 as an open lithic scatter with two bifaces (Rusco 1982b). In conjunction with the BLM, the Nevada State Museum conducted testing at the site in 1981 (Rusco 1982b). This consisted of surface collection and excavation of one test unit.

26EK004687

DRI recorded Site 26EK004687 in 1988 as a dispersed lithic and ground stone scatter with three artifact concentrations, five bifaces, a biface fragment, a Rosegate projectile point, a Gatecliff projectile point, and an Elko Corner-notched projectile point (Hicks 1989). In 1991, P-III revisited the site and conducted testing to re-evaluate the site's eligibility for the NRHP; five test excavation units were investigated (Schroedl and Tipps 1991a, 1991b). P-III returned to the site during the field season of 1993–1994 to conduct data recovery (Schroedl 1996). The data recovery consisted of four excavation blocks, surface collection, and mechanical stripping (Schroedl 1996).

26EK004688

Site 26EK004688 was recorded by DRI in 1988 as a dispersed lithic scatter with localized concentrations, a Desert Side-notched projectile point, a Rosegate projectile point, a scraper, seven biface fragments, two mano fragments, a core, and an unknown ground stone fragment (Hicks 1989). Retrospect Research Associated (RRA) revisited the site in 1989 and extended the boundary (Price 1989). In 1991, P-III revisited the site and conducted testing to re-evaluate the site's eligibility for the NRHP (Schroedl and Tipps 1991a, 1991b). Also in 1991, P-III excluded the extended boundary from the RRA revisit in 1989 (Newsome 1997b). During the testing, eight test excavation units were investigated at the site (Schroedl and Tipps 1991a). P-III revisited the site in 1997 and found it to be similar condition from the previous recordings and conducted no further work at that time (Newsome 1997b). In 1998–1999, P-III conducted more data recovery at the site (Birnie 2001). The data recovery consisted of surface collection, a test excavation unit, and mechanical stripping (Birnie 2001).

26EK004690

In 1988, DRI recorded Site 26EK004690 as a dispersed lithic scatter with a bifacial core fragment and a biface (Hicks 1989). RRA revisited the site in 1988 and noted the site extended further than the DRI recording; however RRA did not update the site form (McLane 1988). RRA observed several artifact concentrations, two cores, an Elko Corner-notched projectile point, and five bifaces (McLane 1988). P-III revisited the site and conducted testing to re-evaluate the site's eligibility for the NRHP (Schroedl and Tipps 1991a). During testing, four test excavation units were investigated at the site (Schroedl and Tipps 1991a). During the 1993–1994 field season, P-III conducted additional data recovery at the site (Schroedl 1996). The data recovery consisted of two excavation blocks, additional testing, surface collection, and mechanical stripping (Schroedl 1996).

26EK004695

DRI recorded Site 26EK004695 in 1988 as a dispersed lithic scatter with a biface midsection and a core (Hicks 1989). In 1991, P-III revisited the site and updated the site form (Newsome, Heath et al. 1992). P-III observed a mano, a Gatecliff Split-stem projectile point, and Elko Corner-notched projectile point (Newsome, Heath et al. 1992). During the 1993–1994 field season, P-III conducted data recovery at the site (Schroedl 1996). During data recovery, an excavation block and a test excavation unit were investigated at the site. P-III also conducted surface collection at the site (Schroedl 1996).

26EK004696

In 1988, DRI recorded Site 26EK004696 as a dispersed lithic scatter with an artifact concentration and a mano (Hicks 1989). P-III revisited the site in 1991 and observed the site in a similar condition as the 1988 recording and therefore did not update the site form (Newsome, Heath et al. 1992). P-III did note in the report that they observed an edge-ground cobble and a biface fragment in addition to the artifacts recorded in 1988 (Newsome, Heath et al. 1992). P-III conducted data recovery in 1993–1994 (Schroedl 1996). The data recovery consisted of an excavation block, a test excavation unit, surface collection, and mechanical stripping (Schroedl 1996).

26EK004749

Site 26EK004749 is a lithic scatter with ground stone, a core, 12 bifaces, eight modified flakes, three mano fragments, a Northern Side-notched projectile point, four Eastgate projectile points, a Rosegate projectile point, an Elko Corner-notched projectile point, a Desert Side-notched point, a small stemmed projectile point, three small corner-notched projectile points, a large corner-notched projectile point, and at least two artifact concentrations (Tipps 1989). P-III documented and conducted data recovery at the site in 1996 (Schroedl 1998). The data recovery consisted of surface collection and four excavation blocks at the site.

26EK004755

In 1989, P-III recorded site 26EK004755 as a small, discrete lithic scatter with a biface fragment (Tipps 1989). P-III conducted data recovery at the site in 1996. During data recovery, one excavation block was investigated at the site. Surface collection was also conducted during the data recovery (Schroedl 1998).

26EK005200

P-III first recorded this site in 1991 as a moderate lithic scatter with seven bifaces, a Rose Spring projectile point, a Desert Side-notched projectile point, and an indeterminate projectile point (Schroedl and Tipps 1991a). P-III revisited the site in the same year but made no changes to the documentation of the site (Schroedl and Tipps 1991b). P-III conducted data recovery at the site in 1992 (Schroedl 1995). The data recovery consisted of two excavation blocks and surface collection.

26EK005270

Site 26EK005270 was originally recorded as part of Site 26EK004831 in 1988 by DRI (Hicks 1989). Site 26EK004831 was described as a very large lithic concentration, though no tools or features were reported (Hicks 1989). In 1991, P-III revisited Site 26EK004831 and determined it to be 66 separate cultural properties including 26EK005270 (Tipps and Popek 1991b). P-III described Site 26EK005270 as a small, discrete lithic scatter with two bifaces (Tipps and Popek 1991b). In 1994, P-III conducted data recovery at the site (Tipps 1996). The data recovery consisted of surface collection and a block excavation (Tipps 1996).

26EK005271

DRI recorded Site 26EK005271 originally as part of Site 26EK004831 in 1988 (Hicks 1989). As noted, P-III revisited site 26EK004831 in 1991 and determined it to be 66 separate cultural properties; they recorded one of these as 26EK005271 (Tipps and Popek 1991b). P-III described site 26EK005271 as a large, dispersed lithic scatter with a Great Basin Stemmed projectile point, an Elko series projectile point, a Gatecliff projectile point, a Rose Spring projectile point, a Cottonwood projectile point, six bifaces, and two manos (Tipps and Popek 1991b). In 1994, P-III conducted data recovery at the site (Tipps 1996). During data recovery, three excavation blocks were investigated at the site (Tipps 1996). Surface collection, additional testing, and mechanical stripping were also conducted at the site (Tipps 1996).

26EK005274

In 1988, DRI recorded Site 26EK005274 originally as part of Site 26EK004831 (Hicks 1989). When P-III revisited site 26EK004831 in 1991 and determined it to be 66 separate cultural properties, they recorded one of those properties as Site 26EK005274 (Tipps and Popek 1991b). P-III described site 26EK005274 as a small, discrete lithic scatter with three bifaces, a drill, a modified flake, and a core (Tipps and Popek 1991b). In 1994, P-III conducted data recovery at the site (Tipps 1996). Data recovery consisted of surface collection and one excavation block (Tipps 1996).

26EK005278

Site 26EK005278 was originally recorded by DRI as part of Site 26EK004831 in 1988 (Hicks 1989). When P-III revisited site 26EK004831 in 1991 and determined it to be 66 separate cultural properties, they recorded one of those properties as Site 26EK005278 (Tipps and Popek 1991b). P-III described Site 26EK005278 as a very large, dispersed lithic scatter with a three bifaces, a modified flake, a scraper, and modern trash (Tipps and Popek 1991b). In 1992, P-III revisited the site, conducted surface collection, and produced a more detailed site sketch and site form (J. B. Jones 1994c). In 1995, P-III again revisited the site and found it to be in similar condition as the 1992 recording (Newsome 1995). Also in 1995, P-III conducted testing at the site (Schroedl and Tallman 1997). The testing consisted of a test unit, surface collection and mechanical stripping (Schroedl and Tallman 1997).

26EK005374

Site 26EK005374 was recorded by P-III in 1991 as a concentrated lithic scatter with three bifaces, a drill, a modified flake, and a core (Newsome, Heath et al. 1992). P-III conducted data recovery in 1993–1994 (Schroedl 1996). During data recovery, one block excavation was investigated at the site; surface collection was also conducted (Schroedl 1996).

26EK006231

P-III recorded Site 26EK006231 in 1994 as a lithic and ground stone scatter, with seven artifact clusters, 50 bifaces, five cores, six modified flakes, eight portable milling stone fragments, a drill, an incised stone, an Elko series projectile point, a Cottonwood projectile point, and a Gatecliff series projectile point (J. B. Jones 1994c). The site was revisited by P-III in 1995; no changes were observed at the time of the revisit (Newsome 1995). In the same year, P-III conducted data recovery at the site (Schroedl and Kenzle 1997). The data recovery consisted of four excavation blocks and surface collection (Schroedl and Kenzle 1997).

26EK006232

In 1994, P-III recorded Site 26EK006232 as a sparse and diffuse lithic scatter with three debitage clusters, 30 bifaces, seven modified flakes, and a bifacial core fragment (J. B. Jones 1994c). P-III revisited the site in 1995 and observed no changes (Newsome 1995). Data recovery was conducted at the site in the same year by P-III (Schroedl 1997). During data recovery, three excavation blocks were investigated at the site; surface collection was also conducted (Schroedl 1997).

26EK006487

Site 26EK006487 was originally recorded by RRA in 1989 as an expansion of the boundary of Site 26EK004688. In 1991,when P-III conducted testing at Site 26EK004688 (Schroedl and Tipps 1991a, 1991b), they excluded the portion of Site 26EK004688 that RRA had added to the site boundary from their definition of the site. In 1997, P-III recorded this area as Site 26EK006487 (Newsome 1997b). P-III recorded the site as a large, variably dense lithic scatter with two artifact concentrations, two milling stone fragments, two Humboldt projectile points, an Elko-eared projectile point, two cores, a drill fragment, and 19 bifaces. P-III conducted data recovery at the site in 1998–1999 (Birnie and Tipps 2000). During data recovery, four excavation blocks were investigated at the site (Birnie and Tipps 2000). Surface collection, additional testing, and mechanical stripping were also conducted at the site (Birnie and Tipps 2000).

26EU001319

Site 26EU001319 was recorded by P-III in 1986 as a concentrated lithic scatter with two Desert Site-notched projectile points and five bifaces (Schroedl 1986). P-III conducted data recovery in 1987 (Tipps 1988). During data recovery, one block excavation and a control unit were investigated at the site; surface collection, and mechanical stripping were also conducted (Tipps 1988).

26EU001320

Site 26EU001320 was first recorded by P-III in 1986 as a lithic scatter with a Gypsum projectile point, an Elko-eared projectile point, two Eastgate series projectile points, a Desert Side-notched projectile point, a small unstemmed projectile point, six performs, four bifaces, seven metates, two ground stone fragments, four manos, two biface knives, two retouched flakes, and a drill (Russell et al. 1986). P-III subsequently tested the site in 1987 (Tipps 1988). During the 1987 testing, four test excavation units were investigated at the site (Tipps 1988). P-III then revisited the site in 1991 (Tipps et al. 1991) and re-evaluated the site’s eligibility for the NRHP in that same year (Schroedl and Tipps 1991b). P-III conducted data recovery excavations at the site in 1992 (Schroedl 1995). During data recovery, three block excavation areas were investigated at the site, and additional testing, surface collection, and mechanical stripping were also conducted.

26EU001482

DRI recorded site 26EU001482 in 1988 as a lithic scatter with five artifact concentrations and a slab metate fragment (Hicks 1989). In 1991, P-III revisited the site and conducted testing to re-evaluate the site’s eligibility for the NRHP (Schroedl and Tipps 1991a, 1991b). During testing, six test excavation units were investigated at the site (Schroedl and Tipps 1991b). P-III conducted data recovery during the 1993–1994 field season (Schroedl 1996). The data recovery consisted of four excavation blocks, additional testing, surface collection, and mechanical stripping (Schroedl 1996).

26EU001483

In 1988, DRI recorded Site 26EU001483 as a large, disperse lithic scatter with localized concentrations, ground stone, two Rosegate series projectile points, four retouched flakes, a core, a projectile point fragment, and a mano (Hicks 1989). In 1991, P-III revisited the site and conducted testing to re-evaluate its eligibility for the NRHP (Schroedl and Tipps 1991a, 1991b). During the revisit, P-III noted the presence of pottery, a Rose Spring projectile point, an Eastgate projectile point, bifaces, modified flakes, cores, scrapers, and various ground stone artifacts (Schroedl and Tipps 1991a). The testing consisted of eight test probes (Schroedl and Tipps 1991a). In 1993–1994, P-III conducted data recovery at the site. The data recovery consisted of three excavations blocks, additional testing, and surface collection (Schroedl 1996).

26EU001487

Site 26EU001487 was originally recorded by DRI in 1988 as a large lithic and ground stone scatter with an Elko Corner-notched projectile point, a Rosegate projectile point, a biface fragment, and a mano fragment (Hicks 1989). In 1991, P-III conducted testing at the site to re-evaluate the site's NRHP eligibility (Schroedl and Tipps 1991a, 1991b). During the testing, 11 subsurface probes were investigated at the site (Schroedl and Tipps 1991b). In 1996, P-III conducted data recovery at the site (Schroedl 1998). During the data recovery, two excavation blocks were investigated at the site; backhoe trenching was also conducted, as well as surface collection (Schroedl 1998).

26EU001492

In 1988, DRI recorded site 26EU001492 as a moderately dense lithic scatter with seven Rosegate series projectile points, three bifaces, and one unidentifiable projectile point fragment (Hicks 1989). P-III revisited the site in 1991 and conducted testing and re-evaluated the site's eligibility for the NRHP (Schroedl and Tipps 1991a). The testing consisted of one test excavation unit (Schroedl and Tipps 1991a). In 1996, P-III conducted recovery at the site. During data recovery, one excavation block was investigated, and surface collection was also conducted (Schroedl 1998).

26EU001494

DRI recorded Site 26EU001494 in 1988 as a lithic scatter with no tools or features (Hicks 1989). In 1991, P-III revisited the site and updated the site form (Tipps and Popek 1991a). P-III noted two artifact concentrations, two biface fragments, and extended the site boundary (Tipps and Popek 1991a). P-III conducted data recovery in 1993 (LaFond et al. 1995). The data recovery consisted of one excavation block and surface collection (LaFond et al. 1995).

26EU001505

In 1988, DRI recorded Site 26EU001505 as a lithic concentration with no tools or features (Hicks 1989). P-III revisited the site in 1991 and found no changes from the original recording (Tipps and Popek 1991b). In 1995, P-III conducted data recovery at the site (Tipps and Stratford 1996). The data recovery consisted of an excavation block (Tipps and Stratford 1996).

26EU001520

DRI recorded site 26EU001520 in 1988 as a dispersed lithic scatter with localized artifact concentrations and a retouched flake (Hicks 1989). In 1991, P-III revisited the site to re-evaluate the site's eligibility for the NRHP (Schroedl and Tipps 1991b). During the revisit, P-III noted the site was larger than the 1988 recording; however, no new tools or features were observed (Schroedl and Tipps 1991b). P-III revisited the site in 1995 and found the site to be as described by the 1991 recording (Newsome 1995). In 1996, P-III conducted data recovery at the site (Schroedl 1998). The data recovery consisted of two test trenches and surface collection (Schroedl 1998).

26EU001522

Site 26EU001522 was originally recorded by DRI in 1988 (Hicks 1989). DRI described the site as a dispersed lithic and ground stone scatter with one biface fragment and a slab metate fragment (Hicks 1989). In 1991, P-III revisited the site to re-evaluate the site eligibility for the NRHP. P-III extended the boundary from the original recording of the site (Schroedl and Tipps 1991b). P-III revisited the site in 1995 and found it to be as described; no further work was conducted at that time (Newsome 1995). In 1996, P-III conducted data recovery at the site (Schroedl 1998). During data recovery, two excavation blocks were investigated and surface collection was conducted at the site (Schroedl 1998).

26EU001524

In 1988, DRI recorded Site 26EU001524 as a dispersed lithic and ground stone scatter with a Gatecliff Split-stem projectile point (Hicks 1989). P-III revisited the site but did not update the site form. In 1992, P-III conducted data recovery (Schroedl 1995). During data recovery, two excavation blocks and a test excavation unit were investigated at the site and surface collection was conducted.

26EU001529

Site 26EU001529 was originally recorded by DRI in 1988 as lithic scatter with five biface fragments, a core, an Elko Corner-notched projectile point, and a distal projectile point fragment (Hicks 1989). In 1991, P-III revisited the site and updated the site form and re-evaluated the site's significance (Schroedl and Tipps 1991b). P-III observed 18 bifaces, a modified flake, an indeterminate corner-notched projectile point, and an Eastgate projectile point. P-III conducted data recovery at the site in 1992 (Schroedl 1995). The data recovery consisted of surface collection and one block excavation (Schroedl 1995).

26EU001530

Site 26EU001530 was originally recorded by DRI in 1988 as a low-density lithic scatter with three bifaces (Hicks 1989). The site was revisited by RRA in 1988; no changes were observed (McLane 1988). P-III revisited the site in 1991 to re-evaluate the site's eligibility for the NRHP (Newsome, Heath et al. 1992). P-III updated the site form as a lithic scatter with four artifact concentrations, four bifaces, and a core (Newsome, Heath et al. 1992). P-III conducted data recovery at the site in 1993–1994 (Schroedl 1996). The data recovery consisted of seven excavation blocks, additional testing, surface collection, and mechanical testing (Schroedl 1996).

26EU001531

DRI recorded Site 26EU001531 in 1988 as a large, disperse lithic scatter with localized concentrations, three bifaces, and a distal projectile point fragment (Hicks 1989). P-III revisited the site in 1992 to re-evaluate the site's eligibility for the NRHP (Newsome, Heath et al. 1992). P-III noted five artifact concentrations, a biface knife, and three biface fragments during the site revisit (Newsome, Heath et al. 1992). P-III conducted data recovery at the site in 1993–1994 (Schroedl 1996). During data recovery, four excavation blocks were investigated at the site, and additional testing, surface collection, and mechanical stripping were also conducted (Newsome, Heath et al. 1992).

26EU001533

In 1988, DRI recorded Site 26EU001533 as a dispersed lithic and ground stone scatter with an edge-ground cobble (Hicks 1989). P-III revisited the site in 1992 and updated the site form and re-evaluated the site's eligibility for the NRHP (Newsome, Heath et al. 1992). P-III observed the site as a diffuse lithic scatter with a central artifact concentration and observed an additional biface (Newsome, Heath et al. 1992). In 2005, SWCA revisited the site and established a new boundary and observed an additional biface and a historic can (Cannon et al. 2008). In 2006, SWCA conducted probing at the site, which consisted of two shovel test excavations (Cannon et al. 2008). In 2007, SWCA conducted additional data recovery at the site (Cannon et al. 2008). During data recovery, 22 auger probes and 14 shovel test excavation units were investigated at the site. Surface collection, remote sensing, and mechanical stripping were also conducted at the site (Cannon et al. 2008).

26EU001534

P-III recorded Site 26EU001534 in 1986 as a dispersed lithic scatter with one artifact concentration, a Cottonwood Triangular projectile point, two projectile point preforms, a projectile point tip, and a metate fragment (Russell et al. 1986). DRI revisited the site in 1988 and updated the site form with an expanded boundary (Hicks 1989). DRI described the site as a dispersed lithic scatter with localized artifact concentrations, three biface fragments, a perforator, and a core (Hicks 1989). In 1991, P-III revisited the site and updated the site form with an expanded boundary (Schroedl and Tipps 1991b). P-III observed two artifact concentrations, a graver, a perforator, four bifaces, and a core (Schroedl and Tipps 1991b). P-III returned to the site during the 1993–1994 field season to conduct data recovery (Schroedl 1996). The data recovery consisted of seven block excavations, additional testing, surface collection, and mechanical stripping (Schroedl 1996).

26EU001539

In 1988, DRI recorded Site 26EU001539 as a low-density lithic scatter with two concentrations and ground stone (Hicks 1989). P-III revisited the site in 1991 and 1993 resulting in expanded boundaries and recordation of additional tools (Schroedl 1993). In 2005, SWCA revisited the site and observed two artifact concentrations, two chipped stone tools, and a ground stone fragment (Cannon et al. 2008). In 2006, SWCA tested the site with three shovel test excavations and one test excavation unit (Cannon et al. 2008). SWCA conducted additional data recovery in 2007 (Cannon et al. 2008). During the 2007 data recovery, 14 auger probes and 22 excavation units were investigated (Cannon et al. 2008). In addition to the excavations, surface collection, remote sensing, and mechanical stripping were conducted at the site (Cannon et al. 2008).

26EU001548

DRI recorded Site 26EU001548 as a low-to-moderate density lithic scatter with five localized concentrations (Hicks 1989). P-III revisited the site in 1993 and observed no changes to the site but did observe an additional biface (Newsome et al. 1993b). In 2005, SWCA revisited the site and identified two artifact concentrations (Cannon et al. 2008). In 2006, SWCA conducted testing at the site; consisting of five shovel test excavations (Cannon et al. 2008). In 2007, SWCA conducted data recovery. The data recovery consisted of surface collection, remote sensing, mechanical striping, and 11 test excavation units were investigated at the site (Cannon et al. 2008).

26EU001595

Site 26EU001595 was recorded by P-III in 1990 as a lithic scatter with at least 60 projectile points, 20 bifaces, and one modified flake (Schroedl 1990). P-III conducted data recovery at the site in 1991 (Schroedl 1994). During data recovery, two shovel probes and two test excavation pits were investigated at the site, and surface collection was also conducted.

26EU001667

In 1988, RRA recorded Site 26EU001667 as a diffuse lithic scatter with no tools or features observed (Price 1988). The site was revisited and updated by P-III in 1991 (Newsome, Popek et al. 1992). P-III expanded the original site boundary to include CRNV-12-7145 (an isolated find). P-III defined the site as lithic scatter with eight activity areas, 12 bifaces, two cores, and a small corner-notched projectile point (Newsome, Popek et al. 1992). In 1993, P-III conducted data recovery consisting of three excavation blocks, additional testing, surface collection, and mechanical stripping (Schroedl 1996).

26EU001734

In 1986, P-III recorded Site 26EU001734 as an extensive lithic scatter with seven artifact concentrations, four performs, one utilized flake, two metate fragments, one scraper, two bifaces, a Cottonwood Triangular projectile point, and a Desert Site-notched projectile point (Russell et al. 1986). P-III revisited the site in 1991 to re-evaluate the site's eligibility for the NRHP (Schroedl and Tipps 1991b; Tipps et al. 1991). During the revisit, P-III extended the boundary and updated the site form (Tipps et al. 1991). P-III conducted data recovery in 1992 (Schroedl 1995). The date recovery consisted of an excavation block, surface collection, and mechanical stripping (Schroedl 1995).

26EU001851

P-III recorded Site 26EU001851 in 1991; they described the site as a lithic scatter with a prehistoric quarry pit and six bifaces (Schroedl and Tipps 1991a). In 1992, P-III conducted data recovery. During data recovery, one excavation block and three test excavation units were investigated at the site. P-III also conducted surface collection at the site (Schroedl 1995).

26EU001904

Site 26EU001904 was recorded by P-III in 1991 as a lithic scatter with a modified flake, a biface, and heat-treated debitage (Schroedl and Tipps 1991a). P-III conducted data recovery at the site in 1993–1994 (Schroedl 1996). During data recovery, two excavation blocks were investigated at this site, and surface collection was conducted (Schroedl 1996).

26EU001906

P-III recorded Site 26EU001906 in 1990 as a lithic scatter with a Cottonwood projectile point, a biface, a uniface, and a modified flake (Schroedl and Tipps 1991a). Date recovery was conducted by P-III in 1993-1994 and consisted of two excavation blocks and surface collection (Schroedl 1996).

26EU001997

In 1991, P-III recorded Site 26EU001997 as a lithic scatter with 11 bifaces, three modified flakes, a hammerstone, a possible knife fragment, an indeterminate projectile point, a large corner-notched projectile point, and a Desert Side-notched projectile point (Newsome et al. 1993a). P-III conducted data recovery at the site in 1992 (LaFond and Jones 1995). The data recovery consisted of two backhoe trenches, two block excavations, and surface collection.

26EU002064

Site 26EU002064 was originally recorded by P-III in 1991 as a large, dispersed lithic scatter with a Humboldt projectile point, a core, a utilized flake, and various biface fragments (Newsome, Heath et al. 1992). SWCA revisited the site in 2005 and observed four artifact concentrations and two additional bifaces (Cannon et al. 2008). In 2006, SWCA conducted testing at the site consisting of 27 shovel test excavations and 10 test excavation units (Cannon et al. 2008). In 2007, SWCA conducted data recovery at the site. The 2007 data recovery consisted of surface collection, remote sensing, mechanical stripping, and 13 test excavation units (Cannon et al. 2008).

26EU002079

P-III recorded site 26EU002079 in 1992 as a moderately dense lithic scatter with a Gatecliff Split-stem projectile point, an Elko Corner-notched projectile point, a Humboldt projectile point, three biface fragments, and a modified flake (Newsome 1992). In 1997, P-III revisited the site and found it to be in similar condition to the original recording (Newsome 1997a). In 2006, the BLM revisited the site and observed significant differences from the original recording (Hockett 2006a). As a result of the 2006 revisit, BLM determined testing was necessary to re-evaluate the site's eligibility for the NRHP (Hockett 2006a). During testing, four test excavation units were investigated at the site; surface collection was also conducted at the site (Hockett 2006a). Based on the testing, the BLM determined the site to be not eligible for the NRHP (Hockett 2006a).

26EU002124

In 1991, P-III documented site 26EU002124 as a discrete lithic scatter with a biface fragment and an Elko Corner-notched projectile point (Tipps and Popek 1992). P-III conducted data recovery at the site in 1994 (Stratford and LaFond 1995). The data recovery consisted of surface collection and one excavation block.

26EU002126

Site 26EU002126 was originally recorded by P-III in 1991 as a discrete lithic scatter with two artifact concentrations, a Cottonwood projectile point, four biface fragments, and a basin milling stone fragment (Tipps and Popek 1992). In 2005, SWCA revisited the site and expanded the site boundary (Cannon et al. 2008). SWCA conducted testing at the site in 2006; consisting of three shovel test excavations and one test excavation unit (Cannon et al. 2008). In 2007, SWCA conducted data recovery (Cannon et al. 2008). During the 2007 data recovery, 56 excavation units were investigated at the site. Surface collection, remote sensing, and mechanical stripping were also conducted at the site.

26EU002181

P-III recorded Site 26EU002181 in 1992 as a sparse lithic scatter with a biface fragment and a Rose Spring projectile point (Newsome 1993). Data recovery at the site was conducted by P-III in 1994 (Tipps and Miller 1998). The data recovery consisted of two test excavations and a surface collection.

26EU002182

In 1992, P-III recorded Site 26EU002182 as a lithic scatter with ground stone, seven biface fragments, an Elko Corner-notched projectile point, a pestle, and a single-hand mano (Newsome 1993). In 1994, P-III conducted data recovery at the site (Tipps and Miller 1998). Data recovery consisted of two test excavations, a block excavation, and surface collection.

26EU002183

Site 26EU002183 was recorded by P-III in 1993 as a lithic scatter with a Desert Side-notched projectile point, 14 bifaces, and a modified flake (Kenzle 1993). P-III conducted data recovery at the site in 1994 (Tipps and Miller 1998). During date recovery one excavation block and three test excavation units were investigated. Surface collection was also conducted during data recovery (Tipps and Miller 1998).

26EU002184

Site 26EU002184 was recorded by P-III in 1992 as a large, diffuse lithic scatter with an Elko Corner-notched projectile point, two Humboldt projectile points, an indeterminate projectile point, a core, a modified flake, 13 bifaces, and a pounding stone (Newsome 1993). In 1994, P-III conducted data recovery (Tipps 1997a). During data recovery, four excavation blocks were investigated and surface collection was performed.

4.2.4. Site Proveniences and Analysis Units

In order to conduct the analyses presented in the following chapters of this research context, data from the sites in the sample were compiled from excavation reports into a single database (Appendix M, submitted electronically to BLM-Elko with this document). Data were cataloged in this database using the provenience units listed in Table 6. For sites excavated by entities other than SWCA (that is, most sites in the sample), these provenience units correspond to the provenience designations that are used in the original report. For sites that SWCA excavated (Cannon et al. 2008), data from SWCA's excavation database were added to the database compiled for this research context project in a manner that allows comparison with data from the rest of the sites; the data for these sites are therefore presented using provenience designations that occasionally differ slightly from the excavation report, though there are no substantive differences. Most reports present data grouped only by rather large-scale provenience units (e.g., by excavation block rather than by 1 × 1–m unit within the excavation block), and this is accordingly how data are grouped here. Some provenience designations were shortened for this document (e.g., "Complete Surface Collection Block" was shortened to "Surface Collection Block").

Proveniences are grouped in Table 6 into "Analysis Units". For the most part, these are the groupings used in the analyses presented in the remainder of this document; for example, the evaluation of the age of occupation presented in Chapter 5 is conducted at the level of the analysis unit. Many of the analysis units correspond to specific investigation areas within a site, such as excavation areas or collection areas. At Site 26EK004687, for example, Excavation Block 1 occurs within Surface Collection Block 1, so these two provenience units are grouped together into the Surface Collection Block 1 analysis unit for this site. In cases such as this, materials from surface and subsurface contexts are combined for analysis; this is justifiable given the limited depth to most archaeological deposits in the study area (discussed further in

Chapter 6), and it is occasionally necessary since surface and subsurface materials are sometimes not distinguished in excavation reports. To the extent that excavation blocks, collection areas, etc. are mapped in excavation reports, the locations of these spatial analysis units can be found on the site maps provided in Appendix A.

For sites at which there is only a single main excavation and/or collection area, and for sites at which only a limited amount of work was done (for example, limited testing rather than block excavation), all material from the site is combined into a single "Site" analysis unit. For sites at which there were multiple excavation and/or collection areas, each of which comprises its own analysis unit, there is generally an "Other" analysis unit that incorporates materials that cannot be tied to one of the other analysis units; for example, materials that come from various locations outside of main work areas and/or materials for which a specific provenience is not reported.

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EK002304	Surface Collection	Site
26EK002304	Unit 1	Site
26EK002304	Unit 2	Site
26EK002304	Unit 3	Site
26EK002304	Unit 4	Site
26EK002304	Unit 5	Site
26EK002304	Unit 6	Site
26EK002304	Unit 7	Site
26EK002304	Unit 8	Site
26EK002304	Unit 9	Site
26EK002304	Unit 10	Site
26EK002304	Unit 11	Site
26EK002304	Unit 12	Site
26EK002304	Unit 13	Site
26EK002304	Unit 14	Site
26EK002304	Site	Site
26EK002305	Surface Collection	Site
26EK002305	Test Units	Site
26EK002305	Site	Site
26EK002307	Surface Collection	Site
26EK002307	Test Units	Site
26EK002307	Site	Site
26EK002309	Surface Collection	Site
26EK002309	0.5 × 1.0–m Test Unit	Site
26EK002309	Site	Site
26EK004687	Surface Collection Block 1	Surface Collection Block 1

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EK004687	Excavation Block 1	Surface Collection Block 1
26EK004687	Surface Collection Block 2	Surface Collection Block 2
26EK004687	Excavation Block 2	Surface Collection Block 2
26EK004687	Excavation Block 3	Surface Collection Block 2
26EK004687	Surface Collection Block 3	Surface Collection Block 3
26EK004687	Excavation Block 4	Surface Collection Block 3
26EK004687	Other Surface	Other
26EK004687	Other Testing	Other
26EK004687	Stripping Area	Other
26EK004687	Site	Other
26EK004688	Activity Locus 1	Activity Locus 1
26EK004688	Activity Locus 2	Activity Locus 2
26EK004688	Activity Locus 3	Activity Locus 3
26EK004688	Activity Locus 4	Activity Locus 4
26EK004688	Activity Locus 5	Activity Locus 5
26EK004688	Activity Locus 6	Activity Locus 6
26EK004688	Activity Locus 7	Activity Locus 7
26EK004688	Activity Locus 8	Activity Locus 8
26EK004688	Activity Locus 9	Activity Locus 9
26EK004688	Activity Locus 10	Activity Locus 10
26EK004688	Activity Locus 11	Activity Locus 11
26EK004688	Surface Collection	Other
26EK004688	Other Testing	Other
26EK004688	Stripping Area 1	Other
26EK004688	Stripping Area 2	Other
26EK004688	Stripping Area 3	Other
26EK004688	Stripping Area 4	Other
26EK004688	Stripping Area 5	Other
26EK004688	Site	Other
26EK004690	Surface Collection Block 1	Surface Collection Block 1
26EK004690	Excavation Block 1	Surface Collection Block 1
26EK004690	Surface Collection Block 2	Surface Collection Block 2
26EK004690	Excavation Block 2	Surface Collection Block 2
26EK004690	Other Surface	Other
26EK004690	Other Testing	Other
26EK004690	Stripping Area	Other
26EK004695	Surface Collection Block	Site

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EK004695	Excavation Block	Site
26EK004695	Other Surface	Site
26EK004695	Other Testing	Site
26EK004695	Stripping Area	Site
26EK004696	Surface Collection Block	Site
26EK004696	Excavation Block	Site
26EK004696	Other Surface	Site
26EK004696	Other Testing	Site
26EK004696	Stripping Area	Site
26EK004749	Surface Collection Block 1	Surface Collection Block 1
26EK004749	Excavation Block 1	Surface Collection Block 1
26EK004749	Surface Collection Block 2	Surface Collection Block 2
26EK004749	Excavation Block 2	Surface Collection Block 2
26EK004749	Surface Collection Block 3	Surface Collection Block 3
26EK004749	Excavation Block 3	Surface Collection Block 3
26EK004749	Surface Collection Block 4	Surface Collection Block 4
26EK004749	Excavation Block 4	Surface Collection Block 4
26EK004749	Other Surface	Other
26EK004755	Surface Collection Block	Surface Collection Block
26EK004755	Excavation Block 1	Surface Collection Block
26EK005200	Excavation Area 1	Excavation Area 1
26EK005200	Excavation Area 2	Excavation Area 2
26EK005200	Surface Collection	Other
26EK005270	Surface Collection Block	Site
26EK005270	Excavation Block	Site
26EK005270	Other Surface	Site
26EK005270	Site	Site
26EK005271	Excavation Block 1	Excavation Block 1
26EK005271	Excavation Block 2	Excavation Block 2
26EK005271	Surface Collection Block	Excavation Block 3
26EK005271	Excavation Block 3	Excavation Block 3
26EK005271	Other Surface	Other
26EK005271	Test Trenches	Other
26EK005271	Northern Stripping Area	Other
26EK005271	Southern Stripping Area	Other
26EK005271	Site	Other
26EK005274	Surface Collection Block	Site

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EK005274	Excavation Block	Site
26EK005274	Other Surface	Site
26EK005278	Test Excavation Block	Site
26EK005278	Surface Collection	Site
26EK005278	Disturbed Area	Site
26EK005374	Excavation Block	Site
26EK005374	Surface Collection	Site
26EK006231	Surface Collection Block 1	Surface Collection Block 1
26EK006231	Excavation Block 1 Surface	Surface Collection Block 1
26EK006231	Excavation Block 1	Surface Collection Block 1
26EK006231	Surface Collection Block 2	Surface Collection Block 2
26EK006231	Excavation Block 2	Surface Collection Block 2
26EK006231	Surface Collection Block 3	Surface Collection Block 3
26EK006231	Excavation Block 3 Surface	Surface Collection Block 3
26EK006231	Excavation Block 3	Surface Collection Block 3
26EK006231	Excavation Block 4	Surface Collection Block 3
26EK006231	Other Surface	Other
26EK006232	Surface Collection Block 1	Surface Collection Block 1
26EK006232	Excavation Block 1	Surface Collection Block 1
26EK006232	Surface Collection Block 2	Surface Collection Block 2
26EK006232	Excavation Block 2	Surface Collection Block 2
26EK006232	Excavation Block 3	Surface Collection Block 2
26EK006232	Other Surface	Other
26EK006487	Excavation Block 1	Excavation Block 1
26EK006487	Excavation Block 2	Excavation Block 2
26EK006487	Excavation Block 3	Excavation Block 3
26EK006487	Excavation Block 4	Excavation Block 4
26EK006487	Surface Collection	Other
26EK006487	Test Trenches	Other
26EU001319	Surface Collection	Site
26EU001319	Excavation Block	Site
26EU001319	Control Units	Site
26EU001319	Stripping Area	Site
26EU001320	Surface Collection Block	Area 1
26EU001320	Excavation Area 1	Area 1
26EU001320	Area 1	Area 1
26EU001320	Surface Area 2	Area 2

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001320	Excavation Area 2	Area 2
26EU001320	Area 2	Area 2
26EU001320	Excavation Area 3	Area 3
26EU001320	Area 3	Area 3
26EU001320	Other Surface	Other
26EU001320	Test Unit 1	Other
26EU001320	Test Unit 2	Other
26EU001320	Test Unit 3	Other
26EU001320	Test Unit 4	Other
26EU001320	Test Unit 5	Other
26EU001320	Stripping Area	Other
26EU001320	Site	Other
26EU001482	Surface Collection Block 1	Surface Collection Block 1
26EU001482	Excavation Block 1	Surface Collection Block 1
26EU001482	Surface Collection Block 2	Surface Collection Block 2
26EU001482	Excavation Block 2	Surface Collection Block 2
26EU001482	Surface Collection Block 3	Surface Collection Block 3
26EU001482	Excavation Block 3	Surface Collection Block 3
26EU001482	Surface Collection Block 4	Surface Collection Block 4
26EU001482	Excavation Block 4	Surface Collection Block 4
26EU001482	Surface Collection Block 5	Surface Collection Block 5
26EU001482	Other Surface	Other
26EU001482	Other Testing	Other
26EU001482	Stripping Area	Other
26EU001482	Site	Other
26EU001483	Surface Collection Block 1	Surface Collection Block 1
26EU001483	Excavation Block 1	Surface Collection Block 1
26EU001483	Surface Collection Block 2	Surface Collection Block 2
26EU001483	Excavation Block 2	Surface Collection Block 2
26EU001483	Surface Collection Block 3	Surface Collection Block 3
26EU001483	Excavation Block 3	Surface Collection Block 3
26EU001483	Other Surface	Other
26EU001483	Other Testing	Other
26EU001483	Site	Other
26EU001487	Surface Collection Block 1	Excavation Block 1
26EU001487	Excavation Block 1	Excavation Block 1
26EU001487	Excavation Block 2	Excavation Block 2

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001487	Other Surface	Other
26EU001487	Other Testing	Other
26EU001487	Site	Other
26EU001492	Surface Collection Block 1	Site
26EU001492	Excavation Block 1	Site
26EU001492	Other Surface	Site
26EU001492	Other Testing	Site
26EU001494	Surface Collection Block	Site
26EU001494	Excavation Block	Site
26EU001494	Other Surface	Site
26EU001494	Site	Site
26EU001505	Excavation Block	Site
26EU001520	Surface Collection	Site
26EU001520	Test Trench 1	Site
26EU001520	Test Trench 2	Site
26EU001522	Surface Collection Block 1	Surface Collection Block 1
26EU001522	Excavation Block 1	Surface Collection Block 1
26EU001522	Surface Collection Block 2	Surface Collection Block 2
26EU001522	Excavation Block 2	Surface Collection Block 2
26EU001522	Other Surface	Other
26EU001524	Excavation Area 1	Excavation Area 1
26EU001524	Excavation Area 2	Excavation Area 2
26EU001524	Surface Collection	Other
26EU001524	Test Unit	Other
26EU001524	Site	Other
26EU001529	Surface Collection Block	Site
26EU001529	Excavation Block	Site
26EU001529	Other Surface	Site
26EU001529	Site	Site
26EU001530	Surface Collection Block 1	Excavation Block 1
26EU001530	Excavation Block 1	Excavation Block 1
26EU001530	Surface Collection Block 2	Excavation Block 2
26EU001530	Excavation Block 2	Excavation Block 2
26EU001530	Surface Collection Block 3	Excavation Block 3
26EU001530	Excavation Block 3	Excavation Block 3
26EU001530	Surface Collection Block 4	Excavation Block 4
26EU001530	Excavation Block 4	Excavation Block 4

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001530	Surface Collection Block 5	Excavation Block 5
26EU001530	Excavation Block 5	Excavation Block 5
26EU001530	Surface Collection Block 6	Excavation Block 6
26EU001530	Excavation Block 6	Excavation Block 6
26EU001530	Excavation Block 7	Excavation Block 7
26EU001530	Other Surface	Other
26EU001530	Other Testing	Other
26EU001530	Stripping Area	Other
26EU001530	Site	Other
26EU001531	Excavation Block 1	Excavation Block 1
26EU001531	Excavation Block 2	Excavation Block 2
26EU001531	Excavation Block 3	Excavation Block 3
26EU001531	Excavation Block 4	Excavation Block 4
26EU001531	Surface Collection	Other
26EU001531	Other Testing	Other
26EU001531	Stripping Area	Other
26EU001531	Site	Other
26EU001533	Op A	Site
26EU001533	Op B	Site
26EU001533	Op C	Site
26EU001533	Op D	Site
26EU001533	Op E	Site
26EU001533	Test Unit 1	Site
26EU001533	Shovel Test 1	Site
26EU001533	Shovel Test 2	Site
26EU001533	General Surface Collection	Site
26EU001533	Stripping Area	Site
26EU001534	Surface Collection Block 1	Excavation Block 1
26EU001534	Excavation Block 1	Excavation Block 1
26EU001534	Surface Collection Block 2	Excavation Block 2
26EU001534	Excavation Block 2	Excavation Block 2
26EU001534	Surface Collection Block 3	Excavation Block 3
26EU001534	Excavation Block 3	Excavation Block 3
26EU001534	Surface Collection Block 4	Excavation Block 4
26EU001534	Excavation Block 4	Excavation Block 4
26EU001534	Surface Collection Block 5	Excavation Block 5
26EU001534	Excavation Block 5	Excavation Block 5

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001534	Surface Collection Block 6	Excavation Block 6
26EU001534	Excavation Block 6	Excavation Block 6
26EU001534	Excavation Block 7	Excavation Block 7
26EU001534	Other Surface	Other
26EU001534	Other Testing	Other
26EU001534	Stripping Area	Other
26EU001534	Site	Other
26EU001539	Cluster 1 Surface	Cluster 1
26EU001539	Op A	Cluster 1
26EU001539	Op B	Cluster 1
26EU001539	Op C	Cluster 1
26EU001539	Op D	Cluster 1
26EU001539	Op E	Cluster 1
26EU001539	Op H	Cluster 1
26EU001539	Test Unit 1	Cluster 1
26EU001539	Shovel Test 1	Cluster 1
26EU001539	Shovel Test 2	Cluster 1
26EU001539	Shovel Test 3	Cluster 1
26EU001539	Cluster 2 General Surface	Cluster 2
26EU001539	Surface Collection Grid 1	Cluster 2
26EU001539	Op F	Cluster 2
26EU001539	Op G	Cluster 2
26EU001539	General Surface, No Cluster	Other
26EU001539	Stripping Area	Other
26EU001548	Surface Collection Grid 1	Surface Collection Grid 1
26EU001548	Op G	Surface Collection Grid 1
26EU001548	Shovel Test 5	Surface Collection Grid 1
26EU001548	Surface Collection Grid 2	Surface Collection Grid 2
26EU001548	Op C	Surface Collection Grid 2
26EU001548	Op A	Other
26EU001548	Op B	Other
26EU001548	Op D	Other
26EU001548	Op E	Other
26EU001548	Op F	Other
26EU001548	Test Unit 1	Other
26EU001548	Shovel Test 1	Other
26EU001548	Shovel Test 2	Other

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001548	Shovel Test 3	Other
26EU001548	Shovel Test 4	Other
26EU001548	General Surface Collection	Other
26EU001548	Stripping Area	Other
26EU001595	Surface Collection Block	Site
26EU001595	Excavation Block 1 Surface	Site
26EU001595	Excavation Block 1 Subsurface	Site
26EU001595	Excavation Block 2 Surface	Site
26EU001595	Excavation Block 2 Subsurface	Site
26EU001595	Test Unit 1	Site
26EU001595	Site-wide Tool Collection	Site
26EU001595	Site	Site
26EU001667	Surface Collection Block 1	Surface Collection Block 1
26EU001667	Excavation Block 1	Surface Collection Block 1
26EU001667	Surface Collection Block 2	Surface Collection Block 2
26EU001667	Excavation Block 2	Surface Collection Block 2
26EU001667	Surface Collection Block 3	Surface Collection Block 3
26EU001667	Excavation Block 3	Surface Collection Block 3
26EU001667	Surface Collection Block 4	Surface Collection Block 4
26EU001667	Surface Collection Block 5	Surface Collection Block 5
26EU001667	Other Surface	Other
26EU001667	Other Testing	Other
26EU001667	Stripping Area	Other
26EU001667	Site	Other
26EU001734	Surface Collection Block	Site
26EU001734	Excavation Area	Site
26EU001734	Site-wide Tool Collection	Site
26EU001734	Other Surface	Site
26EU001734	Stripping Area	Site
26EU001734	Site	Site
26EU001851	Surface Collection Block	Site
26EU001851	Excavation Block	Site
26EU001851	Test Unit 1	Site
26EU001851	Test Unit 2	Site
26EU001851	Test Unit 3	Site
26EU001851	Other Surface	Site
26EU001851	Site	Site

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU001904	Surface Collection Block	Site
26EU001904	Excavation Block	Site
26EU001904	Other Surface	Site
26EU001906	Surface Collection Block	Site
26EU001906	Excavation Block	Site
26EU001906	Other Surface	Site
26EU001997	Surface Collection Area 1	Surface Collection Area 1
26EU001997	Excavation Area 1	Surface Collection Area 1
26EU001997	Surface Collection Area 2	Surface Collection Area 2
26EU001997	Excavation Area 2	Surface Collection Area 2
26EU001997	Backhoe Trenches	Other
26EU001997	Site	Other
26EU002064	Cluster 1 Surface	Cluster 1
26EU002064	Shovel Test 21	Cluster 1
26EU002064	Cluster 2 Surface	Cluster 2
26EU002064	Op B	Cluster 2
26EU002064	Test Unit 7	Cluster 2
26EU002064	Test Unit 8	Cluster 2
26EU002064	Shovel Test 13	Cluster 2
26EU002064	Shovel Test 14	Cluster 2
26EU002064	Shovel Test 15	Cluster 2
26EU002064	Shovel Test 16	Cluster 2
26EU002064	Shovel Test 17	Cluster 2
26EU002064	Shovel Test 18	Cluster 2
26EU002064	Shovel Test 19	Cluster 2
26EU002064	Shovel Test 20	Cluster 2
26EU002064	Shovel Test 22	Cluster 2
26EU002064	Shovel Test 23	Cluster 2
26EU002064	Shovel Test 24	Cluster 2
26EU002064	Cluster 3 Surface	Cluster 3
26EU002064	Op H	Cluster 3
26EU002064	Test Unit 3	Cluster 3
26EU002064	Test Unit 4	Cluster 3
26EU002064	Shovel Test 5	Cluster 3
26EU002064	Shovel Test 6	Cluster 3
26EU002064	Shovel Test 7	Cluster 3
26EU002064	Shovel Test 8	Cluster 3

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU002064	Shovel Test 27	Cluster 3
26EU002064	Cluster 4 Surface	Cluster 4
26EU002064	Op G	Cluster 4
26EU002064	Test Unit 1	Cluster 4
26EU002064	Test Unit 2	Cluster 4
26EU002064	Shovel Test 1	Cluster 4
26EU002064	Shovel Test 2	Cluster 4
26EU002064	Shovel Test 3	Cluster 4
26EU002064	Shovel Test 4	Cluster 4
26EU002064	Shovel Test 25	Cluster 4
26EU002064	Shovel Test 26	Cluster 4
26EU002064	Cluster 5 Surface	Cluster 5
26EU002064	Cluster 6 Surface	Cluster 6
26EU002064	Op A	Cluster 6
26EU002064	Test Unit 10	Cluster 6
26EU002064	Concentration 3 Surface	Concentration 3
26EU002064	Test Unit 5	Concentration 3
26EU002064	Test Unit 6	Concentration 3
26EU002064	Shovel Test 9	Concentration 3
26EU002064	Shovel Test 10	Concentration 3
26EU002064	Shovel Test 11	Concentration 3
26EU002064	Shovel Test 12	Concentration 3
26EU002064	Op C	Other
26EU002064	Op D	Other
26EU002064	Op E	Other
26EU002064	Op F	Other
26EU002064	Op I	Other
26EU002064	Test Unit 9	Other
26EU002064	General Surface, No Cluster	Other
26EU002064	Stripping Area	Other
26EU002079	Surface Survey	Site
26EU002079	Probe Unit 1	Site
26EU002079	Probe Unit 2	Site
26EU002079	Probe Unit 3	Site
26EU002079	Probe Unit 4	Site
26EU002124	Surface Collection Block	Site
26EU002124	Excavation Block	Site

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU002124	Site	Site
26EU002126	Cluster 1 Surface	Cluster 1
26EU002126	Op F	Cluster 1
26EU002126	Test Unit 1	Cluster 1
26EU002126	Shovel Test 1	Cluster 1
26EU002126	Shovel Test 2	Cluster 1
26EU002126	Shovel Test 3	Cluster 1
26EU002126	Cluster 2 Surface	Cluster 2
26EU002126	Op C	Cluster 2
26EU002126	Op A	Other
26EU002126	Op B	Other
26EU002126	Op D	Other
26EU002126	Op E	Other
26EU002126	Op M	Other
26EU002126	Op G	Other
26EU002126	Op H	Other
26EU002126	Op I	Other
26EU002126	Op J	Other
26EU002126	Op K	Other
26EU002126	Op L	Other
26EU002126	Op N	Other
26EU002126	Op O	Other
26EU002126	General Surface, No Cluster	Other
26EU002126	Stripping Area	Other
26EU002181	Surface	Site
26EU002181	Test Trench 1	Site
26EU002181	Test Trench 2	Site
26EU002182	Excavation Block 1	Site
26EU002182	Surface Collection	Site
26EU002182	Test Trench 1	Site
26EU002182	Test Trench 2	Site
26EU002183	Excavation Block 1	Site
26EU002183	Surface Collection	Site
26EU002183	Test Trench 1	Site
26EU002183	Test Trench 2	Site
26EU002183	Test Trench 3	Site
26EU002184	Surface Collection Block 1	Surface Collection Block 1

Table 6. Provenience Units and Analysis Units for Excavated Sites in the Study Area

Site	Provenience	Analysis Unit
26EU002184	Excavation Block 1	Surface Collection Block 1
26EU002184	Surface Collection Block 2	Surface Collection Block 2
26EU002184	Excavation Block 2	Surface Collection Block 2
26EU002184	Surface Collection Block 3	Surface Collection Block 3
26EU002184	Excavation Block 3	Surface Collection Block 3
26EU002184	Surface Collection Block 4	Surface Collection Block 4
26EU002184	Excavation Block 4	Surface Collection Block 4
26EU002184	Other Surface	Other

5. CHRONOLOGY AND THE "MULTICOMPONENT" PROBLEM

Michael D. Cannon and Tanya Johnson

Chronology is fundamental to all other aspects of archaeological investigation. Issues of chronology are particularly important in the LBB and surrounding area since many, if not most, sites in this region exhibit evidence of repeated use throughout the late Holocene, which hampers both synchronic (within a time period) and diachronic (across time periods) analysis. Accordingly, the new analyses presented starting with this chapter of the revised research context begin with a consideration of such issues.

Three main kinds of data are available for dating archaeological assemblages from the study area: radiocarbon dates, temporally diagnostic artifacts (primarily projectile points, but also ceramics), and obsidian hydration measurements. In this chapter, the cumulative radiocarbon record from the study area is considered first in order to provide some overall perspective on the area's occupational history. Next, the projectile point and obsidian hydration chronologies for the area are evaluated. Unlike radiocarbon determinations, which provide absolute dates on their own, diagnostic artifacts and obsidian hydration measurements provide absolute dates (as opposed to relative dates) only when independently correlated using radiocarbon dates and/or stratigraphic evidence. The data that are available for making such correlations are considered here, and the projectile point chronology and phase date ranges for the region are revised while doing so. Next, the ages of individual assemblages from the study area are examined. This allows single-component assemblages to be identified and then grouped by time period so that they can be used in the diachronic analyses that are presented in subsequent chapters.

After evaluating the ages of assemblages from the study area, this chapter considers whether there are factors, either environmental or archaeological, that can be used to predict whether sites or site loci will have single-component assemblages and whether they will contain subsurface archaeological features. Archaeological features are relevant to issues of chronology because they can easily be dated and are often surrounded by large samples of additional data. If buried features can be located efficiently in the field, then the focus of work can quickly turn to evaluating whether the surrounding deposits are multicomponent, and more extensive excavation efforts can subsequently be limited to those single-component deposits that are most useful for exploring change over time. The chapter concludes with the delineation of areas within the general realm of chronology in which future research is required.

5.1. The Little Boulder Basin Area Radiocarbon Record

A total of 124 radiocarbon dates are reported from the sites included in the sample used in this document. Information about these dates, compiled from the excavation report for each site (see Table 5), is presented in Table 7. All of the dates are associated with archaeological features, and feature names are given in Table 7, along with the provenience and analysis unit of each feature (see Table 6). Information about the radiocarbon dates themselves includes lab number, material type (when given in the excavation report), radiocarbon age (or percent modern carbon for dates that are essentially modern), and 1-sigma error term. Though the dates come from sites excavated by multiple organizations (mainly P-III, but also SWCA and the Nevada State Museum), all radiocarbon samples were submitted to Beta Analytic for analysis; thus, all lab numbers in Table 7 are Beta lab numbers.

The last two columns in Table 7 present the results of date calibrations performed specifically for this revised research context. Dates were calibrated using Calib 5.0.1 software (Stuiver and Reimer 1993) and the IntCal04 calibration curve (Reimer et al. 2004). The calibrated 2-sigma age ranges of each date are shown, as is the probability for each calibrated age range; probabilities are calculated as the proportion of the area within the 2-sigma range of the calendar year probability distribution. Calibration results are rounded to the nearest 10 years. Age ranges with probabilities of 0.01 or less are not reported in Table 7, nor are they considered in subsequent analyses; however, complete calibration results are provided in Appendix B. It is assumed that all radiocarbon ages are corrected for isotopic fractionation, since it is standard practice of Beta Analytic to do so, but excavation reports do not always explicitly state that this is the case.

Re-calibration of radiocarbon dates for this document was necessary so that dates could be compared: dates calibrated using different curves are not comparable, and calibrated dates, of course, are not comparable with uncalibrated dates. The calibration results reported here will differ from those presented in excavation reports in cases when, for example, an earlier calibration curve was employed or when 1-sigma ranges were reported rather than 2-sigma ranges.

Multiple radiocarbon determinations are available for three of the features listed in Table 7: two dates were taken on charcoal from Firepit 1 at 26EK005271, three dates were taken on charcoal from Feature 1 at 26EU002126, and two dates were taken on bone recovered near Feature 2 at this same site. In each case, the multiple dates from the same feature are statistically contemporaneous, and a pooled mean date (denoted in Table 7 with a lab number of "Average") is therefore used for each feature in all subsequent analyses instead of the individual multiple dates. Date contemporaneity was evaluated using the T' statistic of Ward and Wilson (1978), and contemporaneity tests were carried out with Calib 5.0.1 software[4], using an alpha level of 0.05. Pooled mean dates were also calculated following Ward and Wilson (1978) and using Calib 5.0.1, and these pooled mean dates were calibrated in the manner described above for individual dates. Averaging multiple statistically contemporaneous dates reduces the uncertainty of age estimation; that is, the error term for a pooled mean date will generally be smaller than the error terms of the dates that are included in the calculation of the mean (Ward and Wilson 1978). For this reason, the calibrated 2 sigma age ranges for the pooled mean dates are slightly narrower than those for the individual dates. Finally, Feature 2 at 26EU002126, for which an average of two bone collagen dates was calculated, also produced a much older charcoal date; this charcoal date is excluded from consideration in all subsequent analyses due to the likelihood that it is subject to "old wood" effects (e.g., Smiley 1994, 1998) as is discussed further in Cannon (2008:141). Modern dates are also excluded from subsequent analyses.

The calibrated 2-sigma age ranges of the LBB area radiocarbon dates are arranged in chronological order in Figure 4; also shown in this figure, for comparative purposes, are the phase boundaries proposed by Schroedl (1995) (see Table 2). There is one very early outlying date in the sample: a date on charcoal and sediment from Rock-filled Firepit 1 at 26EU002182, which has a high-probability calibrated 2-sigma range of 2780–1890 B.C. and a much lower probability range of 2870–2800 B.C. (lab no. 74057). This may represent a human presence in the LBB area as early as the 3rd millennium B.C.; however, given that the two other radiocarbon dates from the same site (lab nos. 74056 and 74058) fall over 1,000 years later than this, it is at least equally plausible that this date is erroneously old, perhaps due to "old wood" effects. This one early date aside, the radiocarbon record picks up (at 2-sigma) just before 1200 B.C. and then continues without interruption until the modern era.

This distribution of radiocarbon dates has several implications. First, at least based on the radiocarbon record, there is no evidence for any substantial hiatus in human occupation of the area from about 1200 B.C. on. Second, the largest number of radiocarbon dates from the study area fall within the Eagle Rock Phase, as defined to have a beginning date of A.D. 1300 (Elston and Budy 1990; Schroedl 1995). If nothing about subsistence and settlement systems changed such that the per capita number of thermal features (from which all of the radiocarbon dates come) increased during the Eagle Rock Phase, this

[4] Calib 5.0.1 incorporates calibration curve error into the total error associated with a radiocarbon age prior to calibration; contemporaneity tests are thus equivalent to the "Case II" of Ward and Wilson (1978).

would suggest that human population density and/or the length of seasonal occupations was greater during this phase than during earlier periods.

Third, while there are smaller but still substantial numbers of radiocarbon dates that fall within the ranges for the Maggie Creek and James Creek phases (A.D. 700–1300 and 850 B.C.–A.D. 700, respectively), there are almost none that fall within Schroedl's (1995) proposed range for the South Fork phase of 4600–850 B.C. Indeed, other than the one potentially problematic third millennium B.C. date discussed above, there is no radiocarbon evidence for human occupation of the area that is anywhere near as old as 4600 B.C.; rather, there are only four radiocarbon dates with calibrated 2-sigma ranges that fall before 850 B.C., and the earliest of these (lab no. 74058, from Rock-lined Firepit 1 at 26EU002182) has a calibrated 2-sigma range that begins only at 1260 B.C. It may be that the LBB area was occupied prior to this time and that the occupants simply did not construct thermal features for archaeologists to date, or that they did but the features have either not been preserved or not been discovered. However, at face value, the radiocarbon record suggests that one of two things must be the case: either the South Fork phase as defined by Schroedl (1995) does not really exist in the LBB area, or the dates for it must be revised considerably. This issue is returned to below after exploring additional chronological data from the region.

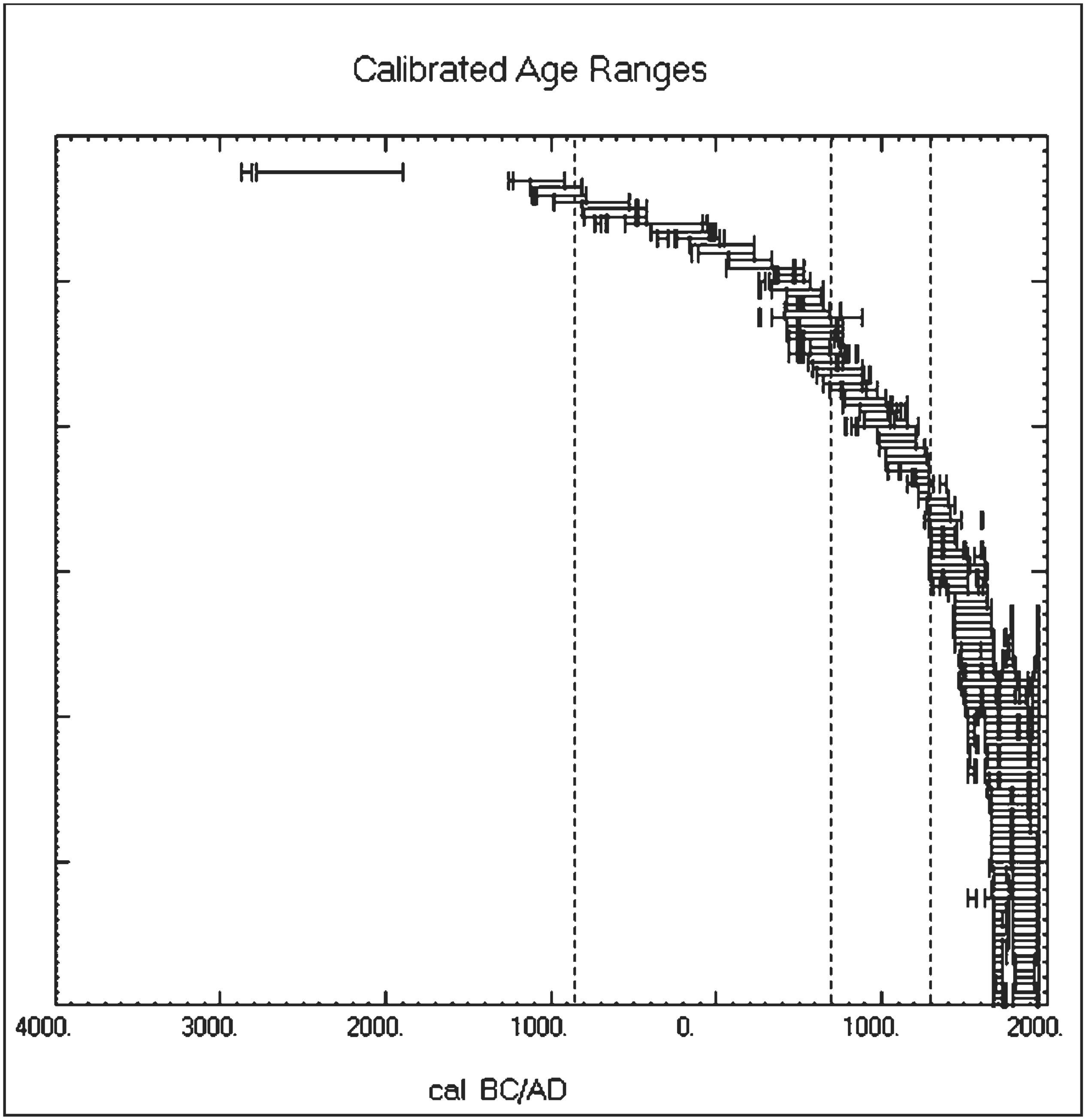

Figure 4. Distribution of radiocarbon dates (calibrated 2-sigma ranges) from excavated sites in the Little Boulder Basin study area.

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EK002304	Hearth	Unit 14	Site	4148	Not Given	470 ± 50	A.D. 1320–1350 A.D. 1390–1520 A.D. 1590–1620	0.047 0.915 0.037
26EK004687	Firepit 2	Excavation Block 3	Surface Collection Block 2	74033	Not Given	1570 ± 80	A.D. 260–280 A.D. 330–640	0.011 0.989
26EK004687	Rock-filled Firepit 1	Excavation Block 4	Surface Collection Block 3	69175	Not Given	1420 ± 80	A.D. 430–500 A.D. 500–730 A.D. 740–770	0.081 0.870 0.050
26EK004687	Rock-filled Firepit 2	Excavation Block 4	Surface Collection Block 3	69173	Not Given	1480 ± 50	A.D. 440–490 A.D. 510–520 A.D. 530–650	0.118 0.015 0.868
26EK004687	Firepit 4	Stripping Area	Other	74035	Not Given	50 ± 50	A.D. 1680–1740 A.D. 1800–1940 A.D. 1950–1960	0.263 0.706 0.026
26EK004687	Firepit with Rocks 4	Stripping Area	Other	69174	Not Given	230 ± 50	A.D. 1510–1600 A.D. 1620–1700 A.D. 1730–1820 A.D. 1840–1880 A.D. 1920–1950	0.141 0.336 0.373 0.032 0.117
26EK004688	Ash Concentration 1	Activity Locus 2	Activity Locus 2	132864	Charcoal	80 ± 50	A.D. 1680–1760 A.D. 1800–1940 A.D. 1950–1960	0.309 0.671 0.018
26EK004688	Storage Pit 1	Activity Locus 3	Activity Locus 3	132865	Charcoal	490 ± 100	A.D. 1290–1530 A.D. 1540–1640	0.825 0.175
26EK004688	Storage Pit 2	Activity Locus 4	Activity Locus 4	132870	Organic Sediment	590 ± 80	A.D. 1270–1450	1.000
26EK004688	Firehearth with Rocks 4	Activity Locus 6	Activity Locus 6	132868	Charcoal	80 ± 40	A.D. 1680–1740 A.D. 1800–1940 A.D. 1950–1960	0.273 0.707 0.014
26EK004688	Firehearth 2	Activity Locus 8	Activity Locus 8	132866	Charcoal	210 ± 50	A.D. 1530–1560 A.D. 1630–1710 A.D. 1720–1830 A.D. 1830–1890 A.D. 1910–1950	0.034 0.287 0.454 0.072 0.154

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EK004688	Firehearth with Rocks 5	Activity Locus 9	Activity Locus 9	132869	Charcoal	100 ± 40	A.D. 1680–1760 A.D. 1800–1940 A.D. 1950s	0.315 0.672 0.012
26EK004688	Firehearth with Rocks 7	Activity Locus 10	Activity Locus 10	132871	Organic Sediment	1080 ± 80	A.D. 770–1060 A.D. 1060–1160	0.910 0.090
26EK004688	Firehearth 6	Activity Locus 11	Activity Locus 11	132867	Charcoal	210 ± 50	A.D. 1530–1560 A.D. 1630–1710 A.D. 1720–1830 A.D. 1830–1890 A.D. 1910–1950	0.034 0.287 0.454 0.072 0.154
26EK004690	Firepit	Stripping Area	Other	69176	Not Given	140 ± 50	A.D. 1670–1780 A.D. 1800–1900 A.D. 1900–1950	0.441 0.376 0.184
26EK004695	Firepit 1	Stripping Area	Site	69177	Not Given	200 ± 50	A.D. 1640–1710 A.D. 1720–1890 A.D. 1910–1950	0.265 0.566 0.165
26EK004749	Rock-filled Firepit 1	Excavation Block 4	Surface Collection Block 4	96776	Charcoal	310 ± 70	A.D. 1440–1680 A.D. 1760–1800 A.D. 1940–1950	0.938 0.049 0.012
26EK004755	Organic Stain 1	Excavation Block 1	Surface Collection Block	96777	Sediment	480 ± 60	A.D. 1310–1360 A.D. 1390–1520 A.D. 1590–1620	0.133 0.810 0.050
26EK005270	Rock-lined Firepit[a]	Excavation Block	Site	74036	Charcoal	330 ± 60	A.D. 1450–1660	1.000
26EK005271	Firepit 1	Excavation Block 1	Excavation Block 1	74038	Charcoal	200 ± 70	A.D. 1520–1570 A.D. 1630–1950	0.062 0.933
26EK005271	Firepit 1	Excavation Block 1	Excavation Block 1	74039	Charcoal	270 ± 60	A.D. 1460–1680 A.D. 1730–1810 A.D. 1930–1950	0.807 0.152 0.041
26EK005271	*Firepit 1*[b]	*Excavation Block 1*	*Excavation Block 1*	*Average*	*Charcoal*	*240 ± 46*	*A.D. 1510–1600* *A.D. 1620–1690* *A.D. 1730–1810* *A.D. 1920–1950*	*0.194* *0.384* *0.323* *0.090*

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EK005271	Rock Cluster	Excavation Block 3	Excavation Block 3	74037	Charcoal	120 ± 60	A.D. 1670–1780 A.D. 1800–1950	0.404 0.586
26EK006231	Firepit 1	Excavation Block 1	Surface Collection Block 1	87454	Sediment	100 ± 120	A.D. 1520–1570 A.D. 1630–1960	0.035 0.965
26EK006231	Firepit 2	Excavation Block 1	Surface Collection Block 1	87451	Charcoal	110 ± 60	A.D. 1670–1780 A.D. 1800–1940 A.D. 1950s	0.389 0.598 0.013
26EK006231	Firepit 4	Excavation Block 2	Surface Collection Block 2	87452	Charcoal	120 ± 60	A.D. 1670–1780 A.D. 1800–1950	0.404 0.586
26EK006231	Firepit with Rocks 1	Excavation Block 3	Surface Collection Block 3	87453	Charcoal	190 ± 70	A.D. 1520–1560 A.D. 1630–1950	0.035 0.960
26EK006232	Firepit with Rocks 1	Excavation Block 1	Surface Collection Block 1	88788	Sediment	1390 ± 80	A.D. 440–490 A.D. 530–780 A.D. 790–810	0.036 0.941 0.014
26EK006232	Firepit 1	Excavation Block 3	Surface Collection Block 2	87455	Sediment	500 ± 60	A.D. 1300–1370 A.D. 1380–1500 A.D. 1600–1620	0.244 0.741 0.014
26EK006487	Firehearth 1	Excavation Block 2	Excavation Block 2	121953	Charred Material	760 ± 40	A.D. 1210–1290	0.991
26EK006487	Firehearth with Rocks 1	Excavation Block 2	Excavation Block 2	129156	Charred Material	490 ± 80	A.D. 1300–1520 A.D. 1560–1630	0.892 0.108
26EK006487	Firehearth 2	Excavation Block 4	Excavation Block 4	129155	Charred Material	150 ± 50	A.D. 1660–1790 A.D. 1790–1890 A.D. 1910–1950	0.468 0.354 0.178
26EU001319	Hearth	Excavation Block	Site	23900	Charcoal	590 ± 50	A.D. 1290–1420	1.000
26EU001320	Firepit 1	Excavation Area 1	Area 1	59609	Charcoal	100 ± 80	A.D. 1670–1780 A.D. 1800–1960	0.395 0.605
26EU001320	Firepit 2	Excavation Area 1	Area 1	59624	Charcoal/Sediment	1420 ± 70	A.D. 440–490 A.D. 530–720 A.D. 740–770	0.053 0.908 0.033
26EU001320	Firepit with Rocks 1	Excavation Area 1	Area 1	59608	Charcoal	330 ± 70	A.D. 1440–1670 A.D. 1780–1800	0.976 0.021

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001320	Firepit with Rocks 2	Excavation Area 1	Area 1	59623	Charcoal/Sediment	1960 ± 80	170 B.C.–A.D. 230	1.000
26EU001320	Rock-capped Firepit 1	Excavation Area 1	Area 1	59625	Charcoal/Sediment	1460 ± 80	A.D. 420–690	0.995
26EU001320	Rock-filled Firepit 1	Excavation Area 1	Area 1	23901	Charcoal	1320 ± 80	A.D. 580–890	1.000
26EU001320	Rock-filled Firepit 2	Excavation Area 1	Area 1	59607	Charcoal	2270 ± 90	730–690 B.C. 550–90 B.C. 80–60 B.C.	0.022 0.962 0.011
26EU001320	Rock-filled Firepit 3	Excavation Area 1	Area 1	59621	Charcoal/Sediment	1620 ± 60	A.D. 260–300 A.D. 320–570	0.047 0.953
26EU001320	Rock-filled Firepit 4	Excavation Area 1	Area 1	59622	Charcoal/Sediment	1810 ± 50	A.D. 80–340	1.000
26EU001320	Rock-lined Firepit 1	Excavation Area 1	Area 1	59606	Charcoal	100 ± 0.6 % of modern	Modern	
26EU001320	Firepit 4	Excavation Area 2	Area 2	59620	Charcoal/Sediment	570 ± 90	A.D. 1260–1490	0.996
26EU001320	Rock-lined Firepit 2	Excavation Area 2	Area 2	59610	Charcoal	170 ± 50	A.D. 1650–1710 A.D. 1720–1890 A.D. 1910–1950	0.202 0.624 0.175
26EU001320	Firepit with Rocks 3	Stripping Area	Other	59619	Charcoal	270 ± 50	A.D. 1470–1680 A.D. 1740–1750 A.D. 1760–1800 A.D. 1940–1950	0.857 0.012 0.106 0.025
26EU001320	Firepit with Rocks 5	Stripping Area	Other	59618	Charcoal	330 ± 70	A.D. 1440–1670 A.D. 1780–1800	0.976 0.021
26EU001320	Firepit with Rocks 8	Stripping Area	Other	59615	Charcoal	760 ± 60	A.D. 1160–1320 A.D. 1360–1390	0.945 0.055
26EU001320	Firepit with Rocks 11	Stripping Area	Other	59613	Charcoal	860 ± 80	A.D. 1030–1280	1.000

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	**Feature**	**Provenience**	**Analysis Unit**	**Lab No.**	**Sample Type**	**Conventional Radiocarbon Age (^{14}C yrs. BP)**	**Calibrated 2 Sigma Range**	**Calibrated Range Probability**
26EU001320	Firepit with Rocks 12	Stripping Area	Other	59614	Charcoal	100 ± 50	A.D. 1680–1770 A.D. 1770–1780 A.D. 1800–1940 A.D. 1950s	0.335 0.013 0.639 0.013
26EU001320	Firepit with Rocks 13	Stripping Area	Other	59612	Charcoal	1290 ± 80	A.D. 610–900 A.D. 920–940	0.984 0.016
26EU001320	Firepit with Rocks 14	Stripping Area	Other	59611	Charcoal	350 ± 50	A.D. 1450–1640	1.000
26EU001320	Rock-filled Firepit 5	Stripping Area	Other	59617	Charcoal	1030 ± 50	A.D. 890–1050 A.D. 1080–1150	0.0847 0.153
26EU001320	Rock-lined Firepit 4	Stripping Area	Other	59616	Charcoal	270 ± 40	A.D. 1490–1600 A.D. 1610–1680 A.D. 1780–1800 A.D. 1940–1950	0.502 0.401 0.081 0.015
26EU001482	Firepit 14	Excavation Block 1	Surface Collection Block 1	74040	Not Given	111.2 ± 0.7 % of modern	Modern	
26EU001482	Firepit with Rocks 3	Excavation Block 1	Surface Collection Block 1	74043	Not Given	330 ± 60	A.D. 1450–1660	1.000
26EU001482	Firepit with Rocks 4	Excavation Block 1	Surface Collection Block 1	74046	Not Given	150 ± 70	A.D. 1660–1950	1.000
26EU001482	Firepit 3	Excavation Block 2	Surface Collection Block 2	74041	Not Given	240 ± 70	A.D. 1470–1710 A.D. 1720–1820 A.D. 1830–1880 A.D. 1910–1950	0.568 0.281 0.056 0.095
26EU001482	Firepit 4	Excavation Block 2	Surface Collection Block 2	74044	Not Given	200 ± 60	A.D. 1520–1560 A.D. 1630–1900 A.D. 1900–1950	0.034 0.807 0.160
26EU001482	Firepit with Rocks 5	Excavation Block 2	Surface Collection Block 2	74045	Not Given	260 ± 50	A.D. 1480–1680 A.D. 1740–1810 A.D. 1930–1950	0.769 0.184 0.047
26EU001482	Firepit 1	Excavation Block 3	Surface Collection Block 3	80083	Not Given	960 ± 60	A.D. 990–1210	1.000
26EU001482	Firepit 2	Excavation Block 3	Surface Collection Block 3	74042	Not Given	540 ± 70	A.D. 1290–1460	1.000

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001482	Firepit with Rocks 1	Excavation Block 4	Surface Collection Block 4	74048	Not Given	210 ± 60	A.D. 1520–1570 A.D. 1630–1890 A.D. 1910–1950	0.066 0.784 0.145
26EU001482	Firepit with Rocks 2	Excavation Block 4	Surface Collection Block 4	74047	Not Given	120 ± 50	A.D. 1670–1780 A.D. 1800–1940	0.394 0.596
26EU001483	Rock-filled Firepit 1	Excavation Block 1	Surface Collection Block 1	69149	Not Given	1950 ± 70	110 B.C.–A.D. 230	0.995
26EU001483	Firepit with Rocks 1	Excavation Block 2	Surface Collection Block 2	69155	Not Given	1060 ± 50	A.D. 890–1050 A.D. 1090–1120	0.970 0.024
26EU001483	Rock-filled Firepit 3	Excavation Block 2	Surface Collection Block 2	69154	Not Given	970 ± 60	A.D. 970–1210	1.000
26EU001483	Rock-filled Firepit 4	Excavation Block 2	Surface Collection Block 2	69153	Not Given	1750 ± 100	A.D. 70–470 A.D. 480–530	0.951 0.049
26EU001483	Firepit 1	Excavation Block 3	Surface Collection Block 3	69151	Not Given	110 ± 90	A.D. 1660–1960	1.000
26EU001483	Firepit with Rocks 3	Excavation Block 3	Surface Collection Block 3	69152	Not Given	820 ± 70	A.D. 1040–1110 A.D. 1120–1290	0.163 0.837
26EU001483	Rock-filled Firepit 5	Excavation Block 3	Surface Collection Block 3	69150	Not Given	920 ± 80	A.D. 990–1260	1.000
26EU001487	Firepit 2	Excavation Block 1	Excavation Block 1	109932	Charcoal/Organic Sediment	510 ± 50	A.D. 1310–1360 A.D. 1390–1460	0.244 0.756
26EU001487	Firepit with Rocks 1	Excavation Block 1	Excavation Block 1	96775	Charcoal	30 ± 50	A.D. 1680–1730 A.D. 1810–1930 A.D. 1950–1960	0.252 0.713 0.035
26EU001487	Firepit with Rocks 3	Excavation Block 1	Excavation Block 1	96774	Charcoal	100.4 ± 0.9 % of modern	Modern	
26EU001487	Firepit with Rocks 4	Excavation Block 1	Excavation Block 1	96773	Charcoal	0 ± 70	A.D. 1680–1740 A.D. 1740–1760 A.D. 1800–1940 A.D. 1950–1960	0.259 0.022 0.689 0.030

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001487	Rock-filled Firepit 1	Excavation Block 2	Excavation Block 2	96772	Charcoal	10 ± 70	A.D. 1680–1740 A.D. 1740–1760 A.D. 1800–1940 A.D. 1950–1960	0.259 0.029 0.684 0.028
26EU001505	Firepit	Excavation Block	Site	87457	Charcoal	490 ± 110	A.D. 1290–1640	1.000
26EU001530	Rock-lined Firepit 1	Excavation Block 4	Excavation Block 4	80084	Not Given	170 ± 70	A.D. 1640–1950	1.000
26EU001530	Firepit 3	Excavation Block 5	Excavation Block 5	80086	Not Given	190 ± 70	A.D. 1520–1560 A.D. 1630–1950	0.035 0.960
26EU001530	Firepit with Rocks 1	Excavation Block 5	Excavation Block 5	80085	Not Given	150 ± 60	A.D. 1660–1900 A.D. 1900–1950	0.819 0.181
26EU001531	Rock-capped Firepit 2	Excavation Block 1	Excavation Block 1	69159	Not Given	1190 ± 50	A.D. 690–750 A.D. 760–910 A.D. 910–970	0.132 0.730 0.139
26EU001531	Rock-filled Firepit 1	Excavation Block 1	Excavation Block 1	69162	Not Given	2630 ± 80	980–520 B.C.	1.000
26EU001531	Rock-filled Firepit 7	Excavation Block 1	Excavation Block 1	69158	Not Given	1420 ± 80	A.D. 430–500 A.D. 500–730 A.D. 740–770	0.081 0.870 0.050
26EU001531	Rock-lined Firepit	Excavation Block 2	Excavation Block 2	69157	Not Given	100 ± 50	A.D. 1680–1770 A.D. 1770–1780 A.D.1800–1940 A.D. 1950s	0.335 0.013 0.639 0.013
26EU001531	Rock-filled Firepit 5	Excavation Block 4	Excavation Block 4	69156	Not Given	1520 ± 50	A.D. 430–630	1.000
26EU001531	Firepit 2	Stripping Area	Other	69160	Not Given	80 ± 60	A.D. 1680–1770 A.D. 1770–1780 A.D. 1800–1940 A.D. 1950–1960	0.326 0.013 0.643 0.018
26EU001531	Firepit 8	Stripping Area	Other	69161	Not Given	109.1 ± 1.3 % of modern	Modern	
26EU001531	Rock-filled Firepit 3	Stripping Area	Other	74049	Not Given	820 ± 80	A.D. 1030–1290	1.000

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001534	Firepit 2	Excavation Block 1	Excavation Block 1	80087	Not Given	130 ± 60	A.D. 1670–1780 A.D. 1800–1950	0.417 0.583
26EU001534	Firepit 3	Excavation Block 1	Excavation Block 1	80088	Not Given	50 ± 50	A.D. 1680–1740 A.D. 1800–1940 A.D. 1950–1960	0.263 0.706 0.026
26EU001534	Firepit with Rocks 3	Excavation Block 5	Excavation Block 5	80089	Not Given	680 ± 70	A.D. 1220–1410	1.000
26EU001534	Firepit with Rocks 2	Excavation Block 7	Excavation Block 7	80090	Not Given	420 ± 70	A.D. 1410–1640	1.000
26EU001534	Rock-lined Firepit	Excavation Block 7	Excavation Block 7	80091	Not Given	540 ± 50	A.D. 1300–1370 A.D. 1380–1450	0.435 0.565
26EU001667	Firepit 1	Excavation Block 1	Surface Collection Block 1	69171	Not Given	220 ± 60	A.D. 1520–1600 A.D. 1620–1710 A.D. 1720–1890 A.D. 1910–1950	0.119 0.288 0.461 0.131
26EU001667	Firepit 4	Excavation Block 1	Surface Collection Block 1	69167	Not Given	300 ± 60	A.D. 1450–1680 A.D. 1780–1800	0.952 0.038
26EU001667	Firepit 8	Excavation Block 1	Surface Collection Block 1	69169	Not Given	60 ± 70	A.D. 1680–1780 A.D. 1800–1940 A.D. 1950–1960	0.339 0.641 0.020
26EU001667	Firepit 20	Excavation Block 1	Surface Collection Block 1	69164	Not Given	10 ± 50	A.D. 1690–1730 A.D. 1810–1930 A.D. 1950–1960	0.233 0.719 0.048
26EU001667	Firepit with Rocks 1	Excavation Block 1	Surface Collection Block 1	74054	Not Given	80 ± 50	A.D. 1680–1760 A.D. 1800–1940 A.D. 1950–1960	0.309 0.671 0.018
26EU001667	Firepit with Rocks 2	Excavation Block 1	Surface Collection Block 1	69163	Not Given	30 ± 50	A.D. 1680–1730 A.D. 1810–1930 A.D. 1950–1960	0.252 0.713 0.035
26EU001667	Miscellaneous Pit 1	Excavation Block 1	Surface Collection Block 1	69172	Not Given	1380 ± 60	A.D. 560–730 A.D. 740–770	0.905 0.095
26EU001667	Miscellaneous Pit 2	Excavation Block 1	Surface Collection Block 1	74052	Not Given	1110 ± 60	A.D. 780–1020	1.000

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001667	Miscellaneous Pit 4	Excavation Block 1	Surface Collection Block 1	74053	Not Given	2790 ± 70	1130–810 B.C.	1.000
26EU001667	Rock-filled Firepit 1	Excavation Block 1	Surface Collection Block 1	74050	Not Given	2150 ± 80	390–40 B.C. 30–20 B.C. 10–0 B.C.	0.978 0.011 0.010
26EU001667	Rock-filled Firepit 2	Excavation Block 1	Surface Collection Block 1	69165	Not Given	200 ± 50	A.D. 1640–1710 A.D. 1720–1890 A.D. 1910–1950	0.265 0.566 0.165
26EU001667	Rock-lined Pit	Excavation Block 1	Surface Collection Block 1	69170	Not Given	2540 ± 70	810–480 B.C. 470–420 B.C.	0.941 0.059
26EU001667	Firepit 10	Excavation Block 2	Surface Collection Block 2	69168	Not Given	200 ± 70	A.D. 1520–1570 A.D. 1630–1950	0.062 0.933
26EU001667	Firepit 11	Excavation Block 2	Surface Collection Block 2	74051	Not Given	220 ± 60	A.D. 1520–1600 A.D. 1620–1710 A.D. 1720–1890 A.D. 1910–1950	0.119 0.288 0.461 0.131
26EU001667	Firepit 21	Excavation Block 3	Surface Collection Block 3	69166	Not Given	40 ± 50	A.D. 1680–1740 A.D. 1810–1940 A.D. 1950–1960	0.258 0.712 0.030
26EU001734	Firepit with Rocks 1	Excavation Area	Site	57784	Burned Sediment	2730 ± 80	1090–780 B.C.	0.991
26EU001734	Rock-filled Firepit 1	Excavation Area	Site	57779	Charcoal	1450 ± 130	A.D. 330–880	0.996
26EU001734	Firepit 1	Stripping Area	Site	57780	Charcoal	140 ± 50	A.D. 1670–1780 A.D. 1800–1900 A.D. 1900–1950	0.441 0.376 0.184
26EU001734	Firepit with Rocks 4	Stripping Area	Site	57782	Charcoal	230 ± 80	A.D. 1490–1710 A.D. 1720–1890 A.D. 1910–1950	0.497 0.395 0.108
26EU001734	Rock-capped Firepit 1	Stripping Area	Site	57783	Burned Sediment	2520 ± 70	800–480 B.C. 470–420 B.C.	0.921 0.079
26EU001734	Rock-filled Firepit 2	Stripping Area	Site	57781	Charcoal	1260 ± 60	A.D. 660–890	1.000

Table 7. Radiocarbon Dates Reported from Excavated Sites in the Study Area

Site	Feature	Provenience	Analysis Unit	Lab No.	Sample Type	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001997	Firepit	Excavation Area 1	Surface Collection Area 1	57961	Not Given	1010 ± 90	A.D. 810–840 A.D. 860–1220	0.019 0.978
26EU002126	Feature 2	Op F	Cluster 1	235549	Charcoal	1160 ± 40	A.D. 780–980	1.000
26EU002126	Feature 2	Op F	Cluster 1	244923	Bone Collagen	750 ± 40	A.D. 1210–1300	0.991
26EU002126	Feature 2	Op F	Cluster 1	244924	Bone Collagen	710 ± 40	A.D. 1220–1310 A.D. 1360–1390	0.816 0.183
26EU002126	*Feature 2*[c]	*Op F*	*Cluster 1*	*Average*	*Bone Collagen*	*730 ± 28*	*A.D. 1230–1300*	*1.000*
26EU002126	Feature 1	Op C	Cluster 2	235062	Charcoal	1630 ± 40	A.D. 340–540	0.995
26EU002126	Feature 1	Op C	Cluster 2	235063	Charcoal	1640 ± 40	A.D. 260–280 A.D. 330–540	0.025 0.975
26EU002126	Feature 1	Op C	Cluster 2	235064	Charcoal	1620 ± 40	A.D. 340–540	1.000
26EU002126	*Feature 1*[d]	*Op C*	*Cluster 2*	*Average*	*Charcoal*	*1630 ± 23*	*A.D. 350–370* *A.D. 380–470* *A.D. 480–530*	*0.023* *0.733* *0.244*
26EU002126	Feature 3	Stripping Area	Other	237710	Charcoal	1390 ± 40	A.D. 570–690	0.999
26EU002182	Firepit with Rocks 1	Excavation Block 1	Site	74056	Charcoal and Burned Sediment	2100 ± 60	360–280 B.C. 230 B.C.–A.D. 30	0.114 0.880
26EU002182	Rock-filled Firepit 1	Excavation Block 1	Site	74057	Charcoal and Burned Sediment	3860 ± 170	2870–2800 B.C. 2780–1890 B.C.	0.031 0.969
26EU002182	Rock-lined Firepit 1	Excavation Block 1	Site	74058	Charcoal and Burned Sediment	2880 ± 60	1260–1230 B.C. 1220–910 B.C.	0.042 0.958

a. An oxidizable carbon ratio (OCR) date was also obtained for this feature, but it is described as not valid (Tipps 1996:3–7) and so is not considered here (also see Killick et al. 1999).

b. Pooled mean of 2 dates (lab nos. 74038, 74039); $T = 0.58$, $df = 1$, $p = 0.448$.

c. Pooled mean of 2 dates (lab nos. 244923, 244924); $T = 0.50$, $df = 1$, $p = 0.480$.

d. Pooled mean of 3 dates (lab nos. 235062, 235063, 235064); $T = 0.13$, $df = 2$, $p = 0.939$.

5.2. Projectile Point Chronology

Early in P-III's research in the LBB, Schroedl (1995:43–57) addressed one of the needs described in the chronology domain of the 1991 historic context by presenting a projectile point chronology for the LBB area. This chronology has been used to assign occupations to temporal phases during virtually all subsequent work conducted in the area. Table 8 shows which projectile point types have been treated as diagnostic of which phases in the LBB area; the phase date ranges used in this table are those presented in Schroedl (1995:Table 9) (see Table 2), and the table is limited to the South Fork through Eagle Rock phases due to the limited evidence from the area of occupation during earlier periods (see Chapter 2).

Table 8. Little Boulder Basin Projectile Point Chronology, after Schroedl (1995:54–57)

Phase	Dates (calibrated B.C./A.D.)	Diagnostic Point Types
Eagle Rock	A.D. 1300–late 1800s	Desert Side-notched and Cottonwood Triangular
Maggie Creek	A.D. 700–1300	Eastgate Expanding Stem, Rose Spring Corner-notched, and "probably" Rye Patch Miniature
James Creek	850 B.C.–A.D. 700	Elko Corner-notched and Elko Side-notched[a]
South Fork	4600–850 B.C.	latter part of phase only: Gatecliff Split Stem, Gatecliff Contracting Stem/Gypsum, and Elko Eared entire phase: Humboldt Concave Base

a. Schroedl (1995:56) notes that these point types also appear to have been used both before and after the James Creek phase time span, and thus should not be considered to be diagnostic of this phase, but they have in practice been treated as diagnostic of this phase in most subsequent work.

It is not possible to directly evaluate the basis of this projectile point chronology because Schroedl gives very little detail about matters of both dating and typology. Despite criticizing other researchers for providing insufficient information about radiocarbon dates from sites they excavated (Schroedl 1995:40–42), Schroedl does not discuss in any real detail how he arrived at the date ranges that he assigns to individual point types (see Schroedl 1995:49); he simply states that P-III examined data from "a variety of excavated sites" in arriving at their chronological conclusions (Schroedl 1995:54). Likewise, after critiquing the typological methods of other researchers in depth (Schroedl 1995:43–48), Schroedl says only that P-III developed their "own grouping of types", and that "we believe that these types represent statistically separate and cohesive clusters in a strict typological sense" (Schroedl 1995:48). The statistical validity of the types is not demonstrated, nor are classification criteria discussed much beyond stating that P-III's types "are based primarily, but not exclusively, on morphological characteristics" (Schroedl 1995:48) and illustrating idealized examples of each point type (Schroedl 1995:49).

Because of the lack of detail that Schroedl provides, it is necessary to start at square one when reevaluating the projectile point chronology for the LBB area. Regarding the dating of point types, this is done here by considering the projectile point assemblages from James Creek Shelter and Pie Creek Shelter, the two excavated, well-reported rockshelter sites located nearest to the LBB. Rockshelters are particularly useful for building projectile point chronologies because they can provide a stratigraphic record of changes in point types, and the relative order of point types revealed by the stratified deposits can be correlated to absolute ages if radiocarbon dates (or some other type of absolute dates) are available (e.g., David H. Thomas 1983). Since there is evident geographical variability in projectile point chronology across the Great Basin—particularly between the eastern Great Basin, on the one hand, and the western and central Great Basin, on the other (e.g., Grayson 1993; Holmer 1986; McGuire et al. 2004)—only these two sites in the immediate vicinity of the LBB are considered. Regarding typology, it is assumed throughout this chapter that P-III's classification of projectile points is consistent with the classifications of other researchers. This assumption is supported by Schroedl's (1995:49) outline drawings of idealized point types, which are generally consistent with types as described in much more detail by others (Holmer 1978, 1986; Holmer and Weder 1980; Justice 2002; D. H. Thomas 1981, illustrations of the point types discussed in this section can be found in these sources). This assumption is also necessary since reclassifying projectile point specimens from the study area is well beyond the scope of this project.

Projectile point data from James Creek Shelter are presented in Table 9. At this site, deposits within the shelter were excavated by stratigraphic unit, which were grouped into "horizons", while the shelter's exterior apron deposits were excavated by arbitrary level, some of which were correlated to horizons within the shelter (Budy and Katzer 1990). Drews (1990:Tables 6 and 7) gives projectile point counts by horizon and level, Budy and Katzer (1990:Table 2) present radiocarbon dates for horizons and levels, and Elston and Katzer (1990) assign horizons to temporal phases. The James Creek Shelter radiocarbon dates were recalibrated for this document because Budy and Katzer (1990) employed a calibration curve that is now out of date; calibration and evaluation of statistical contemporeneity was performed using the same methods discussed in the previous section for the radiocarbon dates from the LBB study area.

Comparable data from Pie Creek Shelter are presented in Table 10. This site was excavated by stratigraphic unit, and the excavators combined strata into "components", each of which they assigned to a phase (McGuire et al. 2004:39–46). Projectile point counts per component are given by McGuire et al. (2004:Table 5, Figure 27), and radiocarbon dates are given by McGuire et al. (2004:Table 4). The Pie Creek Shelter radiocarbon dates were also recalibrated for this document, again following the methods discussed in the previous section, both to ensure comparability with the dates from the LBB study area and because the excavation report presents calibration results in years B.P. rather than B.C./A.D. Full radiocarbon calibration results for both James Creek and Pie Creek shelters are provided in Appendix B, along with results of statistical contemporeneity tests.

Table 9. Projectile Point Counts by Horizon and Level at James Creek Shelter (from Drews 1990:Tables 6 and 7)

Horizon, Level[a]	Phase[b]	Radiocarbon Date Range (calibrated B.C./A.D.)[c]	Desert Side-notched	Rosegate	Elko[d]	Gatecliff Contracting Stem
I, F1	Eagle Rock	A.D. 1520–1800[e]	9	1		
II, F2	Maggie Creek	A.D. 1220–1290[f]	3	7		
III, F3	Maggie Creek	A.D. 690–1210[g]	1	13	3	
IV	James Creek	770 B.C.–A.D. 230[h]		1	10	
V	James Creek	?[i]		1	6	
VI	South Fork	2630–810 B.C.[j]			1	1

a. Arbitrary levels F1 through F3 of the shelter's apron deposits are argued to be coeval, respectively, with Horizons I through III within the shelter (Budy and Katzer 1990:55). No similar correlation is made between any of the apron levels below F3 and any Horizons within the shelter, so the small numbers of points from the lower apron levels are not considered here. Points from Horizon II-KX, which appears to contain a mixture of material that dates to both the Maggie Creek and Eagle Rock phases (e.g., Budy and Katzer 1990:54), are also excluded from consideration here.

b. Phase to which Horizon is assigned by Budy and Katzer (1990).

c. Recalibrated for this report from radiocarbon ages given in Budy and Katzer (1990:Table 2). Calibration of dates and evaluation of statistical contemporeneity was performed using the methods described in the radiocarbon section of the text.

d. One of the Elko points from Horizon III and one from Horizon IV are Elko Eared points; the remainder of the Elko points from the shelter were classified as Elko Corner-notched (Drews 1990:Table 5).

e. Inclusive calibrated 2-sigma range for the pooled mean of the three statistically contemporaneous radiocarbon dates from Horizon I (Beta-7198, Beta-12584, Beta-7196).

f. Calibrated 2-sigma range for the pooled mean of the two statistically contemporaneous radiocarbon dates from Horizon II (Beta-7197, Beta 12582).

g. Based on two sets of statistically contemporaneous radiocarbon dates: one set of three dates from Horizon III and F3 with a pooled mean calibrated 2-sigma range of A.D. 1040–1210 (Beta-10852, Beta-12210, Beta-10853), and one set of two dates from Horizon III with a pooled mean calibrated 2-sigma range of A.D. 690–890 (Beta-12583, Beta-11387).

h. Based on two statistically different radiocarbon dates: one from a "trampled occupation surface" near the top of Horizon IV with a calibrated 2-sigma range of 50 B.C.–A.D. 230. (Beta-11390), and one from a hearth lower in the horizon with an inclusive calibrated 2-sigma range of 770–200 B.C. (Beta-12213). A third date from Horizon IV with an inclusive calibrated 2-sigma range of 1000–420 B.C. (Beta-12211) is excluded from consideration here because it is from a rockfall layer rather than an occupational layer (Budy and Katzer 1990:50–51).

i. Only one out of sequence radiocarbon date is available for Horizon V (Beta-11388); it has an inclusive calibrated 2-sigma range of 1740–1420 B.C. No archaeological features were identified in Horizon V, it is not clear that the date is associated with human occupation, and the dating of this horizon is uncertain (Budy and Katzer 1990:50). Therefore, this horizon is treated as undated here.

j. The terminal date is provided by two statistically contemporaneous radiocarbon determinations from hearths with a pooled mean calibrated 2-sigma range of 1050–810 B.C. (Beta-12212, Beta-10850). A third date, also from a hearth, has a calibrated 2-sigma range of 1670–1190 B.C. (Beta-10851). The beginning date is provided by a fourth radiocarbon determination with an inclusive calibrated 2-sigma range of 2630–2040 B.C. (Beta-11389); this date is described as coming from culturally sterile deposits at the bottom of the horizon (Budy and Katzer 1990:50). As such, this early date provides a limiting date for the stratigraphic unit but not necessarily for human occupation of the shelter; the earliest date from the site that is clearly associated with human occupation is the one with the 1670–1190 B.C. range.

Table 10. Projectile Point Counts by Component at Pie Creek Shelter (from McGuire et al. 2004:Figure 27)

Component	Phase[a]	Radiocarbon Date Range (calibrated B.C./A.D.)[b]	Desert Series[c]	Rose Spring, Eastgate	Elko[d]	Gatecliff Split Stem	Humboldt Concave Base	Northern Side-notched
I	Maggie Creek, Eagle Rock	A.D. 880–modern[e]	6	12	6	1		
II	James Creek	1430–420 B.C.[f]		2	4			
III	South Fork	2640–810 B.C.[g]			1	6		
IV and IVa	Pie Creek	3790–2290 B.C.[h]			1	1	3	1

a. Phase to which Component is assigned by McGuire et al. (2004).

b. Recalibrated for this report from radiocarbon ages given in McGuire et al. (2004:Table 4). Calibration of dates and evaluation of statistical contemporeneity was performed using the methods described in the radiocarbon section of the text. No radiocarbon dates from this site are statistically contemporaneous. Date ranges are based on the calibrated 2-sigma ranges of the earliest and latest date for each component. Date ranges overlap because 2-sigma ranges are used and because there are some dates that occur out of stratigraphic order.

c. Includes four Desert Side-notched and two Cottonwood Triangular points.

d. McGuire et al. (2004) do not distinguish between Elko Corner-notched and Elko Eared in their classification of Elko points from Pie Creek Shelter, but from the photographs of these points (McGuire et al. 2004:Figure 31), all appear to be Elko Corner-notched; none are clearly Elko Eared.

e. Based on four radiocarbon dates from archaeological features: Beta-123222, Beta-123224, Beta-165977, and Beta-163507 with inclusive calibrated 2-sigma ranges of, respectively, A.D. 1690–modern, A.D. 1480–modern, A.D. 1300–1440, and A.D. 880–1120. A fifth date, the one from the lowest depth within the Component I strata, has a calibrated 2-sigma range of A.D. 330–620 (Beta-123223); this date is excluded from consideration here because it is from a "roof fall zone" and is not clearly associated with human occupation (McGuire et al. 2004:Table 4).

f. The terminal date is provided by a radiocarbon determination from a feature located at the top of the Component II strata, which has an inclusive calibrated 2-sigma range of 800–420 B.C. (Beta-163508). The beginning date comes from two radiocarbon determinations from features located at the transition between Component II and Component III strata: one with a calibrated 2-sigma range of 980–810 B.C. (Beta-142179) and one with a calibrated 2-sigma range of 1430–1210 B.C. (Beta-163505).

g. The terminal date comes from the features located at the Component II-Component III transition that provide the beginning date for the James Creek phase. The beginning date comes from a radiocarbon determination from a feature with an inclusive calibrated 2-sigma range of 2640–2210 B.C. (Beta-163510). Two additional dates are also available for Component III: one from a feature that has an inclusive calibrated 2-sigma range of 1880–1450 B.C. (Beta-163509), and one not from a feature that has an inclusive calibrated 2-sigma range of 2280–2030 B.C. (Beta-142180).

h. Based on two radiocarbon dates from features in Component IV deposits and two dates not associated with features in Component IVa deposits. The Component IV dates (Beta-163511 and Beta-163512) have inclusive calibrated 2-sigma ranges of, respectively, 3260–2670 B.C. and 3790–3380 B.C. The Component IVa dates (Beta-163506 and Beta-163504) have inclusive calibrated 2-sigma ranges of, respectively, 2570–2290 B.C. and 3520–3350 B.C.

Schroedl's (1995) projectile point chronology (see Table 8) is mostly consistent with the data from these two rockshelters, allowing for some mixing of materials within the shelters and/or some overlap in the periods during which successive point types were used. Age ranges for specific point types, as indicated by the stratigraphic records from these two sites, are discussed next. Where Schroedl's point chronology is inconsistent with the data from these two sites, the discrepancies are noted here and are then taken into account in a slightly revised projectile point chronology that is presented in the following section.

Desert Side-notched points are the most common type in Horizon I/Level F1 of James Creek Shelter, the occupation of which is dated by three statistically contemporaneous radiocarbon dates to sometime between A.D. 1520 and 1800[5]. This is consistent with an Eagle Rock phase age range for this point type. Desert Side-notched points are also somewhat common, however, in Horizon II/Level F2 of this site, occupation of which is dated to the period of A.D. 1220–1290, late in the Maggie Creek phase, and one even occurs in Horizon III/Level F3, dated to earlier in the Maggie Creek phase. It cannot be ruled out that the point from the lowest level, at least, was displaced by post-depositional processes, but the fact that fully one-fourth of the Desert Side-notched points from this site come from pre–A.D. 1300 strata suggests that use of Desert Side-notched points was not limited to the Eagle Rock phase, as others have also noted (e.g., Holmer 1986; Schroedl 1995:49). Pie Creek Shelter is less useful for establishing the age of late projectile point types because the upper strata at this site, which are disturbed to a greater degree than the lower strata, contain a mixture of material dating to both the Eagle Rock and Maggie Creek phases (McGuire et al. 2004:45–46). However, all of the Desert Side-notched points from Pie Creek Shelter, as well as the two Cottonwood Triangular points from the site, come from Component I strata, occupation of which appears to have occurred after about A.D. 880.

The stratigraphic records from both sites support a Maggie Creek age range for Rose Spring Corner-notched and Eastgate Expanding Stem points (treated as separate types at Pie Creek Shelter but grouped into a single Rosegate type at James Creek Shelter). All but a very few specimens from James Creek Shelter occur in strata dated to between A.D. 700 and 1300. At Pie Creek Shelter, all but two occur in the mixed Maggie Creek–Eagle Rock Component I deposits.

At James Creek Shelter, Elko series points are most common in deposits assigned to the James Creek phase. A total of 10 Elko points were found in Horizon IV, which has two radiocarbon dates from occupational features with calibrated 2-sigma ranges that span the period from 770 B.C. to A.D. 230, and an additional six were recovered from Horizon V, which unfortunately produced no radiocarbon dates that are clearly associated with human occupation, but which must pre-date Horizon V by some amount. At Pie Creek Shelter, four Elko series points were recovered from Component II strata with radiocarbon dates that span the period from 1430 to 420 B.C. These results support the general association between Elko series points and the James Creek phase that is noted by Schroedl (1995) and others (e.g., Elston and Katzer 1990).

However, the results from these sites also suggest that the use of Elko points was not restricted to the James Creek phase time interval, something that Schroedl (1995) and others (e.g., Holmer 1986) have likewise noted. The small numbers of Elko points from pre–James Creek levels in both shelters may be the result of post-depositional disturbance or it may indicate that such points were used to a limited extent prior to the span of time represented by this phase. More notably, larger numbers of Elko points occur in

[5] The date ranges used here are based on calibrated 2-sigma radiocarbon age ranges: the earliest beginning date of a 2-sigma range is used as the beginning date for the horizon/component and the latest terminal date of a 2-sigma range is used as the terminal date for the horizon/component. The length of the date range, therefore, is a function of the uncertainty that is inherent in radiocarbon dating and is not necessarily an indication of the length of an occupational period. That is, assuming that the radiocarbon dates are associated with human occupation, it can be concluded (with about 95% confidence) that occupation occurred sometime within the range indicated, but it should not be concluded that occupation lasted for the entire span of time that the range represents.

post–James Creek phase levels—three in the lower Maggie Creek phase horizon at James Creek Shelter and six in the mixed Maggie Creek–Eagle Rock phases strata at Pie Creek Shelter—and it seems unlikely that all could be the result of post-depositional disturbance. Rather, this would suggest that Elko series points, and hence the atlatl darts that they likely tipped, continued to be used during the Maggie Creek phase alongside the Rose Spring and Eastgate types that were likely used with the bow and arrow (e.g., Grayson 1993:252–253). Elsewhere in the Upper Humboldt region, Hockett and Morgenstein (2003) have also reported Elko points in association with Rosegate points in a context that is radiocarbon-dated to the Maggie Creek phase time period. Taken together, these findings from the region suggest that Elko series points were used during the Maggie Creek phase in addition to the James Creek phase, though perhaps to a somewhat lesser degree.

Though his basis for doing so isn't clear, Schroedl (1995) suggested that Elko Eared points were diagnostic of the later part of his South Fork phase, whereas the Elko Corner-notched and Elko Side-notched varieties were used primarily during the James Creek phase. This proposition is not supported by the data from James Creek and Pie Creek shelters. Of the small number of Elko series points recovered from pre–James Creek phase deposits at these sites (three points in total), none are clearly of the Elko Eared variety. Of the two points from these sites that are identified to the Elko Eared type—both from James Creek Shelter—one is from a James Creek phase level and one is from a Maggie Creek phase level. Thus, there seems to be little basis, at least based on the projectile point assemblages from James Creek and Pie Creek shelters, for concluding that Elko Eared points pre-date other Elko series point types. Rather, it seems most judicious to conclude that all Elko series varieties were used during the James Creek phase and perhaps somewhat less extensively during the Maggie Creek phase.

Though no Gatecliff Split Stem points were found at James Creek Shelter, points of this type are almost as abundant as Elko series points at Pie Creek Shelter. Of the eight Gatecliff Split Stem points recovered from this site, six came from Component III strata, which have radiocarbon dates that span the period from 2640 to 810 B.C. This supports an association between Gatecliff Split Stem points and the South Fork phase, provided that a beginning date much later than Schroedl's proposal of 4600 B.C. is used for this phase, an issue that is returned to below. A single Gatecliff Split Stem point from the Pie Creek phase strata of Pie Creek Shelter may or may not be the result of post-depositional disturbance, but the single specimen of this point type from the upper levels of the shelter most likely is.

The remaining projectile point specimens from James Creek and Pie Creek shelters that could be assigned to a type include one Gatecliff Contracting Stem (or Gypsum) point, three Humboldt Concave Base points, and one Northern Side-notched point. The Gatecliff Contracting Stem point is from Horizon VI at James Creek Shelter, which was assigned to the South Fork phase and which has radiocarbon dates that range between 2630 and 810 B.C. This date range is virtually identical to that of the South Fork phase levels of Pie Creek Shelter in which Gatecliff Split Stem points were abundant, and it likewise suggests a South Fork association for the Gatecliff Contracting Stem type. The Humboldt Concave Base and Northern Side-notched points all come from strata at Pie Creek Shelter assigned to the Pie Creek phase with radiocarbon dates that range from 3790 to 2290 B.C.

5.3. Revised Projectile Point Chronology and Phase Date Ranges

Based on the above evaluation of the James Creek Shelter and Pie Creek Shelter projectile point assemblages and radiocarbon records, and also taking into account the LBB study area radiocarbon record, a point chronology and a phase sequence slightly modified from those of Schroedl (1995) are presented here; these are outlined in Table 11. The Paleoarchaic and Early Archaic periods are not considered here due to the limited evidence for human occupation of the LBB area during those periods; date ranges and diagnostic artifacts for these periods are discussed in Chapter 2.

Table 11. Revised Little Boulder Basin Point Chronology and Phase Date Ranges

Period	Phase	Dates (calibrated B.C./A.D.)	Diagnostic Point Types
Late Prehistoric	Eagle Rock	A.D. 1300–late 1800s	Desert Side-notched and Cottonwood Triangular
Late Archaic	Maggie Creek	A.D. 700–1300	Eastgate Expanding Stem, Rose Spring Corner-notched, Rye Patch Miniature, and Elko series Desert Side-notched and Cottonwood Triangular after A.D. 1200
Middle Archaic	James Creek	850 B.C.–A.D. 700	Elko series
Middle Archaic	South Fork	2600–850 B.C.	Gatecliff Split Stem, Gatecliff Contracting Stem/Gypsum, and Humboldt Concave Base (also Elko series?)
Middle Archaic	Pie Creek	3800–2600 B.C.	Humboldt Concave Base and Northern Side-notched (also Gatecliff Split Stem and/or Elko series?)

5.3.1. Phase Date Ranges and Occupational History

The dates for the latest three phases in this revised sequence do not differ from those in Schroedl's system because the radiocarbon records from James Creek and Pie Creek shelters do not provide a compelling basis for changing them. The Maggie Creek phase strata at James Creek Shelter are well dated to the period between about A.D. 700 and 1300, and the James Creek and Eagle Rock phases, respectively, must pre- and post-date this time span. A beginning date of 850 B.C. for the James Creek phase is not contradicted by radiocarbon dates from James Creek Shelter. The earliest date from a James Creek phase horizon in this site that appears to be associated with human occupation is one from Horizon IV with a calibrated 2-sigma range of 770–200 B.C. The underlying Horizon V is unfortunately not well dated, and though human occupation in this level must pre-date that of Horizon IV by some amount, it is unknown by how much. At Pie Creek Shelter, the James Creek phase Component II is bracketed at the early end by two radiocarbon dates from features found at the transition between the Component II and Component III strata: one with a calibrated 2-sigma range of 980–810 B.C. and one with a calibrated 2-sigma range of 1430–1210 B.C. If it can be assumed that the earlier of these two dates is actually associated with the Component III occupation of this site (an assumption that must be made in order to make sense out of the site's radiocarbon record), then the later date would not be inconsistent, at 2-sigma, with a beginning date of about 850 B.C. for the James Creek phase. At any rate, because the data from neither James Creek Shelter nor Pie Creek Shelter definitively indicate that a beginning date of 850 B.C. is inappropriate, this date is retained here.

On the other hand, Schroedl's beginning date for the South Fork phase of 4600 B.C. does seem to be in need of revision; this conclusion is evident both from the James Creek and Pie Creek shelter radiocarbon records, discussed here, and from the LBB study area radiocarbon record, discussed above. At Pie Creek Shelter, the earliest radiocarbon date from a South Fork phase stratum, a date that comes from an archaeological feature, has a calibrated 2-sigma range that begins at 2640 B.C. At James Creek Shelter, the earliest radiocarbon date from a South Fork phase stratum has a calibrated 2-sigma range that begins at almost exactly the same time, at 2630 B.C. This date, however, is described as coming from culturally sterile deposits at the bottom of Horizon VI (Budy and Katzer 1990:50), and it thus only provides a maximum limiting date for the horizon. The earliest date from James Creek Shelter that is clearly associated with human occupation comes from a hearth in Horizon VI and has a calibrated 2-sigma range of 1670–1190 B.C. This date is more in line with the radiocarbon record from the LBB study area, which—one potentially problematic, outlying date aside—indicates that sustained human occupation began no earlier than just before 1200 B.C. Taken together, these data suggest a South Fork phase beginning date of no earlier than about 2600 B.C. for the Upper Humboldt region as a whole, though it should be recognized that the beginning of sustained human occupation in the LBB area specifically apparently did not coincide with the beginning of the South Fork phase defined as such for the entire region. Rather, a beginning date of no earlier than 1600 to 1200 B.C., well after the start of the South Fork phase as defined here, is better indicated for sustained occupation of the area immediately around the LBB and James Creek Shelter.

Some further discussion of this revision is in order. Elston and Katzer (1990:266) originally defined the South Fork phase, based on their work at James Creek Shelter, to have a beginning date of 1250 B.C. Schroedl (1995:56) subsequently revised this to 4600 B.C., arguing that this was the age of the earliest "established" human occupation of the area as revealed by work conducted at Upper South Fork Shelter. This site, which is located across the Humboldt River approximately 35 miles to the southeast of the LBB, was originally tested in 1959 as part of work performed at Lower South Fork Shelter (Heizer et al. 1968) and was excavated further in 1985 (Spencer et al. 1987); it is to the later 1985 work that Schroedl refers in his discussion of regional chronology. The 4600 B.C. date evidently comes from a 5790 ± 90 ^{14}C yr. B.P. radiocarbon date obtained from Zone IV of Upper South Fork Shelter, which has a calibrated 2-sigma range (determined using the calibration methods described above) of 4850–4550 B.C. However, it is unclear whether this date is truly associated with human occupation of the site. In one place, the Upper South Fork Shelter report describes this date as coming from a hearth feature located near the bottom of Zone IV (Spencer et al. 1987:16), but elsewhere the charcoal sample that was dated is described as coming "from throughout excavation level 22" (a 10- or 20-cm thick arbitrary level: see Spencer et al. 1987:7), thereby providing "an average date for this level which crosscuts three natural strata" (Spencer et al. 1987:24). It is thus highly uncertain what this radiocarbon determination is actually dating. The earliest radiocarbon determination from this site that clearly appears to be associated with human occupation is a date of 1720 ± 70 ^{14}C yrs. B.P. from a hearth in Zone III, which has an inclusive calibrated 2-sigma range of A.D. 130–530. Given this, the Upper South Fork Shelter radiocarbon record does not provide a strong basis for concluding that sustained human occupation of the region began prior to what is indicated by the results from James Creek Shelter.

Findings at Pie Creek Shelter, on the other hand, do seem to clearly indicate a human presence in the Upper Humboldt region prior to the South Fork phase as this phase was defined at James Creek Shelter. Accordingly, and as noted in Chapter 2, McGuire et al. (2004) defined a Pie Creek phase based on the Component IV and IVa strata at this site, which produced radiocarbon dates ranging (at 2-sigma) from 3790 to 2290 B.C. Such a revision was foreshadowed by Schroedl (1995:56), who noted that future work in the region might require his proposed 4600 to 850 B.C. South Fork phase to be subdivided. Here, a date range of 3800–2600 B.C. is used for the Pie Creek phase, which might be considered to correspond to the early portion of the South Fork phase as Schroedl defined it. This date range for the Pie Creek phase assumes that the latest radiocarbon date from Pie Creek Shelter's Component IV and IVa deposits—a date from the shelter's apron deposits that does not come from an archaeological feature and that has an inclusive calibrated 2-sigma range of 2570–2290 B.C.—is not associated with human occupation. The remaining Component IV and IVa radiocarbon dates are consistent with the approximately 2600 B.C. Pie Creek phase–South Fork phase transition that is indicated by the Component III dates from this site.

Before turning to projectile point chronology, the implications of the radiocarbon data discussed here should briefly be summarized. The earliest currently known, well-dated evidence for any substantial occupation of the Upper Humboldt River region—that provided by the 3800–2600 B.C. Pie Creek phase at Pie Creek shelter—corresponds roughly to the transition from the middle Holocene to the late Holocene and its associated climatic amelioration. Occupation of Pie Creek Shelter continued throughout the 2600–850 B.C. South Fork phase and subsequent periods. In the LBB study area, and at nearby James

Creek Shelter, the radiocarbon record indicates that sustained human occupation did not begin until late in the South Fork phase, at perhaps sometime just before 1200 B.C. in the LBB, and possibly as early as about 1600 B.C. at James Creek Shelter.

5.3.2. Revised Projectile Point Chronology

Regarding the projectile points used during the span of time represented by each phase, aside from earlier types such as Great Basin Stemmed and Pinto points that occur in small numbers throughout northeastern Nevada (see Chapter 2), the earliest sustained occupations in the Upper Humboldt region appear to be associated with the Northern Side-notched, Humboldt series, Gatecliff series, and perhaps Elko series point types. Specifically, as noted in Section 5.2, the Pie Creek phase deposits at Pie Creek Shelter contained Humboldt Concave Base and Northern Side-notched points. Single specimens of the Gatecliff Split Stem and Elko series types, both more abundant in later strata at Pie Creek and James Creek shelters, were also found in Pie Creek Shelter's Pie Creek phase deposits, though whether this is the result of post-depositional disturbance or whether Gatecliff and Elko series points truly were used this early cannot presently be determined.

Gatecliff series points (i.e., Gatecliff Split Stem points and Gatecliff Contracting Stem/Gypsum points) appear to have been the most common point types used during the South Fork phase. This is consistent with Schroedl's (1995) observation that these point types were used during what he considered to be the latter part of the South Fork phase, which is recast here to comprise the entirety of this phase. It is not entirely clear whether Humboldt Concave Base points were used during what is here considered to be the South Fork phase, as Schroedl's suggestion that these points were used during all of what he considered to be the South Fork phase would imply, because no Humboldt points were found in South Fork phase or later deposits at either James Creek or Pie Creek shelters. However, Humboldt points are common in contexts further east in the Great Basin that are contemporaneous with the Upper Humboldt region South Fork phase (e.g., Reed 2005b; SWCA Environmental Consultants 2010). Finally, support for Schroedl's suggestion that Elko Eared points are diagnostic of the South Fork phase seems to be lacking. In fact, only two un-eared Elko series points were recovered in the South Fork phase deposits of James Creek Shelter and Pie Creek Shelter collectively, and, as with the single Elko point in the Pie Creek phase level of Pie Creek Shelter, it cannot be determined whether these points came to be located in these deposits due to post-depositional disturbance or whether Elko series points truly were used during the South Fork phase.

Even if Elko series points were used during the South Fork and Pie Creek phases, they were evidently much less important relative to other point types than was the case during the James Creek phase. Indeed, at both James Creek and Pie Creek Shelters, aside from a very few Rosegate points that may be intrusive from higher strata, Elko series points are the only type of points that occur in levels assigned to the James Creek phase. As noted in the previous section, however, use of Elko series points also seems to have continued into the span of time represented by the Maggie Creek phase. As is also discussed in the previous section, Rosegate series points (i.e., Rose Spring Corner-notched points and Eastgate Expanding Stem points) appear to have been used throughout the Maggie Creek phase, and Desert series points (i.e., Desert Side-notched points and Cottonwood Triangular points) appear to have been used from late in the Maggie Creek phase through the period of Euroamerican settlement.

One point type not discussed in the previous section because it was not identified at either James Creek or Pie Creek shelters is the Rye Patch Miniature type. Schroedl (1995:57) suggested that this point type, which is somewhat common in the LBB, is "probably" diagnostic of the Maggie Creek phase, presumably because it often occurs in association with other indicators of this phase (see individual assemblage projectile point data presented later in this chapter in Table 17). Obsidian hydration data, discussed in the next section, support the contemporeneity of Rye Patch Miniature and Rosegate series points in the LBB, so Rye Patch Miniature points are considered to be a marker of the Maggie Creek phase in subsequent analyses in this document.

In those subsequent analyses, projectile point types are taken to be indicative of occupation during the phase(s) in which they are most common, as follows. The few Northern Side-notched points that have been recovered from the study area are considered to be diagnostic of the Pie Creek phase, whereas Humboldt series points are used as evidence for occupation during either the Pie Creek or South Fork phases. Gatecliff series points are taken to indicate occupation during the South Fork phase, and Elko series points are taken to indicate occupation during either the James Creek or Maggie Creek phases. The Rosegate series and Rye Patch Miniature point types are used as diagnostic solely of occupation during the Maggie Creek phase, whereas Desert Side-notched and Cottonwood Triangular points are treated as diagnostic of the Eagle Rock phase. Because the use of some of these point types may have overlapped into phases other than the ones they are used to indicate, age estimates based on projectile point types are subject to some degree of error. However, in the evaluations of assemblage age that are presented below, this error is minimized by not relying solely on projectile point data unless large numbers of points are present.

5.3.3. Projectile Point Type Frequencies

To conclude this section, projectile point type frequencies in the LBB study area are explored using the database compiled for this research context. This provides a record of the area's occupational history that can be compared to that supplied by the radiocarbon record, discussed above (see Figure 4). Data on the projectile point specimens reported from the sites in the analysis sample for this document are presented in Appendix C. Frequencies of projectile points from these sites are shown by point type in Figure 5 and by phase in Figure 6.

In Figure 5, and in the evaluation of assemblage age that is presented below, projectile points are grouped into "analysis point types", which in several cases combine multiple named types as presented in excavation reports. This is necessary due to occasional inconsistencies in the way in which point types are reported: for example, whereas some reports discuss Rose Spring Corner-notched and Eastgate Expanding Stem points as separate types, others combine them into a single Rosegate type. To ensure consistency in cases like this, the "lowest common denominator" type (e.g., Rosegate, rather than Rose Spring or Eastgate) is employed as an analysis point type. In no instance are point types that clearly differ in temporal span combined together into an analysis point type. Appendix C lists, for each projectile point specimen in the analysis sample, both the point type as given in the excavation report and the analysis point type used here. These analysis point types are: Cottonwood Triangular, Desert Side-notched (which includes specimens identified to both the "general" and the Sierra subtypes of the Desert Side-notched type), Rosegate (which includes specimens identified as either Rose Spring, Eastgate, or undifferentiated Rosegate), Rye Patch Miniature, Elko (which includes points identified either as Elko Eared, Elko Corner-notched, Elko Side-notched, or undifferentiated Elko), Gatecliff Contracting Stem (which also includes specimens identified as Gypsum points), Gatecliff Split Stem, Northern Side-notched, Humboldt (which includes points identified as Humboldt Concave Base, Humboldt Basal-notched, and undifferentiated Humboldt), and Great Basin Stemmed.

In Figure 6, projectile point types are assigned to phases as described above and as shown in Table 11. Because, as discussed above, Humboldt points provide evidence of occupation during either the Pie Creek or South Fork phases, and Elko points provide evidence of occupation during either the James Creek or Maggie Creek phases, points of these types were assigned, respectively, to the phases "Pie Creek or South Fork" and "James Creek or Maggie Creek".

Not listed in Table 11 (because only a small number have been recovered in the LBB area) are Great Basin Stemmed points, and these merit some discussion here. Three possible examples of Great Basin Stemmed points provide evidence for some Paleoarchaic period use of the study area, which is not apparent from the area's radiocarbon record. Two of these points are from site 26EK002304 and one is from site 26EK005271. The two specimens from 26EK002304 are both fragmentary, though they appear from their illustrations to indeed be stems of long-stemmed points (Rusco 1982b:88), and they are described as having lateral edge grinding (Rusco 1982b:34), a common characteristic of Paleoarchaic stemmed points (Beck and Jones 1997:204). The specimen from 26EK005271 may also be a stem fragment from a stemmed point, but it was only tentatively identified as a stemmed point preform because it is not completely flaked and exhibits no lateral edge grinding (Tipps 1996:4-28, 4-34). It is perhaps noteworthy that the two sites with Great Basin Stemmed points or possible examples thereof are both located in the northern portion of the study area (see maps in Appendix A). It is also interesting to note that no Pinto points, potentially indicative of Late Paleoarchaic or Early Archaic occupation (Hockett 1995), are reported from the sites in the analysis sample, though it is possible that some may be present but misidentified as Gatecliff Split Stem points.

The projectile point data from the LBB area provide a somewhat different perspective on the area's occupational history than do radiocarbon dates. Other than the earliest, potentially problematic date, no radiocarbon dates from the study area fall within the range for the Pie Creek phase. Likewise, very few fall within the range for the South Fork phase, and those that do fall within this range occur towards the end of it (Figure 4). Projectile points, however, indicate some use of the area during both of these phases. Specifically, a small number of Northern Side-notched points appear to indicate a human presence during the Pie Creek phase, a much larger number of Gatecliff series points indicate occupation during the South Fork phase, and a sizable sample of Humboldt points may indicate occupation during either of these phases.

In addition, Elko series points constitute the most abundant point type in the analysis sample, indicating relatively intensive use of the LBB area during the James Creek and/or Maggie Creek phases. Further, Rosegate series points constitute the next most abundant point type, but, collectively, the two Maggie Creek phase point types, Rosegate and Rye Patch Miniature, outnumber Elko points, making Maggie Creek the best represented phase in the projectile point sample. A substantial proportion of the Rosegate points in the sample—over 150 of them—come from only two sites, 26EU001492 and 26EU001529, both of which have been interpreted as hunting-related camp sites where projectile point manufacture and repair occurred (Schroedl 1995, 1998). Likewise, many of the Elko points—nearly 90—come from a single site, 26EU001595, which has been similarly interpreted (Schroedl 1994). However, even if the points from these three sites are excluded from consideration, Maggie Creek phase diagnostic points are still about equally as abundant as Eagle Rock phase points, and Elko points remain more abundant than Eagle Rock types.

This presents an intriguing contrast with the LBB area radiocarbon record. As noted above, James Creek and Maggie Creek phase radiocarbon dates are not uncommon, but they are far outnumbered by Eagle Rock phase radiocarbon dates. Eagle Rock phase projectile points, on the other hand, are far outnumbered by points used during the James Creek and Maggie Creek phases. This suggests that the way in which people used the LBB area changed substantially at around A.D. 1300. In particular, since all of the radiocarbon dates from the study area are associated with archaeological features, it would appear that resource use changed such that hearths and other features became more important relative to hunting technology, specifically projectile points. Such issues are explored further in Chapter 7 of this document.

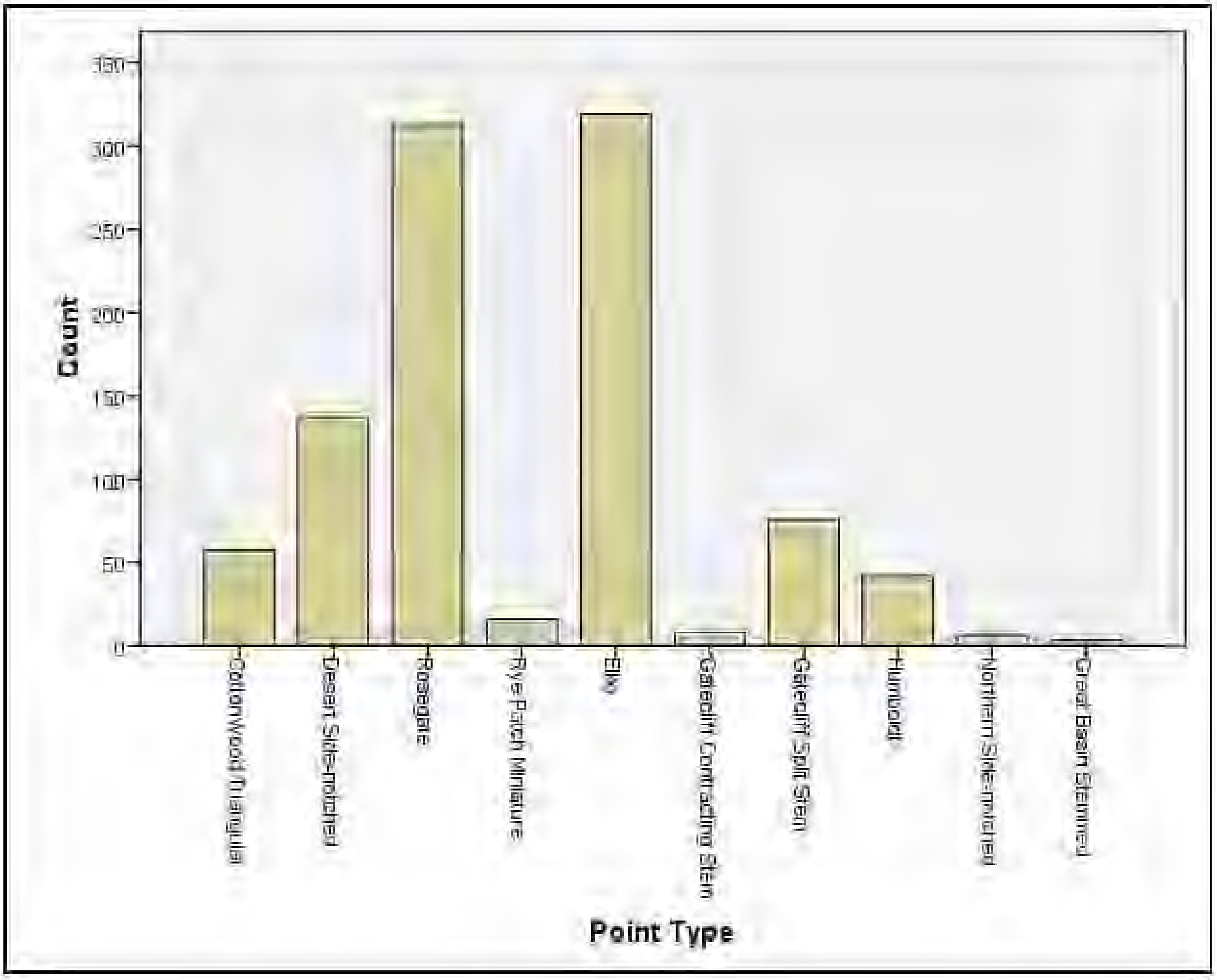

Figure 5. Frequency distribution of projectile points from excavated sites in the Little Boulder Basin study area by type.

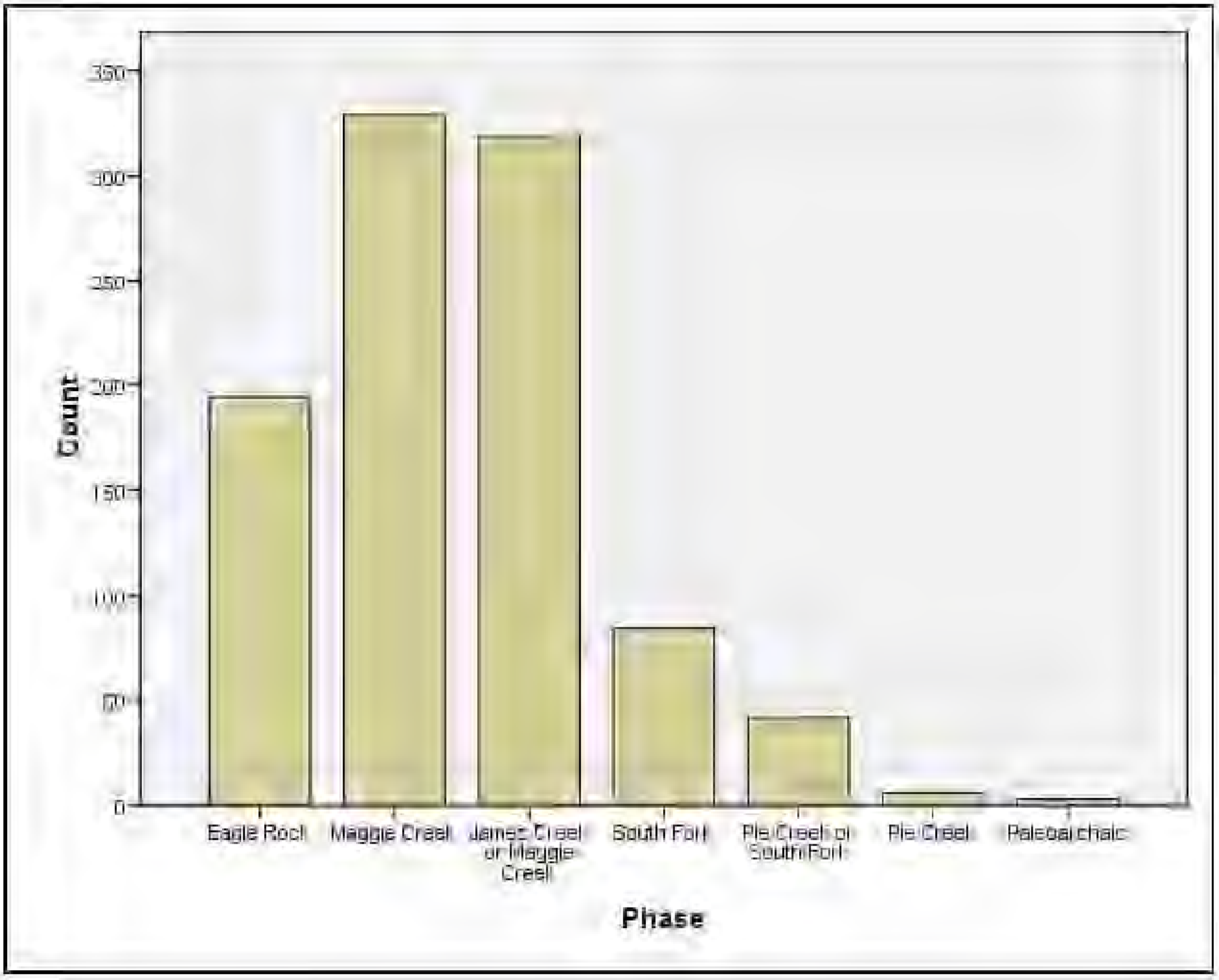

Figure 6. Frequency distribution of projectile points from excavated sites in the Little Boulder Basin study area by time period.

5.4. Obsidian Hydration Chronology

Concurrently with presenting his projectile point chronology for the LBB area, Schroedl (1995:50–54) also presented an obsidian hydration chronology, consisting of a proposed range of hydration band thicknesses for each phase. This chronology is reproduced in Table 12.

Table 12. Little Boulder Basin Obsidian Hydration Chronology, after Schroedl (1995:54)

Phase	Hydration Band Range (microns)
Eagle Rock	1.0–1.9
Maggie Creek	2.0–3.7
James Creek	3.8–4.9
South Fork	≥ 5.0

Schroedl's obsidian hydration chronology has been used throughout subsequent work in the LBB area to date occupational episodes at archaeological sites. As with his projectile point chronology, however, Schroedl (1995:50–54) provides virtually no detail regarding how this hydration chronology was derived. The chronology is therefore reevaluated here. Schroedl (1995:54) states that his chronology is based "primarily" on obsidian specimens from the Paradise Valley source, the source that occurs in the highest frequency at LBB archaeological sites. Because obsidian from different sources in the region appears to hydrate at different rates (e.g., McGuire et al. 2004:67; Schroedl 1995:54), the reevaluation presented in this document focuses solely on Paradise Valley obsidian. Though not considered in depth here, it should be pointed out that, based on their work at Pie Creek Shelter, McGuire et al. (2004:67–68) have derived a hydration rate for Browns Bench obsidian, the obsidian type that, as discussed in Chapter 9, ranks second in abundance after Paradise Valley obsidian in the LBB. Hockett (1995) has also developed a Browns Bench hydration chronology based on projectile points collected throughout northeastern Nevada, largely from surface contexts. Because there is an apparent discrepancy between Browns Bench hydration measurements from Pie Creek Shelter and from Hockett's regional projectile point sample, McGuire et al. (2004:68) note that hydration rates may be substantially lower in buried contexts than in surface contexts; this has implications that are considered below.

The data that are available for reevaluating Schroedl's hydration chronology consist of a small number of obsidian specimens from Pie Creek Shelter, discussed by McGuire et al. (2004:66–68), and projectile points from excavated sites in the study area for this document. The stratigraphic context of the Pie Creek Shelter specimens and their associated radiocarbon dates provide a means of correlating hydration measurements to absolute dates; hydration measurements are unfortunately not available for James Creek Shelter, which produced a larger sample of obsidian sourced to Paradise Valley (Hughes 1990). The LBB study area projectile points provide a means of correlating hydration measurements to phases based on the projectile point chronology discussed in the preceding section.

At Pie Creek Shelter, only three obsidian specimens were chemically sourced to Paradise Valley, but because this constitutes half of the six non–Browns Bench specimens from the site that were chemically sourced, McGuire et al. (2004:67) suggest that "a substantial percentage" of the greater number of obsidian specimens that were visually identified as being not from Browns Bench are from Paradise Valley. Assuming that they are correct, the non–Browns Bench obsidian hydration data presented in McGuire et al. (2004:Table 8) and reproduced here in Table 13 suggest that Schroedl's chronology may require modification. In particular, as McGuire et al. (2004:67) note, the value of 5.0 microns that Schroedl uses a cutoff point for the South Fork phase appears to be too large: no obsidian specimens from Component III of Pie Creek Shelter, assigned to the South Fork phase, have values greater than 3.9. The same can be said of Schroedl's proposed range for the James Creek phase of 3.8 to 4.9 microns, since none of the obsidian specimens from the James Creek phase Component II fall within this range. However, these data do not definitively indicate that Schroedl's chronology for the LBB is inappropriate since, as noted above, obsidian may hydrate more slowly in buried contexts like Pie Creek Shelter than in surface contexts, and since many of the specimens that Schroedl used to develop his chronology surely came from surface contexts. In addition, given the geographic differences between the Tule Valley, where Pie Creek Shelter is located, and the LBB, there may also be differences in hydration rates between the two areas beyond those related to depositional context.

Table 13. Non–Browns Bench Obsidian Hydration Values from Pie Creek Shelter, after McGuire et al. (2004:Table 8)

Component	Number of Specimens	Hydration Band Mean (microns)	Hydration Band Standard Deviation	Hydration Band Range (microns)
I (Eagle Rock and Maggie Creek phases)	4	1.87	0.98	1.0–3.0
II (James Creek phase)	9	3.02	0.79	1.1–3.7
III (South Fork phase)	2	2.55	1.90	1.2–3.9
IV (Pie Creek phase)	12	3.71	1.13	1.1–6.0

Potential differences in hydration rate between Pie Creek Shelter and the LBB can be overcome by considering data from the LBB itself. Because so many sites and site loci in the LBB study area are multicomponent, it is not productive to base an obsidian hydration chronology on associations between obsidian artifacts and radiocarbon dates from this area: there is a good chance that obsidian artifacts will be of a different age than radiocarbon-dated features located nearby. Given this, the most useful way of correlating hydration band thicknesses to absolute ages in the LBB is to consider hydration measurements taken on obsidian projectile points. From the sites included in the analysis sample for this document, hydration measurements are reported for 25 obsidian projectile points that have been identified to a point type and sourced to Paradise Valley; the measurements for these points are presented in Table 14. A total of eight point types are represented in this sample (using the "analysis point types" discussed in Section 5.3), and these point types cover all phases from Pie Creek through Eagle Rock (see Table 11). Table 15 presents summary hydration data for the points in Table 14, with point types listed in order of increasing mean hydration band thickness. Distributions of hydration measurements by point type are illustrated in Figure 7; Schroedl (1995:Figure 10) presents a similar illustration, but it should be noted that his figure includes points from as far away as Rye Patch Reservoir, and it is not clear whether it is limited to artifacts made of Paradise Valley obsidian.

Table 14. Diagnostic Paradise Valley Obsidian Projectile Points with Hydration Measurements from the Little Boulder Basin Study Area

Site	FS Number	Analysis Point Type[a]	Hydration Band (microns)
26EK004687	2025	Gatecliff Split Stem	5.5
26EK004687	55	Gatecliff Split Stem	4.6
26EK004688	794	Elko	3.4
26EK004688	1179	Desert Side-notched	1.0
26EK004688	1433	Cottonwood Triangular	1.1
26EK004688	1462	Cottonwood Triangular	1.0
26EK004688	970	Elko	5.8
26EK004688	281	Northern Side-notched	4.6
26EK004688	494	Gatecliff Split Stem	4.0
26EK006232	44	Humboldt	6.4
26EU001320	2162	Elko	3.5
26EU001487	249	Northern Side-notched	5.8
26EU001492	373	Rye Patch Miniature	3.9
26EU001522	4	Rosegate	2.0
26EU001529	1267	Rosegate	3.5
26EU001595	61	Elko	4.3
26EU001595	63	Elko	4.3
26EU001595	37	Elko	4.0
26EU001595	142	Elko	4.9
26EU001595	149	Elko	4.6
26EU001667	948	Desert Side-notched	4.4
26EU001734	3	Elko	2.9
26EU002124	2	Elko	3.7
26EU002181	20	Elko	3.7
26EU002182	49	Rosegate	3.7

a. "Analysis point types" are described in Section 5.3.

Table 15. Summary Hydration Data by Point Type for Little Boulder Basin Paradise Valley Obsidian Projectile Points

Point Type	Number of Specimens	Hydration Band Mean (microns)	Hydration Band Standard Deviation	Hydration Band Range (microns)
Cottonwood Triangular	2	1.05	0.07	1.0 – 1.1
Desert Side-notched	2	2.70	2.40	1.0 – 4.4
Rosegate	3	3.07	0.93	2.0 – 3.7
Rye Patch Miniature	1	3.90	n/a	3.9 – 3.9
Elko	11	4.10	0.81	2.9 – 5.8
Gatecliff Split Stem	3	4.70	0.76	4.0 – 5.5
Northern Side-notched	2	5.20	0.85	4.6 – 5.8
Humboldt	1	6.40	n/a	6.4 – 6.4

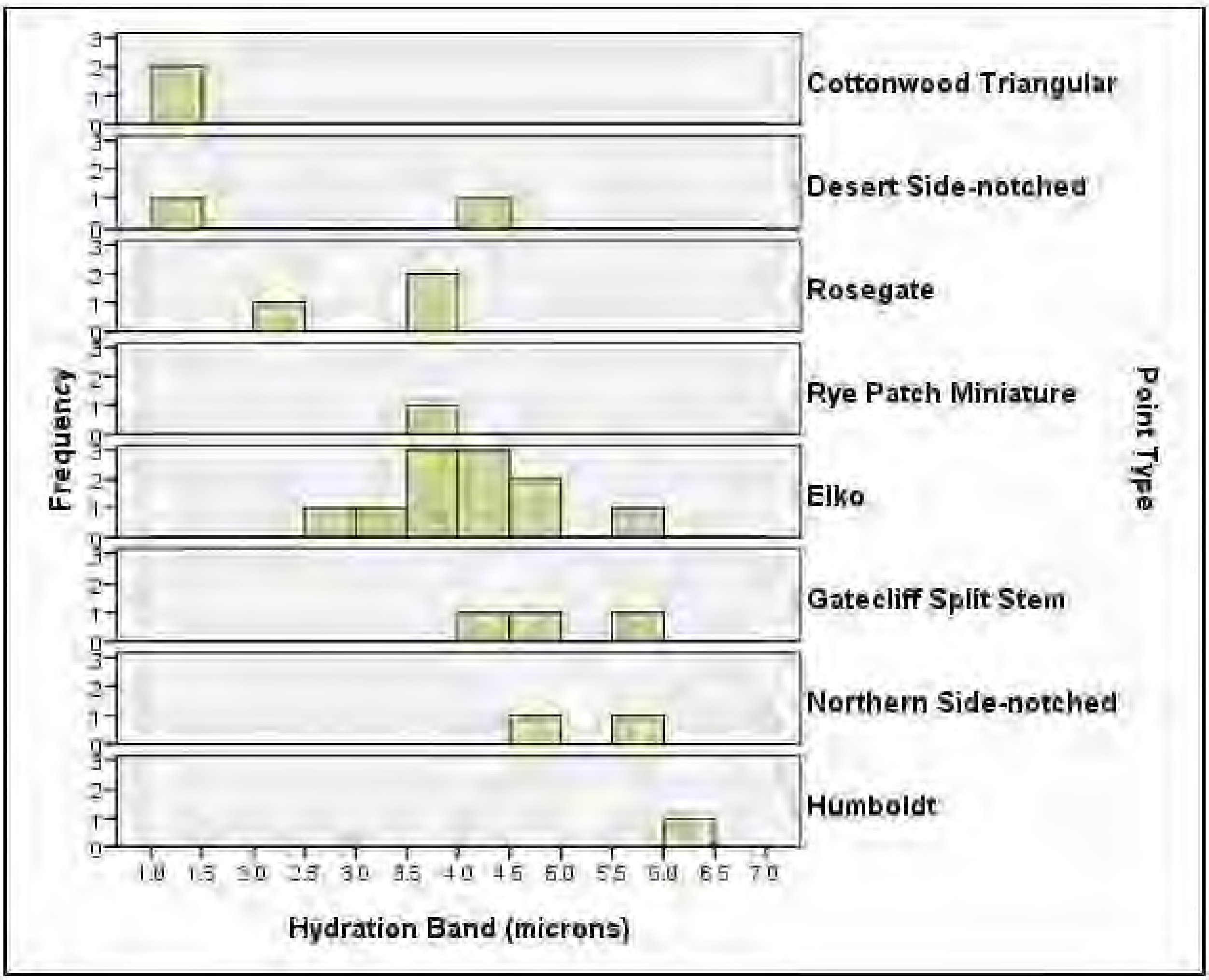

Figure 7. Hydration measurements for Paradise Valley obsidian projectile points from the Little Boulder Basin study area.

An analysis of variance indicates that there are significant differences in mean hydration band thickness among the point types ($F = 5.08$, $p = 0.003$). Tukey pairwise comparison tests[6] show that the Cottonwood Triangular points have hydration bands that are significantly thinner than those of the Elko, Gatecliff Split Stem, and Northern Side-notched types, and that no other pairs of point types differ significantly. Thus, the latest and the earliest point types exhibit significant differences in hydration band thickness, whereas, likely due at least in part to the small samples involved, differences among point types that are closer to each other in age are not statistically significant.

Based on these data, Schroedl's proposed hydration range of 1.0 to 1.9 microns for the Eagle Rock phase appears to be appropriate: three of the four Desert Side-notched and Cottonwood Triangular points in the sample have hydration bands of 1.0 or 1.1 microns, and no points of earlier types have hydration bands less than 2.0 microns thick. There is, however, one Desert Side-notched point with a hydration band of 4.4 microns that is clearly abberant; this highlights the fact that abberant hydration measurements do occasionally occur (e.g., Hockett 1995), perhaps due to reworking of much older tools (e.g., Schroedl 1995:53).

The Rosegate points in the sample, diagnostic of the Maggie Creek phase, have hydration bands that range from 2.0 to 3.7 microns. These measurements correspond exactly to Schroedl's proposed Maggie Creek hydration range and may, in fact, have been the basis of his proposed range. The single Rye Patch Miniature point in the sample has a hydration band of 3.9 microns, which is not greatly different from the values observed for Rosegate points and which supports Schroedl's contention that this point type dates to the Maggie Creek phase.

Although Eagle Rock phase and Maggie Creek phase point types seem to be easily distinguishable from each other based on LBB hydration measurements, this is not the case for point types of the Maggie Creek and earlier phases. Elko series points, by far the most abundant point type in the sample, have hydration values that range from 2.9 to 5.8 microns. The overlap in hydration measurements between Elko points and the purely Maggie Creek phase points is not surprising given that stratigraphic evidence, discussed above, suggests that Elko points continued to be used during the Maggie Creek phase. In fact, the hydration data provide further support for the proposition that Elko points were used throughout this phase. The three earliest point types, Gatecliff Split Stem, Northern Side-notched and Humboldt, have hydration bands that collectively range from 4.0 to 6.4 microns. Given these values, and considering that the Rye Patch Miniature and Gatecliff Split Stem point types apparently date, respectively, to the Maggie Creek and South Fork phases, it is not clear what the hydration range for the James Creek phase should be. That is, there is little room between the Rye Patch Miniature 3.9 micron value (or even the 3.7 micron maximum value for Rosegate points) and the 4.0 micron minimum value for Gatecliff Split Stem points. What is clear is that, as McGuire et al. (2004:67) suggest, Schroedl's cutoff value for the South Fork phase of 5.0 microns is too large: two of the three Gatecliff Split Stem points in the sample—a point type that Schroedl himself recognized as diagnostic of the South Fork phase—have hydration measurements that fall below this value. Moreover, there is substantial overlap in hydration ranges between Gatecliff Split Stem points and Northern Side-notched points, which appear based on the excavation of Pie Creek Shelter to date to the Pie Creek phase. And finally, as noted above, the differences in mean hydration values among the Elko, Gatecliff Split Stem, and Northern Side-notched points from the LBB study area are not statistically significant, and there are likewise no statistically significant differences among the

[6] The Rye Patch Miniature and Humboldt point types must be excluded from the pairwise comparisons because there is only a single specimen of each in the sample. With these two point types excluded, the result of the analysis of variance remains significant ($F = 5.67$, $p = 0.003$). An alpha level of 0.05 is used in the Tukey pairwise comparisons.

James Creek phase, South Fork phase, and Pie Creek phase non–Browns Bench obsidian samples from Pie Creek Shelter (Table 13; $F = 1.68$, $p = 0.211$)[7].

Given that there is almost complete overlap in hydration band ranges between artifacts that appear to date to each of the James Creek, South Fork, and Pie Creek phases, it is perhaps most judicious simply to treat any hydration values of 4.0 and greater as indicating a general "Middle Archaic" age, at least until a larger sample of projectile points with hydration measurements is available. This is the approach taken below in evaluating the age of assemblages from excavated sites in the LBB study area. That approach is summarized in Table 16, which can be considered to be a revised Paradise Valley obsidian hydration chronology for the LBB area, though one that is certainly in need of further refinement through collection of additional data, particularly from contexts that date to before about A.D. 700.

Table 16. Paradise Valley Obsidian Hydration Chronology Based on Little Boulder Basin Projectile Point Data

Phase or Period	Hydration Band Range (microns)
Eagle Rock	1.0 – 1.9
Maggie Creek	2.0 – 3.9
Middle Archaic	≥ 4.0

Before turning to the evaluation of assemblage age, this section concludes by briefly discussing the comprehensive obsidian hydration data compiled for this document. A histogram of all hydration measurements reported for Paradise Valley obsidian artifacts from the sites in the analysis sample is shown in Figure 8, and Figure 9 shows the distribution of measurements grouped by phase or period, according to the chronology presented in Table 16; complete hydration data for obsidian from all sources are provided in Appendix D.

The largest number of Paradise Valley obsidian hydration measurements fall within the range for the Eagle Rock phase. This is consistent with the radiocarbon data but not with the projectile point data in indicating that this phase witnessed the highest human population densities and/or longest-duration occupations. The Maggie Creek phase range has the lowest number of measurements. However, rather than indicating that occupation of the area was least intense during this phase, a finding that would contradict both the radiocarbon and projectile point data discussed above, this likely just reflects a substantial reduction in the use of obsidian during this period of time. As is discussed in Chapter 9, the proportion of obsidian relative to Tosawihi chert in lithic assemblages from the study area is lowest during the Maggie Creek phase, and fewer artifacts made from obsidian would lead to fewer obsidian hydration measurements for this phase. Finally, most of the measurements in the Middle Archaic range fall towards the low end of this range, suggesting that they date to late in the Middle Archaic period. Thus, the hydration data appear to be consistent with both the radiocarbon data and the projectile point data in indicating fairly substantial use of the area during the James Creek phase and much less use before this time.

[7] When the Component I (Eagle Rock and Maggie Creek) sample from Pie Creek Shelter is added to the analysis of variance, the result becomes significant ($F = 3.35$, $p = 0.036$). Thus, as with the LBB projectile point sample, it can be concluded that obsidian artifacts that vary greatly in age can be distinguished by hydration measurements, whereas those that apparently date to various phases within the Middle Archaic period cannot be.

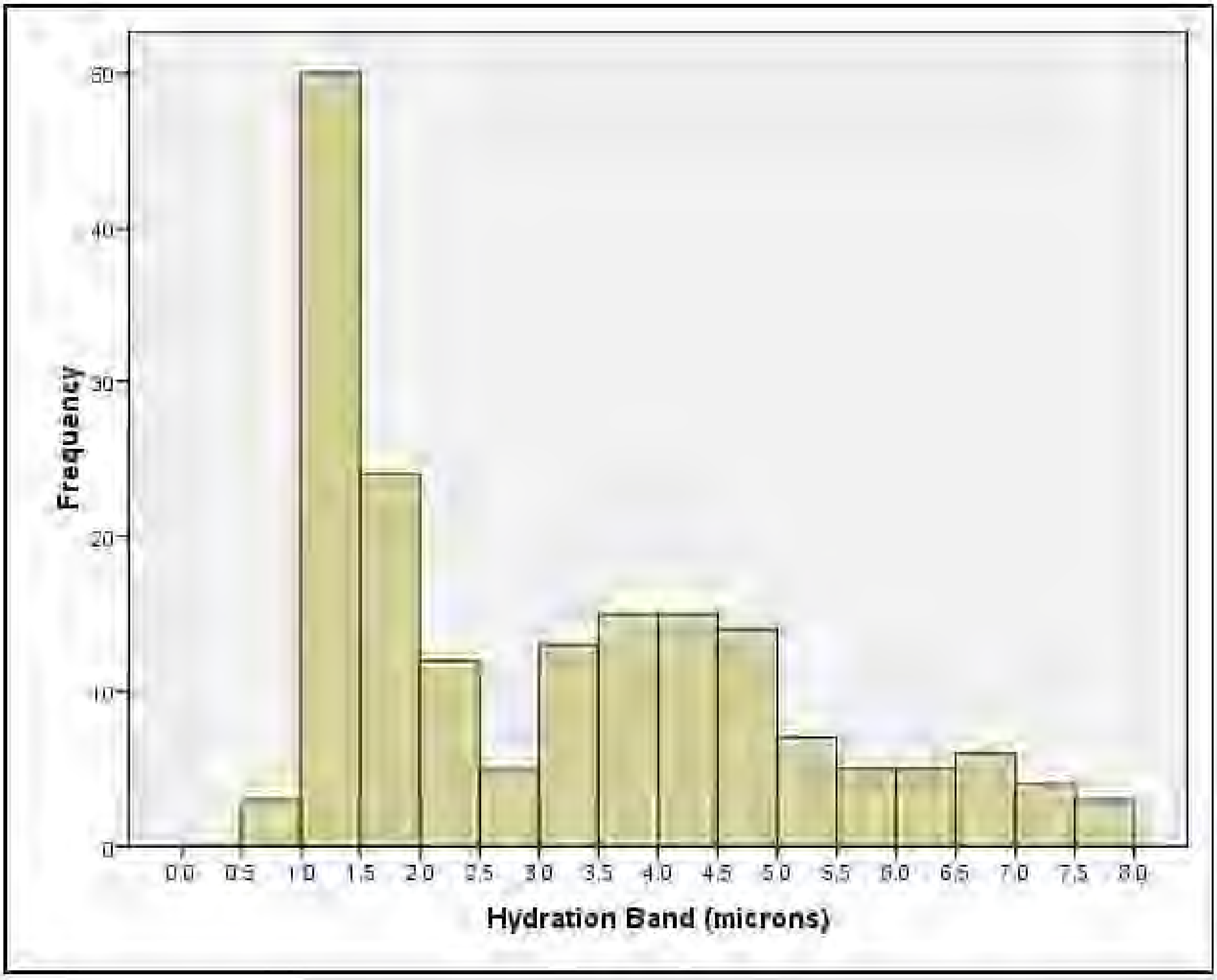

Figure 8. Histogram of Paradise Valley obsidian hydration measurements from the Little Boulder Basin study area.

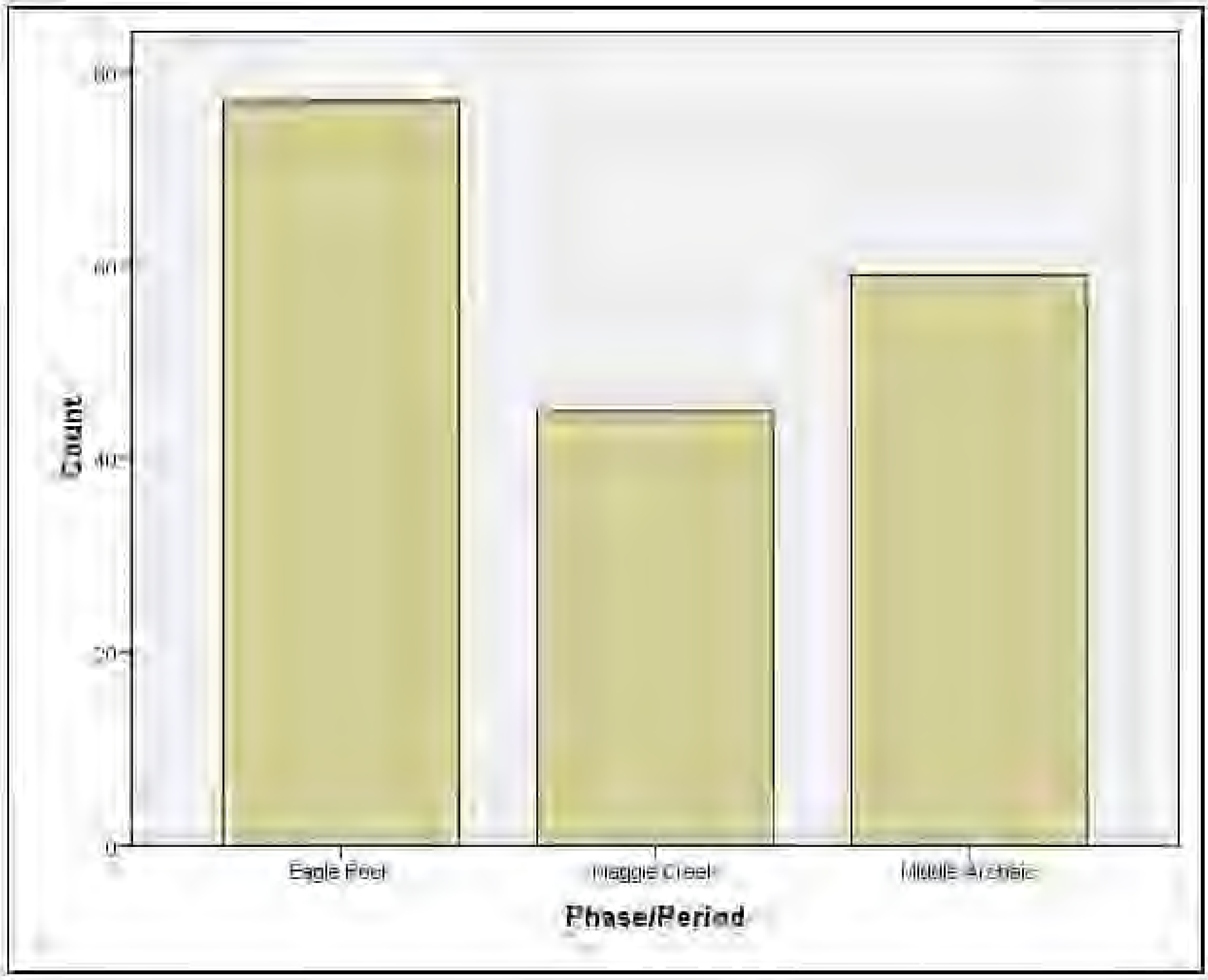

Figure 9. Frequency distribution of Paradise Valley obsidian hydration measurements by phase.

5.5. Dating of Assemblages from the Little Boulder Basin Study Area

With the chronological framework discussed in the preceding sections in place, it is now possible to turn to evaluating the ages of individual assemblages from the LBB study area. It is important to do this for at least two reasons. First, while it has generally been noted that multicomponent, palimpsest assemblages are common in the area, data on just how common they are, generated using a consistent set of criteria for distinguishing single-component from multicomponent deposits, have been lacking. Such data are presented here in order to provide a better understanding of the magnitude of the "multicomponent problem" in the LBB area. Second, addressing many of the research issues considered in subsequent chapters of this document requires being able to explore change over time, and this, in turn, requires identifying single-component assemblages and grouping them into temporal units for analysis.

5.5.1. Assemblage Dating Methods

Assemblage age is evaluated, and assemblages are grouped into time periods for analysis, at the level of the "analysis unit" (i.e., site or site locus), as defined in Chapter 4 (see Table 6). Data relevant to the age of the materials from each analysis unit are considered, including radiocarbon dates, temporally diagnostic artifacts (projectile points and ceramics), and obsidian hydration measurements. Radiocarbon dates are grouped by analysis unit in Table 7 above. Data for each projectile point specimen reported from the sites included in the analysis sample for this document are provided in Appendix C; Table 17 below summarizes the number of projectile points per type for each analysis unit, as well as the number of ceramic sherds reported for each analysis unit. Similarly, Appendix D presents complete sourcing and hydration data for all obsidian specimens for which such data are reported, and Table 18 below lists hydration measurements by analysis unit. Appendix E compiles all dating information from each analysis unit in one place so that the evidence used here in assessing assemblage age can be easily evaluated.

The projectile points types listed in Table 17 are the "analysis point types" described in Section 5.3. The obsidian hydration measurements presented in Table 18 comprise all reported measurements from the sites in the analysis sample, with the exception of those from temporally diagnostic projectile points. Hydration measurements from these artifacts are excluded so that each is counted as only one piece of information regarding the age of occupation at a site, and it is assumed that point type is a more accurate indicator of age than is hydration band thickness.

To determine during which phase(s) a site or site locus was occupied, the radiocarbon, projectile point, ceramic, and obsidian hydration data from each analysis unit were compiled, and the number of pieces of information indicative of occupation during any given phase was tabulated. This information is presented in Table 19 for all but the non-spatial "Other" analysis units, which consist of materials from various locations within a site or materials for which no provenience is reported; these "Other" analysis units are excluded from all subsequent analyses in this chapter, but complete dating information for them is provided in Appendix E.

In Table 19, each individual radiocarbon date, diagnostic projectile point specimen, and obsidian hydration measurement (excluding those from diagnostic projectile points, as noted above) from an analysis unit is counted as a single piece of information, as is any occurrence of ceramics, regardless of the number of sherds. Based on the number of data points indicative of occupation during each phase, a determination is presented in this table regarding whether each individual analysis unit is single- or multicomponent. An analysis unit was determined to be single-component if:

- at least 10 pieces of dating information are available for it, and approximately 85 percent or more of those data points are from a single phase, or

- at least two pieces of dating information are available for it, and that information is of at least two different types (radiocarbon dates, projectile points, ceramics, or obsidian hydration measurements), and all of the information indicates occupation during only one phase.

Thus, any analysis unit with limited dating information available—specifically, less than 10 data points—was determined to be single-component only if the available information unanimously indicated occupation during a single phase and if at least two independent lines of evidence supported occupation during that phase. Analysis units with more information available—specifically, 10 or more data points—were classified as single-component if a large preponderance of the available information indicated occupation during a single phase. For such analysis units with larger sample sizes, unanimity of information is too stringent a criterion for a single-component determination since nearly every site in the study area with a large enough assemblage has some evidence for use during two or more phases. However, if most of the dating information from an analysis unit is from a single phase, then it should be safe to assume that most of the remaining materials from that analysis unit date to that phase and are appropriate for analyses of change over time, and 85 percent seems like a reasonable threshold for this. Analysis units with fewer than two pieces of dating information of any type available, or with fewer than ten pieces of information that are all of a single type (e.g., all obsidian hydration measurements), were determined to have insufficient information for evaluation of whether or not they are single-component. All other analysis units were classified as multicomponent; these are sites or site loci that have significant amounts of evidence for occupation during two or more periods.

The "phases" that are included in Table 19 are Paleoarchaic, Middle Archaic, Pie Creek, Pie Creek or South Fork, South Fork, James Creek, James Creek or Maggie Creek, Maggie Creek, and Eagle Rock. Each radiocarbon date is assigned to the phase within which the majority of its calibrated 2-sigma range falls. A few radiocarbon dates have calibrated 2-sigma ranges that are more or less equally split between the James Creek and Maggie Creek phases; these dates are assigned to the "James Creek or Maggie Creek" category. Projectile points are assigned to phases as described above in Section 5.3, though, for purposes of determining whether analysis units are single-component, Elko points, used during both the James Creek and Maggie Creek phases, are counted as evidence solely for James Creek occupation if sufficient additional, supporting evidence for occupation during that phase exists. Ceramics, listed in Table 17 along with projectile points, are used as indicators of occupation during the Eagle Rock phase because virtually all ceramic specimens from the study area have been identified as Intermountain Brownware, which is considered to be diagnostic of this phase (e.g., Bright 1998b; Schroedl 1995). Further evaluation of the age of ceramics in the LBB area—for example, through thermoluminescence dating—would certainly be a productive avenue for future research, as is discussed in greater detail at the end of this chapter and in Chapter 7.

Obsidian hydration measurements were assigned to phases based on the hydration chronology presented in Table 16. As is discussed above in Section 5.4, because there is no clear separation among hydration ranges for the Pie Creek, South Fork and James Creek phases, it is possible to define only a general Middle Archaic hydration range, consisting of values of 4.0 microns or greater, for the span of time represented by these phases. Consequently, hydration values of 4.0 microns or greater are simply assigned to a general "Middle Archaic" category, and hydration measurements are the only data assigned to this category. In determining whether analysis units are single-component, "Middle Archaic" hydration values are used in support of the other, finer-grained, lines of evidence. For example, an abundance of Middle Archaic hydration values from an analysis unit with a projectile point assemblage dominated by South Fork phase types would be consistent with a single-component South Fork phase age for that analysis unit, whereas the same set of hydration values from an analysis unit with numerous Maggie Creek phase projectile points would indicate that the assemblage is multicomponent.

The hydration ranges listed in Table 16 are applied to all hydration measurements, regardless of obsidian source. The majority of the hydration measurements come from artifacts of Paradise Valley obsidian, and since the ranges in Table 16 were derived from Paradise Valley obsidian, the majority of the obsidian hydration phase assignments should not be problematic. However, since obsidian from different sources may hydrate at different rates, and since Browns Bench obsidian, in particular, is known to be a fast hydrator, there may be some error in hydration measurement phase assignments. This may not be too big a problem for non–Paradise Valley obsidian from sources other than Browns Bench since both Malad obsidian (SWCA Environmental Consultants 2010), present in some quantity in the LBB area, and Wild Horse Canyon obsidian (Seddon 2005), represented in the LBB by at least one specimen, seem to hydrate at roughly the same rate as Paradise Valley obsidian. In addition, in no case does a determination of whether an analysis unit is single-component hinge solely on hydration measurements from Browns Bench obsidian.

Table 17. Counts of Projectile Points by Point Type and Number of Ceramic Sherds per Analysis Unit

Site	Analysis Unit	Diagnostic Projectile Points	Ceramics
26EK002304	Site	5 CT, 2 DSN, 4 Rosegate, 15 Elko, 3 GCS, 6 GSS, 6 Humboldt, 2 GBS	15
26EK002305	Site	2 DSN, 1 Rosegate	
26EK004687	Surface Collection Block 1	1 CT, 2 DSN	
26EK004687	Surface Collection Block 2	2 DSN, 4 Rosegate, 4 Elko, 4 GSS	
26EK004687	Surface Collection Block 3	6 Elko, 1 GCS, 8 GSS, 3 Humboldt	
26EK004688	Activity Locus 1	1 DSN, 1 Rosegate, 1 Elko	
26EK004688	Activity Locus 2	1 Elko	
26EK004688	Activity Locus 3	2 DSN, 1 Rosegate	
26EK004688	Activity Locus 4	2 DSN, 1 Rosegate, 1 Humboldt	
26EK004688	Activity Locus 5	1 GCS	
26EK004688	Activity Locus 6	1 DSN	
26EK004688	Activity Locus 7	1 CT	
26EK004688	Activity Locus 8	5 CT, 5 DSN, 1 Rosegate	
26EK004688	Activity Locus 9		4
26EK004688	Activity Locus 10	4 Rosegate	
26EK004688	Activity Locus 11	2 CT, 3 DSN, 2 Elko	2
26EK004690	Surface Collection Block 1	1 Elko	
26EK004690	Surface Collection Block 2	8 Elko, 1 GSS	
26EK004695	Site	3 Elko, 3 GSS	
26EK004696	Site	2 Elko, 3 GSS, 3 Humboldt	
26EK004749	Surface Collection Block 1	2 DSN, 3 Rosegate, 1 Elko	
26EK004749	Surface Collection Block 2	2 Rosegate, 1 Elko	
26EK004749	Surface Collection Block 3	5 DSN, 1 Rosegate, 1 Elko	
26EK004749	Surface Collection Block 4	8 DSN, 3 Rosegate, 1 RPM, 2 Elko	
26EK004755	Surface Collection Block	1 CT, 15 DSN	79
26EK005200	Excavation Area 1	1 DSN	
26EK005270	Site	3 CT, 6 DSN, 1 Elko	
26EK005271	Excavation Block 1	2 CT, 1 DSN, 1 Elko	

Table 17. Counts of Projectile Points by Point Type and Number of Ceramic Sherds per Analysis Unit

Site	Analysis Unit	Diagnostic Projectile Points	Ceramics
26EK005271	Excavation Block 2	1 Rosegate	
26EK005274	Site	1 CT, 3 DSN	
26EK005374	Site	1 GSS	
26EK006231	Surface Collection Block 2	1 RPM	
26EK006231	Surface Collection Block 3	1 CT, 1 DSN, 1 Rosegate, 2 Elko	
26EK006232	Surface Collection Block 1	1 CT, 1 Elko	
26EK006232	Surface Collection Block 2	1 Elko	
26EK006487	Excavation Block 2	2 DSN, 1 Rosegate, 14 Elko, 1 GSS, 2 Humboldt	
26EK006487	Excavation Block 4	1 DSN	1
26EU001319	Site	2 CT, 4 DSN	
26EU001320	Area 1	1 CT, 1 DSN, 9 Rosegate, 20 Elko, 1 NSN, 3 Humboldt	1
26EU001320	Area 2	5 DSN, 3 Rosegate	2
26EU001320	Area 3	2 Rosegate, 1 Elko	
26EU001482	Surface Collection Block 1	1 CT, 1 DSN	
26EU001482	Surface Collection Block 2	1 CT, 3 DSN	
26EU001482	Surface Collection Block 3	1 CT, 1 DSN	
26EU001482	Surface Collection Block 4	2 CT, 1 DSN	
26EU001482	Surface Collection Block 5	1 Rosegate	
26EU001483	Surface Collection Block 1	1 Rosegate	
26EU001483	Surface Collection Block 2	1 Elko, 1 GSS	2
26EU001483	Surface Collection Block 3	1 DSN, 7 Rosegate, 2 Elko	117
26EU001487	Excavation Block 1	4 CT, 6 DSN, 7 Rosegate, 2 Elko, 4 GSS	91
26EU001487	Excavation Block 2	5 Rosegate, 1 RPM, 3 Elko, 6 GSS, 1 NSN	
26EU001492	Site	69 Rosegate, 2 RPM, 12 Elko	
26EU001494	Site	2 DSN, 1 Elko	
26EU001505	Site	2 DSN	
26EU001529	Site	86 Rosegate, 4 RPM, 3 Elko	
26EU001530	Excavation Block 1	1 Elko, 1 Humboldt	
26EU001530	Excavation Block 2	1 Rosegate, 1 Elko	
26EU001530	Excavation Block 5	1 GSS	
26EU001530	Excavation Block 6	1 Rosegate	
26EU001530	Excavation Block 7	1 Rosegate	
26EU001531	Excavation Block 1	1 Rosegate, 3 Elko	
26EU001531	Excavation Block 2	2 Elko	
26EU001531	Excavation Block 3	1 CT, 3 Elko	
26EU001531	Excavation Block 4	1 Rosegate, 1 Elko, 1 GSS	
26EU001533	Site	1 Elko	
26EU001534	Excavation Block 1	1 DSN	

Table 17. Counts of Projectile Points by Point Type and Number of Ceramic Sherds per Analysis Unit

Site	Analysis Unit	Diagnostic Projectile Points	Ceramics
26EU001534	Excavation Block 2		2
26EU001534	Excavation Block 3	2 Elko	
26EU001534	Excavation Block 4	1 DSN, 1 Rosegate, 2 Elko	
26EU001534	Excavation Block 5	2 CT, 2 Elko, 1 Humboldt	
26EU001539	Cluster 1	1 DSN	
26EU001539	Cluster 2	1 Rosegate	
26EU001595	Site	1 CT, 1 Rosegate, 87 Elko	
26EU001667	Surface Collection Block 1	2 DSN, 1 Rosegate, 9 Elko, 1 GSS	1
26EU001667	Surface Collection Block 2	1 DSN	
26EU001667	Surface Collection Block 3	1 DSN, 1 Humboldt	1
26EU001734	Site	1 DSN, 4 Rosegate, 4 Elko, 4 GSS, 1 NSN, 2 Humboldt	1
26EU001851	Site	1 Elko	
26EU001904	Site	5 Rosegate	
26EU001906	Site	2 CT, 1 Rosegate, 1 Elko	
26EU002064	Cluster 2	1 Elko	
26EU002064	Cluster 3	1 GCS	
26EU002064	Cluster 5	2 DSN	
26EU002079	Site	1 Rosegate, 1 Elko, 1 GSS, 1 Humboldt	
26EU002124	Site	1 Elko	
26EU002126	Cluster 1	3 CT, 1 DSN	
26EU002181	Site	1 DSN, 1 Elko	
26EU002182	Site	1 Rosegate, 6 Elko, 2 GSS, 1 NSN, 1 Humboldt	
26EU002183	Site	1 DSN, 5 Rosegate, 5 Elko, 2 GSS, 1 Humboldt	
26EU002184	Surface Collection Block 2	1 CT	
26EU002184	Surface Collection Block 3	1 DSN, 2 Rosegate, 2 RPM, 2 GSS	

Note: Analysis units listed in Table 6 but not in this table are those for which no diagnostic projectile points or ceramics are reported.

a. CT = Cottonwood Triangular, DSN = Desert Side-notched, RPM = Rye Patch Miniature, GCS = Gatecliff Contracting Stem, GSS = Gatecliff Split Stem, NSN = Northern Side-notched, GBS = possible Great Basin Stemmed.

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
26EK004687	Surface Collection Block 1	1197	Malad	1.3
		1327	Brown's Bench	6.3
26EK004687	Surface Collection Block 2	706	Timber Butte	1.2
		915	Paradise Valley	3.3
		2446	Paradise Valley	4.7
		2447	Unknown Group E	2.4
		2594	Paradise Valley	4.9
26EK004687	Surface Collection Block 3	1647	Paradise Valley	5.6
		2588	Paradise Valley	4.8
		2653	Paradise Valley	5.4
26EK004687	Other	37	Paradise Valley	6.0
		47	Owyhee (Toy Pass)	2.6
		2142	Unknown Group 3	4.8
		2201	Paradise Valley	6.3
		114	Paradise Valley	7.8
26EK004688	Activity Locus 3	1177	Paradise Valley	6.9
		1222	Paradise Valley	0.9
		1654	Paradise Valley	1.0
26EK004688	Activity Locus 4	877	Owyhee (Toy Pass)	1.1
		885	Paradise Valley	1.1
		925	Owyhee (Toy Pass)	1.2
		1609	Paradise Valley	1.1
		1643	Owyhee (Toy Pass)	1.1
		1644	Owyhee (Toy Pass)	1.6
		1648	Owyhee (Toy Pass)	1.2
		1649	Owyhee (Toy Pass)	1.5
		1655	Owyhee (Toy Pass)	1.0
		1656	Owyhee (Toy Pass)	1.3
26EK004688	Activity Locus 5	1658	Owyhee (Toy Pass)	1.1
26EK004688	Activity Locus 7	1237	Montezuma Range	0.9
26EK004688	Activity Locus 8	1452	Unknown	1.0
		1610	Paradise Valley	2.5
		1613	N/A	1.0
		1640	Paradise Valley	1.1
		1645	Paradise Valley	1.3
		1650	Unknown	1.1
		1652	Unknown	2.0

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
26EK004688	Activity Locus 9	1103	Paradise Valley	1.0
		1107	Owyhee (Toy Pass)	1.1
		1612	Paradise Valley	1.0
		1641	Paradise Valley	1.0
		1642	Owyhee (Toy Pass)	1.2
		1647	Paradise Valley	1.0
26EK004688	Activity Locus 11	943	Paradise Valley	1.1
		988	Paradise Valley	1.2
26EK004688	Other	56	Brown's Bench	1.8
		167	Paradise Valley	6.8
		168	Paradise Valley	7.1
		172	Paradise Valley	4.0
		174	Paradise Valley	1.7
		187	Unknown Group A	1.1
		193	Paradise Valley	2.4
		194	Paradise Valley	2.9
		209	Paradise Valley	2.4
		211	Owyhee (Toy Pass)	1.9
		219	Paradise Valley	1.5
		221	Paradise Valley	1.3
		222	Paradise Valley	2.2
		233	Unknown	4.8
		234	Paradise Valley	1.9
		253	Paradise Valley	2.0
		279	Owyhee (Toy Pass)	1.4
		287	Unknown Group 3	2.6
		336	Malad	2.2
		379	Paradise Valley	4.6
		386	Brown's Bench	4.0
		415	Owyhee (Toy Pass)	1.6
		419	Paradise Valley	1.7
		434	Bidwell Mountain	6.5
		385	Brown's Bench	2.7
26EK004690	Surface Collection Block 2	996	Majuba Mountain	2.5
26EK004690	Other	21	Paradise Valley	4.4
26EK004696	Site	12	Paradise Valley	4.8
26EK004749	Surface Collection Block 1	267	Paradise Valley	1.8

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
26EK004749	Surface Collection Block 3	473	Paradise Valley	1.7
26EK004749	Surface Collection Block 4	23	Paradise Valley	2.2
		54	Paradise Valley	1.2
		301	Paradise Valley	1.6
		396	Massacre Lake/Guano Valley	3.4
		541	Paradise Valley	1.7
26EK004749	Other	31	Paradise Valley	1.6
		32	Paradise Valley	2.1
26EK005200	Excavation Area 1	275	Unknown Group 1	1.3
26EK005270	Site	89	Brown's Bench	2.4
		109	Malad	1.8
		140	Malad	1.5
		168	Malad	1.5
		175	Malad	1.5
		182	Malad	1.3
		199	Malad	1.5
		206	Malad	1.6
		217	Malad	1.5
		218	Malad	1.5
		244	Unknown Group D	2.4
26EK005271	Other	132	Unknown Group D	2.5
		147	Paradise Valley	1.2
		203	Paradise Valley	5.0
		225	Timber Butte	1.3
		234	Unknown	1.3
		490	Brown's Bench	3.0
		406	Brown's Bench	2.3
26EK005274	Site	66	Unknown Group C	2.3
		87	Unknown Group C	1.8
		99	Unknown Group C	2.2
		116	Unknown Group C	2.0
26EK006231	Surface Collection Block 1	293	Paradise Valley	1.2
26EK006231	Surface Collection Block 3	649	Paradise Valley	1.2
		651	Paradise Valley	1.2
		817	Unknown	3.6
26EK006231	Other	35	Unknown	1.0
		407	Paradise Valley	3.1

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
26EK006232	Surface Collection Block 1	362	Double H Mountains	3.1
		470	Brown's Bench Area (Unknown Group 10)	9.5
26EK006232	Surface Collection Block 2	272	Paradise Valley	3.0
		314	Unknown	3.0
		323	Unknown	1.3
		440	Paradise Valley	2.7
26EK006232	Other	26	Paradise Valley	1.5
26EU001320	Other	149	Paradise Valley	2.2
		469	Paradise Valley	4.3
		557	Paradise Valley	4.9
		900	Unknown Group 3	1.7
		985	Paradise Valley	6.7
		1139	Paradise Valley	4.8
		1234	Paradise Valley	6.8
		1348	Paradise Valley	1.9
		1739	Paradise Valley	2.2
		1968	Paradise Valley	6.4
		2003	Paradise Valley	5.7
		2070	Paradise Valley	3.8
		2312	Paradise Valley	5.7
		2313	Unknown Group 3	10.6
		2314	Paradise Valley	6.4
26EU001482	Surface Collection Block 4	581	Unknown Group 3	9.0
26EU001483	Surface Collection Block 2	1203	Paradise Valley	7.1
		2328	Paradise Valley	5.3
26EU001483	Other	2	Paradise Valley	4.3
		4	Unknown Group 3	2.0
		244	Paradise Valley	4.3
		280	Malad	1.9
		1292	Paradise Valley	4.7
26EU001487	Excavation Block 1	426	Brown's Bench	12.4
		598	Paradise Valley	1.5
		689	Paradise Valley	1.6
		704	Paradise Valley	1.2
		776	Paradise Valley	3.4
		807	Paradise Valley	1.5
		826	Paradise Valley	3.7

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
		873	Paradise Valley	3.3
		886	Paradise Valley	1.0
		905	Paradise Valley	4.1
		942	Paradise Valley	2.6
		999	Paradise Valley	3.0
		1038	Paradise Valley	1.4
		1039	Brown's Bench Area (Unknown Group 10)	2.5
		1055	Paradise Valley	1.1
		1102	Paradise Valley	1.4
		1111	Paradise Valley	1.3
		1135	Brown's Bench	4.9
		1145	Paradise Valley	3.8
		1152	Brown's Bench Area (Unknown Group 10)	2.6
		1167	Paradise Valley	0.8
		1175	Paradise Valley	3.8
		1190	Paradise Valley	3.8
		1194	Paradise Valley	3.4
		1222	Paradise Valley	3.5
		1236	Paradise Valley	1.0
		1245	Brown's Bench	3.8
		1255	Paradise Valley	3.6
		1316	Paradise Valley	1.0
		1338	Paradise Valley	2.2
		1345	Paradise Valley	3.4
		1355	Paradise Valley	0.9
		1407	Paradise Valley	3.6
26EU001487	Excavation Block 2	208	Brown's Bench	7.3
		269	Paradise Valley	3.5
26EU001492	Site	534	Paradise Valley	3.6
26EU001494	Site	N/A	Paradise Valley	1.3
		N/A	Paradise Valley	1.3
		N/A	Paradise Valley	1.3
		N/A	Paradise Valley	1.3
26EU001522	Surface Collection Block 1	82	Double H Mountains	7.6
		118	Paradise Valley	1.6
26EU001522	Surface Collection Block 2	48	Paradise Valley	1.4
26EU001522	Other	36	Paradise Valley	7.9

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
		186	Brown's Bench Area (Unknown Group 10)	3.5
		191	Paradise Valley	3.0
26EU001524	Other	121	Paradise Valley	5.1
26EU001529	Site	513	Paradise Valley	3.1
		588	Paradise Valley	3.6
		1261	Paradise Valley	7.7
		1648	Paradise Valley	4.1
26EU001530	Excavation Block 2	84	Paradise Valley	5.5
		134	Unknown	1.0
26EU001531	Excavation Block 2	125	Paradise Valley	1.3
		955	Unknown Group A	1.1
26EU001533	Site	11-1	Double H Mountains	7.8
26EU001534	Excavation Block 3	844	Unknown Group C	1.8
26EU001534	Excavation Block 4	911	Topaz Mountain	2.2
		914	Topaz Mountain	2.0
		1224	Topaz Mountain	2.9
26EU001534	Excavation Block 5	486	Brown's Bench	4.8
26EU001534	Excavation Block 7	8	Paradise Valley	1.8
		14	Paradise Valley	1.4
		16	Paradise Valley	1.3
		38	Paradise Valley	1.2
		192	Paradise Valley	1.3
		210	Paradise Valley	1.2
		211	Paradise Valley	1.4
		257	Paradise Valley	1.5
		356	Paradise Valley	1.2
		1187	Paradise Valley	1.1
		1293	Paradise Valley	1.9
26EU001534	Other	1	Paradise Valley	1.0
		971	Paradise Valley	1.6
		994	Brown's Bench	2.5
26EU001548	Other	1	Paradise Valley	1.4
		15-1	Paradise Valley	1.1
26EU001595	Site	345	Paradise Valley	3.7
		371	Paradise Valley	3.4
		376	Paradise Valley	2.5
		83	Paradise Valley	4.6

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
		425	Paradise Valley	4.9
		427	Paradise Valley	4.8
		490	Paradise Valley	4.3
		501	Paradise Valley	1.6
		191	Paradise Valley	4.3
26EU001667	Surface Collection Block 1	22	Brown's Bench Area (Unknown Group 10)	1.2
		1345	Paradise Valley	2.3
		440	Brown's Bench Area (Unknown Group 10)	2.4
		466	Paradise Valley	4.2
		542	Brown's Bench Area (Unknown Group 10)	2.5
		1180	Paradise Valley	3.9
		1446	Unknown Group 3	3.2
		1447	Paradise Valley	1.2
		2846	Paradise Valley	1.4
26EU001667	Other	15	Brown's Bench	2.5
		2670	Paradise Valley	7.1
26EU001734	Site	75	Unknown Group 9	5.1
		87	Paradise Valley	6.7
		89	Paradise Valley	5.3
		151	Unknown	1.8
		831	Paradise Valley	6.7
		1207	Unknown Group 3	7.9
26EU001851	Site	72	Paradise Valley	7.1
26EU001997	Surface Collection Area 1	645	Paradise Valley	6.2
		732	Majuba Mountain	3.1
26EU001997	Other	925	Malad	2.1
		989	Unknown	1.6
		990	Malad	2.4
		991	Paradise Valley	2.2
26EU002064	Cluster 4	77-1	Paradise Valley	1.3
		77-2	Paradise Valley	1.6
		401-1	Paradise Valley	1.1
26EU002126	Cluster 1	13	Wild Horse Canyon	1.6
		1070-1	Paradise Valley	1.2
		1070-2	Paradise Valley	1.8
		1070-3	Paradise Valley	1.8
		1161-1	Paradise Valley	3.2

Table 18. Obsidian Hydration Measurements by Analysis Unit

Site	Analysis Unit	FS No.	Source	Hydration Band (microns)
		1173-1	Paradise Valley	1.3
		1174-1	Paradise Valley	1.3
26EU002181	Site	8	Paradise Valley	1.2
		16	Unknown Group 3	1.3
		28	Paradise Valley	1.3
		29	Topaz Mountain	1.7
		66	Unknown Group 3	4.9
26EU002182	Site	46	Paradise Valley	4.1
		63	Mount Hicks	3.7
		66	Paradise Valley	5.6
		74	Brown's Bench	11.6
		76	Paradise Valley	4.9
		102	Brown's Bench	12.1
		116	Paradise Valley	4.0
		124	Mount Hicks	4.3
		138	Paradise Valley	3.6
		195	Paradise Valley	4.8
		232	Paradise Valley	5.0
		234	Paradise Valley	5.0
		250	Paradise Valley	4.2
		251	Paradise Valley	4.6
		263	Paradise Valley	1.2
		441	Paradise Valley	4.2
26EU002183	Site	99	Unknown Group E	3.8
		100	Paradise Valley	4.3
26EU002184	Surface Collection Block 1	539	Paradise Valley	2.4
26EU002184	Surface Collection Block 3	237	Brown's Bench	6.1
26EU002184	Other	30	Brown's Bench	11.5
		183	Paradise Valley	3.5
		199	Paradise Valley	1.3
		207	Paradise Valley	3.1
		454	Paradise Valley	1.9

Note: Analysis units listed in Table 6 but not in this table are those for which no obsidian artifacts with measurable hydration bands are reported. Hydration measurements for temporally diagnostic projectile points are not included in this table. Obsidian specimens that were sourced but that produced no measureable hydration band are not included in this table but are included in Appendix D.

Table 19. Number of Pieces of Dating Information per Phase for Each Analysis Unit

Site	Analysis Unit	ER	MC	JC/MC	JC	SF	PC/SF	PC	MA	PA	Total	Max. No. Phases	Phases	SC[a]	Analysis Period
26EK002304	Site	9	4	15		9	6			2	45	6	PA-ER	No	
26EK002305	Site	2	1								3	2	MC-ER	No	
26EK002307	Site										0	0	Unknown	?	
26EK002309	Site										0	0	Unknown	?	
26EK004687	Surface Collection Block 1	4							1		5	2	MA, ER	No	
26EK004687	Surface Collection Block 2	3	6	4	1	4			2		20	4	SF-ER	No	
26EK004687	Surface Collection Block 3			6	2	9	3		3		23	4	PC(?)-MC(?)	Yes	MA
26EK004688	Activity Locus 1	1	1	1							3	3	JC(?)-ER	No	
26EK004688	Activity Locus 2	1		1							2	3	JC(?)-ER	No	
26EK004688	Activity Locus 3	5	1					1			7	3	PC, MC-ER	No	
26EK004688	Activity Locus 4	13	1				1				15	4	PC or SF, MC-ER	Yes	ER
26EK004688	Activity Locus 5	1				1					2	2	SF, ER	No	
26EK004688	Activity Locus 6	2									2	1	ER	Yes	ER
26EK004688	Activity Locus 7	2									2	1	ER	Yes	ER
26EK004688	Activity Locus 8	16	3								19	2	MC-ER	Yes	ER
26EK004688	Activity Locus 9	8									8	1	ER	Yes	ER
26EK004688	Activity Locus 10		5								5	1	MC	Yes	MC
26EK004688	Activity Locus 11	9		2							11	3	JC(?)-ER	No	
26EK004690	Surface Collection Block 1			1							1	2	JC or MC	?	
26EK004690	Surface Collection Block 2		1	8		1					10	3	SF-MC	Yes	MA
26EK004695	Site	1		3		3					7	4	SF-ER	No	
26EK004696	Site			2		3	3		1		9	4	PC(?)-MC(?)	Yes	MA
26EK004749	Surface Collection Block 1	3	3	1							7	3	JC(?)-ER	No	
26EK004749	Surface Collection Block 2		2	1							3	2	JC(?)-MC	No	
26EK004749	Surface Collection Block 3	6	1	1							8	3	JC(?)-ER	No	

Table 19. Number of Pieces of Dating Information per Phase for Each Analysis Unit

Site	Analysis Unit	ER	MC	JC/MC	JC	SF	PC/SF	PC	MA	PA	Total	Max. No. Phases	Phases	SC[a]	Analysis Period
26EK004749	Surface Collection Block 4	12	6	2							20	3	JC(?)-ER	No	
26EK004755	Surface Collection Block	18									18	1	ER	Yes	ER
26EK005200	Excavation Area 1	2									2	1	ER	Yes	ER
26EK005200	Excavation Area 2										0	0	Unknown	?	
26EK005270	Site	19	2	1							22	3	JC(?)-ER	Yes	ER
26EK005271	Excavation Block 1	4		1							5	3	JC(?)-ER	No	
26EK005271	Excavation Block 2		1								1	1	MC	?	
26EK005271	Excavation Block 3	1									1	1	ER	?	
26EK005274	Site	5	3								8	2	MC-ER	No	
26EK005278	Site										0	0	Unknown	?	
26EK005374	Site					1					1	1	SF	?	
26EK006231	Surface Collection Block 1	3									3	1	ER	Yes	ER
26EK006231	Surface Collection Block 2	1	1								2	2	MC-ER	No	
26EK006231	Surface Collection Block 3	5	2	2							9	3	JC(?)-ER	No	
26EK006232	Surface Collection Block 1	1	1	1	1				1		5	3	JC-ER	No	
26EK006232	Surface Collection Block 2	2	3	1							6	3	JC(?)-ER	No	
26EK006487	Excavation Block 1										0	0	Unknown	?	
26EK006487	Excavation Block 2	3	2	14		1	2				22	5	PC(?)-ER	No	
26EK006487	Excavation Block 3										0	0	Unknown	?	
26EK006487	Excavation Block 4	3									3	1	ER	Yes	ER
26EU001319	Site	7									7	1	ER	Yes	ER
26EU001320	Area 1	5	9	21	6		3	1			45	5	PC-ER	No	
26EU001320	Area 2	8	3								11	2	MC-ER	No	
26EU001320	Area 3		2	1							3	2	JC(?)-MC	No	
26EU001482	Surface Collection Block 1	4									4	1	ER	Yes	ER

Table 19. Number of Pieces of Dating Information per Phase for Each Analysis Unit

Site	Analysis Unit	ER	MC	JC/MC	JC	SF	PC/SF	PC	MA	PA	Total	Max. No. Phases	Phases	SC[a]	Analysis Period
26EU001482	Surface Collection Block 2	7									7	1	ER	Yes	ER
26EU001482	Surface Collection Block 3	3	1								4	2	MC-ER	No	
26EU001482	Surface Collection Block 4	5							1		6	2	MA, ER	No	
26EU001482	Surface Collection Block 5		1								1	1	MC	?	
26EU001483	Surface Collection Block 1		1		1						2	2	JC-MC	No	
26EU001483	Surface Collection Block 2	1	2	1	1	1			2		8	3	SF-ER	No	
26EU001483	Surface Collection Block 3	3	9	2							14	3	JC(?)-ER	No	
26EU001487	Excavation Block 1	27	24	2		4			3		60	4	SF-ER	No	
26EU001487	Excavation Block 2	1	7	3		6		1	1		19	5	PC-ER	No	
26EU001492	Site		72	12							84	2	JC(?)-MC	Yes	MC
26EU001494	Site	6		1							7	3	JC(?)-ER	No	
26EU001505	Site	3									3	1	ER	Yes	ER
26EU001520	Site										0	0	Unknown	?	
26EU001522	Surface Collection Block 1	1							1		2	2	MA, ER	No	
26EU001522	Surface Collection Block 2	1									1	1	ER	?	
26EU001524	Excavation Area 1										0	0	Unknown	?	
26EU001524	Excavation Area 2										0	0	Unknown	?	
26EU001529	Site		92	3					2		97	2	JC-MC	Yes	MC
26EU001530	Excavation Block 1			1			1				2	4	PC(?)-MC(?)	No	
26EU001530	Excavation Block 2	1	1	1					1		4	3	JC-ER	No	
26EU001530	Excavation Block 3										0	0	Unknown	?	
26EU001530	Excavation Block 4	1									1	1	ER	?	
26EU001530	Excavation Block 5	2				1					3	2	SF, ER	No	
26EU001530	Excavation Block 6		1								1	1	MC	?	
26EU001530	Excavation Block 7		1								1	1	MC	?	

Table 19. Number of Pieces of Dating Information per Phase for Each Analysis Unit

Site	Analysis Unit	ER	MC	JC/MC	JC	SF	PC/SF	PC	MA	PA	Total	Max. No. Phases	Phases	SC[a]	Analysis Period
26EU001531	Excavation Block 1		2	3	2						7	2	JC-MC	No	
26EU001531	Excavation Block 2	3		2							5	3	JC(?)-ER	No	
26EU001531	Excavation Block 3	1		3							4	3	JC(?)-ER	No	
26EU001531	Excavation Block 4		1	1	1	1					4	3	SF-MC	No	
26EU001533	Site			1					1		2	2	MA-MC(?)	Yes	MA
26EU001534	Excavation Block 1	3									3	1	ER	Yes	ER
26EU001534	Excavation Block 2	1									1	1	ER	?	
26EU001534	Excavation Block 3	1		2							3	3	JC(?)-ER	No	
26EU001534	Excavation Block 4	1	4	2							7	3	JC(?)-ER	No	
26EU001534	Excavation Block 5	3		2			1		1		7	5	PC(?)-ER	No	
26EU001534	Excavation Block 6										0	0	Unknown	?	
26EU001534	Excavation Block 7	13									13	1	ER	Yes	ER
26EU001539	Cluster 1	1									1	1	ER	?	
26EU001539	Cluster 2		1								1	1	MC	?	
26EU001548	Surface Collection Grid 1										0	0	Unknown	?	
26EU001548	Surface Collection Grid 2										0	0	Unknown	?	
26EU001595	Site	2	4	87					5		98	3	JC-ER	Yes	JC/MC
26EU001667	Surface Collection Block 1	13	7	9	3	2			1		35	4	SF-ER	No	
26EU001667	Surface Collection Block 2	3									3	1	ER	Yes	ER
26EU001667	Surface Collection Block 3	3					1				4	3	PC or SF, ER	No	
26EU001667	Surface Collection Block 4										0	0	Unknown	?	
26EU001667	Surface Collection Block 5										0	0	Unknown	?	
26EU001734	Site	5	5	5	1	5	2	1	5		29	5	PC-ER	No	
26EU001851	Site			1					1		2	2	JC	Yes	MA
26EU001904	Site		5								5	1	MC	?	

Table 19. Number of Pieces of Dating Information per Phase for Each Analysis Unit

Site	Analysis Unit	ER	MC	JC/MC	JC	SF	PC/SF	PC	MA	PA	Total	Max. No. Phases	Phases	SC[a]	Analysis Period
26EU001906	Site	2	1	1							4	3	JC(?)-ER	No	
26EU001997	Surface Collection Area 1		2						1		3	2	MA, MC	No	
26EU001997	Surface Collection Area 2										0	0	Unknown	?	
26EU002064	Cluster 1										0	0	Unknown	?	
26EU002064	Cluster 2			1							1	2	JC or MC	?	
26EU002064	Cluster 3					1					1	1	SF	?	
26EU002064	Cluster 4	3									3	1	ER	?	
26EU002064	Cluster 5	2									2	1	ER	?	
26EU002064	Cluster 6										0	0	Unknown	?	
26EU002064	Concentration 3										0	0	Unknown	?	
26EU002079	Site		1	1		1	1				4	4	PC(?)-MC	No	
26EU002124	Site			1							1	2	JC or MC	?	
26EU002126	Cluster 1	10	2								12	2	MC-ER	Yes	ER
26EU002126	Cluster 2				1						1	1	JC	?	
26EU002181	Site	5		1					1		7	3	JC-ER	No	
26EU002182	Site	1	3	6	1	4	1	1	13		30	5	PC-ER	Yes	MA
26EU002183	Site	1	6	5		2	1		1		16	5	PC(?)-ER	No	
26EU002184	Surface Collection Block 1		1								1	1	MC	?	
26EU002184	Surface Collection Block 2	1									1	1	ER	?	
26EU002184	Surface Collection Block 3	1	4			2			1		8	3	SF, MC-ER	No	
26EU002184	Surface Collection Block 4										0	0	Unknown	?	

Note: ER = Eagle Rock, MC = Maggie Creek, JC/MC = James Creek or Maggie Creek, JC = James Creek, SF = South Fork, PC/SF = Pie Creek or South Fork, MA = Middle Archaic, PA = Paleoarchaic.

a. SC = Single-component; ? = insufficiecient information

5.5.2. Results: Analysis Time Periods

The phases represented in any amount in the assemblage from each analysis unit are listed in Table 19 in the column "phases"; these are presented simply for informational purposes. For purposes of the analyses conducted in subsequent chapters of this research context, a decision was made—following the criteria listed above—regarding whether each analysis unit is single-component, and each single-component analysis unit was then assigned to an "analysis period". These analysis periods are the temporal groupings used in subsequent analyses that involve examining change over time, and material from analysis units concluded to be multicomponent or for which insufficient dating information is available is generally not included in such analyses.

Several analysis units appear to correspond to single-component occupations that date to either the Eagle Rock or Maggie Creek phases, and these are assigned, respectively, to "Eagle Rock" and "Maggie Creek" analysis periods. However, using the criteria described above, no analysis units can be considered to represent single-component occupations that date to any of the Middle Archaic phases—James Creek, South Fork, or Pie Creek—individually; no single site or site locus has a large sample of datable materials that is dominated by material from any single one of these phases. Thus, if "single-component" is taken strictly to mean "single-phase", then no Middle Archaic assemblages from excavated sites in the study area can be considered to be single-component based on the criteria used here. One possible explanation for why this is the case may be that Middle Archaic occupations in the area were so ephemeral, each leaving very few artifacts and features, and that they made such repeated use of the same locations that discrete occupational episodes simply cannot be sorted out. Another possible explanation may be that all of the types of dating evidence that are currently available are simply too imprecise to do the sorting. Whatever the cause, though, it is not possible to identify single-phase Middle Archaic occupations for the analyses presented in this document.

On the other hand, many analysis units meet the criteria described above for occupation during the Middle Archaic period as a whole, if not during any Middle Archaic phase individually. That is, these analysis units contain substantial evidence for occupation during two or more Middle Archaic phases and/or they have several obsidian hydration measurements that fall within the general Middle Archaic hydration band range, but they have little to no evidence for occupation during the Maggie Creek or Eagle Rock phases. Since this is the case, so that some temporal comparison can be made between the Middle Archaic period and the later phases, these analysis units are assigned here to a general "Middle Archaic" analysis period.

Finally, one site, 26EU001595, has a large projectile point assemblage dominated by Elko series points, together with a few specimens of later point types and some Middle Archaic–range obsidian hydration measurements. Because Elko points may date to either the James Creek or Maggie Creek phases, the 26EU001595 "Site" analysis unit is assigned to a "James Creek or Maggie Creek" analysis period; this is the only analysis unit in the sample of excavated sites in the study area assigned to this period, which may overlap either or both of the Middle Archaic or Maggie Creek periods. None of the three Paleoarchaic or possible Paleoarchaic artifacts from the sites in the analysis sample (one of which is from the "Other" analysis unit for 26EK005271 and is thus not included in Table 19) is from a context that suggests a single-component Paleoarchaic period occupation.

Among the analysis units identified as single-component, the Eagle Rock analysis period is by far the best represented, with 18 sites or site loci assigned to this period. This is followed by six analysis units assigned to the Middle Archaic analysis period, three assigned to the Maggie Creek analysis period, and the one noted above that is assigned to the James Creek or Maggie Creek analysis period. There is thus uneven coverage of time periods in the available sample of single-component sites or site loci, and there is a clear need for the identification and excavation of additional single-component deposits that date to the Maggie Creek and earlier phases in future work in the LBB area. There are, however, at least a few assemblages that can be used to explore change in archaeological remains over the span of time represented by the Middle Archaic period and the Maggie Creek and Eagle Rock phases.

5.5.3. Results: Frequency of Multicomponent Assemblages

As noted at the start of this section, one reason for conducting a systematic evaluation of whether assemblages are single-component is that, though it has often been recognized that multicomponent deposits are common in the LBB area, data on precisely how common they are, generated using a consistent set of criteria, have been lacking. The evaluation conducted here fills this gap.

Of the 121 sites or site loci represented by the analysis units in Table 19, only 28—or about 23 percent—are single-component following the criteria used here. On the other hand, 52 sites or site loci—or about 43 percent of the total—have significant evidence of occupation during two or more phases and were classified as multicomponent ("SC" = "No" in Table 19). The remaining 41 sites and site loci—or about 34 percent of the total—were classified as having insufficient dating information for evaluating their age. Limiting consideration to just those 80 sites or site loci that do have sufficient information, the 52 multicomponent assemblages represent nearly two-thirds (65 percent) of the total. In other words, following the criteria used here, multicomponent assemblages appear to be about twice as common as single-component assemblages in the LBB area.

Of course, less stringent criteria for classification of assemblages as single-component than are used here might result in a greater percentage of assemblages being identified as such, but no matter how the data are sliced, the fact would surely remain that a substantial majority of the deposits that have been excavated in the LBB area to date would have to be considered to be multicomponent by any standard. Anything that can be done to ensure that future excavation efforts focus more productively on single-component deposits would substantially increase the research value of those efforts. Conversely, it would appear that a sufficient number of multicomponent sites have already been excavated and that anything that can be learned from such sites can be learned from those already excavated.

In addition to the proportion of single-component assemblages, the evaluation conducted here also allows calculation of a rough average number of phases represented at sites or site loci in the study area. For this purpose, a "maximum number of phases" for each analysis unit is listed in Table 19; this is calculated as the maximum number of phases that could be represented in the assemblage for each analysis unit based on available dating information. These are maximum numbers because, for analysis units with data that fall into the "James Creek or Maggie Creek" and "Pie Creek or South Fork" categories, each of the two phases in the category are counted as present (e.g., an Elko point is counted as indicating occupation during each of the James Creek and Maggie Creek phases). Obsidian hydration measurements in the Middle Archaic range are counted as evidence for one phase if there is no data from any of the individual phases within the Middle Archaic period. The average maximum number of phases for all analysis units in Table 19 is 1.98; excluding those for which no dating information is available (and which thus have zero phases represented), the average is 2.37. Thus, the "typical" site or site locus in the LBB area will have evidence for occupation during about two phases. Values much higher than this are not uncommon, though, as shown in Figure 10.

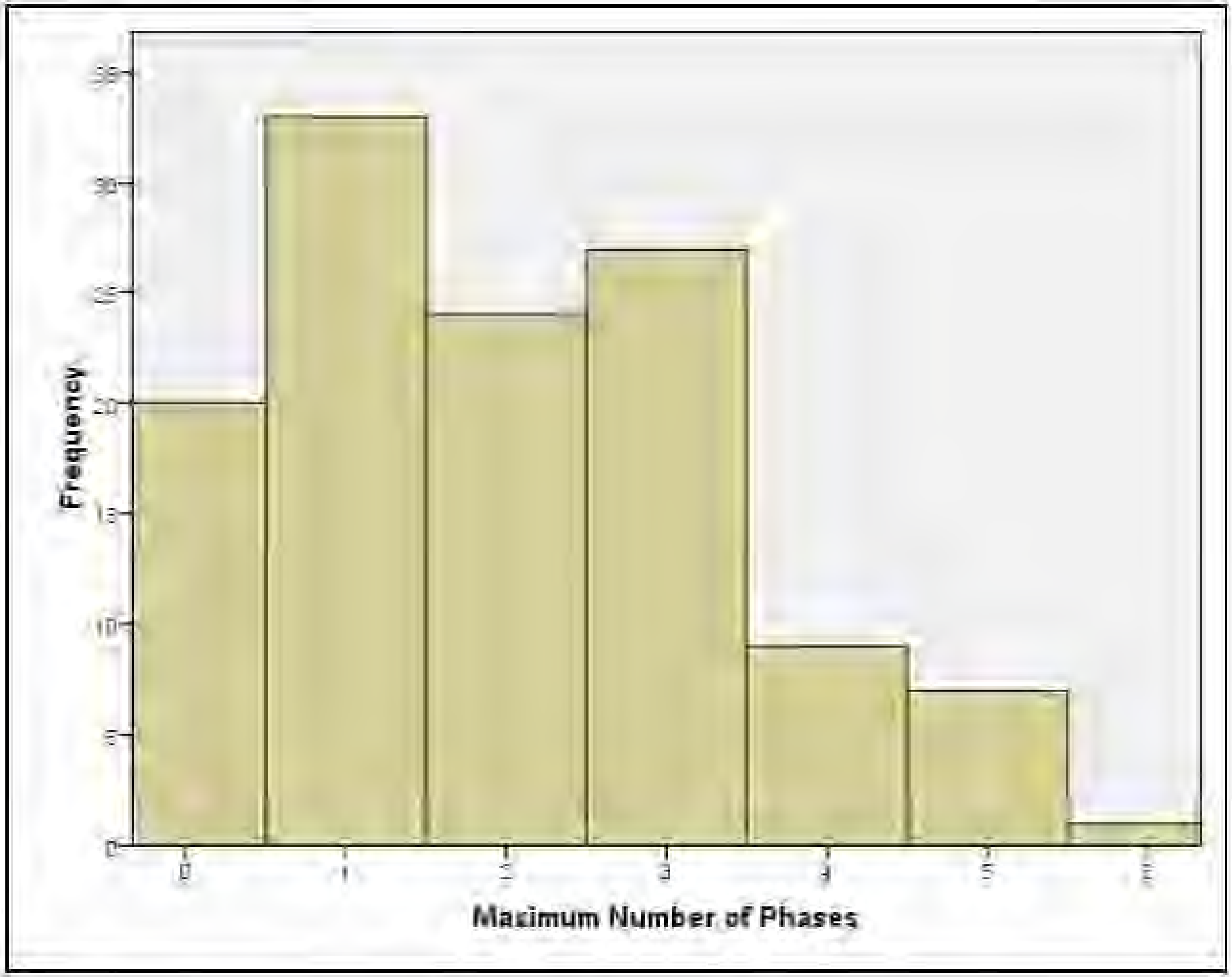

Figure 10. Distribution of maximum number of phases for analysis units in Table 19.

5.5.4. Results: Distribution of All Dating Data by Phase

Returning to the issue discussed in previous sections of this chapter of the study area's occupational history, it is now possible to explore population and settlement trends in the area using the cumulative dating information provided by all of the available lines of evidence. Figure 11 shows the distribution of all of the pieces of dating information listed in Table 19 across the phases that are used in that table. The Eagle Rock and Maggie Creek phases have the most data points, and the number of data points for each of these two phases is approximately equal (Eagle Rock: n = 329, Maggie Creek: n = 325). However, the "James Creek or Maggie Creek" category is close behind these two phases in dating information amount (n = 251), and to the extent that any of these data points (mostly Elko series projectile points) actually date to the Maggie Creek phase, the total for the Maggie Creek phase proper would outpace that for the Eagle Rock phase. Aside from the "James Creek or Maggie Creek" category, dating data are much less abundant for the phases of the Middle Archaic period, even taking into account the obsidian hydration measurements assigned only to the general Middle Archaic category (all Middle Archaic: n = 164). The Paleoarchaic period is barely represented (n = 2).

A more speculative pattern is shown in Figure 12. This pattern is speculative because, in the absence of information to indicate a better way to do it, the "James Creek or Maggie Creek" data points are simply divided evenly between the James Creek and Maggie Creek phases. All data from Middle Archaic phases are combined into a single Middle Archaic category in this figure, and Paleoarchaic data are excluded. Finally, to control for the fact that different spans of time are represented by each period or phase, data counts are normalized by dividing them by the number of calendar years within each period or phase. Spans of 600 calendar years are used for each of the Eagle Rock and Maggie Creek phases (corresponding to the periods of A.D. 1300-1900 and A.D. 700-1300, respectively; see Table 11), whereas a span of 1,900 calendar years is used for the Middle Archaic period (corresponding to the period between 1200 B.C., approximately when the LBB radiocarbon record begins, and A.D. 700). When viewed in this way, the chronological data from the LBB study area seem to indicate that human population densities and/or occupational durations were far lower during the Middle Archaic period (at 0.152 data points per calendar year) than was the case during subsequent periods. They also suggest that human population densities and/or occupational durations were greatest during the Maggie Creek phase (at 0.751 data points per calendar year) and somewhat lower during the Eagle Rock phase (at 0.548 data points per calendar year). This last point, however, is primarily the result of large numbers of Rosegate series and Elko series projectile points from the study area (see Figure 5), and, as discussed previously in this chapter, contradictory patterns emerge from the radiocarbon and obsidian hydration data (see Figure 4 and Figure 9). The large number of projectile points attributed to the Maggie Creek phase may reflect an increased importance of hunting technology during this time, whereas the contradictory pattern that occurs in the obsidian hydration data seems to be simply a function of reduced obsidian use during the Maggie Creek phase, and the one that occurs in the radiocarbon data may reflect an increase in the use of resources that required processing in hearths during the Eagle Rock phase. Such issues are explored further in subsequent chapters of this document. For present purposes, the important point is that it is unclear whether human use of the area was most intensive during the Maggie Creek phase or during the Eagle Rock phase, though it is clear that it was much less intensive during the Middle Archaic period than during either of these two later phases.

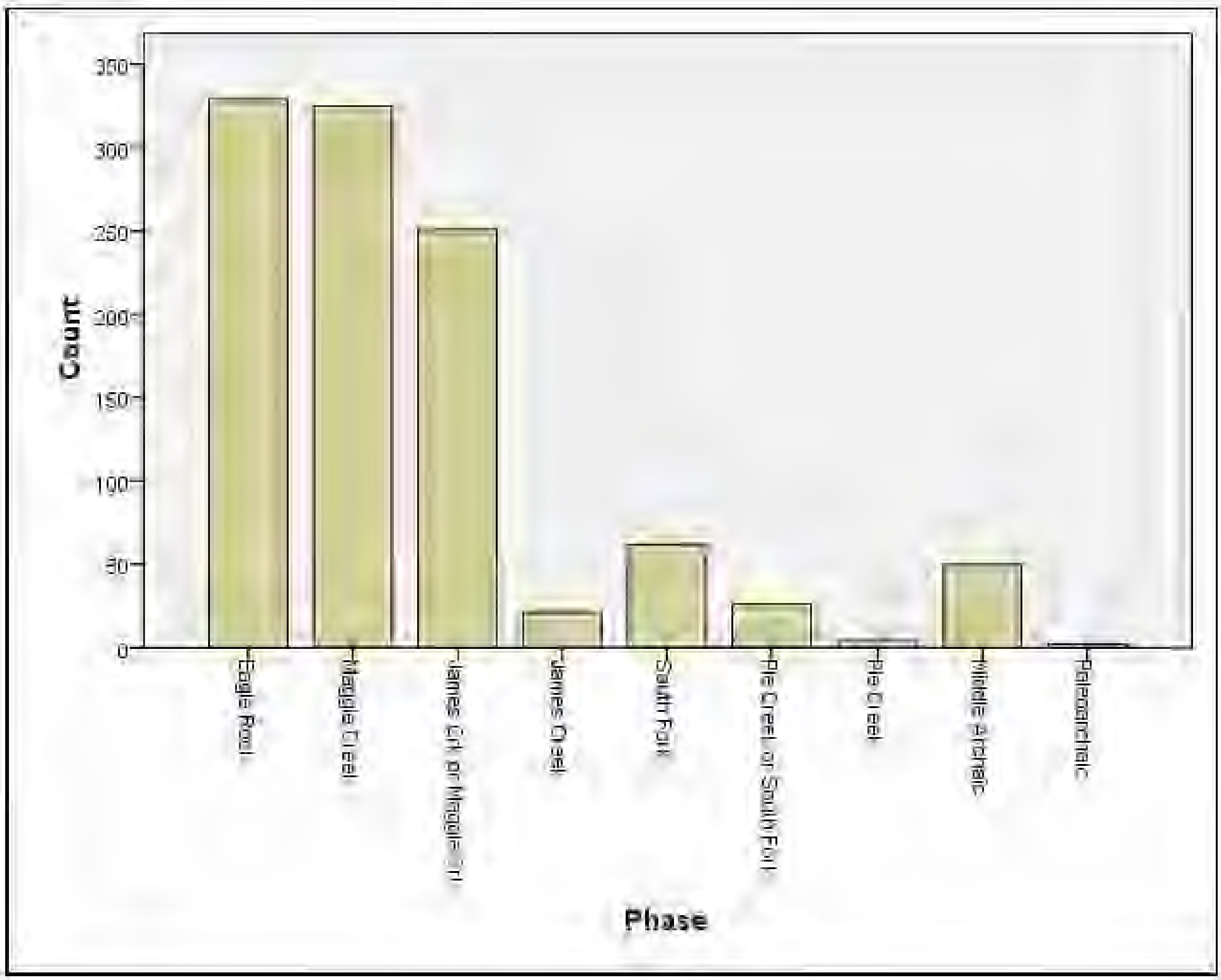

Figure 11. Distribution of all dating data from Table 19 by phase.

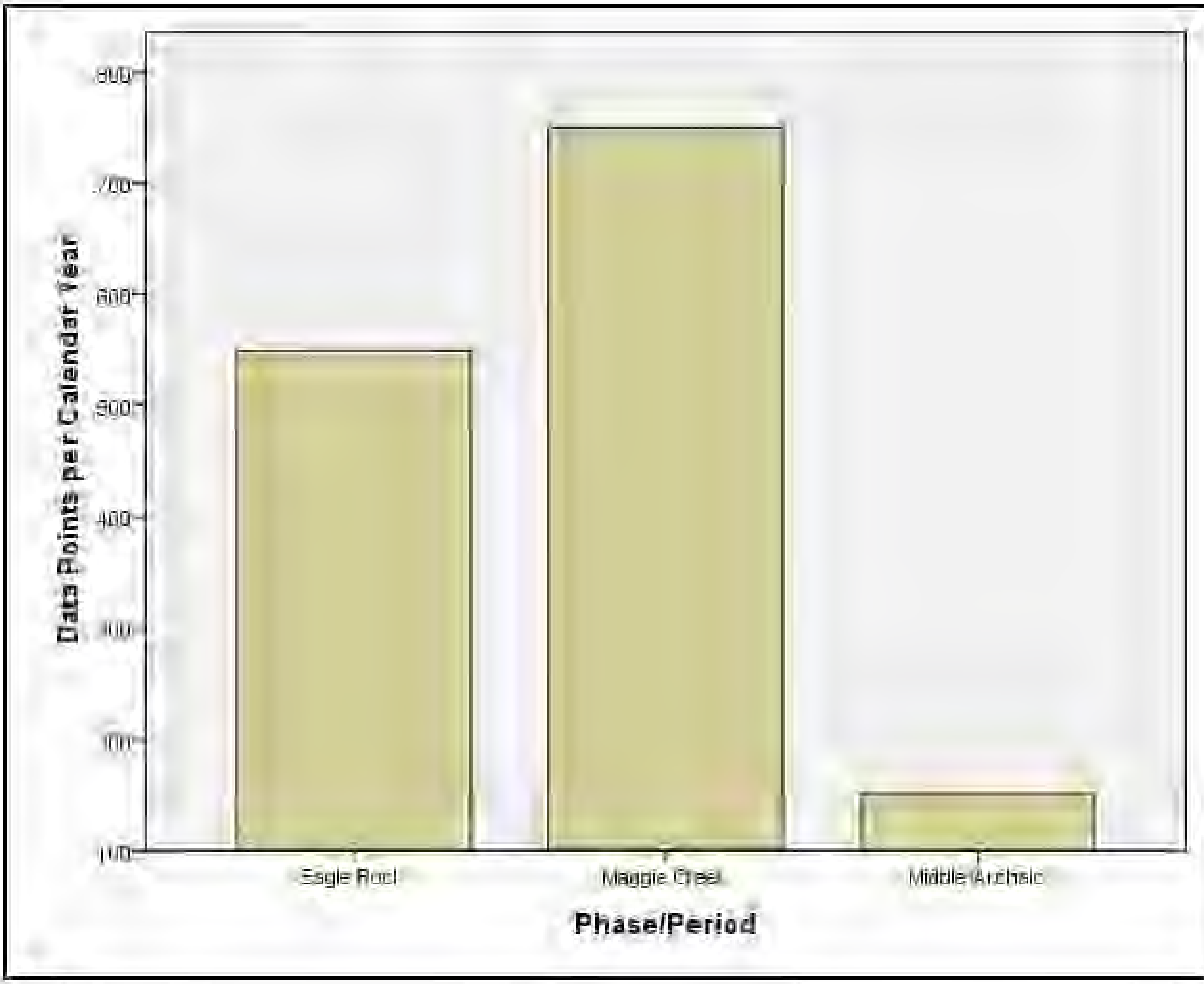

Figure 12. Distribution of all dating data from Table 19 by phase or period, normalized by absolute date range.

5.6. Predicting the Occurrence of Single-component Assemblages and Archaeological Features

Having explored the existing data from the LBB area that are relevant to issues of chronology and multicomponent assemblages, it is now appropriate to evaluate whether there are ways in which it might be possible to more effectively and efficiently identify single-component deposits in future work. As noted above, much previous excavation effort in the area has been expended on deposits that have turned out to be multicomponent, which are of limited use for research purposes. The research productivity of future excavation efforts could be greatly enhanced if it were possible to more successfully predict, prior to excavation, whether deposits were likely to be single-component. This would enable a greater proportion of effort to be expended on those sites or site loci that have the highest research value.

Here, it is evaluated whether there are factors—either environmental variables or characteristics of archaeological assemblages that can be observed during survey—that are associated either with single-component deposits directly or with archaeological features, which can indirectly increase our ability to identify deposits as single-component. If there are environmental or archaeological characteristics that, based on previous work in the area, appear to have a better than random chance of being associated with single-component deposits or with archaeological features, then sites or site loci that possess those characteristics can be targeted in future work, and there should be a better than random chance that effort will be expended on deposits with high utility for research.

5.6.1. Methods

For each analysis unit (see Table 6 above)[8], the following variables were tabulated:

- size of analysis unit area,
- amount of area excavated manually,
- total number of archaeological features identified, including features discovered through mechanical stripping,
- number of archaeological features identified through manual excavation only,
- number of chipped stone debitage specimens reported from surface contexts,
- number of chipped stone tool and core specimens reported from surface contexts,
- number of ground stone specimens reported from surface contexts,
- presence or absence of ceramics (from any context),
- elevation,
- slope,
- aspect,
- soil type,
- vegetation type, and
- distance to water.

Excavation area sizes, numbers of identified features, and counts of artifacts were compiled directly from excavation reports (see Table 5). The remaining information was obtained through analysis of Geographic Information Systems (GIS) data, using ESRI ArcGIS 9.3 software. All site and analysis unit boundaries that are shown on maps in excavation reports were digitized into a GIS database for purposes of this document, and analysis unit size was calculated from the digitized GIS data.

Elevation, slope, and aspect were all derived using 7.5 minute Digital Elevation Models (DEMs) available from the U.S. Geological Survey (USGS). For each analysis unit, average values for these variables were computed using the Zonal Statistics tool of the ArcGIS Spatial Analyst extension.

Soil types for each analysis unit were derived from the Soil Survey Geographic (SSURGO) database, available from the Natural Resources Conservation Service (2010). Analysis unit boundaries were intersected with the SSURGO soils data, and the dominant soil association unit for each analysis unit was recorded as the soil type for that analysis unit. Depth to different restrictive layers—duripan and lithic bedrock—was also determined from the SSURGO database; these variables were recorded because they may be related to a soil type's suitability for construction or preservation of archaeological features. Maps

[8] Only "spatial" analysis units—i.e., those that correspond to such things as excavation blocks or surface collection areas—are included in the analyses presented in this section; analysis units labeled "Other", which comprise materials from various locations within a site and/or materials of unknown provenience, are excluded.

of soil types in relation to the sites in the analysis sample for this document are shown in Figure A4 through Figure A6 in Appendix A.

Vegetation types for each analysis unit were derived from the Nevada Vegetation Synthesis Map available from the Nevada Heritage Program (Nevada Department of Conservation and Natural Resources 2010). This dataset is at 1:100,000 scale and is current as of March, 2008. The vegetation types used in this dataset are those of the International Vegetation Classification (Peterson 2008). As was done for soil types, analysis unit boundaries were intersected with the vegetation data, and the dominant vegetation type for each analysis unit was recorded. The locations of several analysis units are characterized in the Nevada Vegetation Synthesis Map by vegetation types that would not have existed in the area in prehistory (i.e., modern agricultural, disturbed, and invasive vegetation communities), and vegetation type was simply left blank for these analysis units (resulting in a somewhat smaller sample size for this variable than for the rest of the variables used). Maps of vegetation types in relation to the sites in the analysis sample for this document are shown in Figure A7 through Figure A9 in Appendix A.

Finally, distance to water was calculated using high-resolution (1:24,000) layers from the National Hydrography Dataset (NHD) of the USGS (2010). Distance to water was calculated, using the Point Distance tool from ET Geowizards, as the minimum distance from the analysis unit centerpoint to any stream; stream name and NHD stream "level" classification were also recorded. Only streams and not waterbodies were considered because virtually all of the LBB area waterbodies in the NHD are stock or leach ponds that were not present in prehistory.

These variables are evaluated here to determine whether any of them can be used to predict the occurrence of single-component analysis units (see Table 19). In addition, all except for archaeological feature counts are evaluated as to whether they can be used to predict the occurrence of archaeological features. Associations or relationships between the environmental and archaeological predictor variables listed above and the response variables—single-component or multicomponent, and features present or absent—were evaluated using the following statistical methods.

Each of the predictor variables was first screened individually; this was done using Mann-Whitney tests in the case of interval- or ratio-scale predictor variables and chi-square or Fisher exact tests in the case of categorical predictor variables. Non-paramentric Mann-Whitney tests were used rather than paramentric *t*-tests because most of the predictor variables exhibit decidedly non-normal distributions. A significant Mann-Whitney, chi-square, or Fisher exact test result would indicate that the predictor variable differs between the levels of the response variable in a way that might be useful for predicting the occurrence of either single-component deposits or archaeological features. Conversely, an insignificant result would indicate that the predictor variable has little predictive value.

Following initial screening of the predictor variables individually, multivariate logistic regression was used to determine the combination of predictor variables that together appear to have the greatest predictive value. Logistic regression was used because the response variables are binary: single-component or multicomponent, and features present or absent. For both response variables, an analysis of covariance design was followed, treating categorical predictor variables as fixed factors and interval- or ratio-scale predictor variables as covariates. Interaction effects were not included in the models, and many of the predictor variables were logarithmically transformed ($X' = \text{Log10}[X + 1]$) to improve the fit of the data to model assumptions. Predictor variables that appeared based on individual screening to have predictive value were included in a multivariate logistic regression model, and those predictor variables whose individual main effects were significant in the multivariate context were identified. These variables can be considered to be those that have greatest predictive value in a multivariate context in which the effects of other variables are controlled.

In all statistical tests an alpha level of 0.05 was used (1-tailed or 2-tailed, as appropriate). Tables that present the complete datasets compiled for the analyses discussed in this section are presented in Appendix F, along with complete presentation of statistical results.

5.6.2. Predicting the Occurrence of Single-component Deposits

Before discussing the value of the variables just mentioned for predicting the occurrence of single-component deposits, it should be pointed out that the single-best determinant of whether or not an assemblage is single-component, based on the criteria used to identify single-component assemblages in the previous section, appears to be the amount of dating information available for it. Of the analysis units listed in Table 19, those identified as single-component tend to have many more pieces of dating information available for them than do those that were not identified as such: means are 18.1 data points for the single-component assemblages, 10.3 for the multicomponent assemblages, and 0.7 for the assemblages with insufficient information, differences that are statistically significant (non-parametric Kruskal-Wallis test: chi-square = 76.2, $p < 0.001$; see Figure 13). Clearly, for it to be possible to identify single-component deposits during any excavation project, the very first goal should be to recover as much dating information as possible, whether radiocarbon samples, diagnostic artifacts, or obsidian specimens for hydration. Without a sufficiently large sample of chronological data, it will not be possible to determine whether or not the assemblage from a site or site locus is single-component.

The presence of archaeological features also appears to have a substantial effect on the ability to identify deposits as single-component. This is most likely related to the factor of dating information amount since features can be radiocarbon-dated and are also frequently surrounded by large samples of diagnostic and/or obsidian artifacts. Of the sites or site loci identified as single-component, 74.1 percent have at least one feature present, compared to 62.7 percent of those identified as multicomponent and only 20.5 percent of those with insufficient information, differences that are statistically significant (chi-square = 23.1, $p < 0.001$; see Figure 14).

In evaluating other factors that might predict the occurrence of single-component assemblages, sites and site loci classified as having insufficient information are excluded from consideration, and only those that can be definitively identified as either single-component or multicomponent are used. For these sites and site loci, none of the potential predictor variables listed above other than feature counts differ significantly between those identified as single-component and those identified as multicomponent. Thus, there unfortunately appears to be no variable, environmental or archaeological, that might be used to predict prior to excavation whether a site or site locus will be single-component. It would therefore seem that the most productive approach to identifying single-component deposits would simply be to target sites or site loci that appear to be able to provide abundant dating information, so that there will be sufficient data with which to evaluate whether the assemblage is single- or multicomponent. In other words, there is no magic bullet for locating single-component sites or site loci, and the best that can be hoped for is to focus efforts on those that are likely to be able to produce enough dating information that their occupational history can be adequately evaluated. To the extent that the presence of archaeological features increases the amount of available dating information, which it clearly does, focusing on identifying sites or site loci that are likely to contain features is perhaps the next best strategy. Whether there are factors that might help predict the presence of archaeological features is explored below.

First, however, there is one final point about single-component assemblages that should be made. As noted in Chapter 3, some have suggested based on previous work in the LBB that smaller, less dense surface artifact assemblages are more likely to be associated with single-component occupations, whereas larger and denser surface artifact assemblages are more likely to be associated with multicomponent occupations (e.g., LaFond et al. 1995). Such a conclusion is not supported by the cumulative data from the LBB area. Though the differences are not statistically significant, counts of chipped stone artifacts from surface contexts tend to be *higher* for analysis units identified here as single-component than for those identified as multicomponent. Mean surface debitage count is 944.2 for single-component analysis units compared to 928.5 for multicomponent analysis units (Mann-Whitney $U = 276.0$, exact 2-tailed $p = 0.571$; Figure 15), and mean surface tool and core count is 52.8 for single-component analysis units compared to 15.2 for multicomponent analysis units (Mann-Whitney $U = 239.0$, exact 2-tailed $p = 0.155$; Figure 16). This association between larger surface assemblages and single-component analysis units may simply reflect the fact that larger assemblages, and especially larger tool assemblages, provide more datable artifacts and consequently a greater chance of identifying a site or site locus as single-component. However, the more important point here is that the available data provide absolutely no basis for thinking that sites or site loci with larger, denser surface assemblages are more likely to be multicomponent and therefore less useful for research purposes.

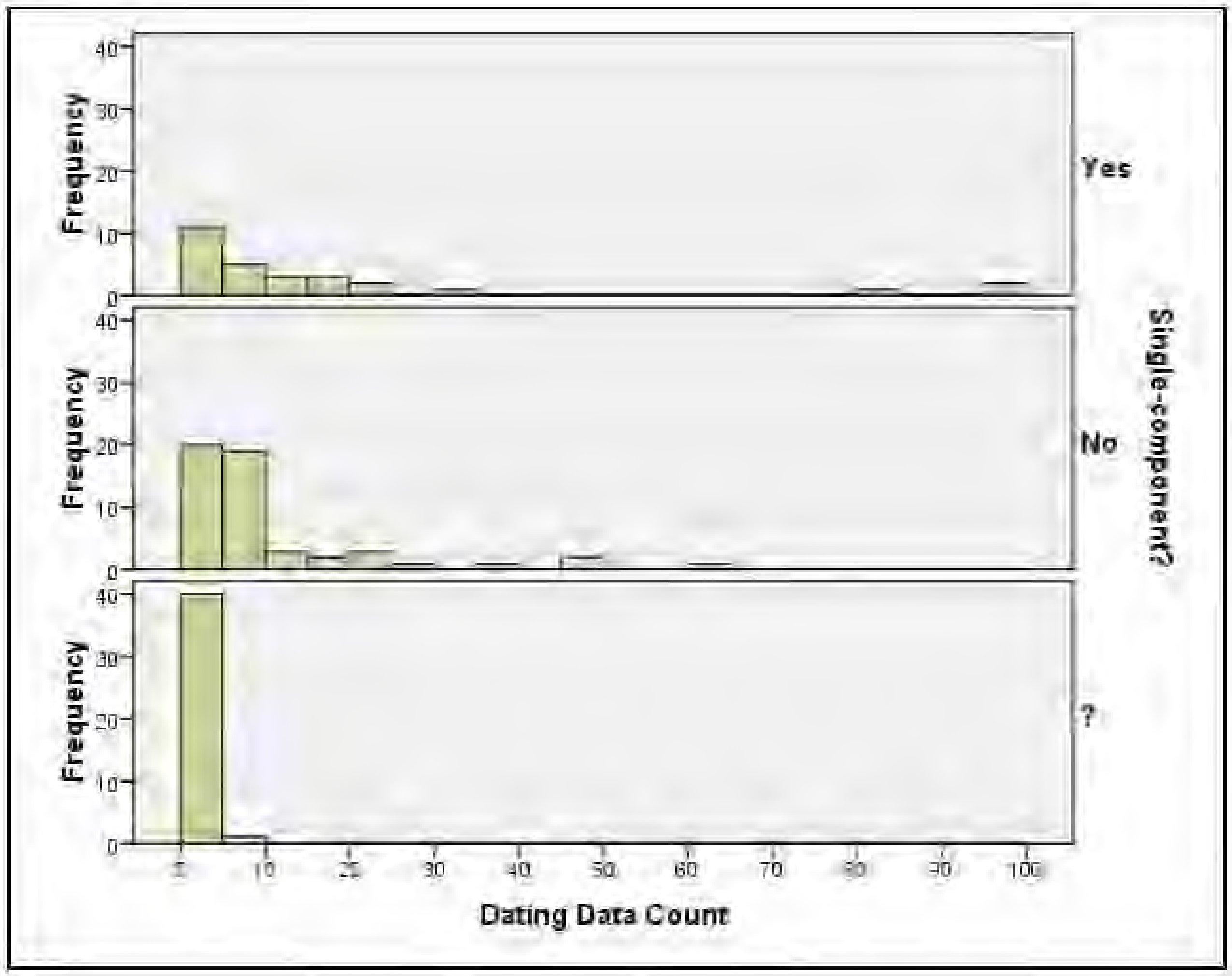

Figure 13. Distributions of dating data counts for single-component and other assemblages.

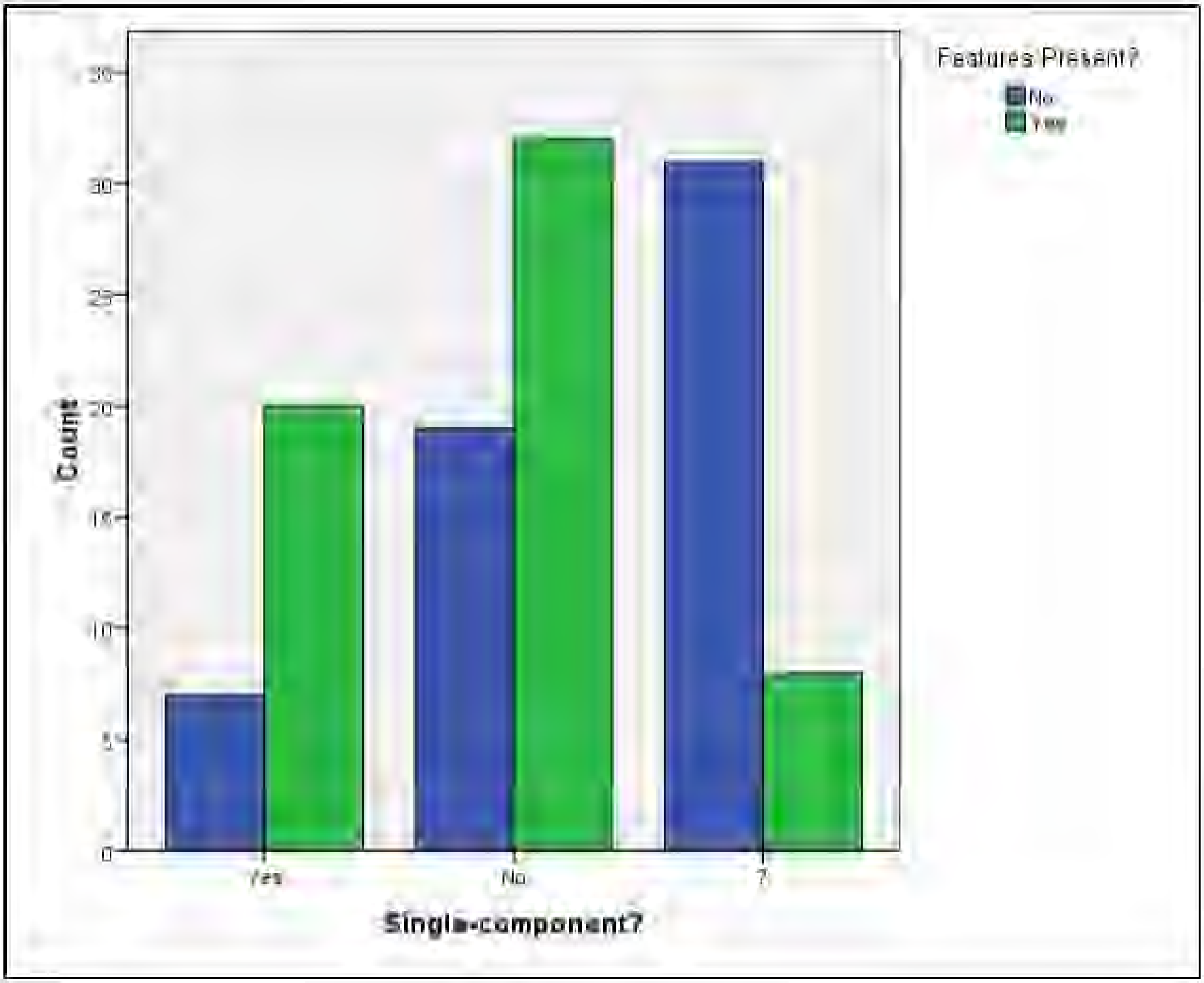

Figure 14. Counts of analysis units with and without features for single-component and other analysis units.

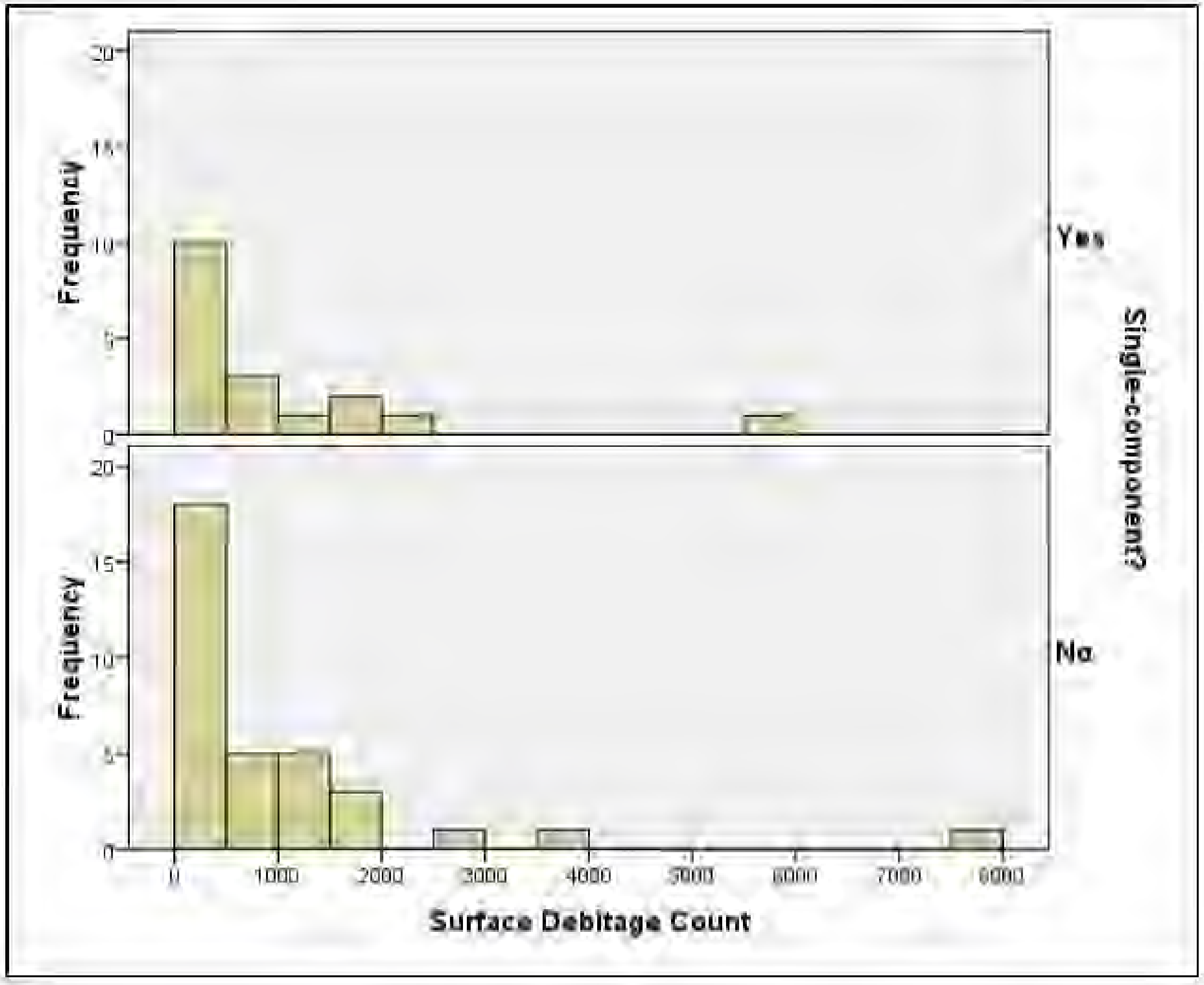

Figure 15. Distributions of surface debitage counts for single-component and multicomponent assemblages.

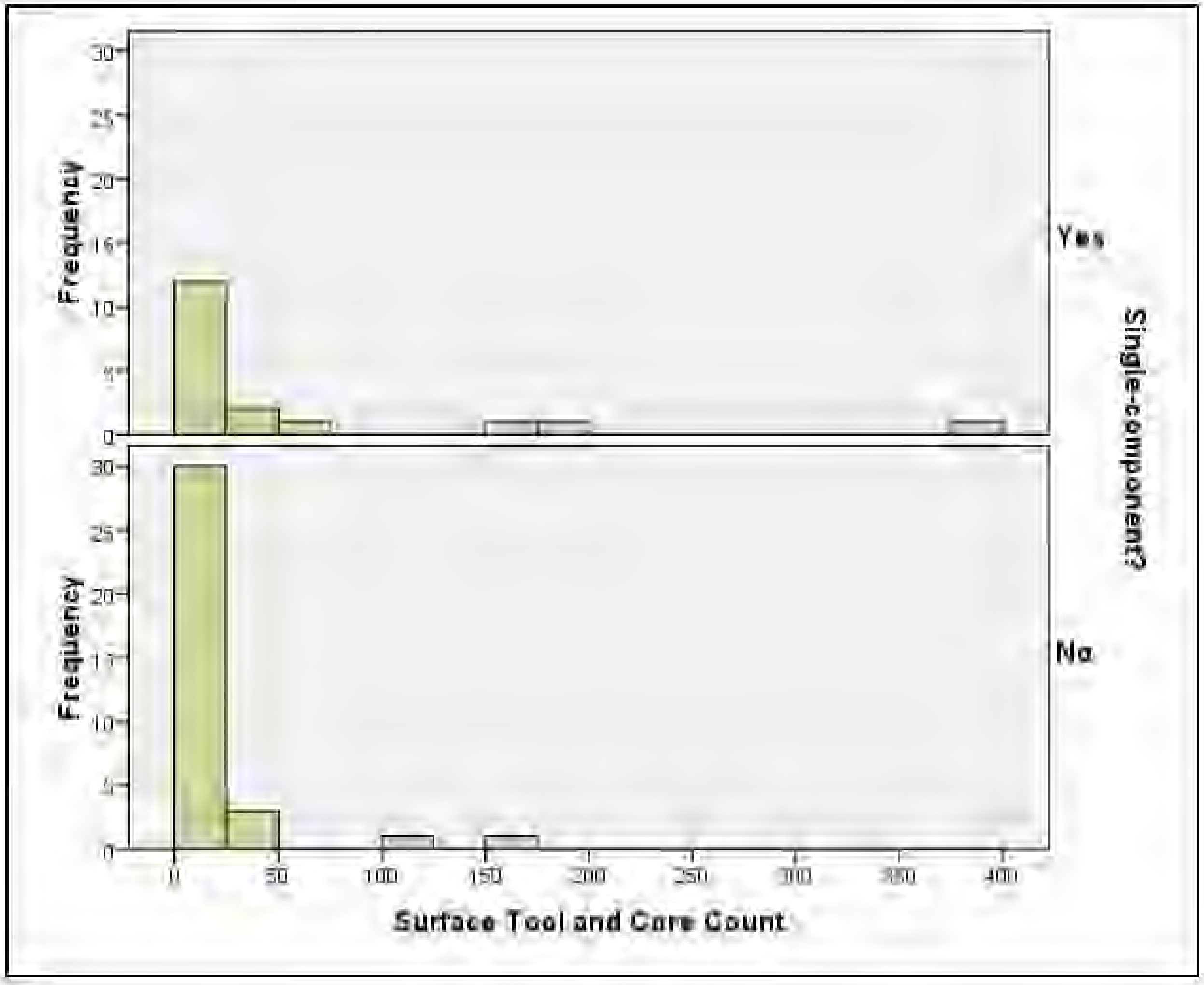

Figure 16. Distributions of surface tool and core counts for single-component and multicomponent assemblages.

5.6.3. Predicting the Occurrence of Archaeological Features

As just noted, since there appears to be no variable by which to directly predict prior to excavation whether a site or site locus will be single-component, but since the discovery of archaeological features greatly increases the chances that a site or site locus will be identified as single-component, the best strategy for identifying single-component deposits would seem to be to focus on locating archaeological features and the dating information that is generally associated with them. The question now becomes, are there ways to predict prior to excavation whether a site or site locus will contain subsurface archaeological features?

In answering this question, it must first be pointed out that the number of features discovered at a site or site locus is strongly related to the amount of area excavated. This is illustrated in Figure 17, which plots the number of features identified during manual excavation against the amount of area excavated for each analysis unit. The relationship shown here is highly significant (Spearman's rank-order correlation coefficient = 0.548, 1-tailed $p < 0.001$), and it is to be expected because the more area that is excavated at a site, the greater should be the chance of locating features. Thus, the amount of area excavated is a factor that must be controlled for when attempting to identify other, more useful variables that might help predict the presence of archaeological features.

Of those other potential predictor variables, the following exhibit significant relationships or associations with the presence or absence of features in an analysis unit: surface debitage count, surface ground stone count, presence or absence of ceramics, soil type, and vegetation type. The remaining variables—analysis unit size, surface tool and core count, elevation, slope, aspect, and minimum distance to water—are not significantly related to or associated with the presence or absence of features.

The variables listed above that are individually related to or associated with feature presence or absence may be useful predictors of the presence of features. However, before this can be concluded with certainty, the variables must be examined in a multivariate context to determine whether their effects remain significant in the presence of other variables. Debitage assemblage size, for example, may be related to feature presence or absence, but it may also be related to the amount of area excavated, and amount of area excavated may actually be the factor determining both debitage assemblage size and feature presence or absence. Such interrelationships among variables are best considered using multivariate methods. When combined in a multivariate logistic regression analysis, only the variables of excavated area, surface ground stone count, and soil type have significant effects on the presence or absence of features.

The first conclusion to draw from this result is that, as noted above, increasing the amount of area excavated at a site or site locus is perhaps the best way to increase the chances of discovering archaeological features. However, it is highly desirable to be able to locate features efficiently, with as little excavation effort as possible, and it is for this reason that other predictors of feature occurrence are sought here.

Regarding such other predictors, the number of ground stone artifacts from surface contexts is higher for site loci with features than for those without, as is shown in Figure 18, and this difference remains significant when the variable of excavated area is controlled. Thus, site loci at which ground stone is observed on the surface, especially in large quantities, can be predicted to have a better than random chance of containing subsurface features.

In addition, as is shown in Figure 19, features appear to occur in much greater than expected frequencies at site loci located on soils of the Chen-Pie Creek-Ramires association and in much lower than expected frequencies at site loci located on soils of the Cherry Spring-Cortez-Chiara association (these are the only two soil types for which chi-square adjusted standardized residuals fall beyond two standard deviations). Both of these associations comprise soils that are well-drained with a depth to water table of over 80 inches (200 cm) (USDA Natural Resources Conservation Service 2009). The two associations are also similar in that they have restrictive layers that occur at similar depths: lithic bedrock at 12–40 in (30–100 cm) in the case of Chen-Pie Creek-Ramires soils, and duripan at 10–40 in (25–100 cm) in the case of Cherry Spring-Cortez-Chiara soils (USDA Natural Resources Conservation Service 2009). There thus appears to be no obvious difference between the two soil types in their suitability for the construction or preservation of archaeological features such as hearths. However, they do differ in at least one other way that may be relevant. Chen-Pie Creek-Ramires soils occur on mountain and hill landforms at elevations of 5,500 to 6,500 feet, whereas Cherry Spring-Cortez-Chiara soils occur at lower elevations of 4,800 to 5,200 feet on alluvial fan remnant landforms (USDA Natural Resources Conservation Service 2009). Thus, though there is no significant overall difference in elevation between sites with and without features (elevation is one of the variables found above to not be significantly related to feature presence or absence), there may be a slightly more complex relationship between feature presence or absence and site landform. Specifically, it appears that, within the LBB area, features occur in greater than expected frequencies at sites located in hilly settings and in lower than expected frequencies at sites located on alluvial fan remnants. Within the study area for this document, excavated sites on Chen-Pie Creek-Ramires soils (where features are overrepresented with respect to all sites in the analysis sample) occur to the north, along Boulder Creek and in the hills to the west of it, whereas excavated sites on Cherry Spring-Cortez-Chiara soils (where features are underrepresented) occur in the central portion of the study area in the heart of the LBB proper (see Figure A4 through Figure A6 in Appendix A).

Surface debitage count, as noted, exhibits a significant bivariate relationship with the presence or absence of features, but this relationship becomes insignificant in the multivariate context. Thus, as was suggested above, this indicates that it is likely that the size of the area investigated is the causative factor underlying the relationship observed between debitage assemblage size and the presence or absence of features. The implication of this is that the abundance of chipped stone artifacts on the surface of a site is apparently not a useful indicator of whether features are present.

And finally, though the presence or absence of ceramics is not significantly associated with the presence or absence of features in a multivariate context—perhaps because ceramics are not present at sites of all time periods in the LBB area—there is a striking association when features and ceramics are considered on their own. As is shown in Figure 20, every single analysis unit for which ceramics are reported also contains archaeological features. Thus, it seems almost certain that, if ceramics are found at a site or site locus, features are also there waiting to be discovered. However, there are also many analysis units without ceramics that do have features, so the absence of ceramics cannot be taken as an indication that features will not be present. Indeed, for occupations that date prior to the Eagle Rock phase, the period to which ceramic use appears to have been limited in the LBB area (though see the discussion below in Section 7.4.2), there is no reason to expect an association between ceramics and features.

In sum, ground stone artifacts and ceramics appear to be reasonably useful predictors of the occurrence of archaeological features at sites in the LBB area. All else being equal, the discovery of these kinds of artifacts on the surface of a site would indicate a better than random chance that features are present. Site loci located in certain kinds of settings, particularly in upland locations, also appear to have a greater than random chance of containing features. In turn, to the extent that the presence of features increases our ability to distinguish single-component from multicomponent deposits, landform (or at least soil type) and the presence of ground stone or ceramic artifacts should be given some consideration in evaluating the research potential of sites in the area.

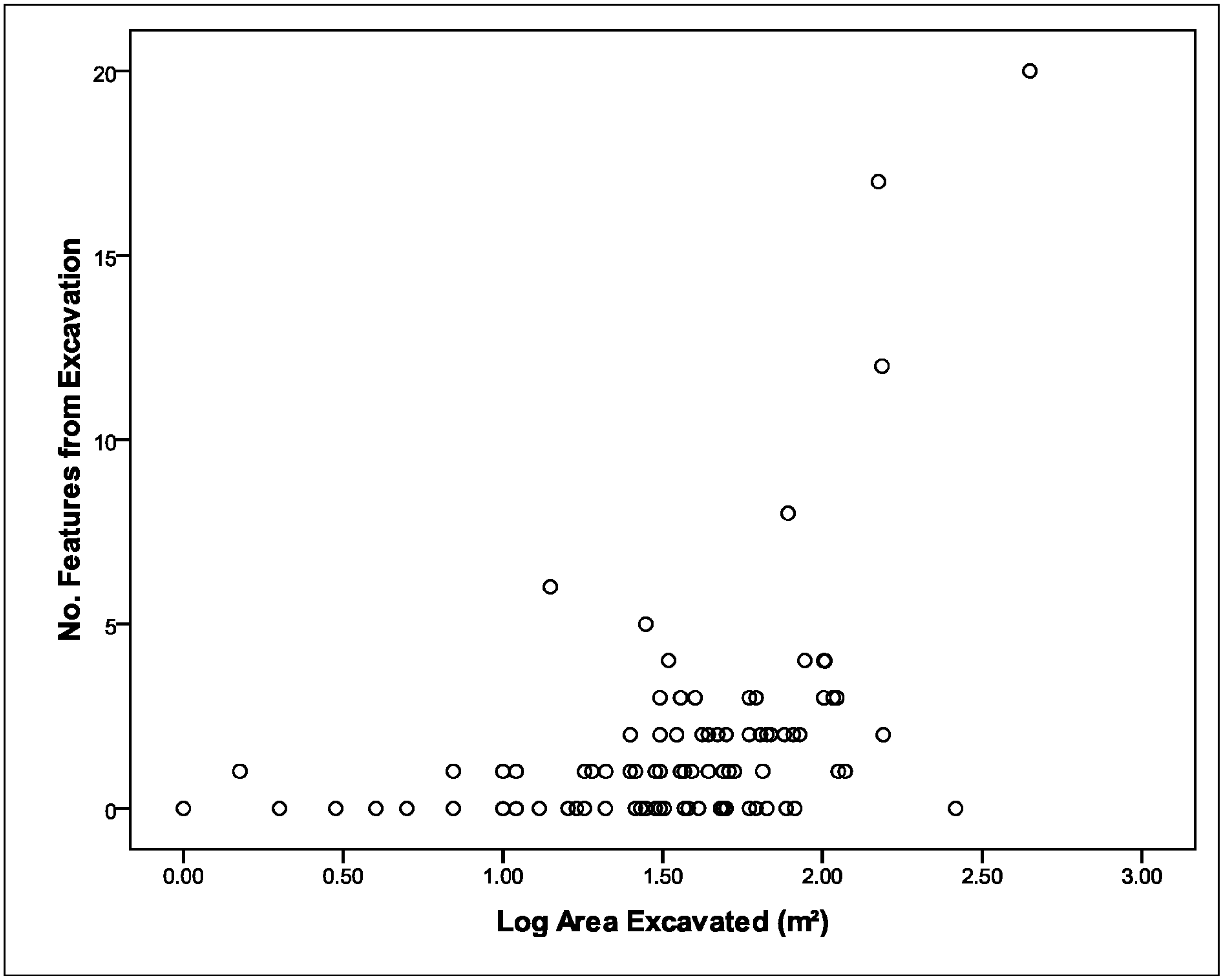

Figure 17. Relationship between number of features from excavation and area excavated for analysis units.

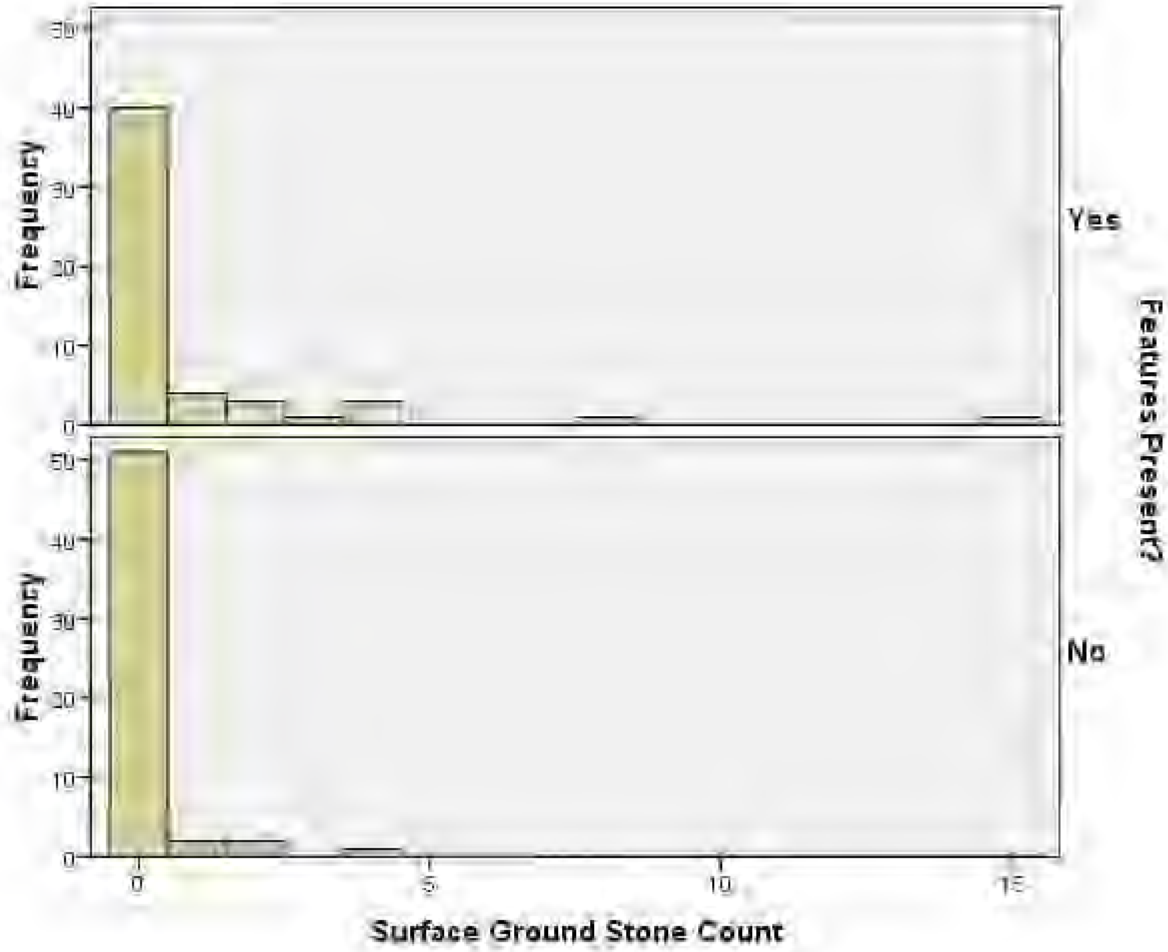

Figure 18. Distributions of surface ground stone artifact counts for analysis units with and without features.

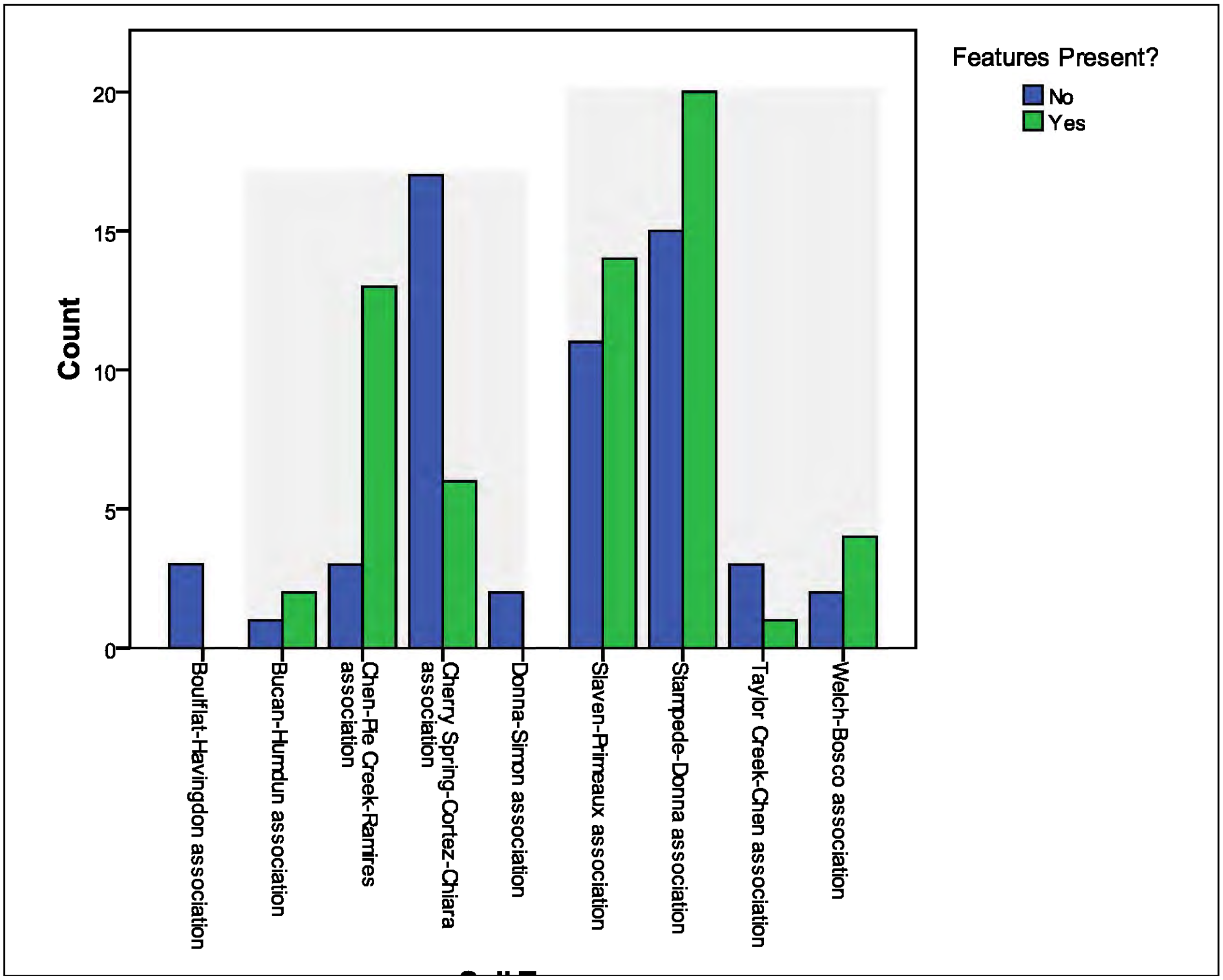

Figure 19. Number of analysis units with and without features, grouped by soil type.

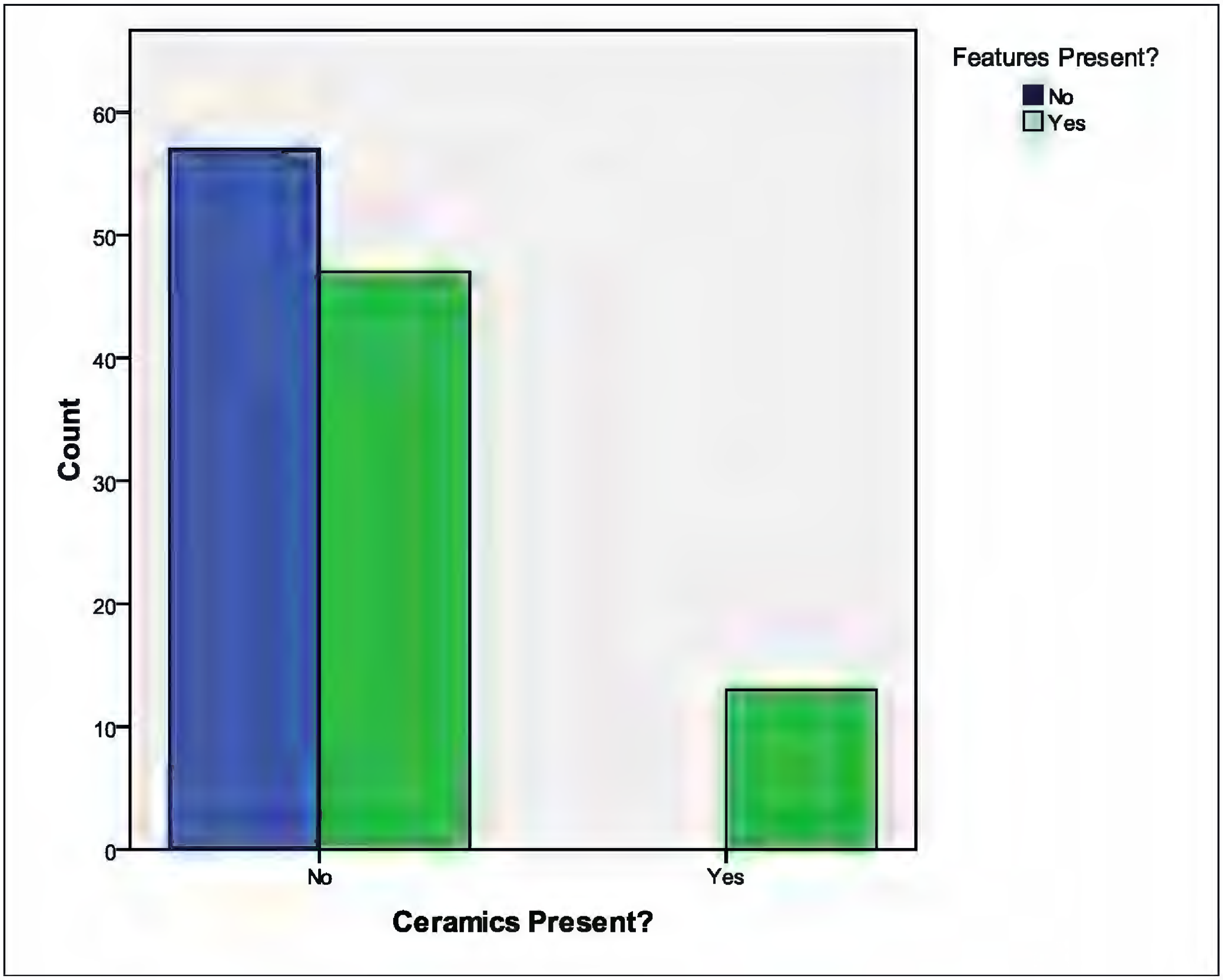

Figure 20. Number of analysis units with and without features, grouped according to whether ceramics are present.

5.7. Conclusions and Directions for Future Research

The analyses of chronological data presented in this chapter lead both to substantive conclusions about the occupational history of the LBB area and to methodological conclusions regarding the study of issues related to chronology. These conclusions, in turn, point to areas in which future research would be most productively directed.

The distribution of radiocarbon dates from the study area suggests that sustained human occupation began around 1200 B.C. and continued without major interruption through the period of Euroamerican settlement. Projectile points provide evidence for at least sporadic use of the area prior to 1200 B.C. The lack of radiocarbon dates from before this time, and the more general paucity of evidence for substantial occupation during the Middle Archaic and earlier periods, may be due to insufficient preservation of earlier materials and/or insufficient archaeological identification efforts, issues that are considered in the next chapter. At face value, however, the available data suggest that humans used the area only lightly until well into the late Holocene.

The largest number of radiocarbon dates from the study area fall after A.D. 1300—i.e., in the Eagle Rock phase—suggesting that human population density and/or the length of seasonal occupations was greater during this phase than during earlier periods. On the other hand, Eagle Rock phase projectile points are far outnumbered by earlier point types, suggesting that occupational intensity may have been higher during the Maggie Creek phase, in particular, than during the Eagle Rock phase. This apparent contradiction between the radiocarbon and projectile point records may indicate that the way in which people used the LBB changed substantially at around A.D. 1300, an issue that is explored further below in Chapter 7. For purposes of understanding the area's occupational history, the important point is that it remains unclear whether human use of the area was more intensive during the Maggie Creek phase or during the Eagle Rock phase.

Based on the synthesis of available chronological data conducted in this chapter, and in light of recent work conducted at Pie Creek Shelter, a slightly revised phase sequence for the area is presented here. The main revisions to the previously used phase sequence are a change in the beginning date of the South Fork phase from 4600 B.C. to 2600 B.C. and the addition of the Pie Creek phase immediately before the South Fork phase. Revisions to the projectile point chronology and the obsidian hydration chronology that have previously been used in the area are also suggested. In particular, it is noted that existing obsidian hydration data from the region do not provide a clear basis for discriminating among the individual phases of the Middle Archaic period.

It has been well established that multicomponent deposits are very common in the LBB, and much previous work has focused on attempting to more successfully limit excavation efforts to single-component deposits, which enable change over time to be examined. Employing an explicit and consistent set of criteria for identifying assemblages as single-component, only a small proportion of the previously excavated assemblages from the study area—no more than about a quarter—can be identified as such. On the other hand, slightly more than 40 percent of previously excavated assemblages can be definitively identified as multicomponent, while about a third lack sufficient dating information to determine whether they are single-component or multicomponent. Moreover, it appears that the "typical" site or site locus in the LBB area will have evidence for occupation during about two phases, and values much higher than this are not uncommon. Of those assemblages from the study area that can be identified as single-component, by far the largest number date to the Eagle Rock phase. Very few date to the Maggie Creek phase, and no assemblages can be identified as single-component and dating to any of the James Creek, South Fork, or Pie Creek phases individually, though some can be identified as "single-component" Middle Archaic assemblages.

A major reason why many previously excavated LBB sites and site loci cannot be identified as single-component is that they lack sufficient dating information for evaluating their occupational history. In light of this, it is obvious that the very first goal of any future excavation project should be to recover as many radiocarbon samples, diagnostic artifacts, and/or obsidian specimens for hydration analysis as possible. Sites that clearly lack sufficient dating evidence should accordingly be considered to be of low research value since it will likely not be possible to identify them as single-component.

An analysis of potential predictor variables shows that there are no clear-cut ways to determine whether a site or site locus is single-component prior to excavation based either on environmental variables or on characteristics of surface archaeological assemblages. However, the number of archaeological features found at a site or site locus does appear to substantially improve the ability to identify deposits as single-component, likely because features typically provide abundant dating information in the form of radiocarbon dates and associated artifacts. The most productive approach to identifying single-component deposits may therefore be simply to focus on locating archaeological features, and there fortunately are some variables that do seem to be able to predict whether a site or site locus will contain archaeological features. In particular, ground stone artifacts and ceramics appear to be indicative of the presence of features with better than random chances. Sites and site loci located in certain kinds of settings, particularly in hilly areas where soils of the Chen-Pie Creek-Ramires association are present, also appear to have a greater than random chance of containing features. Thus, setting (or soil type) and the presence of ground stone or ceramic artifacts should be given some consideration in evaluating the research potential of sites in the area. Contrary to previous assertions, sites or site loci with larger artifact assemblages are demonstrably *not* more likely to be multicomponent than those with smaller assemblages.

Given these conclusions derived from the analyses presented in this chapter, several needs for future research can be specified. These needs are outlined here, and their implications for evaluating the NRHP-eligibility of archaeological sites in the study area are discussed in Chapter 10.

- Radiocarbon dates: As alluded to in the section on the LBB area radiocarbon record, in one case from the area, radiocarbon dates were obtained on both charcoal and animal bone samples found in association with the same archaeological feature, and the charcoal dates returned were several centuries older than the bone dates (which were accelerator mass spectrometer dates taken on bone collagen) (Cannon et al. 2008). The most likely explanation for this was that the charcoal dates were erroneously old due to "old wood" effects (e.g., Smiley 1994, 1998). For this reason, to the extent that it is possible to do so in the future, radiocarbon dates should be obtained from animal bones or, even better, seeds or annual plant remains. This, of course, raises the research potential of sites with floral or faunal remains that are associated with human occupations beyond the potential that those sites have for improving our understanding of subsistence (covered in Chapter 7). If seeds, annual plant remains, or animal bones are not available from a feature, then it is advisable to submit multiple, separate charcoal samples for dating so that the consistency of dates from that feature, at least, can be evaluated.
- Projectile point typology: As was noted above in the section on projectile point chronology, the typological methods that have been used in the LBB area for classifying projectile points to type have frequently been opaque, and reclassification of points from previous projects was beyond the scope of what could be done for this document. As a result of this, the identifications of individual points from individual sites must remain somewhat uncertain, as must any chronological inferences derived therefrom. For the future, a valuable contribution could be made by reclassifying the by now very large projectile point assemblage from the LBB area using a consistent and well-reasoned typological system in order to reevaluate the chronological conclusions that have been made about specific sites and, more important, to explore temporal and functional relationships among point types more thoroughly than has been done to date.
- Obsidian hydration analysis: In order to further refine the Paradise Valley obsidian hydration chronology for the LBB area, currently based on a sample of only 25 projectile points, hydration analysis of additional projectile points is necessary. In fact, it would be worthwhile to conduct sourcing and hydration analysis on all obsidian projectile points from the area that are identifiable to type, including those from existing collections that have not yet been analyzed, as well as any that are found during future work in the area. Hydration analysis of the as-of-yet unanalyzed Paradise Valley obsidian specimens from James Creek Shelter would likely also help refine the regional hydration chronology.
- Ceramic dating: Ceramics from the LBB area are only loosely associated with the Eagle Rock phase based primarily on typological grounds, as has been discussed in this chapter and is also discussed in Chapter 7. Further evaluation of the age of pottery from the area—through thermoluminescence dating, in particular, or perhaps also radiocarbon dating of organic residues found on vessels—would improve the utility of ceramics as chronological indicators and would also advance our understanding of the use of pottery in the region. Such dating analysis could be

done using ceramics included in existing museum collections from the LBB area and/or any ceramics found in future archaeological fieldwork. Direct dating of ceramics would be particularly useful at sites where there are indications of Maggie Creek phase occupation in order to evaluate whether pottery contemporaneous with Fremont occupations occurs in the area (see Hockett and Morgenstein 2003).

- Identifying additional single-component sites or site loci: There is uneven coverage of time periods in the available sample of single-component sites or site loci from the LBB area. A reasonably large sample of excavated single-component Eagle Rock phase assemblages exists from the area, but earlier periods are very underrepresented, limiting our ability to explore change over time. There is thus a clear need for the identification and excavation of additional single-component deposits that date to the Maggie Creek and earlier phases in future work. Conversely, it would appear that a sufficient number of multicomponent sites have already been excavated and that anything that can be learned from such sites can be learned from those already excavated. Likewise, it may be the case that a sufficient number of single-component Eagle Rock phase assemblages have been recovered, and that excavation of additional single-component Eagle Rock phase sites or site loci is warranted only when they appear to be able to provide unique information not already available from existing assemblages. To identify those pre–Eagle Rock phase single-component deposits that will likely best advance our understanding of the prehistory of the LBB area, efforts should focus on locating deposits that appear likely to be able to provide abundant dating information so that their occupational history can be adequately evaluated. Deposits with sparse artifact assemblages and deposits that lack subsurface archaeological features are unlikely to be able to provide such information. The presence of ground stone artifacts and occurrence on soils of the Chen-Pie Creek-Ramires association appear to be useful indicators of whether features are present at pre–Eagle Rock phase sites and site loci.

6. SITE FORMATION PROCESSES AND PALEOENVIRONMENT

Michael D. Cannon

The recommendations discussed in the previous chapter for future research priorities within the realm of chronology include the need for identifying additional single-component deposits, particularly those that date prior to the Eagle Rock phase. Addressing this need requires not only a consideration of matters of archaeological chronology, explored in the previous chapter, but also a consideration of site formation processes and geoarchaeological data, which are examined in this chapter. To the extent that multicomponent assemblages are a product of depositional and erosional processes, understanding such processes in the LBB area may help to identify the kinds of locations, if any, where single-component deposits are most likely to occur. In addition, it may be that pre–Eagle Rock phase deposits, and especially middle Holocene and earlier deposits, occur in some relatively deeply buried contexts in the LBB area, and an understanding of depositional and erosional processes in the area may again help identify the kinds of locations, if any, where such deposits might exist.

The few geoarchaeological studies that have previously been conducted in the LBB area are discussed here in order to draw such conclusions as can be made about the likelihood that additional single-component deposits and/or early archaeological materials remain to be discovered. Because the limited paleoenvironmental data that have been collected from the LBB area come from those same geoarchaeological studies, issues of paleoenvironment are likewise discussed here as part of the evaluation of previous geoarchaological research. Turning from natural to cultural site formation processes, the question of whether artifact collecting has biased surface archaeological assemblages is also addressed in this chapter.

The chapter concludes with recommendations for future research into issues of site formation processes and paleoenvironment. Because such research will likely mainly involve work conducted at locations other than previously identified archaeological sites, these recommendations may be of only limited relevance to archaeological mitigation work conducted within the context of compliance with Section 106 of the NHPA. They are certainly relevant, however, to a more general understanding of the prehistory of the area.

6.1. Previous Geoarchaeological and Paleoenvironmental Research in the Little Boulder Basin Area

The earliest reported geoarchaeological study of archaeological sites in the LBB study area was conducted by Hobey and Eckerle (1993). This study involved investigations that were directed at understanding site formation processes at sites 26EK004687, 26EK004690, 26EK004695, 26EU001483, and 26EU001531. At each of these sites, it was concluded that Holocene sediments were relatively shallow, extending to depths ranging from 15 to 50 cm, and it was suggested that there was limited potential for archaeological materials to be buried at depths greater than this. It should be pointed out, however, that all of the investigated sites were located along the upper reaches of Bell and Brush creeks in somewhat similar geomorphic settings, and the conclusions derived from them may not necessarily be applicable to all types of settings within the LBB area.

A different type of setting was subsequently investigated by LaFond and Jones (1995), who described and interpreted the stratigraphy of Site 26EU001997, located along the floodplain of Rodeo Creek near its confluence with Bell Creek. Most notable among the conclusions of these authors is their suggestion that a stratigraphic unconformity is present within the uppermost sediments at this site, indicating a hiatus in deposition. If correct, this would have important implications for the occurrence of single-component deposits in the LBB since it would suggest that it might be possible to find stratigraphically separated late Holocene occupations, at least in floodplain settings. However, based on later work conducted at 26EU002126, also located on the floodplain of Rodeo Creek just upstream from 26EU001997, it appears that the feature that LaFond and Jones (1995) interpreted to be an unconformity is actually a result of post-depositional pedogenic processes rather than a depositional hiatus (Cannon et al. 2008:176–178). Thus, there may be little reason to expect stratigraphically discrete, single-component occupations in floodplain settings in the LBB, at least without excavating considerably deeper than has been done in previous projects.

A need for excavating deeper in such settings is suggested by Birnie's (1996a) investigation of alluvial stratigraphy in the LBB, in which he identified Mazama tephra along Rodeo Creek approximately from its confluence with Brush Creek to its confluence with Bell Creek. This tephra, a distinct stratigraphic marker that is present across much of the Great Basin and that dates to about 6800 ^{14}C yrs B.P., lies at a depth of approximately 4.5 m below modern ground surface at the eastern end of its exposure along Rodeo Creek but becomes progressively shallower until it pinches out at the surface at the western end of its exposure (Birnie 1996a:A-4). The Mazama tephra along Rodeo Creek is underlain by alluvial sediments (Birnie 1996a:A-7–A-8), raising the possibility that early Holocene or perhaps even terminal Pleistocene archaeological materials might be present in buried context here. Moreover, the post-Mazama deposits along Rodeo Creek could contain middle Holocene or pre–Eagle Rock late Holocene materials. To date, however, a systematic search for deeply buried archaeological materials along Rodeo Creek has not been conducted. Bell and Brush creeks also have somewhat wide floodplains along their lower reaches (Birnie 1996a:A-10); Mazama tephra has not been identified along these creeks, but there is some chance nonetheless that these floodplain deposits could contain buried, early materials.

More to the point of Birnie's analysis, which was primarily paleoenvironmental in focus, he suggests that the Mazama tephra along Rodeo Creek was deposited during a period in which the creek was aggrading. A paleosol at the top of these aggradational deposits indicates a period of stability, which Birnie (1996a:A-17) proposes may have taken place around the time of the middle Holocene to late Holocene transition as conditions were becoming cooler and moister. Birnie suggests that this period of stability was followed by further aggradation and finally by the incision, likely during the historic period (Birnie 1996a:A-2), of the modern channel of Rodeo Creek. Birnie concludes his analysis with a general discussion of past environments in the northern Great Basin (also see discussion in Chapter 2 of this document), which draws very little on data from the LBB area itself because, as Birnie (1996a:A-20) notes, no paleoenvironmental information other than that provided by his own stratigraphic study has been collected from the area. He does propose based on his stratigraphic evidence that groundwater levels and in-stream flows were likely reduced during the early Holocene and especially during the middle Holocene relative to the late Pleistocene. He also suggests that the middle Holocene period of aggradation that is evident along Rodeo Creek was the result of erosion upstream in combination with diminished stream competence due to reduced precipitation (Birnie 1996a:A-21). Finally, Birnie notes that LBB alluvial stratigraphic records are consistent with generally more mesic, though somewhat fluctuating, climatic conditions during the late Holocene.

6.2. Geoarchaeology and the "Multicomponent Problem"

The geoarchaeological work that has been conducted in the LBB study area has some implications for our understanding of the "multicomponent problem", as noted above. These implications are discussed further here, taking into account both the stratigraphic observations summarized above and the geophysical remote sensing work that was the focus of a recent excavation project in the LBB.

6.2.1. Depositional and Erosional Processes

A common theme that is evident throughout virtually every report on archaeological excavations in the LBB area is that artifacts and features tend to occur very close to the surface, usually within the uppermost 20 cm or so. As mentioned above, some studies have explicitly concluded that there is little likelihood of encountering archaeological materials below such depths (e.g., Hobey and Eckerle 1993), though floodplains may provide an exception to this. The cause of this is likely very low rates of deposition during the last few thousand years, the period to which most known archaeological materials from the LBB date. Moreover, within the upper sediments in which artifacts and features tend to occur, there is generally a complete lack of obvious stratigraphic distinctions, much less clear unconformities or depositional hiatuses. The low rates of deposition and absence of definable strata combine to result in a situation in which it is not possible to distinguish vertically discrete assemblages. Thus, if we have learned anything about geomorphological site formation processes in the LBB area, it is that palimpsest deposits, in which material of different ages is spatially co-mingled on or near the surface, are likely to be the rule rather than the exception, a situation that is certainly not unique within the Great Basin (Beck 1994). Again excluding from consideration floodplains, where some stratigraphic separation might occur, single-component assemblages are likely to be present within the LBB area only where occupations of different ages were horizontally separated, and based on the number of multicomponent assemblages from the area, repeated re-use of locations was evidently quite common.

Given this, there are geoarchaeologically based reasons to think that archaeological sites located in most kinds of settings in the LBB area—i.e., all settings but floodplains—are more often than not going to produce multicomponent assemblages. Conversely, any site that does appear to contain stratigraphically distinct occupations should be considered to be a very important research resource. Because over 50 sites have been excavated in the LBB area without the identification of stratigraphically distinct occupations, it is perhaps reasonable at this point to conclude that sites with them are unlikely to exist in the area at all. However, because little to no deep archaeological excavation has been conducted at sites in floodplains—perhaps the only type of setting within the area where it is reasonable to think that stratigraphically distinct occupations might still be found—some additional work devoted to deeper testing of floodplain deposits would not be unwarranted.

6.2.2. Geophysical Remote Sensing

The most recent large-scale excavation project conducted in the LBB area (Cannon et al. 2008) made extensive use of geophysical remote sensing methods. These methods were employed in hopes that they might enable archaeological features and associated datable materials to be found efficiently so that site loci could be quickly screened to evaluate whether they appeared to be single-component before more extensive excavation efforts were initiated. The goal was to develop a methodology that would reduce the overall expense of archaeological fieldwork, while also increasing the research productivity of that fieldwork by reducing the amount of effort expended on multicomponent deposits. A secondary goal was to evaluate the effectiveness of remote sensing methods at locating archaeological features at LBB sites.

In this project, magnetometry and sediment conductivity surveys were conducted across sites 26EU001533, 26EU001539, 26EU001548, 26EU002064, and 26EU002126. Areas for manual excavation were then selected based in large part on the remote sensing survey results, and the sites were finally mechanically stripped in order to locate any archaeological features not found in manual excavation. The project turned out not to provide a useful test case for evaluating the effectiveness of the geophysical methods that were used because, as excavation and manual stripping revealed, archaeological features proved to be absent from four of the five sites investigated. However, the project did provide some very useful insights regarding the use of remote sensing in future archaeological research in the area.

For one, the project led to recommendations about how remote sensing survey methods might be optimized for the LBB area, taking into account the nature of the archaeological target features and the size of archaeological sites in the area, in order to improve survey efficiency (Cannon and Walker 2008). More important for present purposes is that numerous anomalies that appeared to indicate small thermal features were observed in the remote sensing data, but thermal features turned out to be absent at nearly all anomaly locations. Thus, false positives—or remote sensing anomalies that appear to reflect archaeological features but instead are more likely caused by geological phenomena—are clearly an obstacle to the use of remote sensing methods for archaeological purposes in the LBB area. Some efforts were made during the project to identify a geological cause for the false positives with equivocal success (Cannon and Walker 2008), and the recommendation was made that more systematic geoarchaeological research devoted to finding the cause (or causes) be undertaken in conjunction with any future archaeological remote sensing work that may occur (Cannon et al. 2008:304–307). Remote sensing methods may yet prove to be useful for locating subsurface archaeological features in the LBB area, and, in turn, for helping to identify single-component deposits. However, additional background work remains to be conducted before this promise can be achieved.

6.3. Early Archaeological Deposits

As discussed in Chapter 3, it has frequently been speculated that the limited amount of Middle Archaic archaeological material in the LBB area, and the almost complete lack of earlier material, may be a result of depositional and preservational factors. Specifically, it has been suggested that such material may be present but simply deeply buried. Birnie's (1996a) identification of Mazama tephra along Rodeo Creek does seriously raise the possibility that Middle Archaic and earlier material may be buried here. Birnie (1996a:A-18–A-19) himself suggests that late Pleistocene and early Holocene deposits are likely not present along the portion of Rodeo Creek that he studied, but this conclusion seems highly incongruent with his description of the presence of a least a meter's worth of alluvial sediments stratigraphically below the Mazama tephra that is exposed here (Birnie 1996a:A-7–A-8). At any rate, the fact remains that floodplain sediments, perhaps the only place where very early archaeological materials might be preserved in buried context in the LBB area, have yet to be systematically tested for the presence of such materials.

In light of this, and considering the extensive amount of excavation that has occurred throughout the LBB area, deep testing of floodplain deposits represents perhaps the "last frontier" of LBB archaeological research. Recommendations for how such testing might best be incorporated into archaeological investigations in the area are made at the end of this chapter and are elaborated upon in Chapter 10.

6.4. Artifact Collecting and Surface Assemblages

A final issue within the realm of site formation processes that deserves exploration is that of whether surface artifact assemblages from the LBB area are biased due to illegal artifact collecting. This question was raised in the 1991 historic context for the LBB and has been addressed a few times since (e.g., Cannon et al. 2008:296–299). Here, the question is evaluated using the comprehensive database compiled for this document. The ratio of projectile points to debitage is examined on the assumption that projectile points should be among the main targets of artifact collectors, whereas debitage should be of little interest to them. If this assumption is correct, and if artifact collecting has been extensive throughout the study area, then surface assemblages should exhibit lower proportions of projectile points relative to debitage than subsurface assemblages.

Of the excavated sites in the analysis sample for this document, there are 42 for which projectile point and debitage specimens are reported in a manner that allows distinguishing between those that come from surface contexts and those that come from subsurface contexts. Projectile point and debitage counts for these sites are provided in Table 20, along with ratios of projectile points to debitage for both surface and subsurface contexts. The counts for subsurface contexts include only artifacts from the main excavation areas at sites; artifacts recovered from manual stripping or from miscellaneous test units are excluded.

It can be seen in Figure 21 that projectile point to debitage ratios are not higher for subsurface assemblages than for surface assemblages. In fact, the mean projectile point to debitage ratio for the surface assemblages is much greater than that for the subsurface assemblages—about 0.035 and 0.003, respectively—and this difference is highly statistically significant (Mann-Whitney $U = 474.0$, $p < 0.001$). There thus appears to be no evidence that artifact collecting has been extensive enough throughout the LBB area to have substantially affected the content of surface archaeological assemblages.

Of course, it is possible that assemblages from surface and subsurface contexts might differ for reasons related to archaeological recovery methods, and that this might confound efforts to identify the effects of illegal artifact collecting. In particular, it seems intuitive that surface collection during professional archaeological fieldwork might result in a bias toward larger, more visible flakes and that this bias would not affect excavated assemblages recovered through screening. Such a bias against smaller flakes from surface contexts, which would result in smaller overall surface debitage samples, might be the cause of the higher ratios of points to debitage observed here for surface assemblages. However, in the one case in which this issue has been explored empirically using data from the LBB area, such a bias does not seem to be present (Cannon et al. 2008:298–299). In fact, in this case study, smaller debitage specimens actually comprised a higher percentage of the surface-collected debitage assemblages than the excavated debitage assemblages, indicating that it is unlikely that recovery methods were responsible for the difference between surface and subsurface assemblages in the ratio of points to debitage.

To be sure, some artifact collecting likely has occurred at some LBB area sites, as is evidenced by "collector's piles" that are occasionally observed (e.g., Cannon et al. 2008:42), as well as by some instances in which tools reported during initial site recording were not found during later work. Altogether, though, while some illegal artifact collecting may well have occurred in the LBB area, as it does in most places, the analysis presented here suggests that any such collecting does not appear to have *systematically* reduced the abundance in surface assemblages of projectile points—certainly the most attractive type of artifact to collectors—relative to other artifact classes.

Table 20. Projectile Point and Debitage Counts by Context for Adequately Reported Sites in the Analysis Sample

	Surface			**Subsurface**		
Site	**Projectile Points**	**Debitage**	**Ratio**	**Projectile Points**	**Debitage**	**Ratio**
26EK004687	18	12,319	0.00146	40	55,510	0.00072
26EK004690	4	4,119	0.00097	9	23,290	0.00039
26EK004695	4	13	0.30769	2	2,632	0.00076
26EK004696	3	187	0.01604	5	3,358	0.00149
26EK004749	8	827	0.00967	35	7,634	0.00458
26EK004755	0	1,373	0.00000	16	21,068	0.00076
26EK005200	4	217	0.01843	1	513	0.00195
26EK005270	0	2,442	0.00000	12	22,573	0.00053
26EK005271	14	2,100	0.00667	5	1,685	0.00297
26EK005274	2	430	0.00465	2	1,392	0.00144

Table 20. Projectile Point and Debitage Counts by Context for Adequately Reported Sites in the Analysis Sample

	Surface			Subsurface		
Site	Projectile Points	Debitage	Ratio	Projectile Points	Debitage	Ratio
26EK005278	0	44	0.00000	0	6,461	0.00000
26EK005374	1	531	0.00188	0	1,226	0.00000
26EK006231	4	2,690	0.00149	11	12,562	0.00088
26EK006232	2	793	0.00252	3	11,208	0.00027
26EK006487	16	40	0.40000	26	21,532	0.00121
26EU001319	3	270	0.01111	3	343	0.00875
26EU001482	6	4,439	0.00135	8	37,211	0.00021
26EU001483	14	2,551	0.00549	12	24,376	0.00049
26EU001487	8	623	0.01284	48	74,705	0.00064
26EU001492	32	509	0.06287	60	8,857	0.00677
26EU001520	0	1	0.00000	1	68	0.01471
26EU001522	5	175	0.02857	1	1,783	0.00056
26EU001524	1	153	0.00654	0	1,234	0.00000
26EU001529	15	5,641	0.00266	76	65,675	0.00116
26EU001530	8	2,092	0.00382	7	20,313	0.00034
26EU001531	1	143	0.00699	23	21,621	0.00106
26EU001533	1	135	0.00741	0	54	0.00000
26EU001534	23	5,690	0.00404	11	68,557	0.00016
26EU001539	1	3,266	0.00031	0	1,257	0.00000
26EU001548	0	618	0.00000	0	211	0.00000
26EU001667	4	3,217	0.00124	19	38,828	0.00049
26EU001734	12	1,108	0.01083	5	23,866	0.00021
26EU001851	1	328	0.00305	0	201	0.00000
26EU001904	0	272	0.00000	5	4,027	0.00124
26EU001906	3	491	0.00611	1	4,414	0.00023
26EU002064	4	1,325	0.00302	0	438	0.00000
26EU002079	1	50	0.02000	1	16	0.06250
26EU002126	0	123	0.00000	5	6,574	0.00076
26EU002181	0	2	0.00000	2	1,172	0.00171
26EU002182	6	278	0.02158	8	10,637	0.00075
26EU002183	12	26	0.46154	4	1,196	0.00334
26EU002184	10	600	0.01667	11	13,132	0.00084

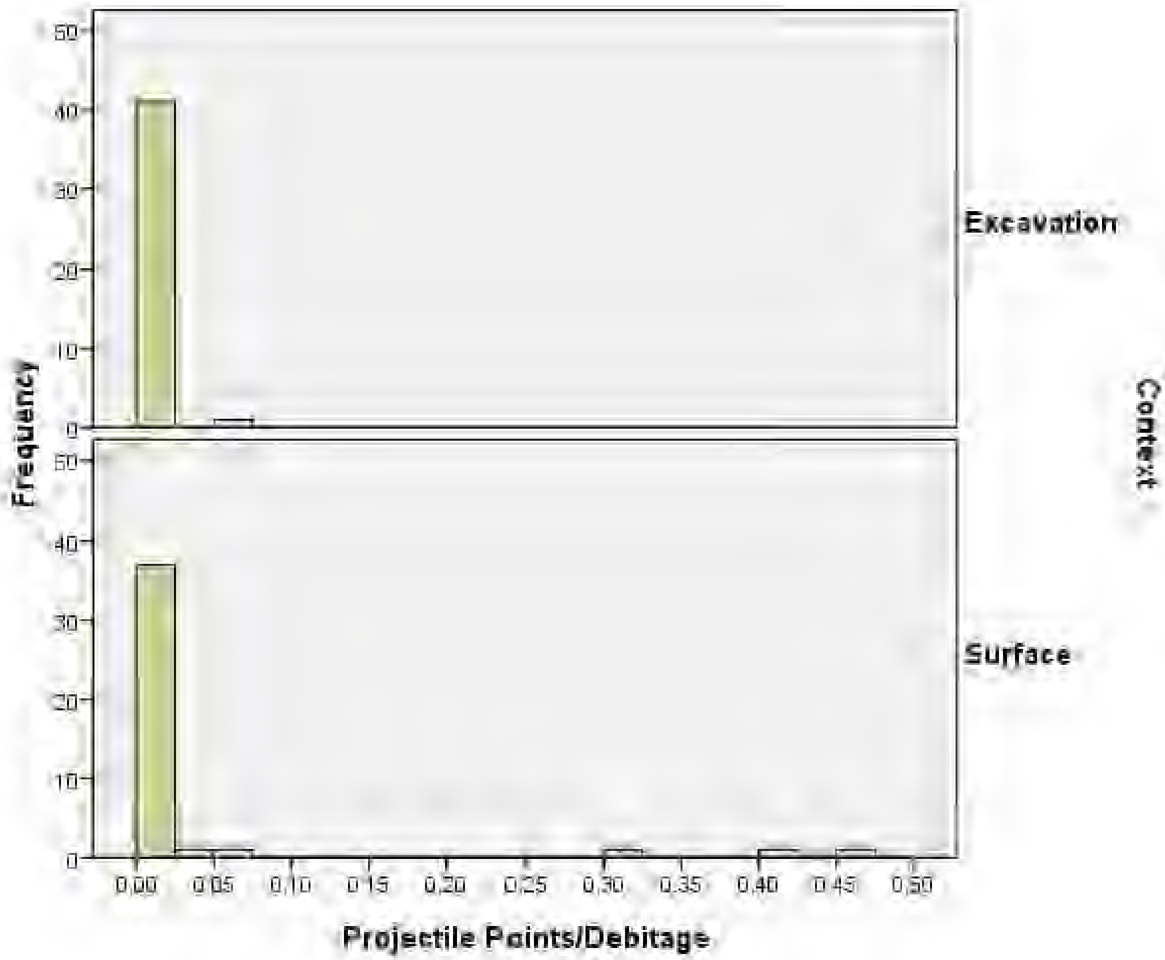

Figure 21. Distribution of projectile point to debitage ratios for surface and subsurface assemblages from the study area.

6.5. Recommendations for Future Research

It should be clear from this brief chapter that only very limited research into site formation processes and paleoenvironment has yet been conducted in the LBB area. The work that has been performed, primarily geoarchaeological in nature, does seem to show that, in most geomorphological settings, archaeological deposits are likely to be shallow and to lack stratigraphic distinctions, a fact that likely goes a long way towards explaining the prevalence of multicomponent archaeological assemblages in the area. Beyond this, additional work remains to be done 1) to collect paleoenvironmental data specific to the LBB and immediately surrounding area, 2) to make geophysical remote sensing methods more useful for application to archaeological research in the area, and 3) to investigate whether early archaeological materials and/or stratified archaeological deposits are preserved in deeply buried contexts in floodplain settings.

Perhaps the main reason why such limited work has yet been conducted in each of these areas is that the necessary efforts fall outside of the scope of what is typically required for cultural resource compliance purposes, whereas most of the archaeological research that has occurred in the area to date has taken place in a compliance context. It may perhaps always be the case that such research topics are best addressed through more academically oriented research. However, as is discussed in greater detail in Chapter 10, it might occasionally be appropriate to conduct "non-site" work to mitigate impacts to cultural resources, and such work could well include geoarchaeological or paleoenvironmental research. Regardless of whether it is conducted in an academic or a compliance context, though, the following are specific ways in which our understanding of site formation processes and past environments in the LBB can best be advanced.

- Paleoenvironmental research. Because virtually no paleoenvironmental data have been collected from the LBB area, almost any such data that are collected during the foreseeable future would advance our understanding of past environments in the area. Sources of paleoenvironmental data that have proven useful in other Great Basin contexts, and that may be available in the LBB or the immediately surrounding area, include packrat middens, spring or other wetland sediments (which can provide charcoal and pollen samples), and paleontological animal bone assemblages. The results of any paleoenvironmental studies that can be conducted in the area should be compared to those of studies conducted in nearby parts of the Great Basin (e.g., Louderback and Rhode 2009) to determine whether the past environments of the LBB area had unique characteristics that might help us better understand the human prehistory of this area.
- Geophysical remote sensing. As discussed elsewhere (Cannon et al. 2008), additional steps must be taken before geophysical data can truly be of use in archaeological research and cultural resource management in the area. In particular, a robust test case involving a site or sites where archaeological features are known to be present or are likely to be present should be conducted to evaluate what geophysical signature, if any, archaeological features of various types have in the area. Such a test case would ideally involve a site or sites with as many as possible of the following characteristics: 1) archaeological features or direct indications of features such as fire-cracked rock are known to be present, 2) artifacts often associated with archaeological features, particularly ceramics and ground stone, are present, and 3) surface sediments are such that they will result in minimal background noise and "false positives" (particularly, they consist of relatively deep deposits of sands or finer sediments, because sites with bedrock at or near the surface and sites in rocky alluvial terrace settings are known to be problematic). And, building on previous research in the area (Cannon et al. 2008), remote sensing anomalies observed in test cases should continue to be "ground truthed" through excavation. As an alternative to such test cases, experimental replication of archaeological features and burial in sediments of the sort found in the area might suffice for this purpose. Research along these lines should also involve further experimentation with survey parameters such as instrument height and orientation. Finally, geoarchaeological research should be conducted in direct connection with geophysical surveys to determine what geological factors are responsible for the most obvious patterns that occur in remote sensing data from the area, so that occurrences of "false positives" can be reduced or eliminated.
- Deep testing in floodplains. Deep testing, likely through backhoe trenching or coring, should be conducted in a systematic manner at least along the floodplain of Rodeo Creek between Brush and Bell creeks, the one area that appears to have the greatest potential for containing middle Holocene or ealier buried archaeological material, as well as the greatest potential for containing stratified archaeological deposits of any age. It may also be useful to conduct such deep testing in other floodplain areas in and around the LBB. Given the extensive excavation that has occurred throughout the area, a sufficient amount of deep testing in floodplain settings should once and for

all resolve the questions of whether early archaeological materials are present in buried contexts and whether stratified, single-component occupations are likely to be present.

- Site formation processes at shallow sites. Given that virtually all known archaeological deposits in the LBB area are very shallow, it would be worthwhile exploring to what degree such shallow deposits can be or have been affected by modern activities (other than artifact collecting). In particular, drill seeding for range management purposes has occurred at some sites in the area, and though this does not appear to have disturbed their spatial integrity to the point that they could not provide valuable information (Bill Fawcett, personal communication, 2010), detailed studies of exactly how such activities might affect sites in the area would be helpful.

7. SUBSISTENCE

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As was discussed in Chapter 3, the 1991 historic context for the LBB area (Schroedl 1991) consisted of six research domains that defined objectives for future archaeological investigations. Over the next several years after implementation of the 1991 historic context, the domains in that context were used to formulate specific research questions for individual excavation projects, and as more was learned about the archaeological record of the LBB area, research questions were modified to better suit the data that were being collected. This chapter describes the research objectives, and changes over time in those objectives, that have been pursued in LBB area studies of archaeological materials relevant to issues of subsistence, specifically faunal remains, floral remains, ground stone, ceramics, and thermal features. Results of previous studies of each of these classes of material are also summarized, and comprehensive analyses of all data compiled for this document are then undertaken. These comprehensive analyses represent a summary of what is currently known about prehistoric subsistence in the LBB area, and they also provide a basis for developing new research questions for future work.

7.1. Faunal Remains

The collection and analysis of faunal remains from the LBB was an essential aspect of the subsistence research domain as it came to be studied under the 1991 historic context. In order to develop new research questions for future studies of faunal remains, it is necessary to first discuss previous research objectives for this type of archaeological data, as well as the results of previous faunal analyses. A new and comprehensive analysis of faunal data from the LBB area is then conducted in order to address previously posed research questions.

7.1.1. Review of Research Questions

The 1991 historic context focused on human ecology as a framework for research into issues of subsistence, citing as a theoretical foundation evolutionary ecology, cultural evolutionism, and cultural ecology. More specifically, it was proposed that models from foraging theory, in conjunction with the framework provided by Binford's (1980) forager-collector continuum, could be operationalized through a "range site analysis" in order to provide insight into subsistence and settlement patterns (Schroedl 1991:66-72). The methodology proposed for the range site analysis was to use soil classifications to reconstruct what resource types would likely have been present in specific areas, presumably to derive predictions about the nature of human activities in those areas (e.g., Drews et al. 2002; Zeanah 1996, 2004; Zeanah et al. 2004). In subsequent archaeological investigations conducted in the LBB area, a range site analysis was never performed, but a range of more basic questions about prehistoric subsistence have been addressed. Those that have involved faunal remains are summarized here.

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

The 1991 historic context was first applied during data recovery excavations performed at six sites by P-III in 1992 (Schroedl 1995). Excavations that P-III conducted before this time in the LBB area either did not address research questions about subsistence (Schroedl 1994), or did not draw on the 1991 historic context but instead proposed testing models of subsistence and settlement based on Steward (1997) and Binford (1980; Tipps 1988). The one excavation project undertaken even earlier in the LBB area focused on the issue of seasonality in its brief consideration of faunal remains (Rusco 1982b).

For P-III's 1992 excavations, site-specific research objectives were developed, which extended the research domains in the 1991 historic context and included determining the temporal affiliation of the sites, identifying the formation processes responsible for the creation of faunal assemblages, and inferring the role of sites within regional subsistence-settlement systems (Zeanah et al. 1992).

Analysis of faunal remains was conducted with the goal of deriving information that could contribute to understanding subsistence patterns, as well as site structure and function. Questions addressed included the following (Zeanah et al. 1992):

- Was hunting a predominant subsistence activity conducted at the site?
- Were subsistence resources processed for transport or consumed on site?
- Was a diverse array of food procurement and processing activities conducted at the site?

1993–1994 Data Recovery Excavations in the North Block Tailing Impoundment Area

The next excavation project reported for the LBB area was P-III's 1993–1994 data recovery investigations at 13 sites (Schroedl 1996), for which two separate treatment plans were prepared (J. B. Jones, Zeanah et al. 1994; Kice et al. 1993). Although this work was generally consistent with the overall research approach outlined in the 1991 historic context, it benefited from knowledge gained during the 1992 project (Schroedl 1995), particularly an increasing recognition that organic materials tend not to preserve well at LBB area sites.

For the 1993–1994 project, analyses of vertebrate faunal remains were undertaken to address three major research objectives: 1) paleoecological reconstruction, 2) interpretation of the temporal context of sites, and 3) interpretation of the procurement of animal taxa for both human subsistence and non-subsistence use. Given the poor preservation expected for faunal remains, it was anticipated that it might be difficult to achieve these objectives.

Data Recovery Excavations at the Yaha Site

The Yaha Site (26EU001997) was the next site excavated by P-III that produced faunal remains (LaFond and Jones 1995). Specific research questions, derived from the general research domains in the 1991 historic context, were developed in the excavation report (a site-specific treatment plan was evidently never developed for this site). Specifically, P-III proposed to use faunal data in interpretations of site seasonality, diet, and resource transport.

Data Recovery Excavations at Site 26EU1494

An archeological data recovery project was conducted at Site 26EU001494 in 1993 (LaFond et al. 1995). In the report on this project, P-III refers to site-specific research questions developed in a data recovery plan for this site (Zeanah, Kice et al. 1993). However, no site-specific research questions regarding subsistence are addressed in the excavation report. Rather, data recovery efforts at Site 26EU001494 were designed to continue P-III's general research effort directed towards understanding prehistoric human ecology in the LBB area.

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

In the summer of 1994, P-III continued their cultural resource investigations in the LBB area by excavating three more sites: 26EK005270, 26EK005271, and 26EK005274 (Tipps 1996). They continued to follow the general research design laid out in the 1991 historic context and incorporated more appropriate site-specific research questions from a treatment plan by Zeanah et al. (1993). The research questions addressed issues such as what types of resources the occupants of the sites used, resource harvesting and collecting techniques, duration and seasonality of site occupation, and transport of plant and animal resources. As with earlier work in the area, these issues continued to be framed in terms of Binford's (1980) forager-collector continuum.

Data Recovery Excavations at Site 26EU2184, and Data Recovery Excavation at Three Prehistoric Sites along Simon Creek

In 1994, P-III also excavated 4 sites in the Simon Creek drainage in the southeastern portion of the LBB area; these excavations were reported in two separate documents (Tipps 1997a; Tipps and Miller 1998) and were based on two separately-prepared treatment plans (J. B. Jones 1994b; J. B. Jones, Kenzle et al. 1994). Although research was based in general on the settlement and subsistence pattern research domain outlined in the 1991 historic context, more specific research questions were developed for these sites. The research questions relevant to the study of faunal remains were, "What dietary resources were exploited by the occupants of the site?" and "Were subsistence resources processed for consumption and storage on-site or were they processed for transport elsewhere?"

Two Penny Ridge: Numic Occupation along Boulder Creek, and Surface Collection, Mapping, and Testing of Site 26EK5278

The next excavation project conducted in the LBB area during which faunal remains were recovered was P-III's 1995 investigation of the Two Penny Ridge Site (26EK006231) (Schroedl and Kenzle 1997). Concurrent with this project, P-III also performed limited testing at Site 26EK005278 (Schroedl and Tallman 1997). Work at these sites was guided by a treatment plan (J. B. Jones 1994c) that addressed research questions about food processing and procurement, among other topics.

1996 Bootstrap Data Recovery Excavations

In the summer of 1996, P-III excavated six more sites that yielded faunal remains (Schroedl 1998). Data recovery investigations at these sites were based on site-specific treatment plans (J. B. Jones 1996a; Schroedl and Stratford 1995), as well as the 1991 historic context. Subsistence-related research questions posed for these sites included:

- Are there faunal remains directly associated with cultural remains or otherwise characterized by evidence of cultural modifications within the assemblage?
- What does the archeological record reveal about subsistence processing and consumption during occupation of Site 26EU1492?
- What dietary resources were exploited by the occupants of Site 42EK4755?

Data Recovery Excavations at Site 26EK6487, and Data Recovery Excavations at Site 26EK4688

The most recent excavation projects undertaken by P-III in the LBB area were those at sites 26EK006487 (Birnie and Tipps 2000) and 26EK004688 (Birnie 2001), both of which were based on a single treatment plan (Tipps 1997b). This treatment plan outlined a variety of low-order, site-specific research questions based on the research domains in the 1991 historic context, as well as some phase-specific questions. The faunal analyses for these projects focused on the use of animal taxa for subsistence purposes, with the goal of identifying strategies of animal procurement and patterns of animal resource consumption.

Data Recovery Excavations at Five Prehistoric Archaeological Sites in the Little Boulder Basin

In 2007, SWCA conducted data recovery excavations at 5 sites (Cannon et al. 2008). The treatment plan for this project (Cannon and Stettler 2007) included an evaluation of work performed under the 1991 historic context and developed a set of research emphases based on that evaluation. These emphases prioritized issues other than subsistence. However, it was also anticipated that, if suitable materials were recovered, issues of subsistence would be addressed within the framework provided by the 1991 historic context and the results of work conducted since its implementation.

Recent Peer-reviewed Research

In a series of articles that are based largely on syntheses of subsistence-related data from P-III's work in the LBB area (e.g., see chapters in Schroedl 1998), Bright and colleagues have addressed questions concerning subsistence and technological change using models from foraging theory, including a novel model of technological investment that they developed (Bright et al. 2002; Ugan and Bright 2001; Ugan et al. 2003). Analyses of faunal remains from LBB play a key role in their arguments. In the first of these articles (Ugan and Bright 2001), it is suggested that a decline in the abundance of artiodactyls relative to smaller-bodied prey in LBB area faunal assemblages supports other evidence for a reduction in foraging efficiency at around A.D. 1300. In the later articles, the technological investment model is developed and tested. The LBB faunal data are not directly used in testing the model, but the tools used to hunt or process vertebrate prey are. Again at around A.D. 1300, investment in milling stones and ceramics is found to increase, while investment in bifacial chipped stone tool manufacture decreases. It is argued that these technological changes are a result of a the decline in the abundance of large-bodied prey and the corresponding reduction in foraging efficiency that is evidenced in part by the archaeofaunal record.

Summary

With the inclusion of the just-discussed papers from the peer-reviewed literature, it can be said that faunal remains from the LBB area have been thoroughly considered in some manner using both theoretical frameworks proposed in the 1991 historic context: foraging theory and Binford's (1980) forager-collector continuum. That said, as the above review of research objectives for faunal analysis makes clear, for much of the history of archaeological research in the area, the research questions that have been posed have been fairly basic, amounting more-or-less to "what did people eat?", with occasional discussions of how this may relate to larger issues such as settlement strategies.

There is now sufficient faunal data available from the LBB area that it is possible to answer the most basic question about the types of vertebrate resources that were used, as the description of recovered faunal remains presented in the following section makes clear. On the other hand, compelling methods for linking faunal data to questions that stem from the forager-collector continuum have yet to be developed, much less applied, in LBB research (and see following chapters of this document for further discussion of the utility of the forager-collector continuum as a theoretical construct). Somewhat serendipitously, however, the recent work conducted by Bright and colleagues points to new avenues of research that are only tangentially related to issues discussed in the 1991 historic context but that are arguably of greater anthropological importance. Accordingly, the updated synthetic analysis of LBB area faunal data that is presented below focuses on evaluating and further developing the work of Bright and colleagues.

7.1.2. Summary of Recovered Faunal Remains

The faunal assemblages recovered from individual excavated sites in the study area for this document are summarized here as they are reported in their respective excavation reports. This provides an overview of the kinds of vertebrate taxa represented in LBB area archaeofaunas, as well as of taphonomic factors that have come to be recognized as being important in the area. Conclusions of previous faunal analyses that are relevant to the research issues discussed in the previous section are also described. Although the preservation of organic materials at open-air Great Basin sites such as those in the LBB area is generally poor, sufficient faunal remains have been recovered to address at least basic research questions. The majority of the faunal specimens from LBB area sites have been recovered from archaeological features such as firepits and hearths, contexts that suggest that humans were responsible for their deposition, and additional evidence of human involvement in taphonomic histories is occasionally provided by alterations to the bones themselves.

Over 8500 vertebrate faunal specimens have been recovered from the excavated LBB area sites in the analysis sample for this document; numbers of identified specimens (NISP) per taxon for the combined assemblages from these sites are presented in Table 21 (see Table 1 in Chapter 2 for common names of taxa). Of the 53 sites in the analysis sample for this document, faunal remains have been reported for 29; Appendix G provides tables of NISP values per taxon by site and by provenience within each site.

Table 21. Total Numbers of Identified Specimens (NISP) of Vertebrate Taxa Reported from Excavated Sites in the LBB Area.

Taxon	**NISP**
Myotis	4
Leporidae	29
Sylvilagus	54
Lepus	451
Sciuridae	1
Marmota	2
Marmota flaviventris	11
cf *Marmota flaviventris*	5
Spermophilus	1,758
Spermophilus beldingii	6
Spermophilus lateralis	1
Thomomys	90
Perognathus	19
Dipodomys	5
Peromyscus	27
Neotoma	2
Microtus	36
Canis	1
Taxidea taxus	12
cf *Taxidea taxus*	3
Lynx rufus	1
Undetermined Ungulate	2
Artiodactyla (Large)	26

Table 21. Total Numbers of Identified Specimens (NISP) of Vertebrate Taxa Reported from Excavated Sites in the LBB Area.

Taxon	**NISP**
Artiodactyla (Medium)	10
Artiodactyla (Size Indeterminate)	738
Cervidae	5
Cervus elaphus	1
Odocoileus	11
Antilocapra americana	8
Bison bison	2
Bos	20
Ovis	4
Ovis canadensis	2
Very Large Mammal	69
Large/Very Large Mammal	222
Large Mammal	348
Medium/Large Mammal	100
Medium Mammal	1,143
Small/Medium Mammal	462
Small Mammal	890
Micro-mammal	33
Mammal (Size Indeterminate)	1,834
Lacertilia	7
Iguanidae	2
Phrynosoma	11
Serpentes	3
Phasianidae	2
Centrocercus	5
Ciconiiformes	1
Corvidae	2
Large Bird	22
Medium Bird	7
Small Bird	1
Indeterminate Vertebrate	54
Total	**8,565**

Archaeological Investigations at the Rossi Mine Sites

26EK002304

A total of 27 faunal specimens was recovered from Site 26EK002304 (Dansie 1982). The majority of these specimens do not provide direct evidence as to whether they accumulated naturally or were the result of human procurement. However, one marmot (*Marmota flaviventris*) mandible and one pronghorn (*Antilocapra americana*) radius fragment have butchering scars, and two bison (*Bison bison*) specimens as well as two Belding's ground squirrel (*Citellus beldingii* [=*Spermophilus beldingii*]) femora exhibit spiral fractures. The report on this site concluded that the site's occupants subsisted upon a diversified grassland fauna.

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

26EK005200

A total of 40 mammal bone fragments was recovered from Site 26EK005200 (Schroedl 1995:214). No direct evidence of animal processing is present in the assemblage; however, tools found at the site are representative of animal processing and suggest that processing may have occurred.

26EU001320

A total of 2,262 faunal specimens was recovered from Site 26EU001320 (Schroedl 1995:447). A large portion of the faunal assemblage consisted of highly fragmented, burned bone recovered from firepits, and several specimens had cutmarks visible. These factors indicate that these specimens were the result of human activity (processing, marrow extraction, cooking). In addition, the taxa present included small- through large-sized animal remains. It was concluded that this faunal assemblage suggests that the procurement of small- to large-sized animals was a primary subsistence activity at this site.

26EU001524

A small assemblage of 16 faunal specimens was recovered from Site 26EU001524. No direct evidence of animal processing is present in the assemblage; however, tools located at the site are representative of animal processing and suggest that processing may have occurred (Schroedl 1995:271)

26EU001529

A total of 547 bone fragments was recovered from Site 26EU001529 (Schroedl 1995:164). The small size and fragmentary nature of the assemblage limited the extent to which inferences could be made. No direct evidence of animal processing is present in the assemblage; however, tools representative of animal processing are present, suggesting that some degree of processing occurred. Large mammal remains, possibly including sheep, in addition to the tool assemblage, suggest that a portion of the faunal specimens could be associated with the human occupation of the site. Low utility parts were recovered, also suggesting that these were remains that had been processed and discarded before returning to a base camp. It was concluded that this faunal assemblage suggests that procuring large mammals was a primary subsistence activity at this site.

26EU001734

A small faunal assemblage of 43 specimens was recovered from Site 26EU001734, and no direct evidence of animal processing is present (Schroedl 1995:337). It was concluded that these specimens are not the result of subsistence activities and are likely not associated with the cultural occupation of the site.

1993–1994 Data Recovery Excavations in the North Block Tailing Impoundment Area

26EK004687

The majority of the 235 faunal specimens from Site 26EK004687 appear to have accumulated as a result of natural processes because these specimens are relatively complete unburned elements (Schroedl 1996:203). However, 30 burned, highly fragmented specimens were recovered from within firepit contexts suggesting human use.

26EK004690

The majority of the 91 faunal specimens from Site 26EK004690 appear to have accumulated as a result of natural processes because these specimens are relatively complete unburned elements (Schroedl 1996:243). The few burned bone specimens recovered from the site could have been the result of natural burning and may not be due to cultural activity. No specimens were located within firepits or had any evidence of butchering or other cultural surface modifications. P-III concluded that these specimens were likely the result of natural processes; however, human activity could not be completely ruled out.

26EK004695

A total of 36 faunal specimens was recovered from Site 26EK004695 (Schroedl 1996:273).The majority of these appear to have accumulated as a result of natural processes since they are relatively complete unburned elements. Only one burned bone was recovered from the site and could have been the result of natural burning because no remains were found within firehearth contexts. No specimens had any evidence of butchering or other cultural surface modifications. P-III concluded that there is no evidence indicative of human involvement with the faunal assemblage

26EU001482

A total of 176 faunal specimens was recovered from Site 26EU001482 (Schroedl 1996:354). The majority of the faunal assemblage included highly fragmented, burned bone located within firepits. Specimens ranged from very large indeterminate artiodactyl to smaller-sized mammals such as ground squirrel (*Spermophilus* sp.). Considering the degree of fragmentation, feature context, and the proportion of burned specimens, P-III concluded that much of this faunal assemblage was deposited by humans, and they suggested further that this site was used for hunting-related activities and functioned as a general base camp.

26EU001483

A total of 298 mammal bone fragments was recovered from Site 26EU001483 (Schroedl 1996:402). It was concluded that the majority of these specimens accumulated as a result of natural processes because they are relatively complete unburned elements. Only 12 burned bones were recovered from the site, and these could have been the result of natural burning because no remains were found within firehearth contexts. Although some specimens recovered may be cultural, evidence is inconclusive regarding whether these and other faunal material from the site are the result of cultural or natural accumulation processes. No direct evidence of animal processing is present in the assemblage; however, tools representative of animal processing are present at the site, suggesting that processing may have occurred. Although hunting is reflected in the assemblage, none of the specimens could be identified as the result of subsistence practices and therefore, no direct evidence that game was procured or processed on the site.

26EU001530

The majority of the 182 faunal specimens from Site 26EU001530 do not provide conclusive evidence as to whether or not they accumulated as the result of natural or cultural processes (Schroedl 1996:458). However, three excavation locations within the site yielded remains that were regarded as cultural due to the degree of fragmentation, feature context, and the proportion of burned specimens. It is uncertain if the remaining specimens from firepit contexts, or the remainder of the specimens from the site, are the result of cultural or natural accumulation processes. P-III concluded that a portion of the assemblage suggests the procurement and processing of large to small mammals, including jackrabbits (*Lepus* sp.) and ground squirrels.

26EU001531

The majority of the 261 faunal specimens from Site 26EU001531 do not provide conclusive evidence as to whether or not they accumulated as the result of natural or cultural processes (Schroedl 1996:509–517). However, two excavation locations within the site yielded remains that were regarded as cultural due to the degree of fragmentation, feature context, and the proportion of burned specimens. It is uncertain if the remaining specimens from firepit contexts, or the remainder of the specimens from the site, are the result of cultural or natural accumulation processes. Specimens ranged from very large indeterminate mammal to smaller sized mammals such as jackrabbits, cottontails (*Sylvilagus* sp.) and ground squirrels. P-III concluded that the diversity of subsistence resources represented suggests that the associated occupations used the site as a short-term base camp.

26EU001534

The majority of the 394 faunal specimens from Site 26EU001534 were concluded to be the result of human activity. In all, 182 ground squirrel and 98 small mammal specimens are burned (Schroedl 1996:570). A large proportion of the remains recovered were identified as ground squirrel and small mammal. Due to their association and context, the degree of fragmentation, and the proportion of burned elements, these specimens were considered to be associated with human activity. A single medium mammal specimen shows burning, polishing, and cutmarks and may have been modified in association with subsistence activities, ornamental purposes or tool manufacture. P-III concluded that these observations suggested an emphasis on the procurement and consumption of small mammals, although large game may have contributed to their diet as well.

26EU001667

The majority of the 1,168 faunal specimens recovered from Site 26EU001667 were concluded to be the result of human activity. A total of 563 ground squirrel and 449 associated small mammal specimens, as well as five American badger (*Taxidea taxus*) and 13 associated medium mammal specimens, were recovered from firepit contexts (Schroedl 1996:628). Due to their association and context, degree of fragmentation, and proportion of burned elements, the majority of these specimens were considered to be the result of with human activity. P-III concluded that the diversity of functional artifacts, features, and subsistence data recovered from the site indicate that it functioned as a short-term base camp.

Data Recovery Excavations at the Yaha Site

No direct evidence of animal processing is present in the assemblage of the Yaha Site (Site 26EU001997) (LaFond and Jones 1995). Five faunal specimens were recovered from the site. These are relatively complete, unburned elements that lack any cultural modification or proximity to a firehearth. P-III concluded that these remains are not the result of subsistence activities and are likely not associated with the cultural occupation of the site.

Data Recovery Excavations at Site 26EU1494

Two faunal specimens were recovered from Site 26EU001494 (LaFond et al. 1995). One nearly complete right mandible, identified as pocket gopher (*Thomomys* sp.), was concluded to have been deposited as the result of natural processes. The other faunal specimen is a culturally modified artiodactyl rib shaft fragment and is likely ornamental. This specimen exhibits flattening, polishing, cutmarks, and red pigment.

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

26EK005271

The faunal assemblage for Site 26EK005271 includes a total of 26 specimens concluded to be the result of both cultural procurement and natural accumulation processes (Birnie 1996c). Five specimens are relatively complete elements that lack any cultural modification or proximity to a firehearth. It is uncertain if the few burned specimens\s from the site are the result of cultural procurement or due to natural fires. The remainder of the faunal assemblage includes specimens identified as pronghorn, jackrabbit, medium mammal, and indeterminate mammal. Due to their association and context, degree of fragmentation, and proportion of burned elements, these specimens are considered cultural. P-III concluded that the procurement and processing of pronghorn antelope, jackrabbit, a medium mammal, and a small to medium mammal occurred at this site.

Data Recovery Excavations at Site 26EU2184

The majority of the specimens recovered from Site 26EU002184 were concluded to be the result of natural accumulation processes. The assemblage is composed of 20 specimens, 19 of which include very large mammal taxa through small-sized mammals such as ground squirrels (Tipps 1997a). There is no direct evidence that these specimens are present as a result of cultural activity at the site. One culturally modified specimen was identified as American badger. This proximal radius has cutmarks located on the shaft, exhibits green bone fracture and is partially burned. P-III concluded that the faunal assemblage from Site 26EU002184 indicates cultural exploitation of badger based on a single specimen with cutmarks.

Data Recovery Excavation at Three Prehistoric Sites along Simon Creek

26EU002181

The faunal assemblage for Site 26EU002181 includes a total of 59 specimens concluded to be the result of both cultural procurement and natural accumulation processes (Tipps and Miller 1998). All but two of these specimens were presumed to be the result of natural mortality and accumulation processes. There is no direct evidence that these specimens are present as a result of cultural activity because they lack cultural modifications and hearths were not observed at the site. However, one American badger specimen exhibits cutmarks and one bone bead fragment manufactured from a medium mammal was recovered. P-III concluded that the faunal assemblage from Site 26EU002181 indicates human use of badger and that it was processed on-site.

Surface Collection, Mapping, and Testing of Site 26EK5278

A total of eight faunal specimens was recovered from Site 26EK005278 (Schroedl and Tallman 1997). Due to their association and context, degree of fragmentation, and proportion of burned elements, the majority, if not all, of these specimens were considered to be the result of human activity.

Two Penny Ridge: Numic Occupation along Boulder Creek

A total of 45 bone fragments was recovered from Site 26EU006231 (Corbeil 1997). The majority, if not all, were concluded to be the result of human use because they were recovered from or near firepits. Taxa present included cottontail, ground squirrel, marmot, medium mammal, and small or medium mammal. P-III concluded these data indicate human procurement of small- to medium-sized mammal taxa.

1996 Bootstrap Data Recovery Excavations

26EU001487

A total of 1,707 faunal specimens was recovered from Site 26EU001487 (Schroedl 1998). The majority were considered to be the result of human activity. Many burned specimens were recovered from or near firepits. Taxa present in this assemblage include rabbits (Leporidae), marmots, medium mammals, and very large to large mammals. Several bones of these taxa exhibited cultural modification in the form of cutmarks, polish, green bone fracturing and scraping. The remainder of the specimens—identified as small mammal, micromammal, sage-grouse (*Centrocercus* sp.), medium bird, large bird, amphibian, and reptile—have no evidence for cultural affiliation. P-III concluded that the assemblage provides evidence that a variety of animals, both large and small, was procured at the site.

26EU001492 (Rodeo Overlook)

A total of 36 faunal specimens were recovered from Site 26EU001492 (Bright 1998a). Most of the assemblage consists of tooth enamel fragments indicating either poor preservation or intensive processing. The lack of distinct cultural modifications and the lack of firehearth context in association with the burned bone make it difficult to determine if these specimens are the result of cultural processes. P-III concluded that this site was part of a behavioral strategy that focused on large game procurement for consumption at residential bases.

26EK004749

No direct evidence of animal processing is present in the assemblage of Site 26EK004749 (Miller 1998). A total of 36 faunal specimens was recovered from the site. These are relatively complete elements that lack any cultural modification or proximity to a firehearth. It is uncertain if the few burned specimens from the site are the result of human activity or due to natural fires. P-III concluded that these remains are not the result of subsistence activities and are likely not associated with the cultural occupation of the site.

26EK004755 (Round Mountain Camp)

A total of 278 faunal specimens and one bone bead were recovered from Site 26EK004755 (Bright 1998c). The faunal assemblage was concluded to be the result of both human use and natural accumulation processes. A large portion of the faunal assemblage included highly fragmented, burned bone identified as jackrabbit and very large through medium mammal located within firepits. Considering the degree of fragmentation, feature context, and the proportion of burned specimens, those remains were considered to be associated with human activity. Tools located at the site may also suggest that processing occurred. P-III concluded that this site indicates the procurement of jackrabbit, artiodactyls, and a very large mammal taxon.

Data Recovery Excavations at Site 26EK6487

A total of 114 faunal specimens was recovered from Site 26EK006487 (Birnie 2000:64, 75, 87). The majority of the assemblage was concluded to be the result of natural accumulation processes, although some of the specimens were thought to likely be cultural. A portion of the large mammal remains are burned and fragmented and are possibly associated with identified deer (*Odocoileus* sp.) specimens since they are of the same body size and have similarities in fracture patterns and condition. One indeterminate large mammal rib shaft fragment has been modified into a bone awl. Therefore, although the bone tool indicates the definitive use of large mammals for non-subsistence practices, the cultural utilization of large mammals for subsistence is also suggested. The absence of evidence for use of smaller taxa may reflect subsistence practices, be a factor of preservation, or both. P-III concluded that large mammals, possibly deer, were an important part of the diet at this site.

Data Recovery Excavations at Site 26EK4688

26EK004688

The faunal assemblage from Site 26EK004688, consisting of 149 specimens, includes specimens concluded to be the result of both human use and natural accumulation processes (Birnie 2001). Taxa identified indicate procurement and processing of indeterminate small mammals, rabbits, ground squirrel, possible yellow-bellied marmot, indeterminate medium-to-large mammal, large mammal, and deer or sheep (Artiodactyla). The presence of one bone bead and one bone tube fragment indicates that some faunal resources were processed for purposes other than consumption. The medium and large mammal specimens are extremely fragmented, whereas a higher proportion of the small mammal specimens are complete or nearly complete. The low numbers of faunal remains suggests that procurement and processing of vertebrates was likely not a major focus of activities at this site. P-III concluded that these data may indicate that large mammal taxa were procured using a low density encounter strategy and more intensive processing in order to extract bone marrow.

Data Recovery Excavations at Five Prehistoric Archaeological Sites in the Little Boulder Basin

26EU002126

A total of 304 faunal specimens was recovered from Site 26EU002126 (excluding 3 specimens that were clearly not deposited by humans) (Cannon et al. 2008). The faunal inventory from the site likely includes specimens that are a result of both cultural and natural deposition. However, given the presence of cutmarks, the abundance of burned bone, the degree of fragmentation, and the association with a hearth, it was concluded that most, if not all, of the specimens from one part of the site designated as Operation F were deposited by humans; the large majority of these specimens were from large- or very large-sized mammals. It was concluded further that the very low abundance of identified postcranial elements in the large mammal assemblage, together with a high number of small, unidentifiable fragments indicates intensive processing (e.g., marrow extraction). Overall, it was thought that the assemblage may be the result of large mammal processing activities conducted by a hunting party operating from a residential base located elsewhere.

7.1.3. Synthetic Analysis of Faunal Data

The faunal assemblages just described were each analyzed individually, with little attempt at comparative or synthetic research involving data from multiple sites. Likely largely for this reason, the kinds of research questions addressed with faunal data in the LBB area have for the most part been site-specific and relatively basic, as discussed above, generally amounting to little more than “what food resources were used at Site X”, even in comparatively recent reports (Birnie 2001:17-6). It was not until Ugan and Bright (2001) explored patterns in artiodactyl relative abundances that faunal remains from the LBB area began to be employed in synthetic analyses directed at higher-order research questions. A single earlier synthetic treatment of faunal assemblages from the area (Corbeil 1996), which incorporated materials recovered in P-III's excavations through 1994, was primarily descriptive in nature.

As summarized previously, Ugan and Bright (2001) demonstrated a decline in the archaeofaunal abundance of artiodactyls relative to leporids at LBB sites between pre– and post–A.D. 1300 periods, and they argued that this was associated with an expansion of the diet to include a wider variety of low return plant and animal resources. A rationale for this argument is provided by the prey model of foraging theory (e.g., Cannon and Broughton 2010; Stephens and Krebs 1986), together with an empirical correlation between vertebrate prey body size and post-encounter return rate (i.e., calories gained per unit "handling" time) (e.g., Broughton 1994a; 1994b ; 1997). Simply put, the prey model predicts that higher-return large-bodied prey should be pursued whenever they are encountered, whereas lower-return smaller-bodied prey should be pursued only when rates of encounter with larger prey are sufficiently low. Thus, a decline in the abundance of large-bodied prey types like artiodactyls relative to smaller bodied prey like leporids in archaeofaunal assemblages would suggest that prehistoric hunters experienced declines in artiodactyl encounter rates, which would necessarily have resulted in reductions in overall foraging efficiency. Expansion of the diet to include not only smaller-bodied vertebrate prey but also a wider variety of relatively low-return plant resources is a predicted response to such a reduction in foraging efficiency.

The faunal data compiled for this document allow the line of research begun by Ugan and Bright (2001) to be advanced in some important ways. First, data are now available from sites excavated since they undertook their analysis, which enables their conclusions to be evaluated against a larger dataset. In addition, the thorough reevaluation of the chronology of LBB area sites or site loci undertaken for this document provides a firmer basis for exploring temporal changes than has previously been the case. And finally, this chronological reevaluation data now enables LBB assemblages to be assigned to three distinct time periods—Middle Archaic, Maggie Creek, and Eagle Rock—rather than just the two pre– and post–A.D. 1300 (i.e., pre–Eagle Rock and Eagle Rock) periods that Bright and colleague considered; this permits examination of changes between the Middle Archaic period and the Maggie Creek phase that were not visible previously.

Artiodactyl and leporid NISP values for the combined assemblages for the three analysis periods defined in Chapter 5 are presented in Table 22. These data come from the sites and site loci that were determined in Chapter 5 to be single-component and that also produced faunal remains; complete faunal data for these single-component analysis units are provided in Appendix G. Also shown in Table 22 are values of the Artiodactyl Index, calculated as Artiodactyl NISP/(Artiodactyl NISP + Leporid NISP) (e.g., Ugan and Bright 2001), which provides a measure of the abundance of artiodactyls relative to leporids.
The artiodactyl index starts out very low at 0.06 in the relatively small Middle Archaic period sample, rises dramatically to 0.97 during the Maggie Creek phase, and then declines again to 0.34 in the Eagle Rock phase, differences that are highly statistically significant (chi-square = 503.6, $df = 2$, $p < 0.001$; all adjusted standardized residuals fall well beyond two standard deviations). This result, based on an updated and larger dataset, is consistent with Ugan and Bright's earlier conclusion that foraging efficiency in the LBB area was lower during the Eagle Rock phase than during the pre–A.D. 1300 period. It also suggests, however, that artiodactyl encounter rates and foraging efficiency were both very low during the Middle Archaic, a period that Ugan and Bright did not specifically consider.

Table 22. Artiodactyl Index Values for the Three Analysis Time Periods

Taxon	Middle Archaic	Maggie Creek	Eagle Rock	Total
Sylvilagus	2	0	1	3
Lepus	1	1	6	8
Small Mammal	18	6	578	602
Small/Medium Mammal	1	1	13	15
Medium Mammal	7	7	42	56
Leporid Total	**29**	**15**	**640**	**684**
Artiodactyla (Large)	0	0	3	3
Artiodactyla (Medium)	0	7	0	7
Artiodactyla (Size Indeterminate)	1	409	129	539
Cervidae	0	0	5	5
Cervus elaphus	0	0	1	1
Odocoileus	0	0	1	1
Ovis	0	2	0	2
Large Mammal	1	5	21	27
Large/Very Large Mammal	0	0	138	138
Very Large Mammal	0	0	28	28
Artiodactyl Total	**2**	**423**	**326**	**751**
Grand Total	**31**	**438**	**966**	**1,435**
Artiodactyl Index	**0.06**	**0.97**	**0.34**	**0.52**

Patterns in vertebrate resource diet breadth and foraging efficiency in the LBB area can be explored further by examining taxonomic richness (i.e., the number of taxa present). As noted, a reduction in foraging efficiency can be predicted to lead to an expansion of diet breadth, and, all else equal, assemblages deposited by hunter-gathererss with wider diet breadths should contain larger numbers of prey types (Broughton and Grayson 1993; Grayson 1991; Grayson and Delpech 1998; E. L. Jones 2004; Nagaoka 2001). Thus, if the pattern in the Artiodactyl Index observed in the LBB truly reflects variability in foraging efficiency, we should expect to see taxonomic richness vary inversely with the Artiodactyl Index. Specifically, we can hypothesize that numbers of taxa (NTAXA) should be relatively low in the Maggie Creek phase sample, reflecting narrow diet breadth during a time of high foraging efficiency, and higher in the Middle Archaic period and Eagle Rock phase samples, reflecting broader diets during periods of lower foraging efficiency.

Since taxonomic richness is widely known to be highly dependent on sample size (e.g., Grayson 1984, 1991), sample size must be taken into account when assessing variation in richness. One approach to doing this is to compare regressions of NTAXA on sample size for sets of assemblages that are hypothesized to differ in richness (i.e., to test for differences in richness through analysis of covariance). Assemblages that are sampling broader underlying diets should exhibit higher regression slopes and/or intercepts, indicating that they contain more taxa, on average, at any given sample size (e.g., Cannon 2004; Grayson and Delpech 1998). This approach is not useful in the present case, however, because the very small number of assemblages from the earliest two time periods preclude meaningful regression analyses. Instead, simple aggregate NTAXA values are used, and these are evaluated in light of overall sample sizes. Aggregate NTAXA values were calculated by pooling the assemblages from the individual analysis units dated to each period and counting the total number of taxa present in the aggregate sample for each period; "overlapping" taxa were counted as described by Grayson (1991).

As expected, aggregate NTAXA is lowest for the Maggie Creek phase and higher for the Middle Archaic period and the Eagle Rock phase (Table 23), suggesting that artiodactyl encounter rates and diet breadth changed in tandem in the manner predicted by the prey model. Though it is not possible evaluate these differences in richness statistically, they do not appear to be driven solely by sample size effects: fewer taxa are present in the Maggie Creek phase assemblages than in the Middle Archaic assemblages, even though the Maggie Creek sample is much larger than the Middle Archaic one.

Table 23. Aggregate Vertebrate Taxonomic Richness Values for the Three Analysis Time Periods

Analysis Period	Number of Taxa	Total NISP[a]
Eagle Rock	9	1,013
Maggie Creek	5	446
Middle Archaic	7	83

a. Includes only specimens identified to taxon; specimens identified only to size classes are excluded.

Overall, then, patterns both in the Artiodactyl Index and in taxonomic richness, shown together in Figure 22, are consistent in suggesting that foraging efficiency was relatively high and diet breadth relatively narrow during the Maggie Creek phase, with lower foraging efficiency and broader diets during both the Middle Archaic period and the Eagle Rock phase. The larger, updated dataset compiled for this document therefore supports Ugan and Bright's (2001) previous suggestion that diet breadth expanded and foraging efficiency declined in the LBB area at around A.D. 1300 (see also Bright et al. 2002). It also reveals, however, that foraging efficiency was not uniformly high and diet breadth uniformly low prior to this time. Rather, the limited Middle Archaic data that are available suggest that foraging efficiency and diet breadth during this period were somewhat similar to those of the Eagle Rock phase, and it is the Maggie Creek phase that stands out in this analysis for diets that appear to have been uniquely narrow and focused on high-return large-bodied mammals. Explanations for the patterns in vertebrate taxonomic relative abundance and richness that are apparent here are considered below, at the end of this chapter. First, other types of subsistence-related data are examined.

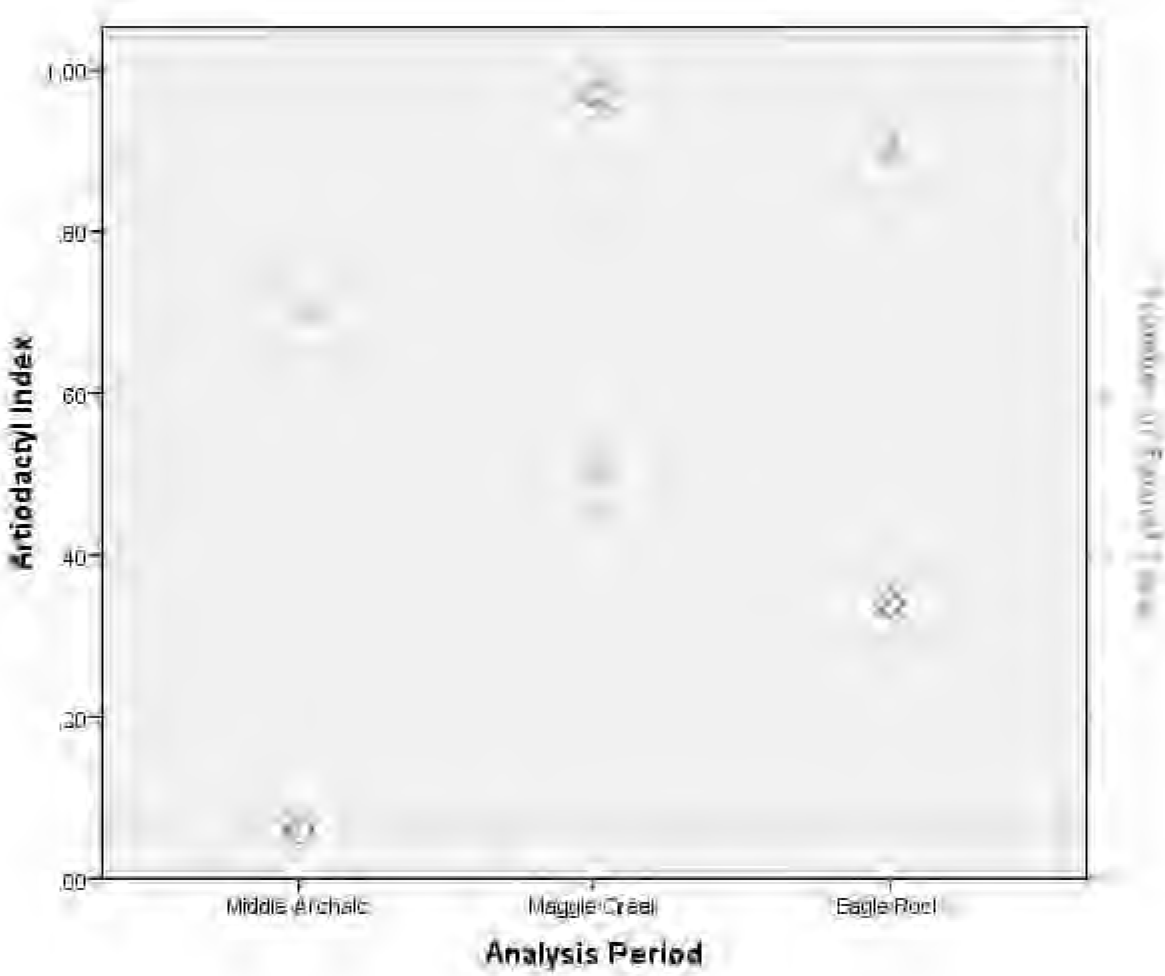

Figure 22. Artiodactyl Index values (black diamonds) and vertebrate taxonomic richness values (gray dots) for the three analysis periods.

7.2. Macrobotanical Remains

Like faunal remains, macrobotanical remains recovered from LBB area sites have been also analyzed with reference to the subsistence research domain in the 1991 historic context. The research questions to which floral data have been applied have been very similar to those addressed with faunal data, and they are described here to the extent that they differ from those discussed above in the section on faunal data. Macrobotanical assemblages from individual sites are then briefly discussed, and, finally, the comprehensive LBB area floral dataset is analyzed in order to build upon the synthetic analysis of faunal data just presented.

7.2.1. Review of Research Questions

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

For the earliest excavations conducted under the 1991 historic context, several goals relating to macrobotanical remains were identified. First, the recovery of burned macrobotanical remains was recognized as being crucial in reconstructing subsistence practices. It was also proposed that macrobotanical remains would be used to determine seasonality of site occupation, and that seasonality indicators would be compared to ethnographic accounts of Shoshone settlement patterns.

1993–1994 Data Recovery Excavations in the North Block Tailing Impoundment Area

For P-III's 1993-1994 data recovery investigations, determining where the settlement strategies represented at individual sites fell along the foarger-collector continuum became a greater focus. It was proposed that macrobotanical remains could contribute to this goal by providing data on the types of plants that were used, the degree to which they were processed, and the season(s) of site occupation. In addition, as alluded to previously, by this time it began to be recognized that faunal and floral remains do not preserve well in LBB. In the report on this project, a synthetic analysis of macrobotanical remains recovered in P-III's excavations up through the 1994 field season was presented, which considered issues of seasonality of site occupation and temporal trends in the richness of macrobotanical assemblages as these relate to ethnographic accounts of hunter-gatherers in the Great Basin and elsewhere (Coulam 1996).

Data Recovery Excavations at the Yaha Site

For the excavation of the Yaha site (26EU001997), greater emphasis was placed on the site's role within larger regional subsistence and settlement strategies. Studies thought to be relevant to this included determining the seasonality of site occupation, identifying the types of plants consumed at the site, and identifying any plant types that must have been transported to the site. In order to address these issues, it was proposed that specific depositional contexts, particularly hearths, would be targeted for excavation in order to increase the chances of recovering preserved plant remains.

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

The research orientation for this project was strongly focused on identifying forager and collector strategies. One goal was to distinguish between the different kinds of strategies based on the degree of variability in taxonomic content among macrobotanical samples. Another goal was to determine seasonality of site occupation, which might also help to distinguish between forager and collector strategies. Finally, it was proposed that an abundance of plant taxa at a site that must have been procured at a distance would indicate a foager strategy, whereas dominance by locally available taxa would indicate a collector strategy.

Data Recovery Excavation at Three Prehistoric Sites along Simon Creek, and Two Penny Ridge: Numic Occupation along Boulder Creek

The next two excavation reports that discuss macrobotanical remains are the Simon Creek and Two Penny Ridge reports. In these reports, the focus was again on characterizing the sites as representing either forager or collector strategies. These specific research questions, which had also been posed in previous projects, were asked: what dietary resources did people use at the sites?, and were seeds being processed for immediate consumption or for storage?

1996 Bootstrap Data Recovery Excavations

For some of the sites excavated during this project, general questions about subsistence were posed; for example, "What does the archeological record reveal about subsistence processing and consumption during occupation of the site?" (Schroedl 1998:141).

Data Recovery Excavations at Site 26EK6487, and Data Recovery Excavations at Site 26EK4688

For these two projects, the following question about subsistence was asked: "what food resources were used?" (Birnie 2001:17-6; Birnie and Tipps 2000:107).

Data Recovery Excavations at Five Prehistoric Sites in the Little Boulder Basin

As noted, for this project, subsistence-related research questions were not a priority. However, an analysis was conducted to evaluate whether numerous charcoal lenses that were discovered were of human origin. Based on an absence of charred remains of edible plants in flotation samples from these features, it was concluded that they were most likely the remains of vegetation burned in range fires. None of the other features discovered during this project that did appear to be of human origin produced macrobotanical remains.

Recent Peer-reviewed Research

As described above in the discussion of zooarchaeological research, Bright and colleagues have published a series of papers that propose that an expansion of diet breadth occurred in the LBB area at around A.D. 1300. These authors refer to previous analyses of macrobotanical data from the area, summarized in the following section, suggesting that these data indicate an increase in the variety of plants that were harvested at around this time. Though they do not themselves present any macrobotanical data, their theoretical linkage of foraging efficiency and diet breadth to technological changes provides a useful framework for exploring patterns in the use of plant resources in relation to changes in other aspects of adaptive behavior.

Summary

In general, the research questions that have been addressed in the LBB area with macrobotanical remains have been very similar to those addressed with faunal remains. As discussed previously, prior to the work of Bright and colleagues, these questions have for the most part been fairly basic. Because the most basic of questions pertaining to floral remains can now be answered adequately, as is demonstrated in the following section, the LBB area is ripe for the development of more sophisticated questions to guide macrobotanical analysis.

7.2.2. Summary of Recovered Floral Remains

Charred seeds identifiable to taxon have been reported from a total of 148 archaeological features at 22 of the sites included in the analysis sample for this document. Over 1500 such macrobotanical specimens have been recovered. These specimens are enumerated by taxon in Table 24, and the habitats and ethnobotanical uses of the taxa recovered are listed in Table 25. Complete specimen counts by feature are provided in Appendix H. The data discussed throughout this section and presented in all tables here and in Appendix H are limited to specimens reported as identifiable charred seeds recovered from flotation samples taken from archaeological features; this is done in order to maximize the likelihood that the materials discussed are associated with human occupation.

Table 24. Total Numbers of Charred Seed Specimens of Plant Taxa Reported from Excavated Features at Sites in the LBB Area

Taxon	Specimen Count
Amaranthus	4
Rhus aromatica	50
Gutierrezia microcephala	1
Mahonia repens	3
Brassicaceae	1
Brassica	1
Descurainia	2
Draba verna	3
Lepidium	8
Sambucus caerulea	15
Silene antirrhina	2
Chenopodium	430
Carex	2
Scirpus	1
Erodium	26
Astragalus	14
Gaura parviflora	1
Oenothera	1
Poaceae	7
Bromus tectorum	6
Stipa arida	528
Sporobolus	22
Poa	372
Polygonum	8
Ruppia maritima	60
Total	**1,568**

Table 25. Habitat and Uses of Plants Recovered from Features at LBB Area Sites

Family	Species	Common Name	Habitat	Paleoethnobotanical Use
Amaranthaceae				
	Amaranthus spp.	Amaranth	Open sites, cultivated land, and roadsides[5]	Food[2], medicinal[2]
Anacardiaceae				
	Rhus aromatica	Fragrant sumac	Open habitats at lower elevations, often in arroyos or along streams or on canyon slopes[4]	Food[2], medicinal[2]
Asteraceae				
	Gutierrezia microcephala	Threadleaf snakeweed	Arid grassland and desert shrub communities[3]	Medicinal[2]
Berberidaceae				
	Mahonia repens	Creeping barberry	Subalpine fir/Oregon-grape habitat type[3]	medicinal[1,2]
Brassicaceae				
	Brassica	Mustard	Shadscale, sagebrush, and pinyon-juniper communities and along roads and disturbed areas[4]	Food[2], medicinal[1], poison[1]
	Descurainia sp.	Tansymustard	Pinyon-juniper woodlands and big sagebrush communities[3]	Food[2], medicinal[1], poison[1]
	Draba verna	Spring draba	Disturbed areas[4]	
	Lepidium	Pepperwort	Greasewood, sagebrush, pinyon-juniper, and shadscale communities and disturbed areas[4]	medicinal[1,2]
Caprifoliaceae				
	Sambucus caerulea	Blue elderberry	Early seral communities or moist forest habitats[3]	Food[2], medicine[1]
Caryophyllaceae				
	Silene antirrhina	Sleepy Silene	Creosote bush, blackbrush, other warm desert shrub, pinyon-juniper, and mountain brush communities[5]	
Chenopodiaceae				
	Chenopodium spp.	Lambsquarter	Sagebrush, pinyon-juniper, mountain brush, spruce-fir, and shadscale communities and disturbed areas[5]	Food[2], medicine[1,2]
Cyperaceae				
	Carex sp.	Sedge	Riparian and moist regions, including sagebrush, pinyon-juniper, mountain brush, spruce-fir, and desert shrub communities[4,5]	Food[2], dye[2],medicine[1], soap[1]

Table 25. Habitat and Uses of Plants Recovered from Features at LBB Area Sites

Family	Species	Common Name	Habitat	Paleoethnobotanical Use
	Scirpus sp.	Bulrush	Margins of ponds and lakes, marshes, springs, seeps, and flood plains[5]	Food[2], weaving[2], medicine[1], poison[1]
Geraniaceae				
	Erodium	Stork's bill	Desert to riparian and disturbed riparian areas[3]	
Fabaceae				
	Astragalus	Milkvetch	Disturbed areas and early seral communities[3]	Food[2], medicinal[1,2]
Onagraceae				
	Gaura parviflora	Velvetweed	Fields, pastures, and streamsides[4]	
	Oenothera	Evening primrose	Wide range of habitats, including open slopes, streambanks, roadsides, and disturbed areas[4]	medicinal[1,2]
Poaceae				
	Bromus tectorum	Cheatgrass	Sagebrush steppe communities[3]	Food[2], medicinal[1,2], weaving[2]
	Stipa arida	Mormon needlegrass	Rocky, shadscale and sagebrush deserts and foothills up to pinyon-juniper woodland[4]	
	Sporobolus	Dropseed	Desert shrub, shrub, grassland, sagebrush, and pinyon-juniper communities[3]	Food[2]
	Poa spp.	Bluegrass	Sagebrush, scrub oak, pinyon-juniper, mountain brush, ponderosa pine, and fir-spruce communities[3]	Food[2], medicinal[1]
Polygonaceae				
	Polygonum	Knotweed	Wetlands, marshes, cultivated fields, dry slopes, alpine or subalpine meadows, and sagebrush, mountain brush, pinyon-juniper, spruce-fir, and ponderosa pine communities[3,5]	Food[2], medicinal[1,2]
Ruppiaceae				
	Ruppia maritima	Widgeongrass	Saline and brackish water[4]	Medicinal[1]

[1] Duke (1994)

[2] Moerman (2003)

[3] U.S. Forest Service (2009)

[4] Cronquist, et al. (1986)

[5] Welsh, et al. (1993)

Archaic and Numic Encampment in the Little Boulder Basin

26EU001319

The first LBB area excavation project that resulted in the analysis of the macrobotanical remains was the one described in the Archaic and Numic Encampment in the Little Boulder Basin report (Tipps 1988). Of the three sites excavated during this project, only Site 26EU001319 produced macrobotanical remains. Sagebrush (*Artemisia* sp.) charcoal recovered from a hearth feature was interpreted as being the result of the use of this taxon for firewood. None of the other plant remains recovered were concluded to be the result of human use.

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

26EU1320

Two sites excavated during P-III's 1992 data recovery project yielded macrobotanical remains (Schroedl 1995). For one, Site 26EU001320, it was concluded that the association of seeds with fire pits and a high frequency of milling stones indicated human subsistence us of plant taxa.

26EU001734

For Site 26EU001734, it was concluded that "all of the identifiable burned seeds recovered from [features at the site] represent taxa that tend to flower and drop seeds in the spring and summer" (Schroedl 1995). An attempt was made to use the plant remains to address several research themes, such as subsistence, term of occupation, and processing intensity, but the sample was determined to be too small and natural deposition could not be ruled out.

1993–1994 Data Recovery Excavations in the North Block Tailing Impoundment Area

26EK004687

Of the 20 sites excavated during the 1993-1994 data recovery project, P-III was able to collect macrobotanical remains from nine of them (Coulam 1996). The first site is 26EK004687. The most ubiquitous taxon in macrobotanical samples from this site was widgeongrass (*Ruppia maritima*). This plant grows near brackish water of ponds and marshes, which indicates that the site was near a pond or marsh or that the occupants frequented ponds and marshes. Knotweed (*Polygonum* spp.), another riparian plant, was found along with widgeongrass in one feature (Firepit 4), further suggesting that ponds and marshes were important resource areas. The majority of the other recovered plant taxa are grasses that occur in close proximity to the site and that were concluded to most likely be the result of natural seed rain. However, creeping barberry (*Mahonia repens*) and fragrant sumac (*Rhus aromatica*) are represented by berries that would have been growing at some distance from the site, and it was concluded that these edible resources were brought back to the site and subsequently preserved as a result of accidental carbonization during processing.

26EK004690

At Site 26EK004690, only one lambsquarter (*Chenopodium* spp.) seed and one knotweed seed were collected, both of which are weedy species that were thought to most likely be the result of natural seed rain.

26EK004695

Multiple thermal features from Site 26EK004695 yielded macrobotanical remains. The presence of redwhisker clammyweed (*Polanisia dodecandra*) and widgeongrass in one feature (Firepit 1) was thought to indicate a focus on riparian habitats. Another feature (Firepit 3) contained a high diversity of plant taxa including a riparian species (widgeongrass) and several grass species (lambsquarter, bluegrass [*Poa* spp.], Mormon needlegrass [*Stipa arida*], and sleepy silene [*Silene antirrhina*]). Such a high diversity was taken to indicate high mobility.

26EU001482

At Site 26EU001482, a contrary pattern was found, but the same behavior was ascribed to it. Here, a low diversity of plant taxa was concluded to indicate high mobility. Among the taxa recovered, at least two were concluded to have been used by humans: widgeongrass because it is found in standing water or ponds, which were not present at the site, and Mormon needlegrass because this taxon was used ethnographically (Coulam 1996).

26EU001483

Overall Site 26EU001483 had a very low diversity of plant taxa. Bluegrass was the most ubiquitous taxon, appearing in three features. The only conclusion made was that fragrant sumac was most likely used for its economic value, and that the presence of lambsquarter in a thermal feature was the result of a processing event.

26EU001530

For Site 26EU001530 it was concluded that a "low diversity of plant taxa may represent a lack of resource stress and high mobility" (Coulam 1996:463). Human processing of bluegrass was suspected because of the high ubiquity of this taxon at the site. The presence of seasonally restricted fragrant sumac was concluded to suggest a late summer occupation, and the presence of big sagebrush (*Artemisia tridentata*) and spring draba was attributed to either use as a fuel resource or natural seed rain (Coulam 1996:463, 465).

26EU001531

Seeds from one feature at Site 26EU001531 (Firepit 2) were thought to indicate a low degree of mobility due to a low diversity of seeds, as well as an early summer occupation. Seeds from a second (Firepit 6) included fragrant sumac and elderberry (*Sambucus caerulea*), which were taken to suggest a late summer–early fall occupation (Coulam 1996:517). Finally, it was proposed that a high frequency of Mormon needlegrass and bluegrass seeds co-occurring with big sagebrush in LBB area sites indicate that seeds of such taxa were roasted over fires fueled by sagebrush (Coulam 1996:520).

26EU001534

At Site 26EU001534, the presence of bluegrass and Mormon needlegrass was concluded to most likely represent local gathering events, whereas the presence of pepperweed (*Lepidium* spp.) in one feature (Firepit 4) was thought to suggest the use of "condiments to spice up their bland seed-based diet" (Coulam 1996:573). Further, widgeongrass and amaranth (*Amaranthus* spp.) seeds recovered from features were suggested to represent either the use of a distant riparian area or the former presence of wetlands near the site.

26EU001667

Overall, the features at site 26EU001667 produced a low diversity of plant taxa. The most ubiquitous taxon recovered was lambsquarter. The presence of this taxon, found in association with big sagebrush charcoal, was suggested to be consistent with the historic ethnobotanical use of grass seeds and chenopods, and it was also concluded that fragrant sumac was used by the site's occupants because of the economic value supplied by the fleshy fruits of this taxon (Coulam 1996:638).

Data Recovery Excavations at the Yaha Site

At Site 26EU001997, only four burned lambsquarter seeds were recovered from flotation samples. It was recognized that it is difficult to make any conclusions based on such a small sample size, but two reasons were given to think that the seeds were associated with human activities at the site: their presence in firepits, and ethnographic data that support the use of this type of seed (Steward 1997).

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

26EK005270

At Site 26EK005270, lambsquarter, knotweed, and water sedge (*Carex* [cf.] *aquatili*s) were interpreted as representing plant resources processed at the site that were transported from riparian environments. It was also concluded that the presence of both bluegrass and lambsquarter seeds, both of which occur locally, suggest that women at the site gathered grass seeds in the summer (Tipps 1996:3.35).

26EK005271

Seeds were not thought to have been a large contributor to the diet at Site 26EK005271 because of the low ubiquity of all the taxa represented. Lambsquarter, bluegrass, and widgeongrass were thought to have been used by people at the site and were taken to suggest a summer occupation. The site also produced remains of,wild mustard (*Brassica* spp.), an invasive species that is suspected to have been introduced into the region between A.D. 1680 and 1940, and it was suggested that Eagle Rock phase occupants of the site may have made use of this exotic plant after its introduction (Tipps 1996:4-65).

Data Recovery Excavation at Three Prehistoric Sites along Simon Creek

26EU002182

Of the three sites excavated during the Simon Creek data recovery project, only one, Site 26EU002182, produced macrobotanical remains (Birnie and Miller 1998). The taxa present at this site were thought to suggest summer-time seed gathering and processing activities. Charring of seeds was taken as evidence of human use. Lambsquarter was concluded most likely to have been collected locally, whereas knotweed and widgeongrass were concluded to have come from riparian environments. One woody plant, fragrant sumac, was recovered and was thought to have been used for fuel.

Data Recovery Excavations at Site 26EU1505 and Surface Collection, Mapping, and Testing of Site 26EK5278

The next two data recovery reports produced by P-III were those for Sites 26EU001505 and 26EK005278 (Schroedl and Tallman 1997; Tipps and Stratford 1996). Very few seeds were collected from these sites, and no substantive conclusions about human subsistence were made.

Two Penny Ridge: Numic Occupation along Boulder Creek

At the Two Penny Ridge site (26EK006231), enough macrobotanical remains were recovered to draw conclusions on a feature-by-feature basis (Coulam 1997). The presence of fragrant sumac in thermal features at the site, along with its high ubiquity, was taken to indicate human use. Remains of invasive species, such as stork's bill (*Erodium* sp.) and knotweed, were concluded to indicate that these exotics were quickly adapted into Native American diets. Seasonally available plant taxa were taken as evidence that the site was occupied from early to mid-summer.

1996 Bootstrap Data Recovery Excavations

The Bootstrap data recovery report included six sites, three of which produced macrobotanical remains: 26EK004749, 26EK004755, and 26EU001487 (Schroedl 1998). Little discussion of these remains is presented in the report other than to note broad similarities between the macrobotanical assemblage from Site 26EU001487 and those from "other large base camps" in the area (e.g., Schroedl 1998:131).

Data Recovery Excavations at Site 26EK4688

The presence of knotweed, buckwheat (*Eriogonum* sp.), and cactus (Cactaceae) remains in fire hearths at Site 26EK004688 was taken to indicate that these taxa may have had some economic importance, though the possibility that the specimens were deposited as part of the natural seed rain could not be ruled out. The occurrence of pine (*Pinus* sp.) specimens was suspected to indicate long distance transport from higher elevations.

7.2.3. Synthetic Analysis of Floral Data

As discussed, in the series of papers that Bright and colleagues have published in which the LBB area archaeological record plays a central role, they describe data that suggest that an expansion of diet breadth occurred in the area around A.D. 1300. As part of this, they refer to Coulam's (1996) early synthetic analysis of floral data from the LBB area, in which she argued that taxonomic richness in macrobotanical assemblages increased during the Eagle Rock phase; they do not themselves, however, present macrobotanical data that directly document such a pattern (e.g., Bright et al. 2002:169-172; Ugan and Bright 2001:1311).

As with the analysis of LBB area archaeofaunal data that was presented above, the comprehensive dataset compiled for this document makes it possible to now present an updated analysis of macrobotanical data, incorporating assemblages excavated since the compilation of Coulam's (1996) dataset, which consisted only of samples obtained through 1994. This enables a reevaluation of the claim that diet breadth, and specifically the diversity of the plant component of the diet, expanded at around A.D. 1300.

Data relevant to such an analysis are presented in Table 26. Here, only macrobotanical data from radiocarbon-dated features are presented, and, for purposes of this analysis, these features are assigned to phases based solely on their radiocarbon dates. Because the charred macrobotanical specimens from a feature can reasonably be assumed to be securely associated with the radiocarbon date from that feature, radiocarbon dates are the only information used to assign features to phases here, and the other chronological data used to assign analysis units to periods in Chapter 5 are not considered. In addition, because radiocarbon dates can be used for this analysis, features that date to the Middle Archaic period can be assigned to individual phases of the Middle Archaic. This contrasts with most other analyses presented in this document, in which Middle Archaic materials are simply assigned to a general Middle Archaic category as described in Chapter 5. Of the 61 features from the sites in the analysis sample for this document that have both radiocarbon dates and macrobotanical assemblages with charred seeds, 38 date to the Eagle Rock phase, 9 date to the Maggie Creek phase, 13 date to the James Creek phase, and 1 dates to the South Fork phase. Complete macrobotanical data for these features, as well as for other features for which radiocarbon dates are not available, are provided in Appendix H.

Table 26. Summary Statistics for Macrobotanical Samples from Radiocarbon-dated Features

Phase	Number of Radiocarbon-dated Features with Charred Seeds	Mean Number of Taxa	Mean Number of Specimens
Eagle Rock	38	1.66	9.26
Maggie Creek	9	1.22	6.22
James Creek	13	1.31	4.23
South Fork	1	1.00	1.00

It can be seen in Table 26 that the mean number of plant taxa (NTAXA) per feature is highest for the Eagle Rock phase, which suggests that the breadth of the plant component of the diet was greatest during this phase, as has previously been argued. As discussed above in the section on LBB archaeofaunal remains, however, it is important to control for sample size in an analysis of richness such as this, and one way to do so is to employ an analysis of covariance design in which regressions of NTAXA on sample size are compared. Such a comparison is illustrated in Figure 23 (the single South Fork phase sample, which consists of only one specimen, is excluded from this analysis, and sample size is logarithmically transformed to improve the fit of the data to statistical assumptions). Here, it is evident that plant richness increases with increasing sample size for both the Eagle Rock phase and the James Creek phase but not for the Maggie Creek phase. Though the differences in regression slope that occur here are not statistically significant ($F = 0.68$; $df = 2$, $p = 0.513$), they are at least consistent with the proposition that diet breadth was relatively wide not only during the Eagle Rock phase but also during the James Creek phase, and that it was relatively narrow during the Maggie Creek phase. In addition, an aggregate plant richness measure, calculated in the same manner as the aggregate vertebrate richness measure used above (with the James Creek and South Fork phase samples combined into a single Middle Archaic category), tracks vertebrate richness quite well (Table 27, Figure 24). Altogether, these differences in plant taxonomic richness are consistent with the pattern that is to be expected given the Artiodactyl Index and vertebrate richness data presented above: collectively, these lines of evidence from the LBB faunal and floral data present a coherent picture of high foraging efficiency and narrow diet breadth during the Maggie Creek phase, with lower foraging efficiency and broader diets both before and after this period.

Given that the available faunal and floral data from the LBB area collectively indicate consistent trends in foraging efficiency and diet breadth during the late Holocene, it is worthwhile asking whether other datasets from the cumulative sample of excavated sites also exhibit congruent patterns. These other lines of evidence are considered next, beginning with the evidence provided by ground stone artifacts.

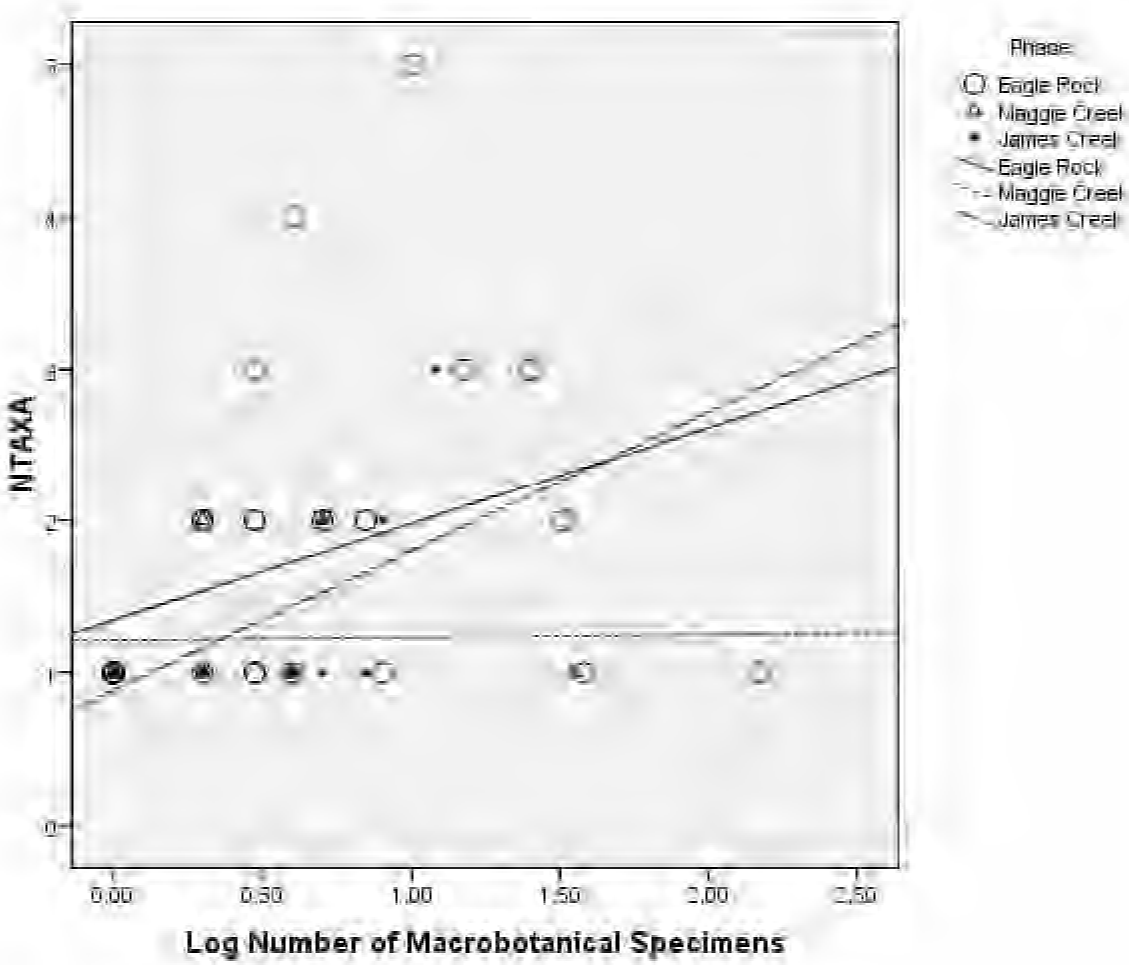

Figure 23. Relationships between plant taxonomic richness and sample size by phase.

Table 27. Aggregate Plant Taxonomic Richness Values for the Three Analysis Time Periods

Analysis Period	**Number of Taxa**	**Total Number of Specimens**
Eagle Rock	16	352
Maggie Creek	5	56
Middle Archaic	8	56

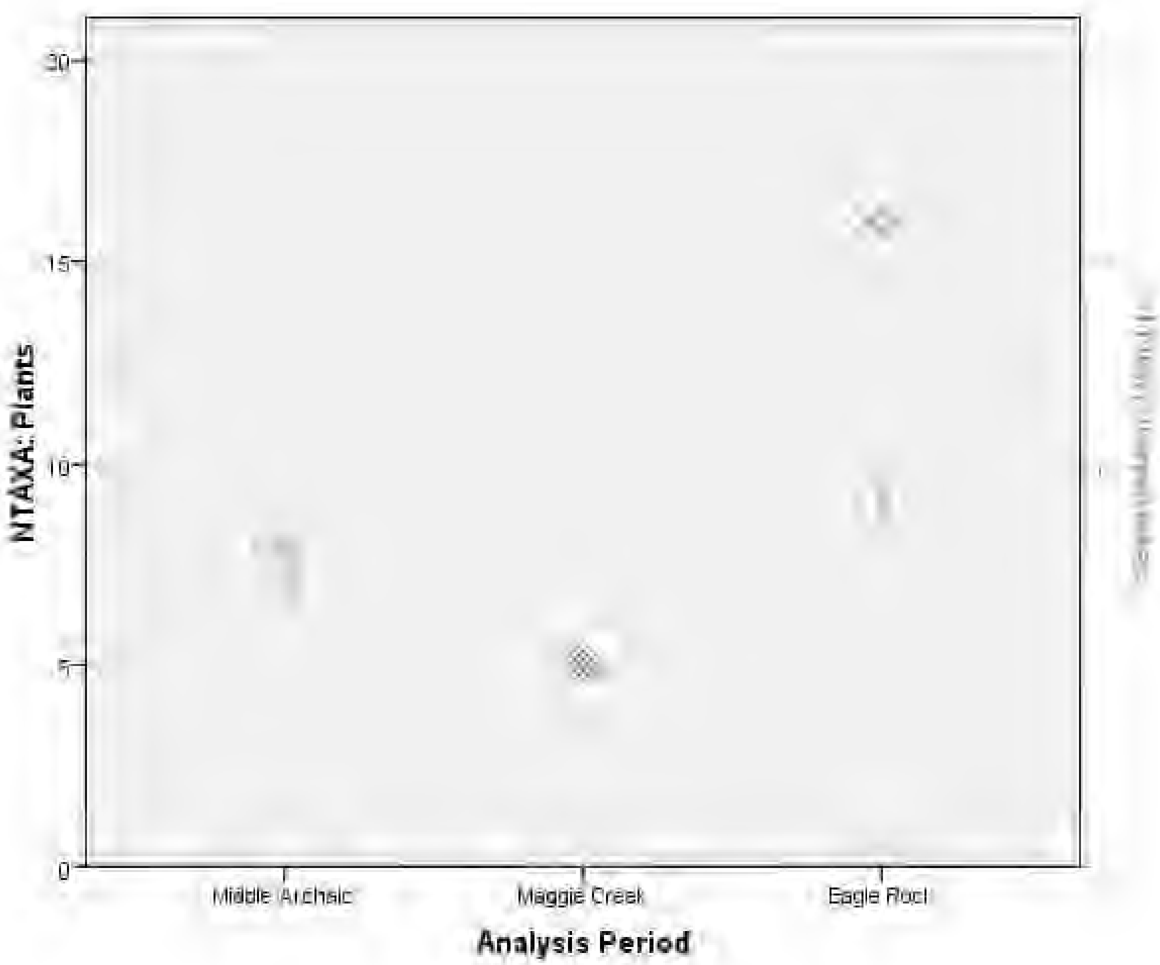

Figure 24. Aggregate plant (black diamonds) and vertebrate (gray dots) taxonomic richness values for the three analysis periods.

7.3. Ground Stone

In the earliest investigations of prehistoric sites in the LBB, the analysis of ground stone tools was only used as a subsidiary dataset when addressing questions of subsistence and settlement. However, as further work was conducted in the region, research questions were refined to better address the contribution of ground stone technology in understanding economic adaptations. In the following section, ground stone–related questions from excavation research designs are summarized. This is followed by summaries of the ground stone assemblages that were recovered from these excavations, and finally by a new synthetic analysis of ground stone data to complement the analyses of faunal and floral remains presented above.

7.3.1. Review of Research Questions

The research questions initially posed in the 1991 historic context only indirectly relate to ground stone (Schroedl 1991). The study of ground stone assemblages was expected to contribute to interpretations associated with subsistence and settlement patterns. It was proposed that subsistence patterns would be studied primarily through the analysis of faunal remains, macrobotanical data, and possibly pollen analysis. However, it was also proposed that functional interpretation of ground stone tool types could provide indirect evidence of subsistence practices.

Ground stone was also proposed as one dataset that might be used to classify sites according to Binford's forager-collector system. Residential bases in both foraging and collecting strategies are expected to exhibit evidence of residential maintenance. This evidence may include assemblages of ground stone, feature complexes, and pottery or specialized artifacts (Schroedl 1991:58). Resource procurement sites, on the other hand, would exhibit evidence of on-site procurement and extractive activities.

Ground stone analysis was to consist of descriptions of artifact morphology and categorization of tools into generally recognized types. The focus would be on identifying raw materials and their source, the methods of manufacture, and the amount of effort expended in tool production. The relative amount of wear on the artifacts would also be recorded (Schroedl 1991:98–99). Little detail was provided, however, on how these data would be used to draw conclusions concerning mobility and subsistence from the ground stone assemblage.

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

The first project in which ground stone–oriented research questions were addressed was the 1992 excavations in the North Block Heap Leach Facility Area (Schroedl 1995). Separate research hypotheses were developed for each site investigated (Zeanah et al. 1992). The hypotheses associated with ground stone focused on three areas: 1) types of food procurement and processing activities conducted at the site as evidenced by the tool assemblage; 2) the classification of the site as a residential base camp based on the presence of particular artifact types in the artifact assemblage, such as ground stone; and 3) the identification of site occupation duration as long-term or short-term based on whether the ground stone assemblage is curated or expedient.

1993–1994 Data Recovery Excavation in the North Block Tailing Impoundment Area

The research design for P-III's data recovery efforts in 1993 and 1994 is consistent with the theoretical approach outlined in the 1991 historic context, but it was refined based on the results of the 1992 excavations (J. B. Jones 1996b). Four areas were listed in which site-specific manifestations of settlement and subsistence patterns might be discerned through site assemblages: 1) the types of subsistence resources associated with an occupation; 2) the level of processing to which those resources were subjected; 3) the duration of occupation; and 4) the level and type of mobility of the site occupants.

The types of sites commonly found in the LBB area and the local environment do not encourage the preservation of floral or faunal remains. Thus, it was noted that the interpretation of the types of subsistence resources used and their level of processing must rely heavily on the analysis of tool and feature assemblages, or on identification of the functional interpretation of activity areas (J. B. Jones 1996b:65). For example, it was thought that the presence of a relatively high proportion of ground stone tools, ceramics, and rock-filled fire pits with chipped stone tools other than projectile points might reflect an emphasis on activities related to the final processing and consumption of resources. In contrast, an artifact and feature assemblage that has a diverse array of tools and features yet also indicates a short-term occupation could be the result of activities that reflect subsistence procurement, processing, and consumption. Though duration of occupation is apparently not well-interpreted from data recovered from ground stone assemblages, P-III proposed using ground stone to help address questions of relative mobility based on Russell's (1989) cost-benefit model for the production, use, and maintenance of milling implements.

Based on this model, it was expected that high mobility groups who occupy sites for a short time would leave expedient ground stone tools—unshaped tools with little wear that are discarded when still serviceable—in the archaeological record. Conversely, the presence of curated tools—which are shaped and rejuvenated, show extensive wear, and are discarded only when broken—was expected to indicate longer occupations by low mobility groups. In terms of the forager-collector model, collector base camps would tend to have curated ground stone assemblages, whereas forager base camps and collector field camps would tend to have expedient ground stone assemblages.

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

In the report detailing results from data recovery excavation at sites near upper Boulder Creek (Tipps 1996), research questions were taken directly from the treatment plan authored by Zeanah et al. (1993). The research questions pertaining to ground stone fall only under the domain of settlement strategy. Again, research objectives were focused on assessing site function and group mobility as understood in the forager-collector continuum. Mobility would be assessed using a cost-benefit model for the production, use, and maintenance of milling tools, as had been proposed in the research design for the 1993 and 1994 excavations. Potential interpretations that might be drawn from ground stone tool analysis were not explicitly stated in the research questions associated with subsistence patterns.

Data Recovery Excavations at Three Prehistoric Sites along Simon Creek

This report discusses the results of data recovery efforts at three sites (26EU002181, 26EU002182, and 26EU002183) that each date to different, consecutive prehistoric time periods (Tipps and Miller 1998). Thus, the research questions were focused primarily on temporal changes in settlement-subsistence patterns. However, three of the research areas presented in the report on the 1993 and 1994 excavations remained; namely, the types of resources exploited, how much processing those resources received, and the degree of of mobility. Sites were also still classified within the forager-collector continuum.

The first research question addressed what dietary resources were exploited by the occupants of each site. The expectation was that a predominance of milling artifacts would indicate that plant resources were being exploited (Tipps and Miller 1998:23). The second research question addressed the issue of whether subsistence resources were processed for consumption and storage on-site or if they were processed for transport elsewhere. The presence of a high proportion of tools and features associated the processing and consumption of resources—tools such as milling implements—with a relatively small food procurement tool assemblage could indicate that the site was a base camp associated with a logistic/collector subsistence strategy (Tipps and Miller 1998:25). The presence of a diverse assemblage of tools, including ground stone, would also be expected on a short-term forager base camp. The third question under settlement and subsistence strategy concerns the relative mobility of the occupants of the sites. In the case of high residential mobility, the cost of curating and carrying ground stone tools outweighs the benefit. Thus, ground stone tools would be expected to have little wear, to be lost or discarded while still serviceable, and to rarely be formally shaped. In the case of low residential mobility, ground stone tools would show extensive wear, be formally shaped, and would be discarded only after they were broken (Tipps and Miller 1998:29). It was noted in this report that the frequency of site reoccupation and the degree of scavenging on reoccupied sites can affect the character of the ground stone assemblage. Though multiple overlapping occupations of sites were considered in the discussion of interpreting the duration of site occupation in earlier research designs, this report contains the first explanation of what complications arise when interpreting ground stone assemblages from multiple occupations.

Two Penny Ridge: Numic Occupation along Boulder Creek, and 1996 Bootstrap Data Recovery Excavations

Several low-level research questions were outlined for the excavation of Two Penny Ridge (Schroedl and Kenzle 1997). The questions that could potentially be answered using ground stone data involved the following: spatial patterning of activity areas, site type and duration of occupation, food processing and procurement, and the nature of chipped stone and ground stone assemblages.

Similar research questions were proposed for the Bootstrap data recovery excavations (Schroedl 1998). The research designs for the individual sites included questions concerning the function of the site, the range of activities represented at the site, the level of mobility of the occupants of the site, and subsistence processing and consumption during occupation of the site. As in earlier reports, a cost-benefit model was used to assess mobility, and sites were classified on the forager-collector continuum.

Data Recovery Excavations at Site 26EK6487

In the 1998 and 1999 excavations at Site 26EK006487, P-III continued to construct a research design around low-level research questions (Birnie and Tipps 2000). The questions under the settlement and subsistence domain are simple: What food resources were used? What was the relative mobility of the site inhabitants? The chipped stone and ground stone tool assemblages at the site would be used as indirect evidence of subsistence activities at the site. Mobility would be assessed by analyzing the nature of both the chipped stone and ground stone tool assemblages in conjunction with the nature of features at the site.

Recent Peer-reviewed Research

As noted previously, in a series of articles (Bright et al. 2002; Ugan and Bright 2001; Ugan et al. 2003), Bright and colleagues have assessed subsistence models for the Great Basin derived from foraging theory and outlined a model of technological investment using data recovered from sites in the LBB. This "tech investment model" is focused on the technological changes that accompany subsistence transitions. One such transition, they propose, was an apparent shift in subsistence and settlement patterns in the Great Basin around A.D. 1300 toward decreased mobility, broadened diet breadth, and more diverse toolkits (Ugan and Bright 2001).

The tech investment model is similar to the cost-benefit model used by P-III to develop their research questions, discussed above, but it focuses on subsistence rather than mobility. The model elucidates the relationship between time invested in the manufacture of processing tools and resource handling time. Assuming that the time invested in manufacturing a tool cannot be invested into another activity and that time invested in tool manufacture leads to time saved in resource handling, the model shows that the greater the amount of time spent handling a particular resource, the higher the payoff for time invested in technology associated with that resource. The model thus predicts that, under conditions of declining foraging efficiency and expanding diet breadth, more time should be invested in technologies used to procure and process low return resources. Bright et al. (2002) test this prediction using data recovered from single-component occupations in the LBB.

According to Bright et al. (2002), milling efficiency can be improved by using milling stones made from raw materials of the appropriate coarseness and by shaping the stones to increase milling area and to better retain the milled resources, which, in the case of the LBB, are presumed to be mostly seeds. Thus, intentional shaping of milling stones and the use of non-local raw materials that are of a particular coarseness indicate increased investment. They hypothesize further that milling stones should appear in the archaeological record at the same time at which seeds enter the diet and that early milling implements should be expedient tools made from locally available material with no evidence of intentional shaping. Around A.D. 1200–1300, however, coincident with the apparent broadening of the diet, milling stones should increase in frequency in artifact assemblages, show evidence of intentional shaping, and more implements should be made of non-local materials. The increase in time invested to produce more efficient milling stones would at least partially offset the increase in time spent handling seed resources (Bright et al. 2002:173).

Bright et al.(2002) conclude that the data from the LBB support the tech investment model and that changes in the nature of tool assemblages are useful in answering questions of subsistence. Simply put, the more important a particular food resource becomes, the greater the investment that will be made in the kinds of technology used to process that resource.

Summary

Compared to the research frameworks that have been employed in most LBB area analyses of faunal and floral remains, those that have guided most ground stone analyses have been somewhat more sophisticated, employing models that relate ground stone use to mobility strategies in interesting ways. Bright and colleagues have taken this approach a step further by applying their model of technological investment to ground stone data from the LBB area, thereby linking changes in ground stone assemblages to changes in food resource selection. Analyses that update those of Bright and colleagues using the dataset compiled for this document are presented below. First, the ground stone assemblages that have been recovered from excavated sites in the LBB area are described.

7.3.2. Summary of Recovered Ground Stone

A total of 420 ground stone artifacts have been reported from the sites in the analysis sample for this document; these artifacts come from 33 sites of the 53 sites in the analysis sample. The recovered ground stone artifacts consist of 350 milling tools, 35 grinding tools, 7 hammerstones, and 28 indeterminate ground stone fragments. Complete data on these artifacts, as compiled from excavation reports, is presented in Appendix I. The gound stone assemblages from individual sites are briefly described next.

Archaeological Investigations at the Rossi Mine Sites

26EK002304

A total of 37 specimens was recovered from 26EK002304, consisting of 14 metates, seven manos, seven edge-ground cobbles, four hammerstones, and five indeterminate fragments. The metates are not shaped, indicating expedient design. The specimens classified as manos all showed evidence of extensive shaping and heavy use. The majority of specimens classified as edge-ground cobbles also show heavy use. The hammerstones recovered from the site have extensively battered edges. It is noted that one hammerstone is of a cryptocrystalline silicate material, though it is not known if it came from a locally available source or was procured elsewhere. In summary, the ground stone from 26EK002304 illustrates heavy use of both strategic (shaped) and expedient (unshaped) ground stone. Two of the edge-ground cobbles from the site had evidence of red staining, suggesting the use of these milling stones in grinding pigment or other minerals (Rusco 1982b).

26EK002305

At 26EK002305, two ground stone artifacts were collected. One is a large fragment from slab-type metate. The fragment has one extensively ground surface. The other artifact from this site is an edge-ground cobble that has one lateral edge that has been heavily used.

26EK002309

At 26EK002309, three metate fragments were collected. These fragments are from a plate-style metate and each has a single ground surface. One fragment also has a shaped edge.

1992 Data Recovery Excavations in the North Block Heap Leach Facility Area

26EU001524

Only one ground stone artifact was recovered from Site 26EU001524. This was a large fragment of a basin metate that showed moderate wear and no shaping, suggesting that it was of expedient design (Schroedl 1995:271).

26EU001734

A total of 13 ground stone specimens was recovered from Site 26EU001734. Eleven of these artifacts are metate fragments. These fragments show minimal to heavy use; the metates showing the most use are also the ones that have evidence of shaping. The only complete ground stone artifacts recovered from this site are a pestle and a polishing stone. Both of these artifacts have not been shaped beyond the shaping that resulted from use. All the ground stone artifacts at this site appear to be made of locally obtained materials. It was concluded that the low diversity of ground stone types as well as the expedient nature of most of these artifacts suggests a short-term occupation focused on expedient milling technology (Schroedl 1995:333).

26EU001320

Site 26EU001320 had 51 ground stone artifacts, consisting of 41 milling implements, two polishing stones, three edge-ground cobbles, and five abraders. The milling implements at this site are composed of five basin metate fragments, 11 slab metate fragments, four indeterminate metate fragments, nine one-hand manos, four two-hand manos, five mano fragments, and three pestles. All the milling implements are made from locally obtainable materials, with the exception of a mano made from vesicular basalt. P-III considered eight of the 18 manos and 11 of the 20 metates to be "curated", or formal as opposed to expedient, tools. They considered the abraders, edge-ground cobbles, and two of the pestles to be curated, and they noted that the artifacts made from coarser grained raw materials were more likely to be heavily used and curated. It was concluded that the diversity of ground stone at this site suggests at least one long-term residential occupation among the multiple prehistoric occupations evident in the mixed remains of the site (Schroedl 1995:437–438).

1993–1994 Data Recovery Excavations in the North Block Tailing Impoundment Area

26EK004687

Ground stone artifacts recovered from 26EK004687 consisted of 78 milling tools, nine grinding tools, and five indeterminate ground stone artifacts (Schroedl 1996). The milling tools are composed of 34 manos and 44 metates, and the grinding tools are composed of nine edge-ground cobbles. It was concluded that the site's large quantity of tools but low diversity of tool types suggests that a limited set of activities was conducted at the site (Schroedl 1996:198). This is supported by the fact that few of the ground stone implements from the site show evidence of secondary use, indicating that these tools were unifunctional. P-III also concluded that the existence of three ground stone clusters at the site suggests the presence of activity areas related to milling.

26EK004695

Six milling tools were recovered from Site 26EK004695: two mano fragments, three metate fragments, and an indeterminate ground stone fragment (Schroedl 1996). All the artifacts are of locally available materials and only one tool shows evidence of secondary use. One artifact is shaped. It was concluded that the low diversity of tool types and the expedient nature of most of the assemblage suggests that the site was used as a short-term, task-specific locus (Schroedl 1996:272).

26EK004696

Four milling implements were recovered from Site 26EK004696. These consisted of three metate fragments and a complete mano. With the exception of one basin metate fragment, the ground stone artifacts at this site appear to be expedient tools made of locally available materials.

26EU001482

The ground stone assemblage from Site 26EU001482 consists of a basin metate, slab metate, and an indeterminate ground stone artifact (Schroedl 1996). The indeterminate fragment was recovered from the rock lining of a fire pit, indicating that broken ground stone was recycled as a cooking or heating stone. Both the metate fragments are made of locally available materials and show moderate wear, suggesting use during a short-term occupation (Schroedl 1996:351). The coarse textures of the use surface indicate that these milling implements were used to process coarse-grained materials.

26EU001483

The ground stone assemblage from Site 26EU001483 consists of 15 milling tools and one indeterminate ground stone fragment (Schroedl 1996). The milling tools are composed of five manos, eight metates, and two pestles. Two of the metates, a basin metate and a slab metate, are complete; all other artifacts in the assemblage are fragments. Evidence of secondary use is present on all three one-hand manos and one of the pestles. Pitting observed on some of the metate fragments as well as the complete basin metate suggests that they may have had secondary use as anvils, though the pitting may also be the result of resharpening. It was concluded that a large number of curated tools and tools with secondary use at the site indicates that these ground stone implements were not considered disposable artifacts.

26EU001530

Eleven milling implements and a miscellaneous ground stone artifact were recovered from Site 26EU001530. The milling implements consist of a complete one-hand mano, four mano fragments, four metate fragments, and two pestle fragments. The miscellaneous ground stone artifact is an abrader fragment. All these artifacts are made of locally available materials. Secondary use is only evident on two tools, indicating that most ground stone tools at the site were unifunctional and discarded when broken. The spatial distribution of the ground stone artifacts was thought to perhaps be the result of multiple occupations at the site. It was also concluded that some of the artifacts were curated, indicating reuse of the site or the presence of longer occupations, though the presence of some expedient ground stone tools also implies some short-term occupations (Schroedl 1996:453–454).

26EU001531

Six milling implements were recovered from Site 26EU001531. These consist of three manos, two metates, and one pestle. All these artifacts are of locally available materials and four of them have been shaped. One mano has evidence of secondary use. It was concluded that the presence of expedient tools suggests that the site was a short-term residence or a task-specific locus, while the presence of portable curated tools suggests that the occupants of the site transported tools to this site. A slab metate fragment described as curated was thought possibly to have been stored at the site for use during reoccupation or to have been scavenged from a nearby site (Schroedl 1996:507).

26EU001534

The ground stone assemblage at Site 26EU001534 consists of 10 milling tools, two grinding tools, and one indeterminate ground stone artifact. Two of these artifacts, the abrader fragment and a one-hand mano, are of nonlocal material types. This suggests that the more portable ground stone implements were made and used elsewhere, and then transported to the site. Four of the tools were shaped and three show evidence of secondary use. These artifacts represent multiple occupations of the site. It was concluded that the presence of a curated metate suggests a possible long-term occupation, whereas the presence of expedient tools suggests shorter occupations or that the site was a task-specific locus (Schroedl 1996:567).

26EU001667

Eleven milling tools, three grinding implements, and one indeterminate ground stone fragments were recovered from Site 26EU001667. The milling tools consist of four mano fragments, a nearly complete basin metate, five metate fragments, and a pestle. The grinding implements consist of an abrader fragment and two polishing stones. This site has a relatively high diversity of tool types, indicating the presence of milling and nonmilling activities. Evidence of secondary use is present on the multifunctional mano and possibly on the basin metate fragment. It was concluded that this, and the fact that most artifacts are fragments, suggests that most of the tools were unifunctional and discarded when broken (Schroedl 1996:625).

26EU001906

A single rhyolite basin metate was recovered from Site 26EU001906. This metate is minimally shaped and exhibits moderate wear. The fact that the tool is of a locally available raw material and has only moderate wear and minimal shaping was thought to indicate that it was an expedient tool (Schroedl 1996:670).

Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavation at Sites 25EK5270, 26EK5271, and 26EK5274 in the East Basin Development Area

26EK005271

A total of 15 ground stone implements was recovered from Site 26EK005271. The majority (n= 14) of these tools are milling implements, consisting of manos, metates, a mortar, and a pestle. The remaining tool is an edge-ground cobble. All but one tool are made of locally available raw materials and four implements show evidence of shaping. Secondary use is evident on only a few implements. Most (n= 10) of the ground stone tools from this site are described as curated, and it was thought that these may have been left on site for reuse. The presence of apparently expedient tools was taken as evidence that the site was a short-term camp. It was concluded further that the site may have been repeatedly used as a short-term camp because of the quantity of apparently curated tools. Some tools were thought to possibly have been scavenged elsewhere and discarded on the site or to have filled a temporary need for expedient tools to supplement the use of curated tools (Birnie 1996c:4-49–4-50).

Data Recovery Excavation at Three Prehistoric Sites along Simon Creek

26EU002182

The ground stone assemblage at Site 26EU002182 consists of six milling implements, composed of four manos, a metate fragment, and a pestle fragment. All of these tools are made of local raw materials and only one mano is shaped. Evidence of secondary use is present on the pestle, indicating that most of the ground stone tools at this site were unifunctional. It was concluded that that the processing of plant resources occurred at the site, but that these were not an especially important part of the diet. It was also thought that the site likely represents multiple short-term occupations (Tipps and Miller 1998:92).

26EU002183

A single basin metate fragment was recovered from Site 26EU002183. This was described as an expediently manufactured, low-cost curated implement that was discarded after it was broken. The absence of other tools at this site was thought to suggest that milled substances were not important to the diet or that ground stone tools were taken elsewhere. It was also concluded that the fact that the metate was heavily worn suggests that this implement was reused during multiple, likely short-term, occupations (Tipps and Miller 1998:168).

Surface Collection, Mapping, and Testing of Site 26EK5278

The ground stone assemblage from this site consists entirely of milling implements, composed of manos and metates. All the ground stone tools are of locally available raw materials. A relatively high proportion of these tools were described as curated, which was taken as evidence that plant resources requiring grinding were an important part of the diet. It was thought further that the type of milling implements would have been most efficient at grinding small, hard seeds. It was concluded that the fact that most of the curated tools are manos suggests these tools were used by highly mobile groups that relied on predominately expedient milling technology with the use of a few easily portable curated tools (Schroedl and Tallman 1997:16–17).

Two Penny Ridge: Numic Occupation along Boulder Creek

A total of nine ground stone tools was recovered from Two Penny Ridge (Site 26EK006231). These tools consist of six milling implements, two hammerstones, and an indeterminate ground stone fragment. All but two of these tools are of locally available raw materials. One mano is shaped and two other artifacts were interpreted as low-cost curated tools; the remaining tools are described as expedient. It was concluded that the expedient nature of most of the assemblage points to short-term occupations, though it was also thought that expedient tools might have been used during longer site use as a complement to the curated tools (Kenzle 1997:D-3).

1996 Bootstrap Data Recovery Excavations

26EU001487: Bootstrap Bench

The ground stone assemblage at Bootstrap Bench consists of 16 milling tools and one ground stone pendant. The milling assemblage comprises manos and metates, a pestle fragment, and two indeterminate ground stone fragments. Over half of these artifacts are described as curated tools. It was concluded that the high number of milling implements combined with the high degree of curation indicates that the site is a residential base camp in which plants resources that required grinding were an important resource for the occupants. It was also thought that the relatively low diversity of milling tools suggests that the site represents multiple short-term occupations (Schroedl 1998:98).

26EU001492: Rodeo Overlook

The ground stone assemblage from Rodeo Overlook consists of four milling tools and one grooved abrader. The milling implements are mano and pestle fragments made of locally available raw materials that show no evidence of shaping. The mano fragments show minimal use, whereas the pestle fragment was intensively used. The abrader was also intensively used. Altogether, the milling assemblage consists of only a few expedient tools, which was thought to suggest that plant processing was not a focus of activities at the site (Schroedl 1998:171).

26EK004755: Round Mountain Camp

Two ground stone artifacts were recovered from Round Mountain Camp: a mano and a slab metate. The mano is an expediently manufactured and minimally used implement. However, the metate is extensively shaped and shows heavy use wear. Though the milling assemblage is small, it was concluded that the presence of a moderate- to high-cost curated metate suggests that plant resources requiring grinding formed a significant portion of the diet (Schroedl 1998:209).

26EK004749

Five milling implements and an indeterminate piece of ground stone were recovered from Site 26EK004749. All five of the milling artifacts were described as curated tools. It was concluded that this reliance on curated tools suggests that resources requiring grinding formed a significant portion of the diet of the occupants of the site. Also, the presence of potentially cached tools was thought to suggest that the occupants of the site expected to return to the site, perhaps as part of a seasonal round (Schroedl 1998:282).

26EU001520

Only two slab metate fragments were recovered from this site. Both artifacts are of locally available raw materials. One metate has been intensively use and shows evidence of resharpening, whereas the other metate is unshaped and has minimal use. No conclusions about these ground stone tools and their relationship to activities at the site were offered, but it appears that both formally-shaped and expedient ground stone technologies were used.

26EU001522

A single slab metate fragment was recovered from this site. The metate is made of locally available limestone, is not shaped, and shows moderate wear. Because only one ground stone artifact was recovered from 26EU001522, no conclusions were offered regarding the relationship of ground stone to subsistence and settlement patterns of the site's occupants.

Data Recovery Excavations at Site 26EK6487

Four ground stone milling implements were recovered from 26EK006487 (Birnie and Tipps 2000). All these tools are unshaped metate fragments that are made of locally available raw materials. Two metates have a minimally worn use surface, whereas the other two exhibit extensive use. It was concluded that the expedient procurement and design of the ground stone tools indicates occupation by highly mobile groups (Birnie and Tipps 2000:108).

Data Recovery Excavation at Five Prehistoric Archaeological Sites in the Little Boulder Basin

A total of seven ground stone tools was recovered from three sites: 26EU001533, 26EU001539, and 26EU002126 (Barger et al. 2008). These consisted of three mano fragments, two metate fragments, one hammerstone, and one indeterminate grinding tool. Six of these tools were described as expedient implements, and one metate fragment shows evidence of strategic design. All these tools or made of raw materials that are locally available. It was concluded that the predominant use of expedient milling technology suggests that the occupants of the area were highly mobile and that the low number of ground stone tools at the sites indicates that plant resources did not form a large part of the diet.

7.3.3. Synthetic Analysis of Ground Stone Data

The research questions that have been considered in regards to ground stone in the LBB area center on two themes: subsistence and mobility. Each of these themes is discussed separately in the following sections. Because milling tools make up most of ground stone assemblage from the area and are more suited to answering research questions about susbsistence and mobility, only milling tools are used in the following analysis; the small numbers of grinding tools (mainly tools classified as various types of abraders), hammerstones, and indeterminate ground stone specimens are not included.

Subsistence

Subsistence-oriented research questions proposed in most previous LBB area excavations can be distilled down to one overarching question: What did people eat? Ground stone artifacts are relevant to this question at a basic level in that the presence of milling implements at a site indicates that plant resources likely contributed some proportion of the diet there. Some previous excavation research designs have also proposed using ground stone to address the question of whether food resources were processed for consumption on site or were processed for transport elsewhere, but the conclusions presented often focus more on mobility and site function.

The contribution of ground stone to the study of LBB area subsistence strategies is better illustrated by Bright et al. (2002) in their discussion of the tech investment model. As previously summarized, this model delineates the relationship between time invested in manufacturing a particular technology and the time spent handling food resources associated with that technology. Bright and colleagues propose that the intentional shaping of ground stone and the acquisition of non-local raw materials may indicate increased investment in the processing of plant resources and, therefore, increased reliance on plant resources in the diet. Using this model, they propose that milling stone data indicate a shift in subsistence strategy around A.D. 1300. However, the ground stone dataset used to support this hypothesis is small, consisting of only 13 milling implements (Bright et al. 2002:173).

The hypothesis of Bright and colleagues can be evaluated more rigorously using the larger ground stone data complied for this document. In addition, the general principles of their tech investment model can be tested more thoroughly by exploring changes across all three time periods that can now be considered—Middle Archaic, Maggie Creek, and Eagle Rock—rather than just the two pre– and post–A.D. 1300 periods that they used. If they are correct, then we would expect to see evidence of changes in ground stone assemblages from dated prehistoric occupations in the LBB as follows. Milling tools from occupations dated to the Maggie Creek phase—when the faunal and floral data discussed previously indicate that foraging efficiency was high and low-return plant resources were accordingly relatively less important—should be made from locally available material and show little to no investment, as evidenced by intentional shaping. A low degree of investement in ground stone technology during this time would also imply relatively low numbers of milling tools overall. On the other hand, milling tools from both the Middle Archaic and the Eagle Rock phase—when other lines of evidence suggest that people spent greater amounts of time processing plant resources—should be more abundant, be more likely to be made of non-local materials, and show greater evidence of intentional shaping.

A total of 72 ground stone tools recovered from excavations in the LBB area can now be assigned to single-component occupations. Of these tools, 62 are milling implements. Counts of these milling implements by period are presented in Table 28; the artifact type categories used here are those used in the original excavation reports.

Table 28. Milling Tools from Single-component Occupations

Artifact Type	Middle Archaic	Maggie Creek	Eagle Rock	Total
One-hand mano	12		1	**13**
Two-hand mano	2			**2**
Indeterminate mano	8	3	1	**12**
Basin metate	1		2	**3**
Slab metate	20		6	**26**
Indeterminate metate	4			**4**
Pestle	1	1		**2**
Total	**48**	**4**	**10**	**62**

The artifact counts shown in Table 28 are consistent with the predictions outlined above in that fewer ground stone milling tools have been recovered from Maggie Creek phase occupations than from either Eagle Rock or, especially, Middle Archaic occupations. Absolute artifact abundances, however, are somewhat problematic as an indicator of technological investment since they are as much a function of the amount of effort that archaeologists have expended on deposits of a given age. To control for this factor, the ground stone artifacts from each time period can be subdivided into those from surface and subsurface contexts, and artifact counts can then be normalized either by the total surface area of investigated sites or site loci, in the case of surface artifacts, or by the total area of excavation units, in the case of artifacts from excavation. Such data are provided in Table 29. The area values used here are the sum of the areas of all single-component analysis units or excavation blocks assigned to each analysis period; areas of individual analysis units, as digitized from maps included in excavation reports, are given in Appendix F, and areas for individual excavation blocks, as reported in excavation reports, are given in the electronic database that accompanies this document (Appendix M). For the excavation data, excavation unit area, rather than volume, is an appropriate measure of excavation effort because buried archaeological materials in the LBB area generally occur within the first 20 cm below surface and excavations routinely proceed no deeper than this (see Chapter 6 for further discussion).

Table 29. Milling Stone Artifact Density and Shape Modification Index

Period/Phase	Context	Number of Ground Stone Artifacts	Area (m^2)	Number of GS Artifacts per m^2	Shape Modified	Shape Unmodified	Shape Modification Index
Eagle Rock	Surface	4	7,822	0.00051	3	7	0.30
	Excavation	6	860	0.00698			
	Total	*10*					
Maggie Creek	Surface	0	30,741	0.00000	0	4	0.00
	Excavation	4	340	0.01176[a]			
	Total	*4*					
Middle Archaic	Surface	8	82,681	0.00010	5	39	0.11[b]
	Excavation	40	291	0.13746			
	Total	*48*					

a. Area is not reported for one excavation block; this is therefore a maximum estimate.

b. Of the 48 Middle Archaic ground stone artifacts, 4 are not reported in a manner that allows determination of whether there shape has been modified.

When the amount of archaeological investigation effort is controlled by normalizing artifact counts by area in this way, the density of milling artifacts from surface contexts does vary in the manner predicted: it is lower during the Maggie Creek phase (0.00000 artifacts/m^2) than during either the Middle Archaic period or the Eagle Rock phase (0.00010 and 0.00051 artifacts/m^2, respectively), consistent with the proposition that investment in milling stones was lowest during the Maggie Creek phase. Among the ground stone artifacts from subsurface contexts, on the other hand, density is higher for the Maggie Creek phase assemblages than for the Eagle Rock phase assemblages and thus does not vary in the manner predicted. However, the area of one Maggie Creek phase excavation block that is included in the sample cannot be determined from the relevant excavation report, and the Maggie Creek phase excavation area used here (340 m^2) is thus a minimum estimate. As a result, the excavation density value derived for the Maggie Creek phase may substantially over-estimate the true value.

The second measure of investment in ground stone technology that is used in this analysis is refered to here as a "shape modification index". This index is analogous to the measure of "intentional shaping" used by Bright et al. (2002), and it reflects the abundance of ground stone artifacts that are described in excavation reports as being formally shaped in some manner relative to those that are described as not being so shaped. As such, this index should co-vary with the amount of time that individuals spent manufacturing food processing implements. This index varies among the three LBB time periods in the manner that is predicted based on the tech investment model, being higher for the Middle Archaic and Eagle Rock assemblages than for the Maggie Creek assemblage, though due to small sample sizes, the differences are not statistically significant (chi-square = 3.07, $df = 2$, $p = 0.216$). Despite the lack of statistical significance, however, the shape modification index and ground stone artifact density collectively present a consistent picture of lower investment in grinding technology during the Maggie Creek phase than either before or after this time (Figure 25). The ground stone shape modification index (Table 29, Figure 25) also tracks aggregate plant richness (Table 27, Figure 24) quite well, suggesting that the patterns observed in the ground stone data are indeed reflecting patterns in foraging efficiency and the breadth of the plant component of the diet.

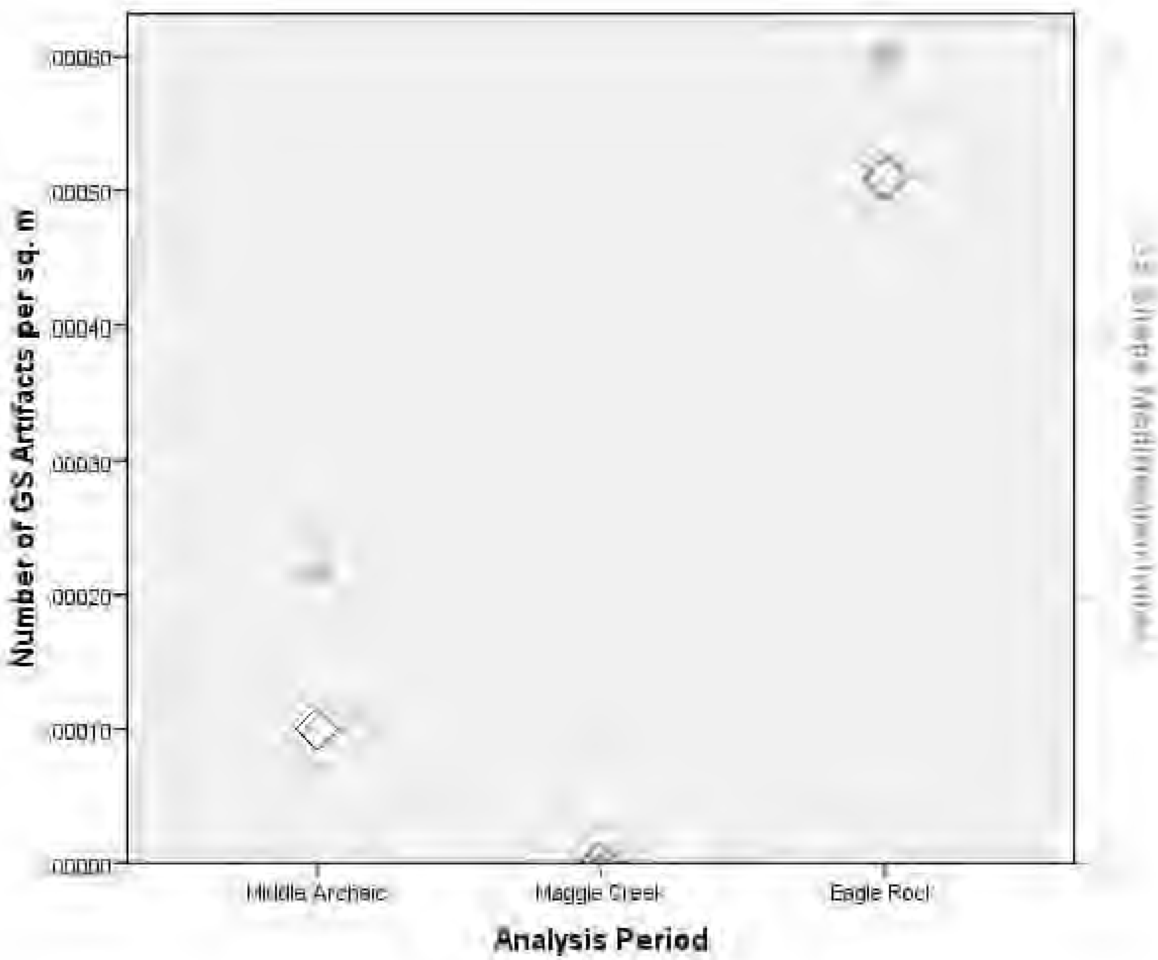

Figure 25. Density of ground stone artifacts from surface contexts (black diamonds) and ground stone shape modification index (gray dots) by analysis period.

Finally, the hypothesis of Bright et al. (2002) that a higher proportion of non-local materials would be present in post–A.D. 1300 milling assemblages is not supported by the available data from LBB area sites. All of the milling artifacts from single-component occupations are made of locally available materials, as indeed are most of the ground stone artifacts from LBB sites overall whether or not they are single-component. The only non-local material present in LBB ground stone assemblages is vesicular basalt (Birnie 1996b:709). Among all ground stone tools in the analysis sample for this document for which a material type was identified (milling and grinding tools from all occupations), vesicular basalt makes up only 1.9 percent of the milling assemblage and 2.4 percent of the ground stone assemblage as a whole. It should be noted that over half (55.6%) of the vesicular basalt ground stone tools show evidence of intentional shaping, suggesting that ground stone tools from non-local materials are more likely to show intentional shaping than tools made of local materials. It should also be noted that even though a raw material is locally available, it does not necessarily mean that a particular specimen was obtained locally. The procurement of a ground stone specimen from beyond the local area would indicate an increased level of investment in ground stone technology, but because of the improbability of identifying the specific locale of procurement, conclusions must be drawn under the assumption that locally available materials were procured in the local area. Overall, the small percentage of ground stone made from non-local raw materials suggests that non-local raw material sources were never as important as local material sources in ground stone tool manufacture in the LBB.

Mobility

Ground stone tools have often been used in the LBB area to answer questions about relative mobility. The expectations underlying P-III's conclusions about ground stone and mobility, as noted, were based on a cost-benefit model for the production, use, and maintenance of milling implements. Central to their conclusions is the issue of artifact curation. It was expected that the cost of curating and transporting ground stone tools outweighs the benefit for groups with high residential mobility, whereas the benefit of curating outweighs the cost of transportation for groups with low residential mobility (Jones 1996:69). P-III measured curation by considering raw material source, evidence of shaping, intensity of use, number of use surfaces, presence of resharpening, the reuse of ground stone fragments, and the condition of the artifact in primary and secondary contexts (Schroedl 1995:Table 11). Ground stone tools could then be classified as expedient, low-cost curated, or moderate- to high-cost curated.

In the summary of ground stone tools analysis for sites excavated by P-III in 1993 and 1994, Birnie (1996b) concluded that the majority of the milling implements from LBB sites were expediently designed tools, suggesting that the prehistoric inhabitants of the area were selecting stones that did not need much modification to be used as milling tools. According to the model that P-III used, this would indicate the presence of more highly mobile groups. However, no attempt was made to evaluate relative mobility patterns in the LBB through time. Using the larger dataset now available, it should be possible to derive conclusions about changes in relative mobility of inhabitants of the LBB throughout prehistory. Bright and Ugan (2001) assert that there was an apparent shift in settlement patterns in the Great Basin toward decreased mobility around A.D. 1300. If the curated/expedient classification system used by P-III is an indicator of residential mobility, then the ground stone tools from sites in the LBB would be expected to reflect this transition by exhibiting an increase in the degree of curation at this time.

Table 30 presents the counts of expedient and curated milling tools, as classified by P-III, in assemblages determined in this document to be single-component. Tools in P-III's expedient category exhibit no shaping and minimal intensity of use, tools in their low-cost curated category are not shaped and have moderate to extensive use, and tools in their moderate- to high-cost curated category show evidence of shaping and have minimal to extensive use.

Table 30. Curated and Expedient Milling Technologies in the Little Boulder Basin

Milling Technology	Middle Archaic	Maggie Creek	Eagle Rock	Total
Moderate- to high-cost curated	8 (16.7%)	0 (0.0%)	3 (30.0%)	**11 (17.7%)**
Low-cost curated	11 (22.9%)	2 (50.0%)	3 (30.0%)	**16 (25.8%)**
Expedient	29 (60.4%)	2 (50.0%)	4 (40.0%)	**35 (56.5%)**
Total	**48**	**4**	**10**	**62**

Of the 62 milling implements from single-component occupations, 82.3 percent are not strategically designed; these tools consist of expedient and low-cost curated implements. This suggests that the prehistoric inhabitants of the LBB reduced manufacturing and acquisition costs by preferentially selecting cobbles and boulders that were suitable for milling activities without further modification. Over half (60.4%) of the tools from Middle Archaic occupations represent expedient technology, and moderate- to high-cost curated tools form only 16.7 percent of the assemblage. During the Maggie Creek phase, the milling assemblage is equally split between expedient and low-cost curated tools with no high-cost curated tools present. During the Eagle Rock phase, the ratio of expedient tools drops to 40.0 percent and the ratio of moderate- to high-cost tools increases to 30.0 percent. These data suggest that moderate- to high-cost curated tools became somewhat more important in the latest phase of prehistoric occupation in the LBB.

Though milling implements are relatively common in Middle Archaic assemblages, the fact that a higher percentage of these tools are expedient than is the case for later periods suggests that mobility was relatively high during this period. Birnie (1996b:716) notes that it may be that highly mobile groups would be less likely to reoccupy a site, and thus less likely to invest in manufacturing curated implements for storage. The higher percentages of curated tools in the Maggie Creek and Eagle Rock periods suggests that residential mobility was somewhat lower during these periods. However, the milling assemblages from Maggie Creek and Eagle Rock occupations are small, and more data from single-component milling assemblages dating to these phases are needed to verify this trend.

The ground stone data alone have perhaps limited potential in answering questions about residential mobility, and analyses of chipped stone tool assemblages, presented in Chapter 9, lead to somewhat different conclusions than those presented here. Chapter 10 further addresses the issue of residential mobility using the results of artifact analyses combined with observations of site structure and function, and the results of the ground stone and chipped stone analyses as they relate to mobility are considered together there.

Summary

Based on the results of previous data recovery excavations in the LBB, it appears that two different frameworks for interpreting ground stone assemblages each lead to a similar conclusion: around A.D. 1300 there is shift toward more investment in ground stone technology, indicating increased use of plant resources and perhaps decreased residential mobility, and prior to this, at around A.D. 700, there was a shift in the other direction towards less investment in ground stone technology.

Though P-III used the curated/expedient technology framework to make conclusions about residential mobility, this framework could also be used to draw conclusions regarding subsistence practices. Both this framework and the tech investment model are based on the relationship between investment in ground stone technology and the benefits of increased milling efficiency. Analyses guided by both models demonstrate that there were changes in the amount of effort invested into producing ground stone tools over time. However, both models have only limited research potential when focused on ground stone technology alone. If the hypotheses presented here are viable, we would expect to see changes in chipped stone technology, as well as in faunal, macrobotanical, ceramic, and feature assemblages. As has been noted already in this chapter, the hypothesis that changes in the degree of investment in ground stone technology were associated with changes in the importance of low-return plant resources in the diet is well-supported by the floral and faunal data from the LBB area, and the general "tech investment" hypothesis is evaluated further with reference to ceramic and feature data below. The implications of the LBB area ground stone data for understanding mobility patterns are considered with respect to chipped stone data from the area in subsequent chapters.

For the future, in order to better test the ground stone-related hypotheses that have been proposed for the LBB area, more ground stone assemblages from dated single-component occupations are needed. In particular, additional ground stone assemblages from single-component occupations that can confidently be dated to the Maggie Creek and Eagle Rock phases would be useful.

7.4. Ceramics

Prehistoric ceramics are rare in the LBB area, but they do occur in sufficient frequency that it is worthwhile examining them in a synthetic manner. Due to their rarity, they have played only a limited role in archaeological research designs for the area from the time of the 1991 historic context on. However, Bright (1998b) has summarized ceramic data from the LBB area, with a focus on understanding variability in ceramic assemblages from the region, and Bright and colleagues (Bright et al. 2002; Ugan and Bright 2001; Ugan et al. 2003) included ceramics in their application of the tech investment model to the LBB archaeological record. Because ceramic artifacts are relevant to the work of Bright and colleagues—work that provides an organizing framework for many of the other analyses presented in this chapter on subsistence—these artifacts are considered in this chapter even though they can certainly inform on a variety of issues beyond subsistence.

7.4.1. Review of Research Questions

As noted, because ceramics occur at only a small proportion of LBB area archaeological sites, they have not typically been considered in detail in research designs for the area. Accordingly, the review of previous research emphases for ceramics presented here focuses on the few synthetic treatments that have been completed. The first of these was Bright's (1998b) analysis of ceramics recovered by P-III through their 1996 field season, in which he considered four issues related to the manufacture, use, and discard of pottery.

First, Bright considered ceramic surface color in relation to vessel quality. The background for this stems from the fact that brownware ceramics, which are by far most common in the LBB area, are typically assumed to be associated with post–A.D. 1300, presumably Numic occupations, whereas grayware ceramics, which also occur throughout the eastern Great Basin, are usually thought to be associated with Fremont occupations. Bright suggests that the difference in color between brownware and grayware ceramics is primarily a result of vessel quality, with a grayer color resulting when potters make greater efforts to produce more durable vessels by firing them in a reducing or incompletely oxidizing atmosphere. Bright tests this hypothesis by comparing variables related to degree of investment in pottery manufacture between brownware and grayware sherds; the variables he considers, after Simms et al. (1997), are wall thickness, maximum temper size, vessel size, and degree of surface preparation. He finds differences between brownware and grayware ceramics in all of these variables that suggest that the graywares are, in general, "higher quality". In turn, he proposes, again after Simms et al. (1997), that the difference in quality is related to differences in mobility, with the higher quality graywares more likely to have been produced by people who were less residentially mobile and/or who stayed at individual sites for longer durations. By this logic, any association between brownare ceramics and Numic populations, on the one hand, and between grayeware ceramics and Fremont occupations, on the other, would presumably be merely an epiphenomenon resulting from differences in mobility between the two groups.

Second, Bright suggests, after Simms (1994), that pottery is more likely to occur at sites that were repeatedly occupied. As Bright notes, "leaving pots behind on sites that one is likely to return to extends the use of the vessel with each reoccupation and concurrently reduces the 'costs' associated with transport" (Bright 1998b:374). An association between ceramic use and site reoccupation in the LBB area does appear to be empirically supported, since, according to Bright, at least nine of the ten sites with ceramics in his sample have evidence for repeated occupation. Third, Bright states that the sites in the LBB area where ceramics occur appear to be limited to locations where clays are immediately available; specifically, certain areas along Boulder Creek and near Brush Creek and its confluence with Rodeo Creek.

The fourth factor that Bright discusses as being relevant to understanding ceramic assemblages in the area relates to the sexual division of labor. He suggests that the distribution of ceramics within the region is likely to reflect the locations where activities were conducted by females, the presumed manufacturers of pottery. He suggests further that, because ceramics are found only at sites close to clay sources, and because the ceramic assemblages from sites with large samples are non-standardized with respect to morphology and temper composition, women's logistical mobility was limited and they did not transport vessels away from the sites where they were produced.

Bright et al. (2002) pursue factors related to the use of ceramics further in their application of the tech investment model to the LBB area. They begin by noting that, though the use of ceramics for cooking can reduce resource handling times, it also takes considerable time to produce ceramic vessels, particularly ones that are highly durable. They state further that, in the LBB area, ceramics tend to be associated with milling stones and with hearths thought to have been used for cooking seeds (Bright 1998b; also see the analysis presented in Section 5.6.3 of this document), which suggests that seeds were the type of resources most often cooked in ceramic vessels in the area. From these premises, Bright and colleagues hypothesize that it would not have been cost-effective for individuals in the LBB area to have begun to use ceramics until they began to spend sufficient time processing seeds (i.e., at around A.D. 1300, as suggested by other lines of evidence discussed previously in this chapter). They hypothesize further that investment in ceramic technology would have continued to rise after this time with further increases in the amount of time spent in seed processing.

They suggest that their first hypothesis related to ceramics is supported since calibrated 2-sigma ranges for radiocarbon dates associated with ceramics in the LBB area tend to fall after A.D. 1200. The seven radiocarbon dates that they consider for this purpose all come from hearth features that are said to have "good associations" with ceramic sherds (Bright et al. 2002:174). They evaluate the second hypothesis by examining relative proportions of brownware and grayware vessels, which, as discussed above, are suggested to differ in color due to differences in manufacturing time investment. Of the ceramic vessels in the sample that they use, three of the four vessels that appear to pre-date A.D. 1600 are said to be lower-investment brownware vessels, whereas two of the three vessels that appear to post-date A.D. 1600 are said to be higher-investment grayware vessels.

7.4.2. Summary of Recovered Ceramics and Synthetic Analysis

Of the 53 sites in the analysis sample for this document, ceramics have been reported for 13; a total of 331 sherds have been reported from these sites. Sherd counts from these sites, subdivided by analysis unit (see Table 6) are presented in Table 31. Also shown in this table is the determination made in Chapter 5 regarding whether each analysis unit is single-component (see Table 19). More complete data on the ceramics from sites in the analysis sample are provided in Appendix J.

Table 31. Ceramic Sherd Counts by Analysis Unit

Site	Analysis Unit	Sherd Count	Single-Component?	Analysis Period
26EK002304	Site	15	No	
26EK004688	Activity Locus 9	4	Yes	ER
26EK004688	Activity Locus 11	2	No	
26EK004690	Other	1		
26EK004755	Surface Collection Block	79	Yes	ER
26EK005271	Other	6		
26EK006487	Excavation Block 4	1	Yes	ER
26EU001320	Area 1	1	No	
26EU001320	Area 2	2	No	
26EU001483	Surface Collection Block 2	2	No	
26EU001483	Surface Collection Block 3	117	No	
26EU001483	Other	2		
26EU001487	Excavation Block 1	91	No	
26EU001531	Other	3		
26EU001534	Excavation Block 2	2	?	
26EU001667	Surface Collection Block 1	1	No	
26EU001667	Surface Collection Block 3	1	No	
26EU001734	Site	1	No	

Nine of the sites in Table 31 are ones that Bright (1998b) used in his earlier analysis of LBB area ceramics; the tenth site that he used, 26EU002448, is one that was not excavated but that had ceramics recovered from the surface, and it is therefore not included in the analysis sample for this document. Four of the sites in Table 31 were not among those that Bright considered. One of these, 26EK002304, he presumably did not include because it was not excavated by P-III, and two of these, 26EK004688 and 26EK006487, were excavated after he completed his synthesis. It is unclear why the fourth, 26EK004690, was not included in his analysis since it was excavated by P-III prior to Bright's synthesis, though, to be fair, only a single sherd was recovered from an unclear context during mechanical stripping at this site (Schroedl 1996:243).

As noted, one of Bright's (1998b) conclusions was that sites with ceramics are limited in distribution within the LBB area to locations where clay is immediately available: specifically, along Boulder Creek extending to the north of the LBB proper, along Brush Creek, and along Rodeo Creek near its confluence with Brush Creek. The additional sites in the sample used here warrant a slight expansion of the distribution of known sites with ceramics in the area (see maps in Appendix A). Three of them—26EK004688, 26EK004690, and 26EK006487—are located to the north of Brush Creek, and two of these—26EK004688 and 26EK006487—are large sites located along a first-order tributary of Bell Creek. The fourth additional site in the sample used here, 26EK002304, is located in the hills to the west of Boulder Creek, fairly far north of all of the other LBB area sites known to have ceramics. It is not presently known whether clay sources would have been available prehistorically near the locations of these additional sites.

More directly relevant to the analyses presented throughout the rest of this chapter, the somewhat larger dataset now available can be used to reevaluate the hypothesis of Bright and colleagues that the inhabitants of the LBB area began to use ceramics in response to a decline in foraging efficiency and a corresponding expansion of the diet to inclue a greater variety of low return seeds. As noted, they found that ceramics were first used in the area around or slightly before A.D. 1300, with increasing investment in ceramic manufacture after this time, findings that support their hypothesis.

As was discussed in Chapter 5, there is a great need for better dating information for ceramics in the LBB area and, especially, more direct dating information such as can be provided by methods such as luminescence dating. For the time being, however, the age of ceramics can be evaluated using only the data that are available. In the dataset compiled for this document, of the three analysis units with ceramics that were determined to be single-component, all date to the post–A.D. 1300 Eagle Rock phase (Table 31). There are another nine analysis units with ceramics that are clearly multicomponent. The fact that the only single-component assemblages with ceramics date to the Eagle Rock phase is consistent with the hypothesis of Bright and colleagues that ceramics did not begin to be used in the area until around A.D. 1300, because it means at the least that there are no ceramics from single-component deposits that pre-date this time. However, because ceramics were among the data used in assigning analysis units to time periods, it is somewhat circular to use the periods assigned to analysis units to evaluate the age of ceramics. More useful information for doing this is provided by radiocarbon dates from features found near locations where ceramics have been recovered.

Of the 18 analysis units with ceramics (Table 31), 14 are spatial analysis units that correspond to discrete sites or site loci, and 4 are "other" analysis units that consist of materials from unknown or miscellaneous contexts within sites. All of the "other" analysis units are from sites at which there is clear evidence for occupation during multiple periods. For 13 of the 14 spatial analysis units, at least one radiocarbon date from an archaeological feature is available (for the fourteenth, Excavation Block 2 at Site 26EU001534, no potential chronological indicators other than ceramics are available). These dates are listed in Table 32, and further information about them is provided in Table 7 in Chapter 5. For eight of the spatial analysis units (indicated by asterisks in Table 32), the calibrated 2-sigma ranges for all available radiocarbon dates fall fully or mostly after A.D. 1300. Three of these eight are single-component Eagle Rock phase sites or site loci (Table 31). For the other five, though all all radiocarbon dates fall within the Eagle Rock phase, occurrences of pre–Eagle Rock projectile points (and in one case pre–Eagle Rock obsidian hydration measurements) led to classification as multicomponent. A total of 195 sherds are reported for these eight analysis units with primarily Eagle Rock phase radiocarbon dates, representing 58.9 percent of the entire sample of 331 sherds.

Table 32. Radiocarbon Dates from Analysis Units with Ceramics

Site	Analysis Unit	Lab No.	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EK002304	Site*	4148	470 ± 50	A.D. 1320–1350 A.D. 1390–1520 A.D. 1590–1620	0.047 0.915 0.037
26EK004688	Activity Locus 9*	132869	100 ± 40	A.D. 1680–1760 A.D. 1800–1940 A.D. 1950s	0.315 0.672 0.012
26EK004688	Activity Locus 11*	132867	210 ± 50	A.D. 1530–1560 A.D. 1630–1710 A.D. 1720–1830 A.D. 1830–1890 A.D. 1910–1950	0.034 0.287 0.454 0.072 0.154
26EK004755	Surface Collection Block*	96777	480 ± 60	A.D. 1310–1360 A.D. 1390–1520 A.D. 1590–1620	0.133 0.810 0.050
26EK006487	Excavation Block 4*	129155	150 ± 50	A.D. 1660–1790 A.D. 1790–1890 A.D. 1910–1950	0.468 0.354 0.178
26EU001320	Area 1	59609	100 ± 80	A.D. 1670–1780 A.D. 1800–1960	0.395 0.605
26EU001320	Area 1	59624	1420 ± 70	A.D. 440–490 A.D. 530–720 A.D. 740–770	0.053 0.908 0.033
26EU001320	Area 1	59608	330 ± 70	A.D. 1440–1670 A.D. 1780–1800	0.976 0.021
26EU001320	Area 1	59623	1960 ± 80	170 B.C.–A.D. 230	1.000
26EU001320	Area 1	59625	1460 ± 80	A.D. 420–690	0.995
26EU001320	Area 1	23901	1320 ± 80	A.D. 580–890	1.000
26EU001320	Area 1	59607	2270 ± 90	730–690 B.C. 550–90 B.C. 80–60 B.C.	0.022 0.962 0.011
26EU001320	Area 1	59621	1620 ± 60	A.D. 260–300 A.D. 320–570	0.047 0.953
26EU001320	Area 1	59622	1810 ± 50	A.D. 80–340	1.000
26EU001320	Area 1	59606	100 ± 0.6 % of modern	Modern	
26EU001320	Area 2*	59620	570 ± 90	A.D. 1260–1490	0.996
26EU001320	Area 2*	59610	170 ± 50	A.D. 1650–1710 A.D. 1720–1890 A.D. 1910–1950	0.202 0.624 0.175
26EU001483	Surface Collection Block 2	69155	1060 ± 50	A.D. 890–1050 A.D. 1090–1120	0.970 0.024
26EU001483	Surface Collection Block 2	69154	970 ± 60	A.D. 970–1210	1.000
26EU001483	Surface Collection Block 2	69153	1750 ± 100	A.D. 70–470 A.D. 480–530	0.951 0.049
26EU001483	Surface Collection Block 3	69151	110 ± 90	A.D. 1660–1960	1.000

Table 32. Radiocarbon Dates from Analysis Units with Ceramics

Site	**Analysis Unit**	**Lab No.**	**Conventional Radiocarbon Age (^{14}C yrs. BP)**	**Calibrated 2 Sigma Range**	**Calibrated Range Probability**
26EU001483	Surface Collection Block 3	69152	820 ± 70	A.D. 1040–1110 A.D. 1120–1290	0.163 0.837
26EU001483	Surface Collection Block 3	69150	920 ± 80	A.D. 990–1260	1.000
26EU001487	Excavation Block 1*	109932	510 ± 50	A.D. 1310–1360 A.D. 1390–1460	0.244 0.756
26EU001487	Excavation Block 1*	96775	30 ± 50	A.D. 1680–1730 A.D. 1810–1930 A.D. 1950–1960	0.252 0.713 0.035
26EU001487	Excavation Block 1*	96774	100.4 ± 0.9 % of modern	Modern	
26EU001487	Excavation Block 1*	96773	0 ± 70	A.D. 1680–1740 A.D. 1740–1760 A.D. 1800–1940 A.D. 1950–1960	0.259 0.022 0.689 0.030
26EU001667	Surface Collection Block 1	69171	220 ± 60	A.D. 1520–1600 A.D. 1620–1710 A.D. 1720–1890 A.D. 1910–1950	0.119 0.288 0.461 0.131
26EU001667	Surface Collection Block 1	69167	300 ± 60	A.D. 1450–1680 A.D. 1780–1800	0.952 0.038
26EU001667	Surface Collection Block 1	69169	60 ± 70	A.D. 1680–1780 A.D. 1800–1940 A.D. 1950–1960	0.339 0.641 0.020
26EU001667	Surface Collection Block 1	69164	10 ± 50	A.D. 1690–1730 A.D. 1810–1930 A.D. 1950–1960	0.233 0.719 0.048
26EU001667	Surface Collection Block 1	74054	80 ± 50	A.D. 1680–1760 A.D. 1800–1940 A.D. 1950–1960	0.309 0.671 0.018
26EU001667	Surface Collection Block 1	69163	30 ± 50	A.D. 1680–1730 A.D. 1810–1930 A.D. 1950–1960	0.252 0.713 0.035
26EU001667	Surface Collection Block 1	69172	1380 ± 60	A.D. 560–730 A.D. 740–770	0.905 0.095
26EU001667	Surface Collection Block 1	74052	1110 ± 60	A.D. 780–1020	1.000
26EU001667	Surface Collection Block 1	74053	2790 ± 70	1130–810 B.C.	1.000
26EU001667	Surface Collection Block 1	74050	2150 ± 80	390–40 B.C. 30–20 B.C. 10–0 B.C.	0.978 0.011 0.010
26EU001667	Surface Collection Block 1	69165	200 ± 50	A.D. 1640–1710 A.D. 1720–1890 A.D. 1910–1950	0.265 0.566 0.165
26EU001667	Surface Collection Block 1	69170	2540 ± 70	810–480 B.C. 470–420 B.C.	0.941 0.059
26EU001667	Surface Collection Block 3*	69166	40 ± 50	A.D. 1680–1740 A.D. 1810–1940 A.D. 1950–1960	0.258 0.712 0.030
26EU001734	Site	57784	2730 ± 80	1090–780 B.C.	0.991

Table 32. Radiocarbon Dates from Analysis Units with Ceramics

Site	Analysis Unit	Lab No.	Conventional Radiocarbon Age (^{14}C yrs. BP)	Calibrated 2 Sigma Range	Calibrated Range Probability
26EU001734	Site	57779	1450 ± 130	A.D. 330–880	0.996
26EU001734	Site	57780	140 ± 50	A.D. 1670–1780 A.D. 1800–1900 A.D. 1900–1950	0.441 0.376 0.184
26EU001734	Site	57782	230 ± 80	A.D. 1490–1710 A.D. 1720–1890 A.D. 1910–1950	0.497 0.395 0.108
26EU001734	Site	57783	2520 ± 70	800–480 B.C. 470–420 B.C.	0.921 0.079
26EU001734	Site	57781	1260 ± 60	A.D. 660–890	1.000

*Calibrated 2-sigma ranges for all dates from this analysis unit fall fully or mostly after A.D. 1300.

For the remaining five of the spatial analysis units with both ceramics and radiocarbon dates (those not indicated by asterisks in Table 32), at least some radiocarbon determinations fall prior to A.D. 1300. These sites and site loci are discussed in greater detail next.

A single sherd was recovered from Area 1 at Site 26EU001320. A total of 10 radiocarbon dates are available for this area, spanning the James Creek through Eagle Rock phases (Table 17). The excavation report on this site describes the provenience of this sherd only as Area 1 (Schroedl 1995), so it is not possible to determine with which, if any, of the radiocarbon-dated features within Area 1 this sherd may have been associated. The age of this sherd, therefore, cannot be evaluated.

The same is true of the ceramics from Site 26EU001483, where 2 sherds were recovered from excavation units within the Surface Collection Block 2 area and a very large sample of 117 sherds was recovered from surface and subsurface contexts in the Surface Collection Block 3 area. The former area contained features that produced radiocarbon dates that fall within the James Creek and Maggie Creek phases, while features in the latter area date to both the Maggie Creek and Eagle Rock phases. The excavation report on this site again does not associate ceramics with any individual features (Schroedl 1996). Bright et al. (2002:175) use the two radiocarbon determinations from Surface Collection Block 3 that fall within the Maggie Creek phase (lab numbers Beta-69150 and -69152) to date ceramics from this site, but they do not discuss their basis for associating ceramics with these dates. It seems best, therefore, to again treat the age of ceramics from this site as unevaluated.

Finally, single sherds were recovered from Surface Collection Block 1 at Site 26EU001667 and from Site 26EU001734. These analysis units produced, respectively, 12 and 6 radiocarbon dates, and in each case the dates span virtually the entire period of human occupation in the LBB area as it is documented by the radiocarbon record. The sherd from Surface Collection Block 1 at Site 26EU001667 was recovered, during excavation, from Firepit 6 (Schroedl 1996:627). Unfortunately, none of the radiocarbon dates from this site come from this feature (Table 7). The excavation report for site 26EU001734 does not associate the sherd from this site with any feature, dated or not (Schroedl 1995). Thus, the ceramics from these two analysis units cannot be associated with any radiocarbon dates.

In sum, the radiocarbon record seems to generally support the proposition that ceramics in the LBB area largely post-date A.D. 1300, as Bright et al. (2002) contended that it does. Almost 60 percent of the sherds that have been recovered from excavated sites in the area come from sites or site loci that are either clearly single-component and date to the Eagle Rock phase, or that have only Eagle Rock phase radiocarbon dates even though some earlier projectile points or obsidian hydration measurements are present. Virtually all of the remaining sherds, or about 40 percent of the total, come from sites or site loci that are clearly multicomponent. Perhaps the best that can be said is that no sherds can be confidently associated with features that have pre–Eagle Rock phase radiocarbon dates based on the information that is currently available in excavation reports for the area.

While these results are suggestive that ceramics date primarily to the Eagle Rock phase in the LBB area, it should also be clear from this discussion that the dating evidence that is available for ceramics from the area is far from definitive. In light of this, obtaining more secure dates for ceramics should be a high priority for future research in the region, as was also discussed in Chapter 5. It should go without saying that, for any future discoveries of ceramics, their provenience and relationships with any features should be carefully documented and reported, and any associated datable materials (e.g., charcoal from features, obsidian, etc.) should be submitted for analysis. In addition, to eliminate the uncertainties that arise when ceramics are dated based on associated materials, efforts should be made in future research to date ceramics directly through luminescence dating.

Regarding the larger question of the relationship between ceramic technology and subsistence changes in the LBB area, the available dating evidence at least tentatively supports the hypothesis that ceramics began to be used in response to a decline in foraging efficiency and a corresponding expansion of the diet to include more lower return resources such as seeds, which other evidence previously presented indicates happened at around A.D. 1300. A final line of evidence that is relevant to this hypothesis—that provided by thermal features—is considered next.

7.5. Thermal Features

Archaeological features, particularly thermal features such as hearths, have been discovered at numerous sites in the LBB area. These features have routinely been described and documented quite well in excavation reports for the area, such that it is not necessary to recapitulate feature descriptions here. Rather, the research issues to which archaeological features have been applied are discussed, and an updated synthetic analysis of feature-related data is presented. The focus is on evaluating and revising Bright's (1998d) previous very throrough thermal feature analysis, which incorporated data on features that P-III excavated from 1992 through 1996. An additional analysis pertaining to thermal features, which considered environmental and archaeological factors related to the distribution of features within the LBB area, was presented in Chapter 5.

7.5.1. Review of Research Questions

As noted, features have typically been described in considerable detail in LBB area excavation reports. Based on perceived variability in feature morphology and content, a fairly elaborate typology for features has been developed and was applied by P-III throughout much of their work in the area. This typology was fully described by Kenzle (1995) in P-III's earliest large-scale excavation report for the area. In this typology, features were categorized into types such as firehearths, firepits, firepits-with-rocks, rock-filled firepits, rock-lined firepits, and rock-capped firepits, among others. Though this work was primarily descriptive, feature-related data did play some role in P-III's early attempts to interpret site structure and settlement patterns in terms of Binford's (1980) forager-collector continuum (e.g., Schroedl and Coulam 1996), and efforts were also made to derive functional interpretations for individual feature types based on the ethnographic record (Kenzle 1996).

More recently, Bright (1998d) presented an updated analysis of thermal features in the LBB area, which differed somewhat in both typological approach and research orientation from P-III's earlier work. Bright first evaluated the diverse array of types into which Kenzle (1995) classified features, and he concluded that there were few statistically significant differences in measureable attributes among most of her types. On the other hand, when classified simply according to whether or not rocks were present, he found that there was a statistically significant difference in feature size, with features with rocks being notably deeper than those without. He therefore proposed a simply dichotomy between "firehearths" and "firehearths-with-rocks" and proceeded to explore subsistence-related differences among these two feature types. The differences he found include an apparent association between small mammal remains and thermal features without rocks, on the one hand, and between large mammal remains and features with rocks, on the other. In addition, he found that features without rocks contained significantly more seeds, on average, than features with rocks. Based on these differences, he proposed that hearths without rocks were used primarily for processing lower-return resources such as small mammals and seeds, whereas hearths with rocks were used primarily for processing higher-return resources such as large mammals. Finally, based on an apparent increase in the proportion of features without rocks relative to features with rocks, Bright suggested that the diets of LBB area hunter-gatherers broadened over time, especially after about A.D. 1250.

Bright and colleagues (Bright et al. 2002; Ugan and Bright 2001) subsequently relied heavily on this change in the relative abundance of different feature types in their exploration of changes in foraging efficiency and diet breadth in the LBB area and in their application of the tech investment model to the area. Indeed, it was the feature data, far more than any of the other lines of evidence that were available to them (all of which are examined in this chapter), that led them to propose that a change in subsistence occurred in the first place, in response to which changes in technology were developed. Because of the centrality of the feature data to the arguments of Bright and colleagues as they presented them, these data are reconsidered here in a manner that parallels Bright's original analysis.

7.5.2. Summary of Excavated Thermal Features and Synthetic Analysis

A total of 310 features of likely or presumed human origin have been reported from the sites in the analysis sample for this document, including both features found during manual excavation and features found during mechanical stripping; such features are present at 30 of the 53 sites in the sample. The data on these features that are used in the analyses presented here are presented in Appendix K, and more complete data on individual features are available in the electronic database submitted to BLM-Elko along with this document (Appendix M). Of the 310 archaeological features, 301 were classified as thermal features for purposes of the analysis presented here based on the descriptions and data that are available for them; the remaining 9 are described as non-thermal features (groundstone clusters, storage pits, organic or soil stains, and a single possible posthole), and these are not included in the analysis presented here. The sample of 301 thermal features that is used here is somewhat larger than the sample of 245 features from 21 sites that Bright (1998d) used in his analysis.

Features were classified, after Bright (1998d), into those with rocks and those without rocks based on the descriptions and data available for them. Of the available sample of 301 thermal features, 167 (55.5 percent) have rocks and 134 (44.5 percent) do not. Bright argued that the dichotomous classification of features into those with and without rocks was valid because there is a statistically significant difference in depth between them. Such a difference does occur in the larger sample used here (Mann-Whitney U = 1429.5, $p < 0.001$), as is illustrated in Figure 26. Significant differences between features with and without rocks also occur in length (Mann-Whitney U = 7233.5, $p < 0.001$), width (Mann-Whitney U = 7114.0, $p < 0.001$), and volume (Mann-Whitney U = 964.0, $p = 0.046$; summary statistics for all variables are presented in Table 33). It thus appears that there is statistical validity, as Bright argued, to this simple feature typology. However, it should also be pointed out that there is considerable overlap between features with rocks and those without in all dimensions of size, as the distributions in Figure 26 (and the large standard deviations in Table 33) make clear.

Table 33. Summary Statistics for Size Variables for Features With and Without Rocks

	Depth (cm)			Length (cm)			Width (cm)			Volume (l)		
Feature Type	n[a]	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.
Rocks Absent	74	8.8	4.3	132	50.0	24.8	130	42.7	21.5	37	8.4	10.1
Rocks Present	90	14.0	5.5	161	61.5	22.9	161	51.2	16.8	68	18.5	21.5

a. Number of features with a measurement for this variable reported.

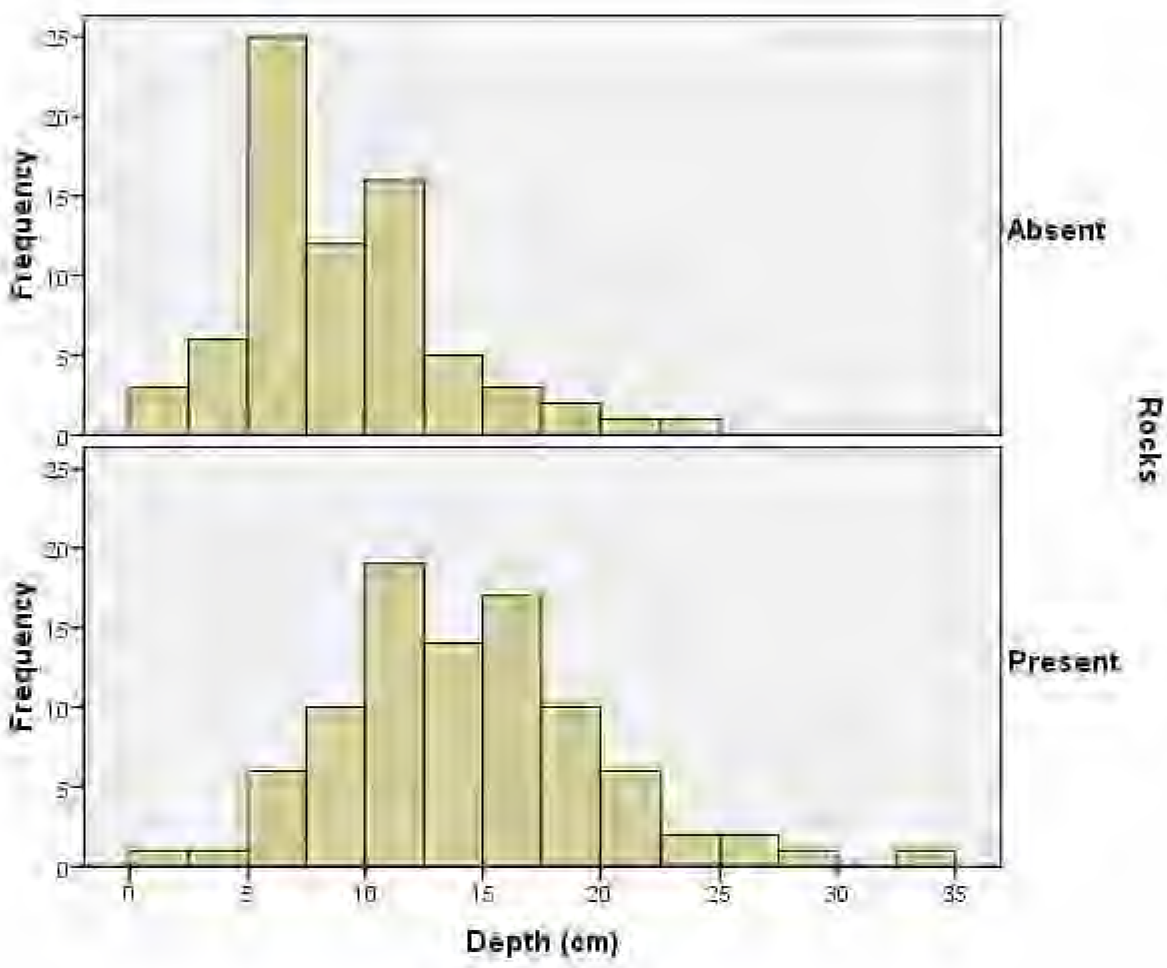

Figure 26. Distributions of feature depths for features with and without rocks.

Of greater import to the subsistence-related issues explored throughout this chapter are the differences that Bright (1998d) found between these two types of features. As noted, he suggested that features with rocks were associated with large mammal resources, whereas features without rocks were associated with small mammal and plant resources. These associations are assessed next, and relevant data are presented in Table 34.

Table 34. Summary Statistics for Faunal and Macrobotanical Variables for Features With and Without Rocks

	Artiodactyl Index			Rodent Index			Charred Seed Count		
Feature Type	**n**	**Mean**	**S.D.**	**n**	**Mean**	**S.D.**	**n**	**Mean**	**S.D.**
Rocks Absent	15	0.27	0.44	17	0.33	0.37	134	8.11	35.04
Rocks Present	12	0.34	0.49	14	0.23	0.42	167	2.72	9.35

To evaluate whether there is indeed an association between features with rocks and large mammal remains, the Artiodactyl Index (defined in the section on faunal remains above) can be compared between the two feature types. If Bright is correct, this measure should be higher, on average, for features with rocks than for features without, indicating greater abundances of large mammal (artiodactyl) remains relative to small mammal (leporid) remains in features with rocks. For features in the analysis sample from which artiodactyl and/or leporid remains were recovered, Artiodactyl Index values are higher, on average, for features with rocks than for those without (Table 34, Figure 27). This is consistent with Bright's conclusion that there is an association between hearths with rocks and large mammal remains. However, this association is weak—most features with rocks have no artiodactyl remains, and some features without rocks do—and the difference is not statistically significant (Mann-Whitney $U = 81.0$, $p = 0.608$).

Associations between feature types and particular types of vertebrate resources can be explored further by examining a "Rodent Index", calculated as the proportion of all identified mammal specimens (including specimens identified only to size class) that are rodents (or are identified to the "micro-mammal" size class). If Bright is correct about there being a tendency for small mammals to have been processed in features without rocks, this measure should be higher, on average, for such features than for features with rocks. Among features from which any identifiable mammals specimens were recovered, Rodent Index values are indeed higher, on average, for features without rocks than for those with rocks, which is again consistent with Bright's conclusions (Table 34, Figure 28). However, also again, the association is far from absolute, and the difference is not significant (Mann-Whitney $U = 91.0$, $p = 0.223$).

Finally, an association between plant food processing and hearths without rocks can be evaluated by considering, as Bright does, seed counts between the two types of features. Here, analysis is limited to charred seeds, as in the section on macrobotanical remains above. If Bright is correct that features without rocks were used more often to process seeds than were features with rocks, then seed counts should be higher, on average, in the former than in the latter. This is indeed the case (Table 34, Figure 29; note the logarithmic vertical axes in Figure 29), though, again, the association is again far from absolute—with many features without rocks producing no charred seeds and some features with rocks producing sizable seed samples—and the difference is not significant (Mann-Whitney $U = 10950.0$, $p = 0.730$).

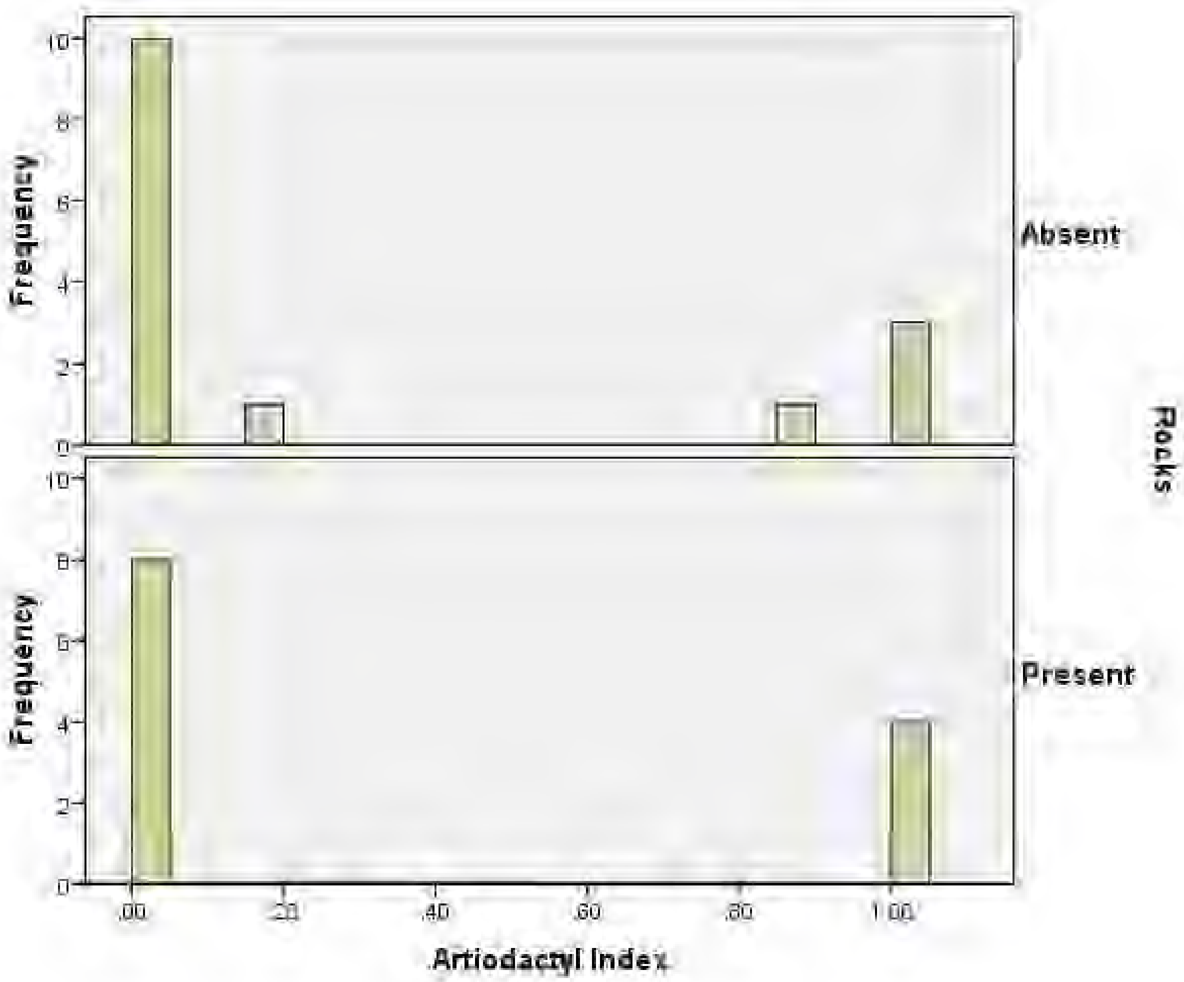

Figure 27. Distributions of Artiodactyl Index values for features with and without rocks.

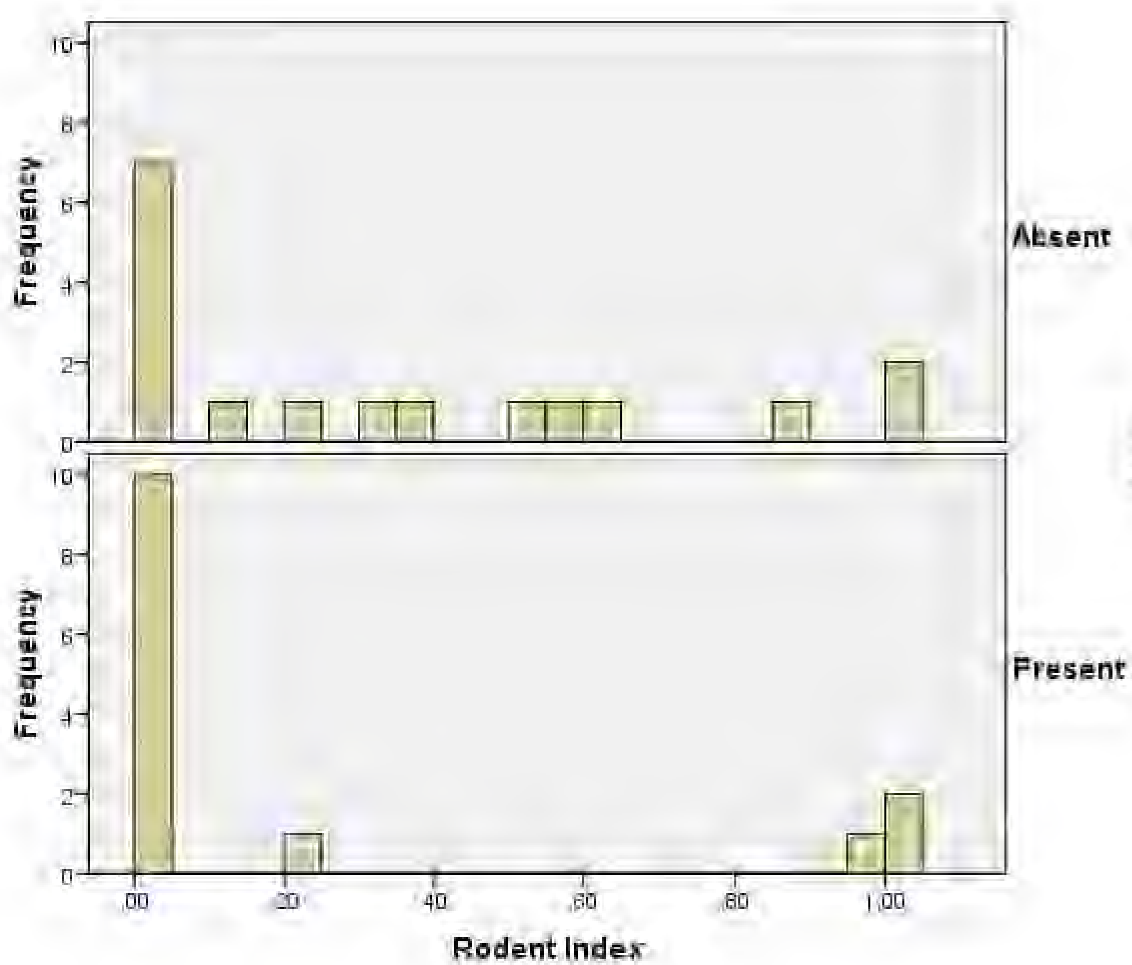

Figure 28. Distributions of Rodent Index values for features with and without rocks.

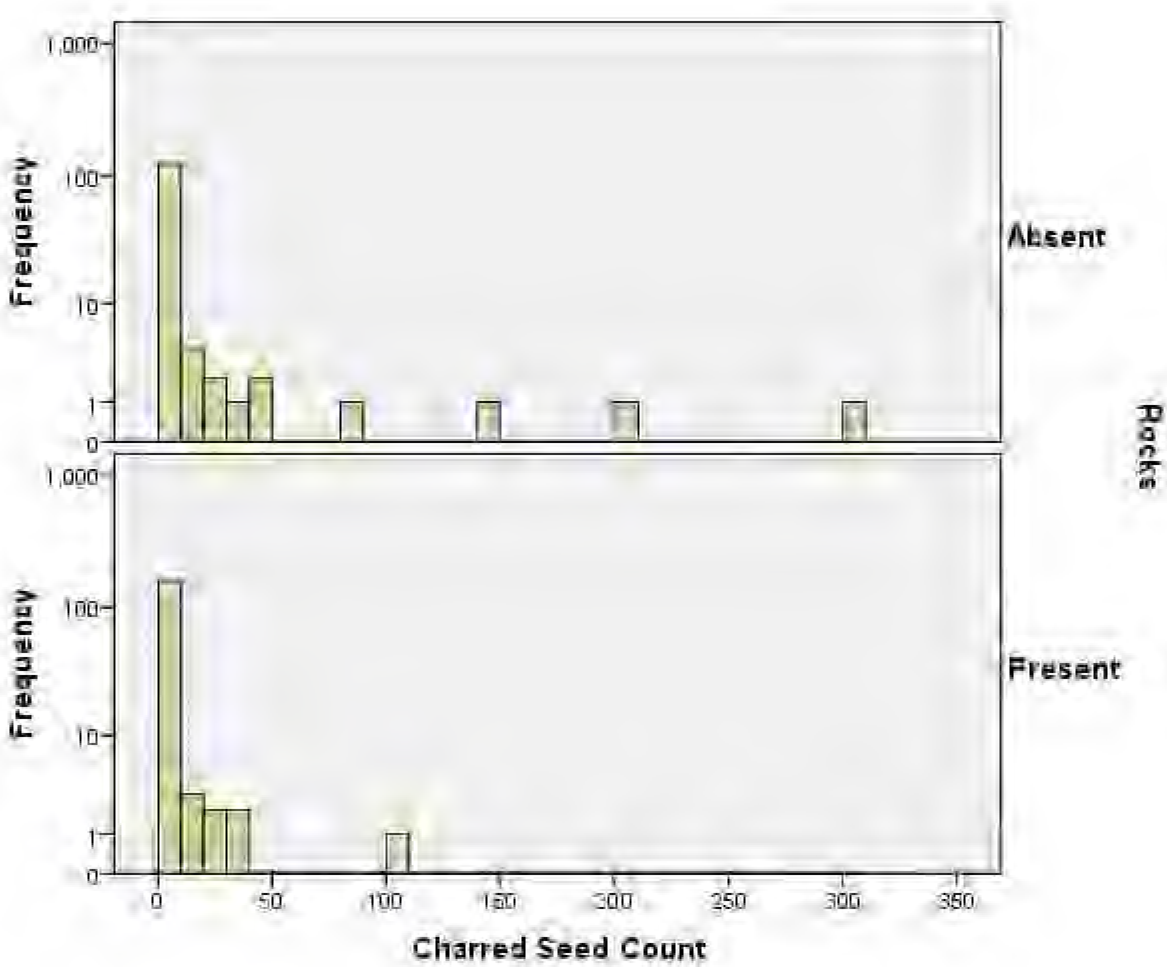

Figure 29. Distributions of charred seed counts for features with and without rocks

Overall, then, while the associations between feature types and resource types that Bright (1998d) proposed are supported in some sense by the larger dataset compiled for this document, these associations are weak and not statistically significant. There is, to be sure, an interesting temporal trend in the abundance of features without rocks relative to features with rocks, as Bright found. This trend is illustrated in Figure 30, which presents counts of all radiocarbon-dated features with and without rocks by the phase within which the calibrated 2-sigma ranges of their radiocarbon dates fall (as has been noted elsewhere in this report, there are three features with radiocarbon date ranges that straddle the James Creek and Maggie Creek phases). Excluding the very small South Fork and James Creek/Maggie Creek feature samples shown in Figure 30, only 12.5 and 23.5 percent, respectively, of James Creek and Maggie Creek phase features lack rocks, whereas 49.3 percent of Eagle Rock phase features do, differences that are highly significant (chi-square = 11.8, $df = 2$, $p = 0.003$).

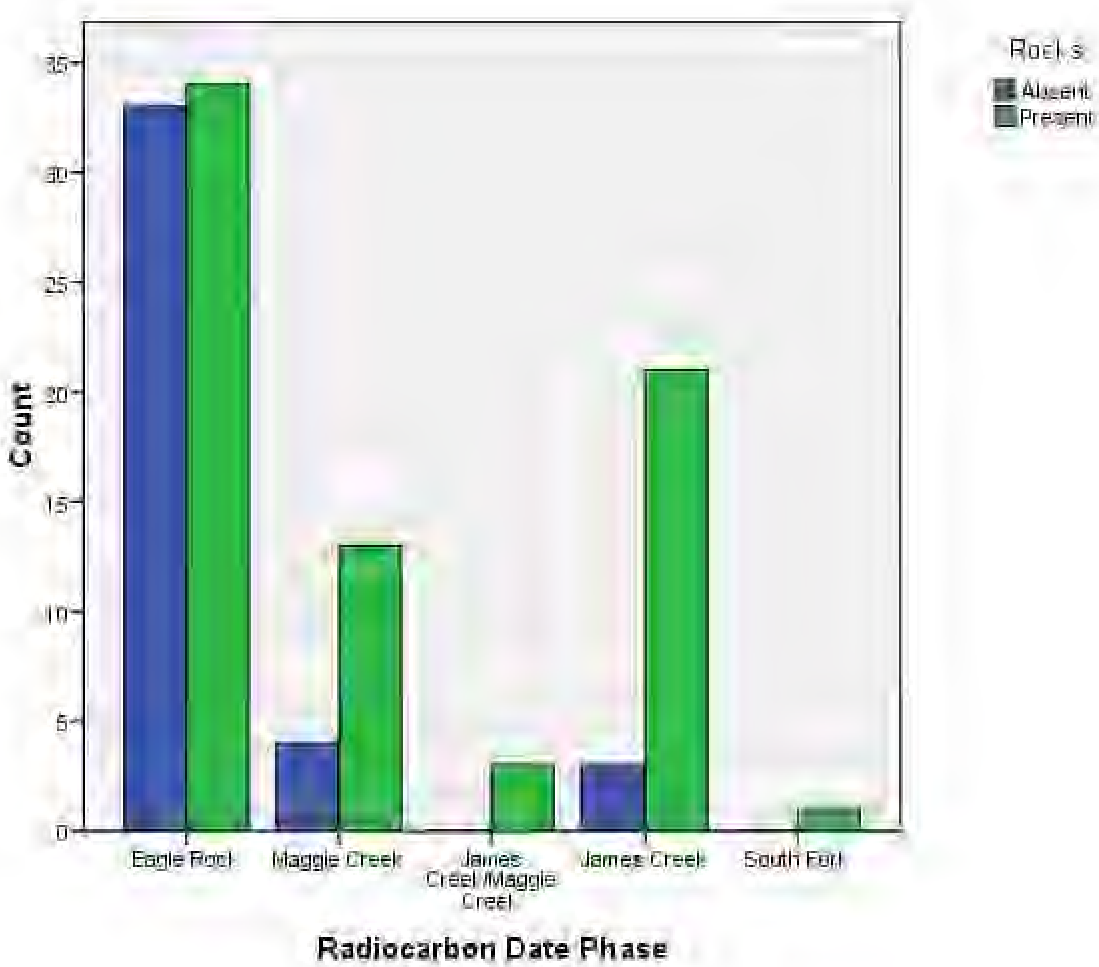

Figure 30. Counts of radiocarbon-dated features with and without rocks by phase.

Because hearths without rocks may have been used primarily to process low-return food resources, and because those types of hearths clearly did increase in relative abundance over time in the LBB area, these results could indicate changes over time in the relative importance of low-return resources to people in the region, as Bright and colleagues (Bright et al. 2002; Ugan and Bright 2001) have suggested. However, due to the weak and statistically insignificant associations between feature types and resource types, these data provide far less compelling documentation for such a change than do other types of data presented previously in this chapter. In particular, the faunal and floral data that are available from the LBB area demonstrate far more directly than the feature data can that foraging efficiency declined and diet breadth expanded between the Maggie Creek and Eagle Rock phases. To the extent that the association between feature types and resource types is real, the temporal pattern seen in the relative abundance of the two types of features is likely understandable as being a result of changes in foraging efficiency and diet breadth, in the same way in which the tech investment model makes changes in groundstone assemblages in the LBB area and the appearance of ceramics in the region understandable as such.

Another interesting pattern occurs in the abundance of all thermal features, regardless of type, normalized by the amount of excavated area as was done above with ground stone abundances; this pattern is shown in Table 35. The area values used here are the sum of the areas of all single-component excavation blocks assigned to each analysis period, as with the ground stone analysis above (Table 29), and the feature counts are the sum of all features found during manual excavation in those excavation blocks. The density of thermal features is far lower for Maggie Creek phase excavation blocks than for either Middle Archaic period or Eagle Rock phase excavation blocks, a pattern that closely matches those seen in other lines of subsistence-related evidence from the LBB area (e.g., Figure 24, Figure 25). If it is the case that thermal features were used mainly to process low-return resources whether or not they contained rocks—something that cannot presently be fully evaluated since most features contain few or no subsistence remains—then this pattern would again be understandable in terms of the tech investment model together with the faunal and floral data presented above.

Table 35. Number of Features per Square Meter by Analysis Period

Period/Phase	Feature Count[a]	Area (m^2)	Features/sq. m
Eagle Rock	30	860	0.03488
Maggie Creek	2	340	0.00588[b]
Middle Archaic	12	291	0.04124

a. Includes only features found in manual excavation; features found in mechanical stripping are excluded.

b. Area is not reported for one excavation block; this is therefore a maximum estimate.

One final point regarding this temporal pattern in feature densities deserves mention. As was discussed in Chapter 5, there are far more radiocarbon dates from the LBB area that fall within the range for the Eagle Rock phase than is the case for any other time period. This could indicate that the human population of the area and/or occupational durations were greater during the Eagle Rock phase than during earlier periods, if it were safe to assume that the ratio of radiocarbon dates per person per year of occupation remained roughly constant. The data in Table 35, however, indicate that it is clearly not safe to make such an assumption. For whatever reason—perhaps one related to subsistence, and particularly to temporal variability in the importance of the kinds of resources that were processed in thermal features—there is reason to think that the number of features per capita changed substantially over time. Thus, because all of the radiocarbon dates associated with prehistoric human occupation of the LBB area come from thermal features, it cannot be assumed that radiocarbon dates provide a valid measurement of human population size and/or occupational duration in the area. Rather, they may be telling us more about changes in the use of a particular type of technology that was used to process food resources.

7.6. Summary

As it has been developed in excavation research designs prepared for the LBB area since implementation of the 1991 historic context, the subsistence research domain has by now been thoroughly covered. The largely basic questions about subsistence posed in those research designs can be answered because we now know, in general, what types of food resources were used prehistorically in the area. Other research questions that have been considered—primarily those that revolve around Binford's (1980) forager-collector continuum—seem to have fallen by the wayside over the course of archaeological investigations in the area, perhaps due to an inability to develop methods for making sense out of subsistence-related data in terms of the forager-collector framework in a compelling manner. Such research questions may, in fact, now be obsolete, since analyses presented in the following two chapters of this document lead to an updated understanding of issues such as site function and mobility that is not based on Binford's framework.

Far more interesting questions related to subsistence—questions that can actually be addressed with archaeological data in a compelling way—derive from the work of Bright and colleagues (Bright et al. 2002; Ugan and Bright 2001; Ugan et al. 2003), which, though it originated during the course of P-III's compliance-oriented investigations in the LBB area (e.g., Bright 1998b; Bright 1998d), was developed primarily in the peer-reviewed academic literature. These authors presented intriguing hypotheses about changes in diet breadth and resultant changes in technology, and they argued that tests of those hypotheses against LBB area archaeological data were largely supportive. The analyses presented in this chapter represent updated tests of their hypotheses using a larger dataset and a more rigorous and finer-grained evaluation of the age of archaeological assemblages. These updated tests lead to even more compelling support for the general arguments that Bright and colleagues derive from their tech investment model, as well as a somewhat more complicated picture of changes over time in subsistence and subsistence-related technology in the LBB area.

7.6.1. Evidence for Patterns in Subsistence-Related Behavior

Patterns in the Artiodactyl Index (i.e., the abundance of artiodactyls relative to leporids) and in both vertebrate and plant taxonomic richness collectively indicate in a very consistent manner that foraging efficiency was higher, and diet breadth lower, during the Maggie Creek phase than was the case either before or after this time. These data, presented elsewhere in this chapter in their raw form, are reproduced in Figure 31 where they are shown as normal deviates (Z-scores) to facilitate comparison among them. (In their raw form, each of the variables has a different scale, and normalization into Z-scores enables comparison on a uniform scale.) The patterns that occur in these faunal and floral variables are consistent with the argument made by Bright and colleagues that diet breadth expanded at around A.D. 1300 (i.e., between the Maggie Creek and Eagle Rock phases); however, the analyses presented here reveal that substantial changes occurred before this time as well. Foraging efficiency was not uniformly high and diet breadth was not uniformly low prior to A.D. 1300, as the analysis of Bright and colleagues might lead one to believe, but it instead varied over time in such a way that it is the Maggie Creek phase that stands out in comparison to both the preceding Middle Archaic period and the subsequent Eagle Rock phase. The faunal and floral data also demonstrate changes in foraging efficiency and diet breadth far more directly and compellingly than to the thermal feature data, which was the primary indicator of diet breadth upon which Bright and colleagues relied.

Patterns in ground stone data track the patterns in the faunal and floral data very closely (Figure 31) and do so in a manner that is fully understandable in light of the tech investment model developed by Bright and colleagues. This model shows that it makes economic sense to invest more time in the production of technologies used to "handle" a particular type of resource, the greater the amount of time that is actually spent handling that resource. The LBB area faunal and floral data suggest that, due to lower rates of encounter with high-return resources, more time was devoted to low-return plant resources during the Middle Archaic period and the Eagle Rock phase than during the Maggie Creek phase. The greater overall abundances of milling implements and the evident greater investment in manufacturing such implements that characterize the Middle Archaic period and the Eagle Rock phase are, therefore, an entirely predictable consequence.

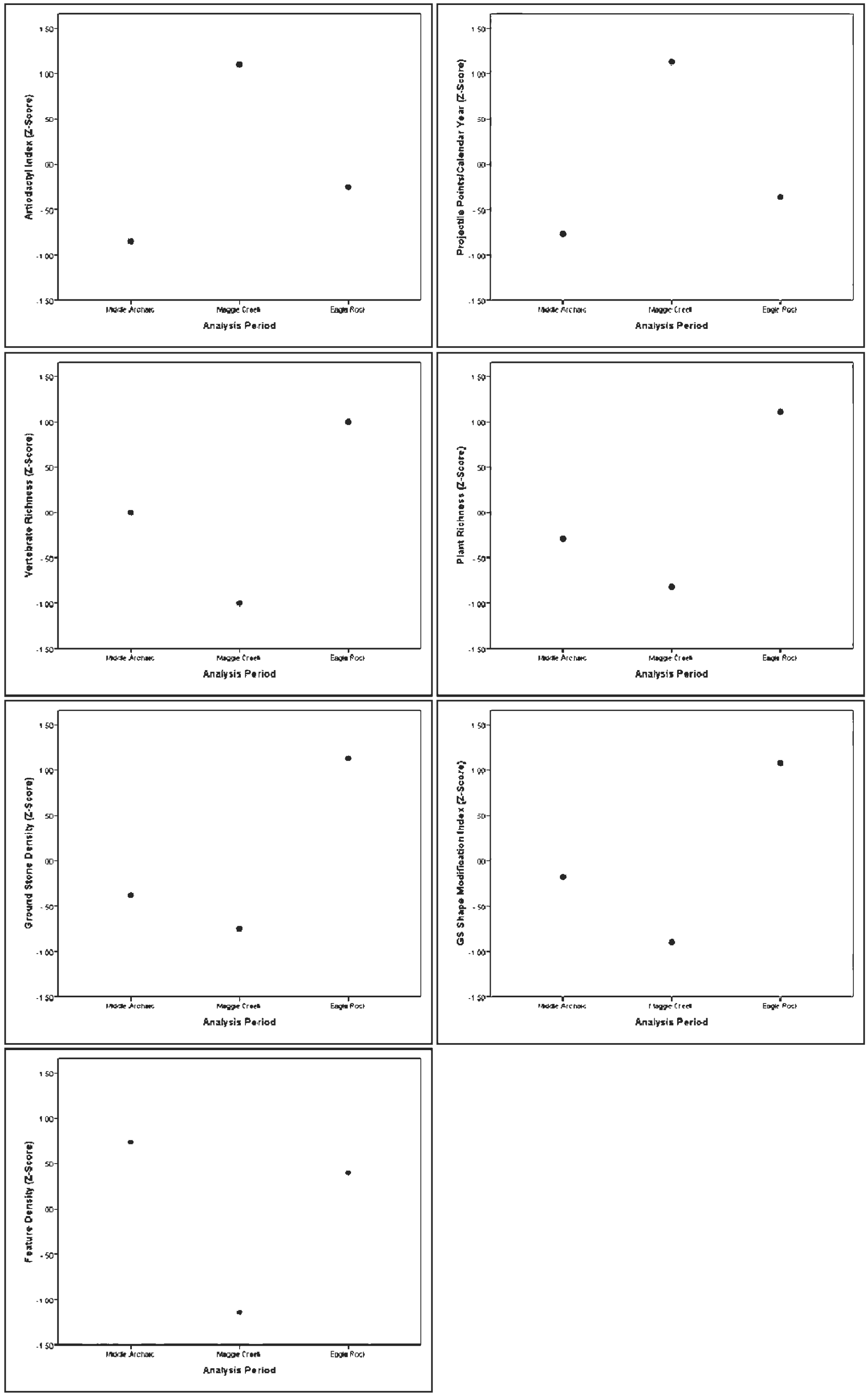

Figure 31. Comparison of temporal changes in subsistence-related variables, normalized as Z-scores.

Changes in projectile point abundances—discussed not in this chapter but in Chapter 5—are also fully understandable in light of the tech investment model. Projectile points appear to have been produced in larger numbers during the Maggie Creek phase than either before or after this time (e.g., Figure 6 in Chapter 5). Using the same methods that were used to produce Figure 12 in Chapter 5, which shows the distribution of all dating data per analysis period normalized by calendar year span, projectile point counts per calendar year for the Middle Archaic period, Maggie Creek phase, and Eagle Rock phase, respectively, are 0.16, 1.03, and 0.35 (Table 36). Because projectile points were clearly used for hunting vertebrates, and arguably primarily large-bodied vertebrates (e.g., Broughton et al. 2008), the fact that these time-normalized projectile point counts tracks the Artiodactyl Index nearly perfectly (Figure 31) is to be fully expected. As the tech investment model predicts, it appears that LBB area hunters spent greater amounts of time manufacturing projectile points when high-return large-bodied vertebrates were most abundant and when the greatest amount of time was consequently spent pursuing such prey. A comparable close correspondence between the Artiodactyl Index and a measure of projectile point abundance has also been observed across strata that span the Holocene at Hogup Cave, located in the Bonneville Basin approximately 300 km east of the LBB (Broughton et al. 2008).

Table 36. Projectile Point Counts by Time Period

Period/Phase	Number of Temporally Diagnostic Projectile Points Reported from Excavated Sites	Number of Projectile Points per Calendar Year
Eagle Rock	207	0.35
Maggie Creek	618	1.03
Middle Archaic	305	0.16

Note: Counts of Elko series points are split evenly between the Middle Archaic period and the Maggie Creek phase.

Finally, the evident appearance at around A.D. 1300 of ceramics, likely used primarily for cooking low-return seed resources (Bright 1998b), is understandable in terms of the tech investment model in the same way in which variability in the abudance of milling implements is. And, if it can be assumed that thermal features were also used primarily to process low-return, as opposed to high-return, resources, the fact that feature density tracks variability in all other lines of subsistence-related evidence considered here (Figure 31) would also make sense in light of the tech investment model.

Altogether then, a variety of independent measures are all consistent with the conclusion that artiodactyl encounter rates and foraging efficiency in the LBB were highest, and diets narrowest, during the Maggie Creek phase and that the degree of investment in technologies used to handle different types of resources varied accordingly[9].

7.6.2. Explaining Patterns in Subsistence-Related Behavior

This conclusion raises a new question: what caused the evident Maggie Creek phase peak in foraging efficiency, which was apparently associated with a whole suite of attendant changes in resource choice and technology?

[9] The fact that artifactual data such as those provided by ground stone tools and projectile points exhibit patterns that are so consistent with patterns observed in organic materials—faunal and floral remains—suggests that it is unlikely that the patterns that occur in the organic materials is solely a result of poor preservation of organics from earlier periods.

Regarding a cause, it is noteworthy that the span of time represented by the Maggie Creek phase—approximately A.D. 700 to 1300—corresponds to a time when climatic conditions throughout much of the Great Basin appear to have been quite favorable for both human foragers and their large mammal prey (see overview in Grayson 2006). Winter temperatures were likely elevated during this period, and summer precipitation evidently reached its late Holocene maximum due to more frequent incursions of monsoonal storms; both of these conditions can be expected to have resulted in increases in artiodactyl population densities (e.g., Broughton et al. 2008). At both Hogup and Homestead Caves, located in the Bonneville Basin to the east of the LBB, a range of measures of artiodactyl encounter rates exhibit a peak during precisely this time, a fact that is most likely the result of increased effective precipitation (Broughton et al. 2008; Byers and Broughton 2004). The suite of patterns seen in the LBB area archaeological record may thus be understandable as being a result of a several centuries-long improvement in rates of encounter with high return, large-bodied vertebrate resources, which led to increased foraging efficiency, reduced diet breadth, and changes in the relative importance of technologies associated with high- and low-return resources.

Evidence for other potential causes of the variability seen in the LBB area archaeological record is less compelling. Ugan and Bright (2001) implied that the post–A.D. 1300 decline in the Artiodactyl Index that they observed was a result of resource depression (e.g., Broughton 1994a, 1994b)—that is, a reduction in artiodactyl abundance caused by human predation. However, as was discussed in Chapter 5, evidence for an increase in human population density between the Maggie Creek and Eagle Rock phases—an important prerequisite for building a resource depression argument—is ambiguous. Though radiocarbon dates increase in frequency between these two phases in a manner that might suggest that human populations grew such that they could have reduced abundances of artiodactyls in the area, there is reason to think that the radiocarbon date frequencies may have more to do with changes in the frequency of thermal feature construction than with changes in human population density. In addition, projectile point frequencies, another potential indicator of human population density, decline between the Maggie Creek phase and the Eagle Rock phase (a decline that may also have more to do with changes in subsistence-related technology than with changes in human population density). And finally, the one increase in human population density that does clearly seem to have occurred in the LBB area took place between the Middle Archaic period and the Maggie Creek phase, but artiodactyl encounter rates seem to have increased significantly at this time. It is thus difficult to make the case that humans, through their predation, played any substantial role in structuring artiodactyl population density in the LBB area during the late Holocene.

Another potential cause of the Maggie Creek phase peak in the Artiodactyl Index might have been a temporary increase in male status competition and signaling manifested through large mammal hunting (e.g., McGuire and Hildebrandt 2005). However—aside from other problems with the signaling hypothesis as it has been developed for the prehistory of western North America (see Broughton and Bayham 2002; Cannon 2009; Codding and Jones 2007; Zeanah 2004)—though such a hypothesis might be able to account in a particularistic manner for the pattern observed in the LBB area Artiodactyl Index, it is difficult to see how it might also explain associated patterns in variables such as diet breadth and investment in ground stone technology. Changes in these aspects of behavior would appear to be no more than coincidental in light of the signaling hypothesis as it has been developed to date. They are perfectly understandable, though, as a set of responses to climate-induced variability in artiodactyl population densities in light of the prey model and its corollary the tech investment model. Climatic variability, therefore, seems to be the ultimate causal factor that can best explain the full suite of changes in subsistence and subsistence-related technology that are evident in the LBB area archaeological record. A comparable argument can be made for similar sets of changes in other parts of the northern Great Basin (Broughton et al. 2008; Byers and Broughton 2004).

7.7. Directions for Future Research

Based on the summary of subsistence-related conclusions just presented, and on other points made elsewhere in this chapter, research questions to guide future LBB area investigations within the subsistence domain can be proposed as follows.

7.7.1. Research Questions for Faunal Remains

Though zooarchaeological research in the LBB area is somewhat limited by poor preservation of faunal materials at open sites, faunal remains have proven useful for testing hypotheses about foraging efficiency and related issues. Going forward, larger samples—particularly from Middle Archaic contexts, for which only small samples are currently available—would certainly be useful for testing the temporal patterns described above more thoroughly and for beginning to also understand spatial variability in faunal assemblages (e.g., Hockett 2005). In addition, the patterns in vertebrate richness described above cannot presently be evaluated statistically, and additional pre–Eagle Rock phase faunal assemblages from would especially help alleviate this deficiency. And finally, to futher evaluate whether the patterns in the faunal data described above truly are reflecting variability in foraging efficiency, data should be collected, either from newly or previously excavated assemblages, on large mammal body part representation, artiodactyl age structure, and degree of bone processing (e.g., Broughton 1997; Cannon 2003; Nagaoka 2002; Ugan 2005).

Worthwhile research questions for future faunal analyses in the LBB are are thus:

- With larger sample sizes, are there statistically significant differences in vertebrate taxonomic richness among time periods?
- Are changes in mean utility or some other economic measure related to artiodactyl body part representation consistent with the evidence for variability in foraging efficiency that is provided by artiodactyl taxonomic relative abundance?
- Do patterns in artiodactyl age structure suggest that hunters experienced resource depression?
- Did the intensity of bone processing increase when other lines of evidence suggest that foraging efficiency declined?
- Is there spatial variability in faunal assemblages within the LBB area that is understandable in terms of the geographic distribution of different types of resources and/or different functional site types?

7.7.2. Research Questions for Macrobotanical Remains

As with faunal remains, macrobotanical remains from the LBB area have proven somewhat useful for evaluating hypotheses about changes in diet breadth, but available samples are presently too small for results to be statistically significant. Thus, again, larger samples would be helpful. In addition, developing an understanding of spatial variability within the LBB area would be just as important for floral resources as for faunal resources. And finally, it would be very worthwhile to conduct a detailed comparison of temporal and spatial variability in macrobotanical assemblages relative to faunal assemblages in order to determine if patterns are present that are interpretable in terms of the sexual division of labor (e.g., Zeanah 2004). These research needs lead to the following questions:

- Are there statistically significant differences in plant taxonomic richness among time periods?

- Is there spatial variability in macrobotanical assemblages within the LBB area that is understandable in terms of the geographic distribution of different types of resources and/or different functional site types?
- What do patterns in floral and faunal data suggest about settlement patterns in light of the division of labor model presented by Zeanah (2004)?

7.7.3. Research Questions for Ground Stone

Analysis of the LBB area milling tool assemblage indicates greater investment in milling technology during the Middle Archaic period and the Eagle Rock phase, as evidenced in part by intentional shaping to increase milling efficiency. However, the majority of the milling tool assemblage still represents expedient technology. Future research in the LBB would be expected to provide more information regarding the relationship between increased milling efficiency and increased exploitation of plant resources. As part of this, it would be useful for future research to consider variability in functional milling tool types, in addition to variability in simply degree of shaping or degree of "curation". In addition, because samples are currently too small for patterns in the degree of shaping to be statistically significant, larger assemblages of ground stone, particularly for the Maggie Creek phase, would be helpful. And finally, since it has been argued, in essence, that ground stone, ceramics, and at least some types of thermal features represent a technological complex designed for processing low-return seed resources (Bright 1998b), it would be worthwhile to further evaluate whether these things do, in fact, typically occur in tight spatial association.

Subsistence-oriented research questions for ground stone can therefore be phrased as follows:

- With larger sample sizes, does the degree of investment in milling technology exhibit temporal patterns that are consistent, in light of the tech investment model, with those observed in faunal and floral data? How about when mano length is considered (e.g., Hard et al. 1996) in addition to degree of shaping?
- Why are the majority of the ground stone milling tools from the LBB area relatively informally shaped ("expedient"), even from time periods when other lines of evidence suggest that the amount of time spent using them was relatively high?
- Are there differences in the functional types of ground stone tools present in Middle Archaic, Maggie Creek, and Eagle Rock occupations? What do the types of ground stone tools recovered indicate about the activities performed during these occupations?
- Are ground stone artifacts typically located in close spatial proximity to small thermal features?
- Does the presence of intentionally shaped milling stones coincide spatially with the presence of ceramic vessels?

7.7.4. Research Questions for Ceramics

Few ceramics have been recovered from sites in the LBB and even fewer can be assigned to single-component occupations or clearly associated with radiocarbon dates. A preponderance of the currently available evidence suggests that ceramics were not manufactured in the LBB area before about A.D. 1300, but because this evidence is so limited, ceramic chronology in the area is, in reality, poorly understood. More ceramics from single-component contexts and/or from contexts where they can clearly be associated with radiocarbon dates, as well as more direct luminescence dates for ceramics, are needed to further explore the role of ceramics in shifting subsistence strategies. The most basic research questions about ceramics thus remain unanswered, as do other questions raised by Bright's (1998b) previous discussion of LBB area ceramics (summarized in the section on ceramics above):

- When do ceramics first appear in the archaeological record in the LBB? Are ceramics present in Maggie Creek (pre–A.D. 1300) occupations, and, if so, what is their relationship to "Fremont" ceramics that are present elsewhere in northeastern Nevada (e.g., Hockett and Morgenstein 2003)?
- Do ceramics typically occur in close spatial association with milling tools and small thermal features?
- Does investment in ceramic technology change over time? Are grayware ceramics truly present at LBB sites?
- Within the LBB area as a whole, where were clay sources available prehistorically, and how does the distribution of sites with ceramic artifacts relate to the distribution of those sources?
- How does the distribution of sites with ceramics within the LBB area inform on settlement patterns in light of the division of labor model presented by Zeanah (2004)?

7.7.5. Research Questions for Thermal Features

Two hypotheses were tested in the thermal feature analysis. The first was that features with rocks are associated with large mammal remains, whereas features without rocks are associated with small mammal and plant remains. Such associations are present, but they are neither strong nor statistically significant. The second was that the frequency of features without rocks increased over time. Such as trend does occur, but because any associations between specific feature types and specific resource types are weak at best, the implications of this trend are unclear. On the other hand, the density of all thermal features, regardless of type, unexpectedly tracks other subsistence-related variables quite closely. In light of these facts, further research into the precise uses of thermal features in the LBB area is in order. Related to this are issues not considered in this chapter and only briefly discussed by Bright (1998d) in his earlier work. One such issue is whether some thermal features in the LBB area may have been used for purposes not directly related to subsistence, specifically for heat treatment of lithic resources. A second is how the amount of rock and the degree to which it has been cracked might relate to length of occupation. Worthwhile questions for future research on thermal features in the area are thus:

- What types of food resources were processed in thermal features? Do associations exist between specific feature types and specific resource types? Are there temporal or spatial patterns in the types of resources processed in thermal features?
- Are there ways in which thermal features used for heat treating lithic materials can be distinguished from those used for processing food resources?
- Are there associations between fire-cracked rock attributes and independent indicators of mobility/occupational duration?

7.7.6. Other Subsistence-Related Research Questions

Other, more general research questions that cross-cut data types derive from the discussions presented in this chapter, as well as from larger debates in Great Basin archaeology. In particular, the explanation presented above for changes observed in the LBB area—that they were ultimately the result of climatic variability—merits further testing in relation to alternative explanations, such as those that might involve resource depression or male status competition. Methods for testing these hypotheses further using data that are available or that can be expected to be obtainable should be developed. Relevant questions include:

- What caused the changes over time in subsistence-related aspects of the archaeological record that are evident in the LBB area?
- How do those changes, particularly those that occur around A.D. 1300, relate to the postulated spread of Numic-speaking peoples into the LBB?
- Is there evidence for contemporaneous subsistence-related changes in portions of the Great Basin adjacent to the LBB area or elsewhere?

7.7.7. Data Needs for Future Subsistence Research in the Little Boulder Basin Area

Approximately two decades of research at archaeological sites in the LBB area has resulted in a sufficiently large dataset that it is possible to begin developing and testing ideas about subsistence change through time. However, the poor preservation of some types of materials and difficulty in separating occupations at multi-component sites has led to a smaller dataset than would be desirable. There are thus a number of data needs for addressing subsistence-related research questions in the LBB area. These needs can be met by focusing on the following:

- Any pre–Eagle Rock, dated, single-component deposits containing faunal remains, macrobotanical remains, ground stone, and/or thermal features. The majority of the sites excavated thus far in the LBB area are either not well dated or represent multiple occupations from different time periods. Many of the subsistence research questions outlined above require sufficient data from single-component contexts, particularly those from time periods prior to the Eagle Rock phase, to draw conclusions regarding changes in subsistence practices through time.
- Any deposits of any age containing ceramics. The relationship of the introduction of ceramics technology in the LBB area to changes in subsistence cannot be adequately investigated without knowing when ceramics were first used in the area. However, ceramics from the area are frequently not reported in manner than enables associations with dated features to be evaluated, and no attempts at all have been made to date them using more direct methods such as luminescence dating. Going forward, every reasonable effort should be made to recover and date ceramics from LBB area sites.

8. SITE STRUCTURE AND FUNCTION

Matthew T. Seddon and Jamie Clark

For nearly 20 years, researchers in north-central Nevada have attempted to apply Binford's forager-collector model (Binford 1980) to the archaeological record with minimal success. Despite the elegance of the model, good ethnographic data regarding settlement practices by native populations in the recent past, and the availability of multiple lines of archaeological evidence, it has proven to be extraordinarily difficult to consistently and objectively identify the types of archaeological sites predicted by the model. A quick perusal of site types identified from past excavations in the LBB area reveals the following disparate set of terms: residential base camp, short-term residential base camp, campsite, short-term logistic field camp, short-term field or base camp, long-term base camp, hunting field camp or game monitoring station. None of these terms match the original list of site types expected in the area (base camp, location, field camp) and all involve a high degree of subjective interpretation of the archaeological remains at each site. Developing a more rigorous set of site types and criteria is an important first step towards better defining prehistoric settlement systems.

Difficulties in defining site types and settlement systems are not unique to research in the north-central Great Basin or the LBB area. Researchers have tried a variety of approaches in many world areas and found it extremely difficult to develop consistent terminology for site types, particularly for hunter-gatherer populations. In more complex societies, the presence of architecture, settlement hierarchies, and associated ethnographic and historical information, all assist in defining site types. With prehistoric hunter-gatherers, however, the ephemeral nature of the archaeological signature of open camp occupations, the large geographic range covered by the settlement system, and factors such as site reoccupation all conspire to simultaneously increase variability in site characteristics and reduce our ability to explain that variability.

The excavated site database for the LBB area, comprising multiple sites and including a wide range of data on site structure and artifact assemblages, provides an excellent opportunity to revisit definitions of site structure and function and develop new approaches to this difficult issue. In this chapter we will examine a number of past approaches from the literature, the broader Great Basin, and the LBB area itself. We will examine theoretical and practical approaches to site structure in terms of their strengths and weaknesses for explaining variability in site characteristics. We will also examine the past work in the LBB area in detail, evaluating the consistency in application of models and in drawing conclusions. These examinations demonstrate that any "outside" approach, that is, any model that attempts to determine in advance what site types should be present in a region and then seeks to find them, is almost necessarily doomed to failure.

Therefore, we will not utilize this approach using the site database. Instead, we will conduct a rigorous exploration of the data itself and seek to determine if there is any variability indicative of different site types prior to assigning those types to any given site. This approach will utilize variables that are common to most sites in the region, thus avoiding having type criteria (such as certain perishable artifact types), that are not identifiable in the record. We will utilize a combination of statistical techniques and interpretive analysis to first determine if there is any consistent and potentially meaningful variability in site types in the LBB area. This analysis suggests that for certain time periods, there may be such variability in the record, although the number of site types may be greatly lower than predicted by previous models. This exercise has the additional benefit of enabling us to posit general site characteristics in the LBB area which can be used to identify sites differing greatly from these characteristics and therefore meriting additional research. We will then apply the defined site types to excavated single-component occupations in the area to examine possible changes in settlement over time.

8.1. Theoretical Approaches to Site Structure

Defining archaeological site types on the basis of surface or excavation data is a difficult task. Surface data from non-stratified or minimally stratified archaeological sites may represent palimpsests of multiple occupations, or may have been disturbed by post-depositional processes. Even when occupations can be defined or separated through excavations, these excavations can rarely investigate the span of entire occupations, and site structure may be beyond that which can reasonably be observed (O'Connell 1993). Furthermore, archaeologically observed site structure data, even when well-controlled, can easily be seen to lie on a continuum from very simple small occupations to large and complex occupations with no clear breaks between these occupation types. Thus, defining site types can be a problem both in terms of theory (what would site types be) and methods (how can we recognize these types).

Archaeologists have developed two general approaches to this problem. Both can be broadly characterized as “etic” in their methods; they attempt to define a set of expected site types based on neutral, outside expectations of hunter-gatherer behavior. Although these expectations are developed from observing modern hunter-gatherers and/or using historical accounts, they typically result in a relatively neutral set of site types that are felt to apply to a wide range of hunter-gatherer groups. These types are therefore not developed using criteria employed by any given group. Rather, they are developed primarily as a means of exploring anthropological questions about settlement behavior, particularly with regard to behavior within a given ecosystem. The original model was interested in demonstrating that hunter-gatherer settlement behavior could be explained by the distribution of resources on the landscape (Binford 1980), and therefore, the site types are designed to best express how populations might select different portions of the landscape for exploitation rather than on any indigenous definitions of their own settlement system.

In executing this etic approach, one group of archaeologists has focused on a number of lines of evidence that can suggest relationships between archaeological observations and site types. The work generally focuses on the organization and complexity of activity areas. Ethnoarchaeological research has suggested that the spatial organization and diversity of activity areas on a site is generally related to the size of the group and the length of occupation. Activities tend to center on hearth localities, where activities result in the production of refuse near the hearth. Over time, drop and toss zones may develop as material accumulates and as secondary cleaning and sorting activities occur at longer term occupations (Binford 1978a). Thus, the degree of spatial boundaries, site cleaning and maintenance, and spatial distinction between activities generally is reflective of the length and complexity of the site occupation (Kent 1987, 1992).

Using these general concepts, researchers in the region have recently proposed two typologies of sites and activity areas. Developed for the Wyoming Basin, but applicable to and applied in other areas (Talbot and Richens 2002:22–24), Thompson and Pastor (1996) have proposed a typology composed of six activity area types correlated with length of occupation (Table 37). This typology distinguishes between short-term occupations characterized by a hearth associated with an artifact concentration (e.g. Type 1 and 2) from longer term occupations characterized by multiple features and artifact concentrations sorted by task or material type (e.g. Types 3–6). This type of model is best applied to excavation data, where detailed information about site structure can be identified with confidence.

Table 37. Summary of Thompson and Pastor's (1996) Site Type Model

Activity Area/ Site Type	Distinguishing Attributes	Length of Occupation
Type 1	Single feature, associated single artifact concentration. Material types are not sorted but clustered in a single area.	Several hours to a single day
Type 2	Single feature, associated with two or more artifact concentrations. Materials are sorted by type and evidence performance of multiple tasks.	One to two days
Type 3	Multiple features, associated with multiple artifact concentrations sorted by type.	Several days to several weeks
Type 4	Single feature, associated with well defined drop and toss zones. Size sorting of materials and removal of larger debris from a central area is evidenced.	Several days to several weeks
Type 5	Multiple features, associated with well defined drop and toss zones. Size sorting of materials and removal of larger debris along with task differentiation is evidenced.	Several weeks
Type 6	Multiple features, associated with housepits or other structural features, along with well developed drop and toss zones, size sorting, and task differentiation.	Several weeks to several months

To assess and account for surface data, Janetski recently proposed a typology for the Capital Reef National Park area. This typology has more recently been applied to data from the Sand Hollow area (Talbot and Richens 2002:400–401). The typology proposes six major site types defined predominantly on the basis of presence and/or frequency of artifact types and surface features (Table 38). A general distinction is between sites with limited diversity of materials and few or no features (suggesting short-term occupations) and those with a greater diversity of features and materials (suggesting longer term occupations).

Table 38. Summary of Janetski's Model of Site Types (from Talbot and Richens 2002)

Activity Area/Site Type	Distinguishing Attributes	Length of Occupation
Special activity site	All lithic scatters, quarries, reduction stations, and rock art.	Short term
Short-term processing camp	Limited cultural debris, including grinding tools, with or without stains <2 m in diameter.	Short term
Short-term hunting camp	Limited cultural debris, including late-stage bifaces, projectile points, unifaces, or utilized flakes, with or without stains <2 m in diameter.	Short term
Residential camp	Diverse cultural debris including grinding tools, late-stage bifaces, projectile points, unifaces, or utilized flakes, plus stains <2 m in diameter.	Longer term
Seasonal or short-term residence	Diverse cultural debris (e.g., debitage, tools, sherds, etc.), middens, plus stains >2 m in diameter.	Longer term
Long-term residence	Diverse and abundant cultural debris and middens, plus evidence of sturdy residential structures.	Very long term

Notably, both of these models (and all others like them), tend to examine two major variables at the same time: length of occupation and occupational focus or emphasis. They attempt to capture both whether an occupation was long term or short term and whether the focus was on multiple activities, particular resources, or any combination thereof. As will be discussed below, past efforts in the LBB area have also employed this approach, with definitions for types generally consisting of an assessment of the length of occupation (“long-term” versus “short-term”) and the function of the occupation (“residential camp,” “base camp,” “hunting camp,” etc.).

A second major approach dispenses with attempts to define site functional types, and focuses instead simply on length of occupation. Based on concepts developed by Kent (1992), this approach seeks to distinguish short- and long-term occupation both in terms of actual length of occupation but also anticipated length of occupation. In essence, this model holds that the length of time that a group plans to spend at a site will result in differences in investment in labor in such things as feature construction, artifact and resource diversity, and site structure (Kent 1992). The length of time then actually spent at a site will result in differences in deposited artifacts, site cleaning, and other aspects of site structure.

This model has been developed in greater detail and applied to sites in the Great Basin and Colorado Plateau by Reed (2001; Reed and Seddon 2002; Reed et al. 2001). Utilizing various measurements of labor investment at each site, Reed has classified excavated sites in the database into four categories based on anticipated and actual length of occupation—anticipated long, actual long; anticipated long, actual short; anticipated short, actual short; and anticipated short, actual long (Reed 2005a). Reed found a number of variables to be most easily replicable and useful. These include: Type of Habitation Architecture, Pit Feature Labor, Storage Feature Labor, Ceramic Labor Investment, Ground Stone Types, Presence of Nonlocal Ceramics, Presence of Ornaments, Debitage Density, and number of Flaked Stone Tool Classes (Reed 2005a:634–635). Utilizing these criteria, Reed was able to place site types into the four major categories based on anticipated and actual length of occupation.

The degree of success of these models has, however, been highly variable. For example, Talbot and Richens explicitly evaluated the sites in comparison to the site type models described above. They generally identify a bipartite distribution of site types, although the archaeological data are not entirely clear. They identified sites with habitation structures which appear to represent site type 6 in the activity area typology of Thompson and Pastor (Talbot and Richens 2002:402; Thompson and Pastor 1996), or longer term occupations (up to several months) including structures. These were contrasted with the other sites which appear to represent site Type 3, or medium-term occupations of several days to several weeks, based on the presence of multiple features and artifact concentrations. When evaluated following Janetski's criteria, two site types are also evidenced: Seasonal Residences associated with the habitation structures, and Residential Camps, or sites lacking structures but having diverse cultural debris and small soil stains. However, the full range of site types was not identified and there was no clear and perfect match between observed site structure and the expected site types.

Even the model focusing solely on length of occupation has potential problems. While it is possible to utilize the model criteria and characterize the sites, there is no objective means of determining if the characterization is accurate. In other words, a site identified as “anticipated long, actual short” cannot be verified by criteria other than those used to characterize the site and the model cannot be independently tested. It may well accurately characterize sites, but there is no absolute test of the model’s accuracy.

Furthermore, these models become even more problematic when trying to distinguish sites that are likely to be highly similar, such as prehistoric hunting and gathering sites in the north-central Great Basin. As discussed in other portions of this report, past research in the region has clearly indicated that populations were highly mobile throughout prehistory. Unlike other areas of the continent, there is little evidence for any sustained period where populations adopted more sedentary lifeways, except in limited portions of the region. Thus, in this area, distinguishing site types is much more a matter of distinguishing degrees of mobility, from very high mobility and generalized foraging to perhaps some increased reliance on logistical mobility and occasional use of base camps or residential occupations of a moderate length. Many measures of long-term occupations (e.g. structures, secondary refuse disposal), are entirely absent from much of the archaeological record in the area. It is clear that all occupations were relatively short term, and the distinguishing factors between occupations may have more to do with what resources were locally available around a site and the time of year a site was occupied.

Additionally, all of these models have no good means of coping with site reoccupation during a single time period. The models tend to impute increased length of occupation and occupational intensity to sites that are larger, with more features, and a larger and more diverse artifact assemblage. However, reoccupation of a given site by small groups over multiple years could lead to the same patterning. In a locality such as the LBB area, where sediment deposition is minimal and no sites exhibit stratigraphic distinctions, this factor further complicates defining site types in the region.

As will become clear in the next section, attempts to define site types in the LBB area based on etic variables and characteristics have been highly difficult and problematic. Variables expected to co-vary—such as artifact diversity, presence of ground stone, numbers and complexity of features, etc.—do not appear to vary following the patterns expected. This analysis suggests that a new approach needs to be taken to defining site types in the LBB area and north-central Nevada.

8.2. Previous Site Type Definitions in the Little Boulder Basin

The 1991 historic context was the first attempt to classify site variability in the LBB area using a theoretical framework. Middle Range Theory was employed to infer behavioral strategies based on observations from the static archaeological record. Binford (1980) applied this theoretical framework to a model known as the forager/collector continuum. This model is based on the assumption that forgers and collectors operate in different capacities and will produce different archaeological signatures. Using ethnographic models from Steward's (1997) work with the Western Shoshone in conjunction with Binford's forager/collector continuum, the previous researchers in the LBB area classified prehistoric sites into three categories: base camps, field camps, and locations.

Each of these categories was considered associated with a variety of aspects of site structure and artifact assemblages. For a site to be considered a base camp it should exhibit signs of residential maintenance, feature complexes, ground stone assemblages, pottery or specialized artifacts. Base camps can be a reflection of both foraging and collecting strategies; indications of a collector strategy will be characterized by storage, caches or evidence of structures. Field camps can only be made by collectors and were described as being similar to base camps but lacking evidence of features or specialized artifact types. For a site to be considered a location it should exhibit evidence of on-site procurement and extractive activities. Locations can be produced by both foraging and collecting strategies, with forager locations closer to base camps and collector locations further from base camps (Schroedl 1991).

While this methodology for classifying site types was based on a theoretical framework, it was not specific enough to implement. For instance, "specialized artifacts" were said to be indicative of base camp assemblages and absent from field camp assemblages. However, the precise definition of what constitutes "specialized artifacts" was never explicitly stated, thus introducing an unnecessary element of ambiguity into the classification process. In a later data recovery plan (Kice et al. 1993), the researchers prepared to implement the 1991 historic context at specific sites and proceeded to provide greater methodological guidance for site classification based on both site structure and artifact assemblage composition.

For each specific site type (e.g. base camp, field camp etc.), assemblage expectations were clarified, in an etic approach, by the presence or absence of certain artifacts or features. Within this new framework, a site designated as a base camp should exhibit the following: variability in the artifact assemblage, exhausted curated tools, presence of ground stone, presence of complex features, evidence of secondary refuse and pottery. Field camps were classified as having a homogenous artifact assemblage, absence of ground stone, absence of portable or expedient tools, a small amount of curated tools, and generally limited to one or two functional tool types. Finally, locations were said to exhibit a limited artifact assemblage, high frequency of expedient tools showing little or no evidence of maintenance and be located in close proximity to a given resource. This specification which was lacking in the 1991 historic context provided a seemingly clear opportunity to methodically classify sites in the LBB area. Table 39 indicates the final site type classification for each of the excavated sites.

Table 39. Summary of Original Classification of Site Types in the Little Boulder Basin

Site Number	Original Component Designation	Original Site Type Classification	Apparent Basis for Classification
26EK002304	Multicomponent	Campsite	Assemblage consists of chipped stone debitage and tools, and a ground stone scatter. Thermal features present. This assemblage likely represents a campsite where blank reduction and tool production occurred.
26EK002305	Multicomponent	Undetermined	Assemblage consists of chipped stone debitage and tools, a utilized core, and a metate. No thermal features present. Site appears to have been used for blank reduction and possible tool production.
26EK002307	Undetermined	Undetermined	Assemblage consists of chipped stone debitage and tools. Thermal features present.
26EK002309	Single Component. Eagle Rock phase.	Base camp	Assemblage consists of chipped stone debitage and tools, fire-affected rocks and a metate. Thermal features present.
26EK004687	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, ground stone, and pecked stone. Thermal features present.
26EK004688	Multicomponent	Locations, camps and short-term base camps	Assemblage consists of chipped stone debitage and tools, and a ground stone concentration. Thermal features present. It appears the focus of activities was on the production, maintenance and retooling of hunting-related toolkits, specifically bifaces and projectile points. Although plant processing is present, is does not appear to be a major focus. The assemblage represents a short-term camp occupied by highly mobile hunter-gatherers.
26EK004690	Multicomponent. Emphasis on South Fork phase.	Field camp	Assemblage consists of tertiary chipped stone debitage, core reduction flakes and tools like bifaces, modified flakes and a scraper. No thermal features present.
26EK004695	Multicomponent	Short-term camp	Assemblage consists of chipped stone debitage and tools, a core fragment, and a mano. No thermal features present.
26EK004696	Single Component. South Fork phase.	Field camp	Assemblage consists of chipped stone debitage and tools, cores and ground stone. No thermal features present. Lithic technology appears to emphasize utilization and production of formal bifacial tools as well as expedient tools like modified flakes and choppers. These tools are indicative of generalized processing and camp maintenance activities.
26EK004749	Multicomponent	Short-term Residential base camp or field camp	Assemblage consists of chipped stone debitage and tools, and a small ground stone assemblage. Thermal features present. Formal chipped stone tools and ground stone indicate hunting-related tool manufacture, maintenance, plant food procurement and processing occurred at the site. Limited use of local materials and low reliance on expedient tools is suggestive of a highly mobile population.

Table 39. Summary of Original Classification of Site Types in the Little Boulder Basin

Site Number	Original Component Designation	Original Site Type Classification	Apparent Basis for Classification
26EK004755	Single Component. Eagle Rock phase.	Residential base camp	Assemblage consists of chipped stone debitage and tools, pottery, ground stone, incised stone, a bone bead and crinoid fossils. Thermal features present. Diagnostic debitage suggests bifacial reduction for the production of formal tools. The assemblage as a whole reflects toolkit manufacture, maintenance and various processing activities. The random distribution of high-quality toolstone also suggests a highly mobile subsistence strategy.
26EK005200	Multicomponent	Field camp or residential base camp	Assemblage consists of chipped stone debitage and tools, and cores. Thermal features present.
26EK005270	Single Component. Eagle Rock phase.	Residential base camp	Assemblage consists of chipped stone debitage and tools, and incised stone. Thermal features present. The debitage suggests an emphasis on the manufacture of bifacial tools. Presence of formal curated tool technology suggests a highly mobile subsistence strategy.
26EK005271	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, pottery, shell, bone fragments, incised stone, macrobotanical remains, manos, a mortar, metate and pestle fragments. Thermal features present. The debitage is consistent with reduction technology associated with the production and maintenance of bifacial tools. The wide variety of activities as suggested by the assemblage, indicate this site functioned as a residential base camp.
26EK005274	Single Component. Eagle Rock phase.	Short-term residential base camp	Assemblage consists of chipped stone debitage, tools, and a core. No thermal features present. Tools and debitage indicate the production of projectile point preforms and bifacial tools was a primary task, followed by various camp maintenance and processing activities.
26EK005278	Undetermined	Long term base camp	Assemblage consists of chipped stone debitage and tools, ground stone and incised stone. General early stage bifaces and projectile points dominate the assemblage. Thermal features present. The high proportion of milling implements suggests plant resources were important in diet at this site.
26EK005374	Single Component. South Fork phase.	Short-term field camp	Assemblage consists of chipped stone debitage and tools. No thermal features present. The small homogenous assemblage indicates a short-term occupation associated with production of bifacial tools; the maintenance of hunting implements indicates an emphasis on faunal resources.
26EK006231	Multicomponent. Emphasis on Eagle Rock phase.	Short-term residential base camp	Assemblage consists of chipped stone debitage and tools, ground stone, and cores. Thermal features present. The tools and cores emphasize a formal bifacial tool technology as well as the practice of a highly mobile subsistence strategy.
26EK006232	Multicomponent	Field camp or short-term residential base camp	Assemblage consists of chipped stone debitage, and tools Thermal features present. This assemblage reflects a manufacturing, toolkit maintenance, and processing site. The emphasis on formal tools suggests a highly mobile subsistence strategy.
26EK006487	Multicomponent	Short-term camp	Assemblage consists of chipped stone debitage and tools, cores, ground stone, a pottery sherd, a bone tool and single historic artifact. Thermal features present. Assemblage indicates an emphasis on the production, maintenance and retooling of a hunting related toolkit, specifically bifaces, projectile points.
26EU001319	Single Component. Eagle Rock phase.	Field camp	Assemblage consists of chipped stone debitage and tools. Thermal features present. The assemblage indicates a manufacturing technology where medium to large bifaces and small projectile points were made.

Table 39. Summary of Original Classification of Site Types in the Little Boulder Basin

Site Number	Original Component Designation	Original Site Type Classification	Apparent Basis for Classification
26EU001320	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, ground stone, incised stone, a manuport, and thermally altered rock. Thermal features present.
26EU001482	Multicomponent	Short-term residential base camp	Assemblage consists of secondary and tertiary bifacial reduction flakes, tools, and stone bowl fragments. Thermal features present. The assemblage suggests a diversity of activities indicative of a short term residential base camp.
26EU001483	Multicomponent	Short-term residential base camp	Assemblage consists of chipped stone debitage and tools, sherds of brownware pottery and ground stone. Thermal features present. Assemblage diversity in tool and material type as well as debitage from all stages of reduction are consistent with residential base camps. Short-term occupation is indicated by the variety of documented subsistence resources and evidence of re-occupation.
26EU001487	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, cores, ground stone, ceramics, faunal remains, and incised stone. Thermal features present. Collectively, this site represents the location of several base camps whose main focus was manufacture and retooling. The emphasis on formal tools suggests a highly mobile subsistence strategy.
26EU001492	Single Component. Maggie Creek phase.	Hunting Field camp	Assemblage consists of chipped stone debitage, tool and core fragments. No thermal features present. The projectile point and projectile point preforms and edged flake blanks reflect the maintenance and production of hunting implements.
26EU001494	Single Component. Eagle Rock phase.	Hunting Field camp or game monitoring station	Assemblage consists of chipped stone debitage and tools, unmodified bone, and a bone ornament. No thermal features present. Assemblage indicated an emphasis on the production and maintenance of formal bifacial tools associated with hunting related activities. The lack of features suggests short term occupation.
26EU001505	Single Component. Eagle Rock phase.	Hunting Field camp or game monitoring station	Assemblage consists of chipped stone debitage and tools. Thermal features present. Debitage reduction at the site appears to be associated with the manufacture of bifacial tools and maintenance of hunting implements, specifically arrows. The location of the thermal feature in relation to the distribution of artifacts is characteristic of short term camps.
26EU001520	Undetermined	Undetermined	Assemblage consists of chipped stone debitage, tools and ground stone. No thermal features present. Debitage from all reduction stages indicates primary manufacture as well as final finishing and rejuvenation of tools, while the ground stone assemblage suggests plant processing activities.
26EU001522	Multicomponent. Emphasis on Maggie Creek phase.	Short-term residential base camp	Assemblage consists of chipped stone debitage, tools and a core. No thermal features present. The artifacts represent a diverse range of on site activities that included procurement and processing of faunal resources, and the processing of plant resources.
26EU001524	Multicomponent	Residential base camp	Assemblage consists of tools, cores, and a basin shaped milling stone fragment. The assemblage is indicative of a mixed hunting and gathering subsistence strategy. No thermal features present.
26EU001529	Single Component. Maggie Creek phase.	Field camp	Assemblage consists of chipped stone tools. An associated faunal assemblage is comprised primarily of large ungulates. Thermal features present.

Table 39. Summary of Original Classification of Site Types in the Little Boulder Basin

Site Number	Original Component Designation	Original Site Type Classification	Apparent Basis for Classification
26EU001530	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, cores, faunal specimens, ground stone tools and incised stone. Thermal features present. The assemblage contains evidence of maintenance, retooling, and food processing; thus, wide array of functional tool types and debitage from all stages of reduction are consistent with residential base camps.
26EU001531	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage, tools, cores, faunal specimens, ground stone tools, pottery sherds, a manuport and a single historic artifact. Thermal features present. There is an emphasis on formal tools, but expedient tools are also present. The diverse range of tool types and debitage from all stages of reduction are consistent with residential base camps.
26EU001533	Multicomponent	Undetermined	Assemblage consists of chipped stone debitage, tools, and a ground stone fragment. No thermal features present.
26EU001534	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage, tools, cores, faunal specimens, ground stone tools, obsidian manuports, pottery sherds, pigment and a stone bead. Thermal features present. This assemblage contains evidence for reduction in all stages of manufacture, evidence of repair, and tools associated with food processing, which are collectively indicative of residential base camps.
26EU001539	Multicomponent	Undetermined	Assemblage consists of chipped stone debitage, tools, fire cracked rock, one core and two pieces of ground stone. No thermal features present.
26EU001548	Single Component. Eagle Rock phase.	Undetermined	Assemblage consists of chipped stone debitage with a single tool. No thermal features present.
26EU001595	Single Component. James Creek phase.	Short-term logistic field camp	Assemblage consists of small thinning flake debitage and tools. No thermal features present. This assemblage likely represents a special purpose site where finishing, repair and rehafting of projectile points occurred.
26EU001667	Multicomponent	Residential base camp	Assemblage includes chipped stone debitage and tools, cores, faunal specimens, ground stone tools, manuports, pigment items and pottery. Thermal features present. Tool diversity suggests manufacturing, processing and maintenance occurred at this site. The faunal remains are consistent with Numic subsistence patterns suggesting a hunter-gatherer subsistence strategy.
26EU001734	Multicomponent	Residential base camp	Assemblage consists of chipped stone debitage and tools, faunal remains, ceramics, ground stone and manuports. Thermal features present. The dominance of biface technology and emphasis on non-local raw material is indicative of highly mobile hunter-gatherers.
26EU001851	Multicomponent. Emphasis on Maggie Creek phase.	Undetermined	Assemblage consists of chipped stone debitage and tools. No thermal features present. The high proportion of bifaces suggests quarrying and reduction were the primary on-site activities.
26EU001904	Single Component. Maggie Creek phase.	Short-term field camp	Assemblage consists of chipped stone debitage, and tools. No thermal features present. The assemblage suggests primary lithic reduction was for the production of projectile point preforms & retooling. Whereas modified flake tools indicate plant processing, game processing or production/maintenance of bone & wood tools

Table 39. Summary of Original Classification of Site Types in the Little Boulder Basin

Site Number	Original Component Designation	Original Site Type Classification	Apparent Basis for Classification
26EU001906	Single Component. Eagle Rock phase.	Short-term field camp	Assemblage consists of chipped stone debitage, tools, and ground stone. No thermal features present. Debitage suggests late stage bifacial reduction. The absence of debitage from each reduction stage is consistent with predictions for field camps. Due to the small size and nature of the scatter, this site likely represents a single, short-term occupation.
26EU001997	Multicomponent	Short-term base camp	Assemblage consists of chipped stone debitage, tools, cores, incised stone, animal bone or teeth and burned goosefoot. Thermal features present. All stages of manufacture are present with a bias toward later stages of reduction. The generalized nature of the chipped stone assemblage appears to be consistent with a base camp.
26EU002064	Multicomponent	Undetermined	Assemblage consists of chipped stone debitage, tools, and faunal remains. No thermal features present.
26EU002079	Multicomponent. Emphasis on Maggie Creek phase.	Undetermined	Assemblage consists of chipped stone debitage and tools. No thermal features present.
26EU002124	Multicomponent. Emphasis on Eagle Rock phase.	Hunting field camp	Assemblage consists of chipped stone debitage and tools. No thermal features present. The assemblage reflects the production and rejuvenation of quarry bifaces and knifelike bifaces. The assemblage was likely produced in a single, short term occupation and fits the classification of a field camp.
26EU002126	Multicomponent	Undetermined	Assemblage consists of chipped stone debitage, a tool fragment, a basin milling stone fragment and burned artiodactyl bones. No thermal features present.
26EU002181	Multicomponent	Short-term field or base camp	Assemblage consists of chipped stone debitage, tools, ecofacts, minerals and faunal remains. No thermal features present. This assemblage is indicative of the production and maintenance of formal bifacial tools.
26EU002182	Multicomponent	Short-term residential base camp	Assemblage consists of chipped stone debitage, tools, ground stone and unmodified hematite and limonite. Thermal features present. Collectively, the assemblage reflects the production and maintenance of formal tools for a highly mobile subsistence strategy.
26EU002183	Multicomponent	Short-term field or base camp	Assemblage consists of chipped stone debitage, tools, and one ground stone artifact. No thermal features present. The assemblage reflects an emphasis on the production and maintenance of formal tools suggestive of a highly mobile population.
26EU002184	Multicomponent. Emphasis on Eagle Rock phase.	Short-term field camp or base camp	Assemblage consists of chipped stone debitage, tools, a pounding stone, ground stone and tested cobbles. No thermal features present. Site appears to have been used for plant food processing based on abundance of ground stone. The emphasis on formal tools suggests a highly mobile subsistence strategy.

As illustrated in Table 39, sites were classified into functional categories based on interpretations of their assemblage variability and how they fit into the forager/collector continuum of site types. While this approach was beneficial in identifying parameters that were applicable to the data, there are several shortcomings that need to be addressed. First and foremost is the lack of consistency. At the most basic level sites are classified only as a camp, with no specification as to whether it represents a field or base camp. At a more complex level, there is an inherent problem distinguishing between short-term residential base camps and field camps. In the data recovery plan (Kice et al. 1993) specific distinctions were made that allowed for a clear separation of sites based on their artifact and feature attributes (e.g. if X, Y, and Z present then site is a base camp , if only Y and Z then site is a field camp). However, these boundary lines were blurred in the original classification of sites by researchers in the LBB area. For example, at site 26EK006232, the assemblage is characterized by chipped stone debitage, various tools and the presence of features. The presence of features suggests classification as a base camp, whereas the lack of ground stone suggests classification a field camp. The site was subsequently typed as a field camp or short-term base camp. A "short-term base camp" was never formally defined in the data recovery plan (Kice et al. 1993) and an entire suite of new questions arise with regard to the difference, if any, between a field camp and a short-term base camp.

Although guidelines in the 1993 data recovery plan (Kice et al. 1993) explicitly state that what constitutes a residential base camp, field camp etc., it proved more difficult to actually classify sites into these functional categories. Difficulty seemed to stem from the fact that functional site types were separated by the presence or absence of a single artifact or feature. For example, the lack of ground stone or features would classify a site as a field camp rather than a base camp. In theory this type of reasoning should work, however it fails to acknowledge that the presence or absence of artifacts or features could be a result of factors that have nothing to do with prehistoric cultural processes. The absence of ground stone could be a result of it being unnoticed, hidden, or buried at the time the site was recorded. The same is true for features. Thus, classifying sites as field camps vs. base camps on the basis of presence or absence of artifacts or features can be problematic and inaccurate. Upon review of the existing data, it is apparent the original researchers in the LBB area did not adhere to their own stated guidelines which resulted in inconsistent site classifications.

In addition to the classification scheme of site structure and types, the data recovery plan (Kice et al. 1993) also put forth a series of research questions in an attempt to relate the data back into a general body of theory. The questions were designed to tease information out of the static archaeological record in order to make dynamic statements of behavioral strategies (Binford 1980). The researchers hoped to analyze site function and structure based on the artifact and feature assemblages, see if site structure or function of similar sites changed over time, as well as gain an understanding of how environmental factors like topographic location and proximity to water affected site function. However, in the associated reports where each site in the LBB area is individually broken down, described, and analyzed in detail, few if any of these research questions are addressed. In order to better capture the variability of site structure as a function of behavioral strategies, a more coherent discussion of what constitutes site type with relation to the forager/collector continuum needs to be addressed.

The model developed from the 1991 historic context and 1993 data recovery plan (Kice et al. 1993; Schroedl 1991) was a positive step towards a more systematic approach with regard to site classification. It was founded out of a theoretical framework and identified specific expectations as to what constituted a given site type. On paper these expectations were coherent and explicit, but proved difficult to apply to the actual archaeological data. The three basic site types—base camp, field camp, and location—were applied in a case-by-case interpretive strategy in a manner inconsistent with the model. Difficultly arose when an assemblage exhibited expectations of more than one site type, i.e. representing both a base and field camp. Thus, it is clear that this original model based on an assumed set of outside categories failed to adequately characterize the variability in site structure and assemblages. In order to gain the clarity necessary for accurate site type classification, a new approach is needed. This approach should focus on variability. Future research needs to analyze if variability is actually present in the LBB area archaeological record, and what such variability might represent.

8.3. New Approaches to Site Structure and Types in the Little Boulder Basin

As is clear from previous attempts in the LBB area and beyond, characterizing the archaeological record by outside, etic categories is fraught with difficulties. While it is possible to develop very clear and neat models of what site types should be, it is rarely possible to identify these types in the field. Assemblages vary in ways unpredicted by the model, and not all of the variation is clearly or obviously related to variability in settlement strategy. Site reoccupation, post-abandonment site formation processes, and probably other random factors seem to affect site structure and assemblage characteristics in ways that make it difficult to explain the observed variability.

Moreover, it remains highly possible that the models archaeologists have developed regarding expected site types may, in fact, be completely wrong. Nearly all developed site typologies assume that there must be at least two, if not three or more site types in an area when it is entirely possible that past populations, particularly of hunters and gatherers, may have simply had a single site type, a generalized “camp.” Variability between these “camps” may reflect random factors (the dropping of a mano here, the creation of a somewhat more elaborate fire pit on a windy day there), rather than meaningful variation in site types.

Consequently, we have chosen to reapproach the data from the LBB area from the inside out, or from the bottom up. Rather than attempting to define expected site types and their archaeological signatures, we choose instead to examine the data itself and see if first there are any statistically significant and meaningful patterns in site structure in the LBB area and then see what these patterns might suggest for settlement types and strategies in the past.

This approach is of necessity interpretive; it involves examining variability in the data and attempting to relate it to broad expectations for hunter-gatherers in the region. This interpretation is not divorced from theoretical perspectives. We fully expect that there is a high probability that there may be different site types in the LBB area and that these may reflect ways that hunters and gatherers are understood to utilize the landscape. To be clear, we expect that there may be sites characterized by focuses on different resources, or by overall diversity of activities (such as residential base camps or extractive localities). However, rather than deciding in advance what site types must be present and then desperately attempting to find these types, we choose instead to examine the variability systematically, search for co-varying patterns, and then attempt to determine if these patterns make sense, given our models of occupation in the area.

A major principal in this exercise is that site structure and assemblage variables should co-vary in meaningful ways. The presence or absence of any single variable (a feature, ground stone, etc.) should not be a determining factor for separating site types because any single variable may be present or absent due to random or non-systematic factors such as preservation, excavation strategy, etc., rather than behavioral differences. True site “types,” which reflect human planning and organization, should be visible in the form of co-variation across multiple variables. Either multiple variables should go up together (e.g., as the number of features goes up, so should the amount of ground stone) or there should be contrasts that are consistent and explicable (e.g., as the amount of chipped stone tools and debitage goes up, the amount of ground stone goes down).

8.3.1. Methods

Variability in site structure and artifact assemblages was explored using statistical analysis of several site variables. Site attributes were picked on the basis of their consistent visibility across sites and our ability to ensure that they could be made comparable between sites. As a consequence we focused primarily on a number of simple variables that were consistently recorded and frequently present. We utilized densities where possible to ensure that counts were adjusted by the volume of the excavated area. The variables used consist of the following:

- Feature density: A simple count of the number of features, regardless of type, found in a defined activity area or occupation divided by the volume of the excavated area.
- Debitage Density: The count of debitage in an excavated activity area or occupation divided by the volume of the excavated area.
- Tool Density: The count of chipped stone tools and cores in an excavated activity area or occupation divided by the volume of the excavated area.
- Ground Stone Density: The count of ground stone artifacts in an excavated activity area or occupation divided by the volume of the excavated area.
- Faunal Richness: The richness, or number of species identified, in an excavated activity area or occupation divided by the volume of the excavated area.

Other variables were not selected for a variety of reasons. Botanical data were not used because they were rarely identified at all and tended to covary heavily with the presence of features, as might be expected. Chipped stone tool types and diversity were not used because the number of types defined varied greatly by researcher and attempts to combine these types into consistent categories resulted in a minimal number of categories that could not be meaningfully utilized in the analysis. Other variables, such as presence of houses, exotic artifacts, etc. were not used either because they weren't present (e.g. houses) or because so few sites had any of the artifact classes in question that they were not meaningful. All densities were converted to Z-scores in order to reduce the amount of weight given to artifact numbers (such as high debitage counts) and to make the comparison focus on relative differences rather than absolute numbers.

The variables were examined across only single-component occupations. While utilizing only identified single-component occupations reduces the number of sites in the analysis, it ensures that variability is due to past behavior and not due to accumulations of multiple occupations. We also examined the variability across all time periods and within time periods. Examining variability across time periods enables the identification of broad patterns in site structure and helps to identify any sites that are particularly distinct. Focusing on variability within time periods enables us to ensure that change in site structure or settlement practice over time can be observed and classified. Unfortunately, the number of Middle Archaic period sites and Maggie Creek phase sites were very low. As a consequence, our conclusions for these periods can be considered preliminary at best.

Analysis also focused on only the data from excavation blocks associated with single-component occupations. Although there are often larger surface collection areas around these blocks, and, in some cases, entire sites appear to be single components, we restricted our counts of artifacts, fauna, etc., to data from excavation blocks themselves and did not include surface artifacts from other site areas or artifacts from test units, trenches, etc. that were not associated with the excavation blocks. This approach is inherently conservative, in that it ensures that the artifact and other counts that we are associating with a single-component occupation have the highest probability of all being associated with that component. Although focusing only on data from excavated areas did occasionally exclude surface artifacts, such as ground stone, that were not in or over the excavation block but which may have, nonetheless, been associated with the same occupation, we felt that it was more important to utilize a data set that was confidently associated with the occupation(s) in question. Surface artifacts away from excavation blocks are equally likely to represent other occupations than they are to confidently represent the excavated occupation, and therefore, we focused on artifacts reported from excavation data alone.

We used two main statistical tools to assist in the analysis: Principal Components Analysis and Cluster Analysis. Principal Components Analysis is a means of examining variability across a number of variables or "factors" to determine if any factors co-vary in a given assemblage and asset in identifying patterns. Cluster Analysis is another technique for defining cases, in this case, single-component occupations, that appear similar or different. Both techniques provide non-subjective means of identifying what types of variables covary in consistent manners. We used both techniques to help identify variation.

8.3.2. Site Variability Regardless of Time Period

We have chosen to begin the analysis by examining variability across all single-component sites and activity areas in order to search for any sites that stand out from other sites in notable manners. Because we would expect that settlement strategies and site variability would differ between time periods, examining sites regardless of time periods will tend to blur these important differences. However, if any sites are particularly noteworthy or distinctive when compared to all sites, these sites should also be identifiable and visible during analysis of each time period. Thus, examining all sites sets the context for examining individual periods. We will, however, concentrate on identifying major differences and what might be significant factors distinguishing site types.

An initial examination of variables and associated Z-scores demonstrates that there is a high degree of variability across all categories of data, and that it is difficult to identify clear site clusters on these data alone (Table 40). The wide range of variables, the lack of notable variation across all variables for any single site or group of sites, and other factors make it difficult to easily identify site types. Consequently Principal Components Analysis and Cluster Analysis become very useful means of identifying particular sources of variation in the assemblage.

Table 40. Site Structure Variables, Raw Counts, and Z-scores for All Single-component Sites and Components in the Little Boulder Basin

Site and Provenience	Excavated Volume	No. of Features	Feature Z-score	Debitage Count	Debitage Z-score	Tool Count	Tool Z-score	Ground Stone Count	Ground Stone Z-score	Faunal Richness	Faunal Z-score
26EK004688-Activity Locus 4	7.29	1	-0.49	8,840	0.05	39	-0.20	0	-0.37	0	-0.75
26EK004688-Activity Locus 6	3.92	1	0.04	4,075	-0.08	11	-0.33	2	1.17	1	-0.22
26EK004688-Activity Locus 7	5.37	0	-1.10	1,690	-0.62	11	-0.36	0	-0.37	0	-0.75
26EK004688-Activity Locus 8	9.41	2	-0.15	22,277	0.91	113	0.14	1	-0.05	0	-0.75
26EK004688-Activity Locus 9	4.95	2	0.70	1,188	-0.67	12	-0.35	3	1.46	2	0.31
26EK004755-Surface Collection Block	10.70	2	-0.27	21,068	0.61	46	-0.25	2	0.20	5	1.90
26EK005200-Excavation Area 1	0.90	1	3.84	152	-0.73	7	-0.08	0	-0.37	0	-0.75
26EK005270-Site	5.10	1	-0.23	22,573	2.43	63	0.16	0	-0.37	0	-0.75
26EK006231-Surface Collection Block 1	5.50	2	0.52	5,054	-0.17	31	-0.18	0	-0.37	3	0.84
26EK006487-Excavation Block 4	4.60	1	-0.13	2,093	-0.51	34	-0.10	0	-0.37	0	-0.75
26EU001319-Site	2.70	1	0.55	343	-0.76	20	-0.09	0	-0.37	0	-0.75
26EU001482-Surface Collection Block 1	11.70	3	0.04	10,603	-0.18	15	-0.40	0	-0.37	2	0.31
26EU001482-Surface Collection Block 2	7.30	3	0.73	1,337	-0.71	6	-0.43	0	-0.37	0	-0.75
26EU001505-Site	3.00	1	0.38	1,220	-0.55	0	-0.47	0	-0.37	0	-0.75
26EU001534-Excavation Block 1	7.50	2	0.09	8,602	0.00	37	-0.22	0	-0.37	1	-0.22
26EU001534-Excavation Block 7	17.40	4	-0.08	19,201	-0.03	29	-0.38	0	-0.37	0	-0.75
26EU001667-Surface Collection Block 2	13.60	2	-0.44	8,673	-0.38	31	-0.35	0	-0.37	4	1.37
26EU002126-Cluster 1	2.00	1	1.12	5,848	1.32	23	0.11	0	-0.37	2	0.31
26EK004688-Activity Locus 10	5.40	2	0.55	2,788	-0.47	51	0.01	0	-0.37	1	-0.22
26EU001492-Site	29.20	0	-1.10	8,847	-0.63	449	0.31	5	0.15	2	0.31
26EU001529-Site	12.00	2	-0.36	65,675	3.21	1,275	4.90	0	-0.37	5	1.90

Table 40. Site Structure Variables, Raw Counts, and Z-scores for All Single-component Sites and Components in the Little Boulder Basin

Site and Provenience	Excavated Volume	No. of Features	Feature Z-score	Debitage Count	Debitage Z-score	Tool Count	Tool Z-score	Ground Stone Count	Ground Stone Z-score	Faunal Richness	Faunal Z-score
26EK004687-Surface Collection Block 3	28.90	8	0.13	20,134	-0.33	162	-0.19	46	4.44	6	2.43
26EK004690-Surface Collection Block 2	7.50	0	-1.10	18,517	0.98	63	-0.04	0	-0.37	4	1.37
26EK004696-Site	10.30	0	-1.10	2,500	-0.67	16	-0.39	0	-0.37	0	-0.75
26EU001533-Site	3.00	0	-1.10	14	-0.85	0	-0.47	0	-0.37	0	-0.75
26EU001851-Site	1.50	0	-1.10	131	-0.79	6	-0.27	0	-0.37	0	-0.75
26EU002182-Site	15.80	4	0.03	9,647	-0.40	125	-0.07	2	0.01	0	-0.75

Our first exploratory analysis focuses on a Principal Components Analysis for all variables across all sites. Principal Components Analysis identifies co-varying factors that can be used to account for the majority of variation across a collection of data points, in this case, sites. The Principal Components Analysis identified two main components, or groups of sites (Table 41). The first is characterized by relatively high scores for debitage and tool densities, along with a moderate score for fauna richness. The second is characterized by high scores for ground stone density and fauna richness. These data suggest that there may be two major types of sites in the area: one characterized by an emphasis on tool production and repair and another by an emphasis on botanical and faunal processing.

Table 41. Principal Components Analysis Rotated Component Matrix for All Single-component Sites and Components in the Little Boulder Basin

Z-score for Variable	Component 1	Component 2
Features	-.197	.014
Debitage	.909	.063
Tools	.896	.098
Ground Stone	-.236	.907
Fauna Richness	.415	.806

Note: Rotation converged in three iterations.

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The analysis also scores each site by a "factor" for each of the two components. Notably high factor scores for individual components indicate sites with a strong expression of either of the two main distinguishing factors. Table 42 provides the associated factor scores for each component for all sites in the LBB area. For ease of comparison, notably high scores (greater than 1) are highlighted. Interestingly, only five sites had particularly high factor scores for either component. This alone suggests that there may only be a few distinct sites in the area and a very simple overall site typology. Sites 26EK005270 and 26EU001529 had high scores on Component 1 (high densities of debitage and tools), whereas sites/components 26EK004688-Activity Locus 9, 26EK004755, and 26EK002687-Surface Collection Block 3 had high scores on Component 2 (high densities of ground stone and high fauna richness). The overall analysis, as a first approach to the data, suggests that there may be three basic site types—a generalized camp with a variety of debris, sites with a high emphasis on tool manufacture and repair, and sites with an emphasis on botanical and faunal processing.

Table 42. Associated Principal Components Factor Scores for All Sites in the Little Boulder Basin

Site-Provenience	Period or Phase	Component 1	Component 2
26EK004688-Activity Locus 4	Eagle Rock	-0.04889	-0.63677
26EK004688-Activity Locus 6	Eagle Rock	-0.48057	0.65835
26EK004688-Activity Locus 7	Eagle Rock	-0.38578	-0.62190
26EK004688-Activity Locus 8	Eagle Rock	0.42185	-0.46273
26EK004688-Activity Locus 9	Eagle Rock	-0.83270	1.16457
26EK004755-Surface Collection Block	Eagle Rock	0.44433	1.08085
26EK005200-Excavation Area 1	Eagle Rock	-0.83233	-0.48350
26EK005270-Site	Eagle Rock	1.24797	-0.73961
26EK006231-Surface Collection Block 1	Eagle Rock	-0.02160	0.22218
26EK006487-Excavation Block 4	Eagle Rock	-0.31106	-0.60414
26EU001319-Site	Eagle Rock	-0.50193	-0.57443
26EU001482-Surface Collection Block 1	Eagle Rock	-0.15752	-0.06064
26EU001482-Surface Collection Block 2	Eagle Rock	-0.65917	-0.56514
26EU001505-Site	Eagle Rock	-0.56128	-0.58132
26EU001534-Excavation Block 1	Eagle Rock	-0.06632	-0.34428
26EU001534-Excavation Block 7	Eagle Rock	-0.22091	-0.61828
26EU001667-Surface Collection Block 2	Eagle Rock	-0.02162	0.48105
26EU002126-Cluster 1	Eagle Rock	0.69763	-0.10471
26EK004688-Activity Locus 10	Maggie Creek	-0.23473	-0.31507
26EU001492-Site	Maggie Creek	-0.02462	0.24905
26EU001529-Site	Maggie Creek	4.28295	0.50598
26EK004687-Surface Collection Block 3	Middle Archaic	-0.85607	4.15545
26EK004690-Surface Collection Block 2	Middle Archaic	0.85492	0.39791
26EK004696-Site	Middle Archaic	-0.42358	-0.61912
26EU001533-Site	Middle Archaic	-0.54656	-0.61001
26EU001851-Site	Middle Archaic	-0.42081	-0.61634
26EU002182-Site	Middle Archaic	-0.34157	-0.35740

Note: Notably high scores for each component are highlighted.

Cluster analysis supplements these interpretations. Cluster analysis was used to produce a dendrogram of sites grouped into clusters (Figure 32). While this analysis produces an almost bewildering array of clusters, examining only the higher levels of clusters, in this case the first four, does enable an easier distinction of what factors might be associating sites.

To see the variability, it is best to examine the dendogram from the bottom up. The first site distinguished, forming its own cluster, is 26EU001529. This site is a Maggie Creek phase site also known as Point Blank Hill. It has an extremely high density of debitage and tools. The excavators noted the high numbers of tools and debitage and it has long been identified as a particularly noteworthy site in the region. It is also distinguished in the Principal Components Analysis, and it clearly merits consideration as a separate site type.

The next major break is also a separate site, 26EK004687-Surface Collection Block 3. This is a Middle Archaic period site with a high feature density along with high densities of ground stone and high fauna richness. It is identified separately in the Principal Components Analysis and may represent a distinct example of a site with an emphasis on botanical and faunal processing.

One final site also forms its own group, site 26EK005200-Excavation Area 1. This site is mainly distinguished by having the highest feature density Z-score of any site. However, the high feature density is based on a single feature that happened to be found in a very small and shallow (and therefore low volume) excavation block. This factor alone should not be as distinguishing as it appears in the analysis, as a slightly greater excavation volume would have lowered the feature density Z-score for this site. In all other respects, this site does not seem particularly distinct, and the separate line in the cluster analysis can be attributed to a chance factor of a small excavation area.

The next major break in the diagram distinguishes five sites or components from all others. These five sites/components consist of 26EK004755, 26EK004690-Surface Collection Block 2, 26EU001667-Surface Collection Block 2, 26EK005270, and 26EU002126-Cluster 1. The last two of these sites have notably high tool and debitage densities, whereas the other three have notably high fauna richness and ground stone density. With the exception of 26EK004690-Surface Collection Block 2 and 26EU002126-Cluster 1, all of these sites exhibited high factor scores in the Principal Components Analysis as well.

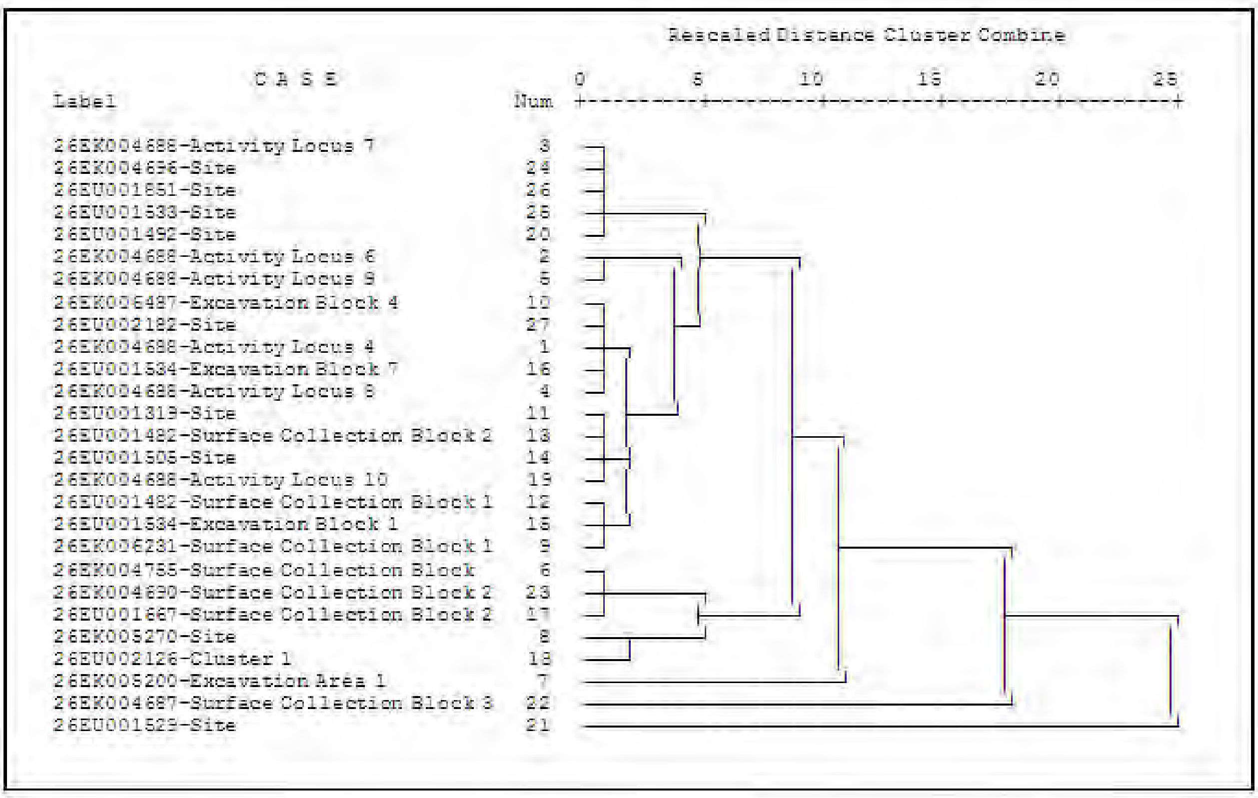

Figure 32. Cluster analysis dendogram (Ward Method) for all single-component sites and components in the Little Boulder Basin.

The remaining sites, forming the last major set of clusters at the top of the diagram, mostly vary in terms of debitage and tool densities, fauna densities, etc. but generally all within one standard deviation of the mean. Thus, these likely represent a general background site type of "camp" with slight variations in the intensity of ordinary camp activities—tool production and repair, food processing, etc.—resulting from ordinary variations in everyday activity rather than any distinct set of types.

The initial exploratory analysis therefore suggests that there may be broad patterning in site types. Three main site types appear suggested: a generalized camp, a site with a greater emphasis on tool production and repair, and a site type with a greater emphasis on botanical and faunal processing.

8.3.3. Site Variability by Time Period

Although examining variability in site structure across all time periods for single-component sites provides a useful means of capturing the overall variability in the excavated collection and identifying true site standouts, variability is best examined within given time periods. Because differing settlement strategies may have been employed in different time periods, it is important to look at variability within the defined periods. Indeed, as will be argued in Chapter 9, it appears from chipped stone tool, core, and debitage data that size of the annual range and, possibly, overall mobility strategies may have differed in each period. Thus, it is crucial to examine time periods on a case-by-case basis.

Middle Archaic Period

Middle Archaic period components are represented by a total of six sites/excavated activity areas. Because the overall sample size of these sites is so small, statistical analyses were not considered useful and it is best to simply examine the site data directly in search of patterning. Examining the data this way, in particular focusing on Z-scores, or the relative way in which the artifacts and feature vary across Middle Archaic period sites and components only is revealing of potential patterning in site structure (Table 43).

Table 43. Site Structure Variables and Z-scores for Middle Archaic Period Sites and Components in the Little Boulder Basin

	Z-scores				
Site and Provenience	**Features**	**Debitage**	**Tools**	**Ground Stone**	**Fauna**
26EK004687-Surface Collection Block 3	1.4	0.0	0.3	2.0	1.6
26EK004690-Surface Collection Block 2	-0.6	1.9	1.1	-0.5	0.9
26EK004696-Site	-0.6	-0.5	-0.9	-0.5	-0.6
26EU001533-Site	-0.6	-0.7	-1.4	-0.5	-0.6
26EU001851-Vinini Quarry-All Site	-0.6	-0.7	-0.2	-0.5	-0.6
26EU002182-Excavation Block 1	1.2	-0.1	1.0	-0.2	-0.6

Examining the data, it is clear that a number of sites are very similar, but several are notably different. Sites 26EK002696, 26EU001533, 26EU001851, and 26EU002182 are notably similar in terms of proportions of features and all artifacts and fauna diversity. For all of these sites, nearly all variables have Z-scores ranging between -1 and 1, which represents values within one standard deviation of the mean. It is somewhat surprising that 26EU001851 is similar to other sites, in that it is a quarry site. However, it may well be the case that all of these sites represent small camp sites, including a small camp at the quarry itself. The Middle Archaic period component at Site 26EU002182 (Excavation Block 1) has a higher than average number of features (a total of four). However, all other aspects of this site seem very similar to other Middle Archaic period sites, and the high numbers of features may simply represent random variation in feature construction, site reoccupation, or simple preservation factors. Site 26EU001533 has a lower than average density of chipped stone tools, but variation in this single variable is not likely to reflect meaningful variation in settlement strategy. Overall, it seems that many of the Middle Archaic period sites are quite similar and represent a range of activities and processing.

The Middle Archaic period component at Site 26EK004690 (Surface Collection Block 2) is distinct in having a higher density of debitage and chipped stone tools than other sites, and the fauna Z-score is almost outside of the norm. This site may represent a site with a focus on production of tools and gear for hunting or processing hunted game. It has a faunal richness of 4, one of only two Middle Archaic period sites with faunal richness scores above 0. It also fell into one of the major distinct site groupings in the analysis of all sites in the previous section. The site may represent a slightly more focused camp, although we are disinclined to define it as a separate site type solely on the basis of a single line of data and variability primarily across only two major variables. A larger assemblage of Middle Archaic period sites would assist in determining if the faunal richness at this site is truly notable and, therefore, potentially indicative (along with the debitage and tool data) of a specialized, hunting-focused site.

The most notable component is Site 26EK004687 (Surface Collection Block 3). This site has a high number and Z-score of features (8 and 1.4), along with notably high Z-scores for ground stone and fauna richness. Z-scores for debitage and tools of this component are higher than others, but still within one standard deviation of the mean. Notably, this site was distinct even when compared to all sites as a whole, as revealed previously in the section describing cluster analysis results. The high numbers of features, ground stone, and fauna richness suggest that processing of botanical and faunal materials was a significant focus at this site. Three of the features consist of ground stone clusters or caches, and it is clear that occupation anticipated botanical and possibly faunal processing. This component is notably distinct from the other sites.

Thus, overall, the data from the Middle Archaic period occupations suggest that there may have been two general site types during this period. The main type, characterized by no features, no ground stone, low to zero faunal richness, and a general assemblage of debitage and tools appears most common. This site type seems similar to a general, short-term camp locale. There is some variation in that sites of this type will occasionally evidence features or higher densities of one artifact class or another, but without additional information it appears premature to assign a specific type to these sites. A distinct second type is represented by Site 26EK004687 (Surface Collection Block 3), and consists of a site with higher densities of features, ground stone artifacts, and faunal richness. This may represent a more specialized processing locale. Notably, even though the number of features on this particular site is high, most are all within a relatively small area, and are likely to represent features created on separate occupations. Along with the presence of ground stone caches on the site, it seems that site reoccupation may have produced some of the high numbers and densities of features and ground stone artifacts. Therefore, the site may simply represent a more focused small camp occupation that was revisited and re-occupied multiple times, rather than a larger, more complex, single occupation.

Maggie Creek Phase

There are only three Maggie Creek phase components in the LBB area excavated site sample. As a consequence, it is extremely difficult to draw substantive conclusions from the small assemblage. Nonetheless, examining the sites does suggest that there may be differences in site types present (Table 44).

Table 44. Site Structure Variables and Z-scores for Maggie Creek Phase Sites and Components in the Little Boulder Basin

	Z-Scores				
Site and Provenience	**Features**	**Debitage**	**Tools**	**Ground Stone**	**Fauna**
26EK004688-Activity Locus 10	1.0	-0.5	-0.6	-0.6	-0.8
26EU001492-All Site	-1.0	-0.6	-0.5	1.2	-0.4
26EU001529-Entire Site	-0.1	1.2	1.2	-0.6	1.1

Of the three sites, 26EU001529 is distinct. It has high densities of debitage, tools, and fauna relative to the other two sites. This site, also known as Point Blank Hill, was noted during the original excavations to be distinctive and has been recognized as such since. The site is also identified as unique in the overall cluster analysis of all sites, and is clearly a stand-out in terms of the amount of debitage and tools relative to the low numbers of features. It also has a notably high faunal richness. The original excavators identified it as a field camp associated with intercept hunting. A focus on hunting and game processing does not seem unreasonable for this type of site. It has thousands of chipped stone tools and more than a hundred discarded projectile points. Ground stone was absent and only two features were identified over a large excavation area.

Site 26EU001492 is also slightly distinct, but the difference is not clearly significant. This site has a higher than average density of ground stone (a total of 5, compared to 0 at the other two sites). However, variation in this single variable is difficult to interpret and may simply represent random variation in site artifacts rather than a meaningful difference in settlement type.

Although the number of sites is very low, almost too low to draw significant conclusions, it does appear that there may have been at least two site types during the Maggie Creek Phase: a simple generalized camp with a variety of artifacts and activities, and a large site characterized by intensive tool production and possibly hunting activities.

Eagle Rock Phase

The Eagle Rock phase is represented by a much larger assemblage of sites. Indeed, for this phase, the difficulty is in determining if there is any patterning in the overall variation. Compared Z-scores across the numerous variables indicate that there is a great deal of variability, and in many cases this variability is in one or a few variables, with little clear patterning. Thus, we utilized Principal Components Analysis and Cluster Analysis, conducted on the Eagle Rock phase assemblage of sites alone, to assist in identifying possible site patterning.

As was the case with the overall assemblage, the Principal Components Analysis identified two major components (Table 45). The first seems to be characterized by high Z-scores for debitage and tool densities. The second is characterized by high scores for ground stone density and fauna richness, with a slight high proportion of debitage density. The distinction is interesting because it again suggests at least a distinction between tool production and processing sites and botanical/faunal processing sites. Notably, there seems to be little variation in feature numbers or types. Nearly all Eagle Rock phase sites have at least one or a few features, and this variable does not seem to be a significant way to distinguish site types.

Table 45. Principal Components Analysis Rotated Component Matrix for Single-component Eagle Rock Phase Sites and Components in the Little Boulder Basin

Z-Score for Variable	Component 1	Component 2
Features	-.114	-.615
Debitage	.933	.204
Tools	.879	-.272
Ground Stone	-.254	.523
Fauna Richness	-.013	.754

Note: Rotation converged in three iterations.

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Notably, however, few Eagle Rock phase sites had high scores for these factors (Table 46). Sites scoring high for Component 1 (high debitage and tool density) included 26EU002126 (Cluster 1), 26EK005270, and 26EK004688 (Activity Locus 8). Sites scoring high for Component 2 (high ground stone density and fauna richness) are 26EU001667 (Surface Collection Block 2), 26EK004755, and 26EK004688 (Activity Locus 6 and Activity Locus 9). The remaining sites have a great deal of variability in their factor loadings for both components. Alone, these data suggest that there may be three major site types: a generalized camp with a variety of debris, a camp characterized by a high degree of tool and debitage processing, and a camp characterized by higher degrees of botanical and/or faunal processing.

Table 46. Component Factor Scores for Eagle Rock Phase Sites in the Little Boulder Basin

Site-Provenience	Component 1	Component 2
26EK004688-Activity Locus 4	0.16860	-0.21107
26EK004688-Activity Locus 6	-0.60914	1.05022
26EK004688-Activity Locus 7	-0.63429	0.03909
26EK004688-Activity Locus 8	1.48181	-0.20421
26EK004688-Activity Locus 9	-1.15619	1.18336
26EK004755-Surface Collection Block	0.36330	2.06632
26EK005200-Excavation Area 1	-0.44867	-2.46578
26EK005270-Site	2.61218	-0.03789
26EK006231-Surface Collection Block 1	0.02666	0.35239
26EK006487-Excavation Block 4	0.02370	-0.59175
26EU001319-Site	-0.20026	-0.96051
26EU001482-Surface Collection Block 1	-0.51032	0.38144

Table 46. Component Factor Scores for Eagle Rock Phase Sites in the Little Boulder Basin

Site-Provenience	Component 1	Component 2
26EU001482-Surface Collection Block 2	-1.03076	-0.76576
26EU001505-Site	-0.99301	-0.53545
26EU001534-Excavation Block 1	0.04866	-0.10593
26EU001534-Excavation Block 7	-0.39461	-0.26889
26EU001667-Surface Collection Block 2	-0.42653	1.23776
26EU002126-Cluster 1	1.67886	-0.16335

Note: Notably high scores for each component are highlighted.

Cluster analysis generally supported this interpretation. As is always the case with cluster analysis, the challenge is to interpret the data and determine which clusters are meaningful. The cluster analysis yielded three major clusters, two other significant clusters, and a series of smaller groupings (Figure 33). The first notable site is 26EK005200 at the bottom of the diagram. This site is notable for a high feature density. However, as discussed above, this site only has a single feature, and the feature density is only high because it came from a small, shallow block. Thus, this site should be considered similar to other sites, and the first major break is at the next step in the diagram.

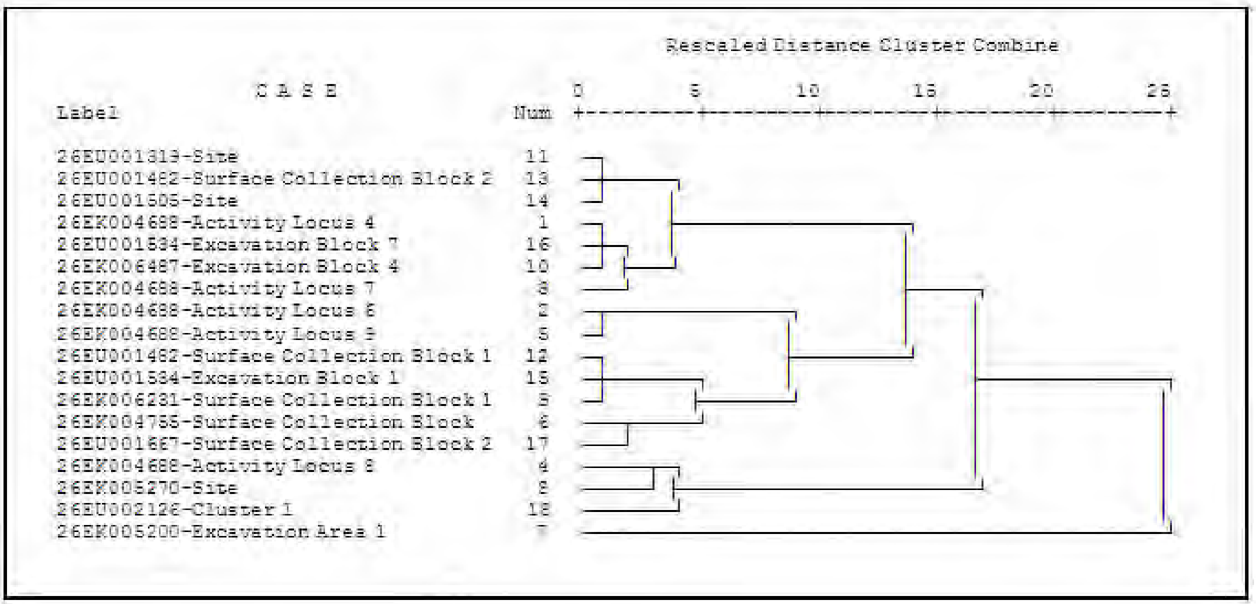

Figure 33. Cluster analysis dendogram (Ward Method) for Eagle Rock phase sites and components in the Little Boulder Basin.

It is useful to examine the dendogram along with the Z-Scores for the sites in question (Table 47). For ease of comparison, the sites in Table 47 have been arranged from top to bottom to correspond to the first four major groupings (including the one for 26EK005200). The first notable cluster consists of sites 26EU002126, 26EK005270, and 26EK004688 (Activity Locus 8). This cluster has high positive debitage and tool Z-scores, suggesting a group of sites with a focus on tool production and repair. The other sites below this cluster have debitage and tool Z-scores generally between -1 and 1, and represent in many ways an "average" amount of tool production and repair. Within this latter group the main notable distinction is of a group with similar, and generally average, proportions of ground stone and fauna (the group of seven sites beginning with Site 26EU001319 in Table 47). The final major cluster (the group of seven sites beginning with Site 26EK004688-Activity Locus 6 in Table 47) includes sites with positive or high Z-scores for ground stone, fauna, or both. There is a great deal of variability in this group, but it is notable that all four sites or components that scored high on Component 2 in the Principal Components Analysis are included in this group. Furthermore, these four sites/components—26EU001667 (Surface Collection Block 2), 26EK004755, and 26EK004688 (Activity Locus 6 and Activity Locus 9)—all have their own individual clusters at the final level.

Table 47. Z-scores for Eagle Rock Phase Single-component Occupations in the Little Boulder Basin

Site and Provenience	Feature	Debitage	Tools	Ground Stone	Fauna
26EK005200-Excavation Area 1	3.4	-0.9	0.7	-0.4	-0.7
26EU002126-Cluster 1	0.8	1.6	1.6	-0.4	0.6
26EK005270-All Site	-0.5	2.9	1.9	-0.4	-0.7
26EK004688-Activity Locus 8	-0.4	1.1	1.8	0.2	-0.7
26EU001319-Site	0.3	-0.9	0.6	-0.4	-0.7
26EU001482-Excavation Block 2	0.4	-0.8	-1.1	-0.4	-0.7
26EU001505-Site	0.1	-0.6	-1.3	-0.4	-0.7
26EK004688-Activity Locus 4	-0.7	0.1	0.1	-0.4	-0.7
26EU001534-Excavation Block 7	-0.3	0.0	-0.9	-0.4	-0.7
26EK006487-Excavation Block 4	-0.4	-0.6	0.6	-0.4	-0.7
26EK004688-Activity Locus 7	-1.3	-0.7	-0.8	-0.4	-0.7
26EK004688-Activity Locus 6	-0.2	-0.1	-0.6	2.4	-0.1
26EK004688-Activity Locus 9	0.4	-0.8	-0.7	2.9	0.6
26EK004755-Surface Collection Block	-0.5	0.7	-0.2	0.6	2.5
26EK006231-Surface Collection Block 1	0.2	-0.2	0.1	-0.4	1.2
26EU001482-Excavation Block 1	-0.2	-0.2	-1.0	-0.4	0.6
26EU001534-Excavation Block 1	-0.2	0.0	0.0	-0.4	-0.1
26EU001667-Surface Collection Block 2	-0.7	-0.4	-0.7	-0.4	1.8

Note: Sites are grouped to correspond to clusters identified in Figure 33.

Thus, despite the overall variability, we suggest that there may be three general site types during the Eagle Rock phase in the LBB area, although the variability between all of them is slight. The most common appears to be a generalized camp, characterized by one or a few features, moderate densities of debitage and tools, and low to absent numbers of ground stone and fauna. This generalized camp seems to form a background against which there is some variation in activity focus. One potentially distinct site type consists of sites with higher than moderate densities of tools and debitage. These have debitage densities between 2,000 and 5,000 flakes per cubic meter and tool densities above 10 per cubic meter.

They may represent sites with a particular focus on stone tool reduction activities. Another group consists of sites with either ground stone or high fauna richness, or both. These sites appear to potentially represent a greater investment in plant and animal processing, and may indicate a separate occupational focus.

However, it is important to note that none of this variation is particularly substantial. In all cases, the main artifact type at a site is debitage and tools, and most sites have a single feature. Notable increases in either debitage or tool production or botanical/faunal processing may simply represent slight variations in activities or artifact deposition rather than any significant planning differences. The activities represented at all these sites are general “camping” activities that one might expect for a hunter-gatherer: produce and repair tools, cook, process food. Variation in the intensity of these is, overall, slight, and may not be significant if the Eagle Rock phase sites in the LBB area were compared to other, and potentially more distinct, sites in the wider region. Certainly, there is less clear and significant variation in the Eagle Rock phase than was seen for the Middle Archaic period and the Maggie Creek phase. None of the Eagle Rock phase sites have the types of extreme artifact or feature counts represented by either 26EU001519 (Point Blank Hill) or 26EK004687 (Surface Collection Block 3). It may also be the case that there is no significant difference in site types for the Eagle Rock phase that cannot be accounted for by expected random variation in camping activities.

8.3.4. Summary: Variability in Site Types in the Little Boulder Basin

Overall, the exploratory and interpretive analysis suggests that there may be three site types in the LBB area. One consists of a very general site, including one or a few features (or occasionally none), notable debitage and tool densities, and low but occasional frequencies of ground stone and faunal remains. This site could best be characterized as a general camp for a small group occupying the area for a short period of time. A second site is similar to this camp but exhibits much higher densities of tools and debitage, suggesting that a focus on tool production and repair was occasionally emphasized. In some cases, such as the Maggie Creek phase site, 26EU001529 (Point Blank Hill), this emphasis was extreme. A third site type consists of sites with higher ground stone densities and greater faunal richness. This type may represent an area where food procurement and processing was emphasized, perhaps even as a focus.

This pattern seems to hold across all time periods, although the low numbers of single-component sites or activity areas during the Maggie Creek phase and Middle Archaic period limits our ability to draw significant inferences for these periods. Notably, two of the most distinct sites overall 26EU001529 (Maggie Creek phase, Point Blank Hill) and 26EK004687-Surface Collection Block 3 (Middle Archaic period), are from these two periods, suggesting (though not demonstrating) that site differentiation may have been more dramatic in these periods than in the later Eagle Rock phase.

8.4. Site Types and Distribution in the Little Boulder Basin

A final means of examining potential differentiation in site types is to examine sites relative to their geographic placement on the landscape. Although the LBB area overall is small, and relatively homogenous in terms of macro-environment, there is variation in factors such as proximity to springs, location on hills or ridges, and proximity to the major floodplains of Bell and Rodeo creeks. If the site types we have examined represent true differential occupation strategies, we would expect these types to vary in relatively consistent manners across the landscape.

To explore this possibility, we have taken the single-component sites and characterized them as one of the three site types identified above (Table 48). These types include the generalized camp, a “Tool Production” site (characterized by high densities of tools and debitage) and a “Food Processing” site (characterized by high densities of ground stone and high faunal richness. A map showing the locations of sites and site loci classified into these categories is provided in Figure A10 in Appendix A.

Table 48. Sites Characterized by Age and Tentative Site "Type"

Site and Provenience	Period/Phase	"Type"
26EK004688-Activity Locus 4	Eagle Rock	General Camp
26EK004688-Activity Locus 6	Eagle Rock	Food Processing
26EK004688-Activity Locus 7	Eagle Rock	General Camp
26EK004688-Activity Locus 8	Eagle Rock	Tool Production
26EK004688-Activity Locus 9	Eagle Rock	Food Processing
26EK004755-Surface Collection Block	Eagle Rock	Food Processing
26EK005200-Excavation Area 1	Eagle Rock	General Camp
26EK005270-Site	Eagle Rock	Tool Production
26EK006231-Surface Collection Block 1	Eagle Rock	General Camp
26EK006487-Excavation Block 4	Eagle Rock	General Camp
26EU001319-Site	Eagle Rock	General Camp
26EU001482-Surface Collection Block 1	Eagle Rock	General Camp
26EU001482-Surface Collection Block 2	Eagle Rock	General Camp
26EU001505-Site	Eagle Rock	General Camp
26EU001534-Excavation Block 1	Eagle Rock	General Camp
26EU001534-Excavation Block 7	Eagle Rock	General Camp
26EU001667-Surface Collection Block 2	Eagle Rock	Food Processing
26EU002126-Cluster 1	Eagle Rock	Tool Production
26EK004688-Activity Locus 10	Maggie Creek	General Camp
26EU001492-Site	Maggie Creek	General Camp
26EU001529-Site	Maggie Creek	Tool Production
26EK004687-Surface Collection Block 3	Middle Archaic	Food Processing
26EK004690-Surface Collection Block 2	Middle Archaic	Tool Production
26EK004696-Site	Middle Archaic	General Camp
26EU001533-Site	Middle Archaic	General Camp
26EU001851-Site	Middle Archaic	General Camp
26EU002182-Site	Middle Archaic	General Camp

Examination of the data yielded interesting insights with regard to site location distribution variability. This variability will be discussed at three levels—topographic, period/phase and site type—moving from broad patterns across the landscape to more specific patterns of function.

Within the LBB area, there are a variety of locations in which sites occur. Analysis of the 27 single-component sites revealed that a vast majority are situated on ridges, a few located on terraces and knolls, and a minor number located on alluvial floodplain areas (Table 49). All sites have access to creeks and/or springs; specifically, Bell, Rodeo and Simon creeks. The land between Bell and Rodeo creeks contains the highest proportion of sites, offering two sources of perennial water access. However, this pattern likely a result of the fact that archaeological survey has been concentrated between these two creeks as a result of mine development. Based on previous report data (Schroedl 1996; Tipps and Miller 1998), three sites (26EK004687, 26EK004696, and 26EU002182) were identified as being associated with springs. Although there are broad commonalities sites exhibit, like being located predominately on ridges or near a perennial water source, no discernable patterns were apparent.

The next facet of the analysis focused on single-component sites from each of the three periods/phases—Eagle Rock, Maggie Creek and Middle Archaic—and their distribution within the LBB area landscape. Of the 27 single-component sites, 18 of them are assigned to the Eagle Rock phase. Eagle Rock sites occur primarily on ridges and terraces, with access to one or both of Bell and Rodeo creeks. None of these sites are associated with springs. The Maggie Creek phase is represented by a mere three sites, and the ensuing information is likely to be skewed as a result. Maggie Creek sites are located on knolls and ridges, with access to one or both of Bell and Rodeo creeks. None of these sites are associated with springs. The Middle Archaic phase is represented by the remaining six single-component sites. Middle Archaic sites are located primarily on ridges and knolls, with a small faction occurring on flat or alluvial areas. These sites have access to one or all three of Bell, Rodeo and Simon creeks. The three aforementioned sites (26EK004687, 26EK004696, and 26EU002182) that were recorded as being associated with springs are all representative of the Middle Archaic phase. Whether or not proximity to springs represents a trend in Middle Archaic site choice remains to be seen and is likely an avenue for future research. Notably, this analysis has focused on single-component sites. We do know from multicomponent sites that occupations from all of these phases occurred in other locales, and therefore the single-component sites should not be considered fully representative of the settlement system for any given period.

Table 49. Tentative Site Type and Environmental Variables for Single-component Occupations, Little Boulder Basin

Site and Provenience	Period/ Phase	Site Type	Nearest Stream	Proximity	Near Spring	Topography	Vegetation
26EU002182-Site	Middle Archaic	General Camp	Simon Creek	Medium	Yes	Alluvial	Great Basin Pinyon-Juniper Woodland
26EK004690-Surface Collection Block 2	Middle Archaic	Tool Production	Bell & Rodeo	Medium/Far	No	Flat Area	North American Arid West Emergent Marsh
26EU002126-Cluster 1	Eagle Rock	Tool Production	Bell & Rodeo	Close	No	Floodplain	Inter-Mountain Basins Big Sagebrush Shrubland
26EU001492-Site	Maggie Creek	General Camp	Bell Creek	Medium	No	Knoll	Inter-Mountain Basin Big Sagebrush Steppe & Inter-Mountain Basins Big Sagebrush Shrubland
26EU001851-Site	Middle Archaic	General Camp	Rodeo Creek	Close	No	Knoll	Great Basin Foothill and Lower Montane Riparian Woodland and Shubland
26EU001529-Site	Maggie Creek	Tool Production	Rodeo Creek	Medium	No	Knoll	Recently Mined or Quarried
26EU001505-Site	Eagle Rock	General Camp	Bell & Rodeo	Close	No	Ridge	Great Basin Xeric Mixed Sagebrush Shrubland
26EU001319-Site	Eagle Rock	General Camp	Rodeo Creek	Medium	No	Ridge	Recently Mined or Quarried
26EU001533-Site	Middle Archaic	General Camp	Rodeo Creek	Far	No	Ridge	Inter-Mountain Basins Semi-Desert Grassland
26EU001667-Surface Collection Block 2	Eagle Rock	Food Processing	Rodeo Creek	Medium	No	Ridge	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004688-Activity Locus 6	Eagle Rock	Food Processing	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004688-Activity Locus 9	Eagle Rock	Food Processing	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004755-Surface Collection Block	Eagle Rock	Food Processing	Bell Creek	Medium	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004687-Surface Collection Block 3	Middle Archaic	Food Processing	Bell Creek	Close	Yes	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK005200-Excavation Area 1	Eagle Rock	General Camp	Bell Creek	Medium	No	Ridge (E-W)	Great Basin Xeric Mixed Sagebrush Shrubland
26EK004688-Activity Locus 4	Eagle Rock	General Camp	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland

Table 49. Tentative Site Type and Environmental Variables for Single-component Occupations, Little Boulder Basin

Site and Provenience	Period/ Phase	Site Type	Nearest Stream	Proximity	Near Spring	Topography	Vegetation
26EK004688-Activity Locus 7	Eagle Rock	General Camp	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004688-Activity Locus 10	Maggie Creek	General Camp	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK004696-Site	Middle Archaic	General Camp	Bell & Rodeo	Medum/Far	Yes	Ridge (E-W)	Great Basin Xeric Mixed Sagebrush Shrubland
26EK004688-Activity Locus 8	Eagle Rock	Tool Production	Bell Creek	Close	No	Ridge (E-W)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK006231-Surface Collection Block 1	Eagle Rock	General Camp	Bell Creek	Medium/Far	No	Ridge (NW-SE)	Inter-Mountain Basins Big Sagebrush Shrubland
26EK005270-Site	Eagle Rock	Tool Production	Bell Creek	Far	No	Saddle	Recently Mined or Quarried
26EU001482-Surface Collection Block 1	Eagle Rock	General Camp	Rodeo Creek	Medium	No	Terrace	Great Basin Foothill and Lower Montane Riparian Woodland and Shubland
26EU001482-Surface Collection Block 2	Eagle Rock	General Camp	Rodeo Creek	Medium	No	Terrace	Great Basin Foothill and Lower Montane Riparian Woodland and Shubland
26EU001534-Excavation Block 1	Eagle Rock	General Camp	Rodeo Creek	Medium	No	Terrace	North American Arid West Emergent Marsh & Inter-Mountain Basins Semi-Desert Grassland
26EU001534-Excavation Block 7	Eagle Rock	General Camp	Rodeo Creek	Medium	No	Terrace	North American Arid West Emergent Marsh & Inter-Mountain Basins Semi-Desert Grassland
26EK006487-Excavation Block 4	Eagle Rock	General Camp	Bell Creek	Medium	No	Terrace, bench and colluvial slope	Inter-Mountain Basins Big Sagebrush Shrubland & Great Basin Xeric Mixed Sagebrush Shrubland

Lastly, the newly identified site types of generalized camp, tool production and food processing site, were examined to attempt to identify geographic themes or commonalities specific to each type. As far as frequency, generalized camps were the predominant site type of the 27 selected single-component sites. Generalized camps were present in all three phases of occupation. No patterns were indicated by the geographic distribution of the generalized camps. Tool production sites are present in all three phases (Eagle Rock, Maggie Creek and Middle Archaic), and occur across a variety of topographic locations. They are located near one or both of Bell and Rodeo creeks. Review of the data suggests no patterns of geographic distribution for tool production sites.

There was a suggestion of potential patterning in site locale for the food processing sites. Food processing sites occur primarily in the Eagle Rock phase, with a single site representing the Middle Archaic phase. Every single food processing location occurred on a ridge, and was associated with an Inter-Mountain Basins Big Sagebrush Shrubland vegetative community (according to imagery taken from the National Agricultural Imagery Program; see Table 49 and Figure A10 in Appendix A). This is the only instance when a discernable geographic pattern was noted. As far as water is concerned, food processing sites have access to either Bell or Rodeo creek, with the one Middle Archaic site having access to a spring.

In summary, site distribution within the LBB area landscape appears highly variable. However, a comprehensive review of this data suggests three main points of interest. First, a majority of the sites—including generalized camps, tool production and food processing sites—were topographically oriented on ridges. Second, access to water was available to every site whether through a perennial creek or spring. And lastly, food procurement sites are the only site type to occur solely on ridges and solely within a single vegetative community (Inter-Mountain Basins Big Sagebrush Shrubland). While this type of environmental setting is present throughout the LBB area, the data suggests that it was a preferred by prehistoric people for food procurement activity. Future research is warranted to understand how this logistical strategy relates to the larger picture of occupation within the LBB area.

8.5. Conclusions

Defining site types and site structure has long been a difficult operation, and it has been particularly difficult in the LBB area. Despite a high number of excavated sites, there has long been lots of distinct and visible variation in site structure and attributes but no clear patterning to lead to the definition of unambiguous site types. While we cannot claim to have solved this problem definitively, we do believe that through utilization of an interpretive, quasi-emic, approach based on the data itself, we have identified a number of potential site types and developed a more consistent means of identifying these types (or new types) in the future.

Most attempts to develop site typologies, within the LBB area and out, have utilized an "etic" approach, where site types are developed on a theoretical basis prior to any excavation and then the excavation results have been examined in light of the sites. In general, these approaches have not been particularly successful when applied to the archaeological record. As demonstrated above, in the LBB area, despite development of a clear model, it has proven impossible to apply site variables consistently to the model and, as a result, there has been a plethora of defined site types with no clear and unambiguous distinctions between them. Despite multiple, determined attempts to identify site types predicted by Binford's forager-collector model, it has proven impossible to do so. In a way, this is not particularly surprising. It is hard to imagine the types of highly specialized extractive sites imagined by the model and much easier to visualize variations on the general theme of "residential camp." It was clearly time to abandon this etic approach and try and look at the information from the bottom up; beginning with what is present on the ground rather than deciding what should be on the ground and looking to prove the existence of a theoretical construct. Our approach focused on examining the data itself, utilizing exploratory statistical tools to identify potential consistent variation in site types.

We are able to make a number of immediate observations. In the case of the LBB area, all sites, from all time periods, appear to represent the remains of small groups of highly mobile hunters and gatherers who occupied sites for short periods of time. Despite years of heroic effort, no structures have been identified on any sites of any time period. The numbers of features on sites are generally low, and even sites with high numbers of features are likely to have been re-occupied repeatedly. Features are almost always very simple, unlined fire pits. A few appear to have been rock lined, but none approach the complexity of lined fire pits, deep bell-shaped or other storage pits, and other feature types seen in other areas of the Great Basin and Intermountain West. No secondary refuse areas have been identified, and site structure—as defined by features and artifact distributions—is extremely small, simple, and easily interpreted as representing short occupations by small, mobile, probably extended-family groups. The majority of sites can be characterized, as we have here, as simple, generalized, camps.

Variation, therefore, even if identified, is slight and concentrated in areas of relative artifact and faunal material density differences. We believe we have identified two potential other types in addition to the generalized camp. One is characterized by high densities of debitage (generally greater than 2,000 flakes per cubic meter) and tools (generally greater than 10 tools per cubic meter). These sites may represent areas where stone tool production and repair (and possibly associated hunting) were a particular focus. Another potential type is characterized by higher densities of ground stone (generally two or more ground stone artifacts) and high faunal richness (generally more than 3). These sites may represent areas where food collection and processing were relatively more emphasized.

It is notable that distribution of these potential types is not entirely as patterned as might be expected. General camps and tool processing sites appear to be located across a variety of settings, distances to water, and vegetation zones in the LBB area. This is not entirely surprising, however, as a general camp might be expected in a variety of locales, and intensive tool processing (particularly when most of the raw material is from distant quarries), can be carried out anywhere. Importantly, however, food processing sites appear restricted to particular ridge tops and the big sagebrush vegetation zone. One might expect food processing sites to be situated in a restricted range of locales, so the observed pattern in the LBB area lends credence to the idea that the food processing site is a valid type.

A number of other observations have emerged from this analysis. One is that the mere presence of ground stone, long thought to be an important distinguishing factor between site types, is of itself a poor discriminator between sites. In the LBB area at least, it is rare, but occasionally present. It does not seem to clearly covary with any other factors considered in this analysis (though it does covary with the presence and absence of features, as demonstrated in Chapter 5), and the Principal Components Analysis demonstrated that it is predominantly important when ground stone is present in high quantities and co-occurs with a high faunal richness, and not simply when it is present or absent. Additionally, features are also poor discriminator between sites overall. With the exception of the Middle Archaic period, features are relatively common and often found on most sites. During the Eagle Rock phase, nearly all sites have at least one feature. The little variation that was observed in feature numbers appears more likely to be related to site reoccupation during a given time period rather than indicative of true differences in site structure. Indeed, the absence of features is often more revealing of site distinctions than the presence of features. Unfortunately, this was most often observed on sites from older time periods, the Middle Archaic period and Maggie Creek phase in particular, and lack of features may actually be an artifact of preservation problems as sites age rather than true differences in settlement practices. For the LBB area at least, the most important distinguishing factors between sites appear to fall in densities of artifacts and richness of faunal remains.

Overall, examination of the data itself suggests that for all time periods, in the LBB area at least, a very simple site typology was in effect. The general camp is the most common site, associated with sites with particular foci on tool production and repair or food procurement and processing. During the Middle

Archaic period and Maggie Creek phase, this bipartite distribution of sites is particularly striking and clearest. Sites such as 26EK004687-Surface Collection Block 3 during the Middle Archaic period (with a focus on ground stone and fauna processing) and 26EU001529-Point Blank Hill of the Maggie Creek phase (high densities of tools, debitage, and hunting debris) are dramatically different from the other sites of those phases. This suggests that settlement strategies during these periods may have been more specialized than during the Eagle Rock phase, when distinctions between sites are not nearly as stark or obvious as in earlier periods. It may be the case that use of the LBB area during the Eagle Rock phase was, in fact, much more homogenous. This pattern may be reflective of a real change in settlement strategies during the Eagle Rock phase. However, the low numbers of pre–Eagle Rock phase sites make these observations tentative rather than conclusive.

Indeed, overall this study has provided a new theory to approach, rather than providing definitive answers. While it is the case that we can no longer view the forager-collector model, strictly written, as a "guide" to understanding settlement in this area, and while we have defined some potential new site types and settlement strategies, additional research questions remain for all time periods.

- Is there a bipartite site type distribution in the Middle Archaic period characterized by small generalized camps and specialized plant and animal processing sites? Or, are more site types present?
- Are there any larger, multi-family group occupations during the Middle Archaic period or are all sites with multiple features simply sites that have been reoccupied repeatedly during the Middle Archaic?
- Is there a bipartite site type distribution in the Maggie Creek phase characterized by small generalized camps and specialized hunting and animal processing sites? Or, are more or fewer site types present?
- Is there a tripartite site distribution in the Eagle Rock phase characterized by small generalized camps, specialized hunting and tool production/repair camps, and specialized botanical and faunal processing sites? Or, are more or fewer site types present?
- Are there any larger, multi-family group occupations during the Eagle Rock phase?
- Are site types and inter-site differentiation greater prior to the Eagle Rock phase with less inter-site variability during the Eagle Rock phase?
- Are food processing sites consistently restricted to particular portions of the landscape?

Notably, for many of these research questions, data are now needed from outside the LBB area. The LBB itself was clearly populated by hunters and gatherers with a wide annual range during nearly all time periods (see Chapter 9). Sites in the LBB area represent only a portion of the overall settlement pattern and strategy for these populations. For the Eagle Rock phase in particular, where we now have a large body of single-component sites, additional data from the LBB area should focus on any sites that are dramatically different. In this case, that would entail any sites with evidence or high potential for structures, any sites with an artifact density greater than 5,000 per cubic meter (which would indeed be extreme on the surface), and any sites that appear to represent something other than a site where chipped stone tools were repaired or produced and general camp activities occurred. For other phases, however, additional sites can help to test the model considerably, as the number of sites present is low and our confidence in the typology for these periods is very tentative.

9. LITHIC SOURCE USE, TECHNOLOGY, AND MOBILITY

Matthew T. Seddon, Amy Spurling, and Victor Villagran

Prehistoric human occupations in the LBB area are quickly recognized by the sea of white Tosawihi chert debitage and tools that characterize all sites in the area. Although non-lithic artifacts are present, and attest to a wide range of activities and behaviors in the past, the absolute abundance and dominance of lithic debris creates the impression that the occupants were primarily engaged in lithic tool production and repair almost to the exclusion of other activities. It is clear, however, that regardless of the exact relative importance of lithic production and repair in the LBB area, the occupants did expend considerable time and energy in the production of stone tools, primarily utilizing chert from the Tosawihi Quarries, located approximately 20 km to the northwest of the LBB (Figure 34).

The remains of these activities have long been recognized as having high potential to provide insights into prehistoric human adaptation in the LBB area. Suitable toolstone is a raw material with limited distributions which must be obtained much like other economic resources. The way in which this material is obtained and the technological strategies utilized in producing stone tools are intimately related to overall technological strategies, mobility patterns, and economic adaptations. Because at least some subsets of the lithic materials in the LBB area can be identified to particular source locations, and because the technological strategies utilized in stone tool production can be inferred from tool types, waste flake (debitage) forms, and other attributes of lithic tools and debitage, the lithic assemblages from LBB area sites have high potential to provide information regarding human adaptation in the region.

Over nearly 20 years of research on lithic assemblages in the region, several key research questions have emerged. These predominantly focus on the utilization of the nearby high-quality Tosawihi chert quarries. As many researchers have noted, and as our own synthetic analysis demonstrates below, material from Tosawihi is by far the most commonly utilized raw material for stone tool manufacture, even relative to locally available suitable toolstone. The procurement and use of Tosawihi chert relative to other available materials within overall systems of mobility and economic strategies is the focus of lithic research in the area. Nonetheless, despite years of research in the area, archaeologists have only developed the most basic of models of mobility patterns and chipped stone assemblage variation for the area. These models differ considerably across many aspects of the problem; they differ in terms of their concept of the timing of changes as well as the nature and expected patterning of changes in mobility and chipped stone assemblages. The use of the full dataset from the LBB area enables an examination of the overall pattern and provides an opportunity to produce new models of mobility and lithic technology.

In this chapter, we utilize the chipped stone tool and debitage assemblages from more than 20 excavated sites representing more than 50 discrete occupations to address questions of lithic procurement, processing, technology, and mobility in the LBB area. Ultimately we attempt to use the chipped stone assemblages from the area to help refine models of regional mobility patterns in the region. To meet this goal, we focus on three major research areas: 1) How was Tosawihi chert obtained and exploited? 2) What is the exploitation of Tosawihi chert relative to other lithic sources and particularly different obsidian sources? What does the use of Tosawihi chert and obsidian say about the size of the annual foraging range in the past? 3) What do reduction strategies and transportation strategies of this high quality material say about regional mobility patterns and overall past settlement systems?

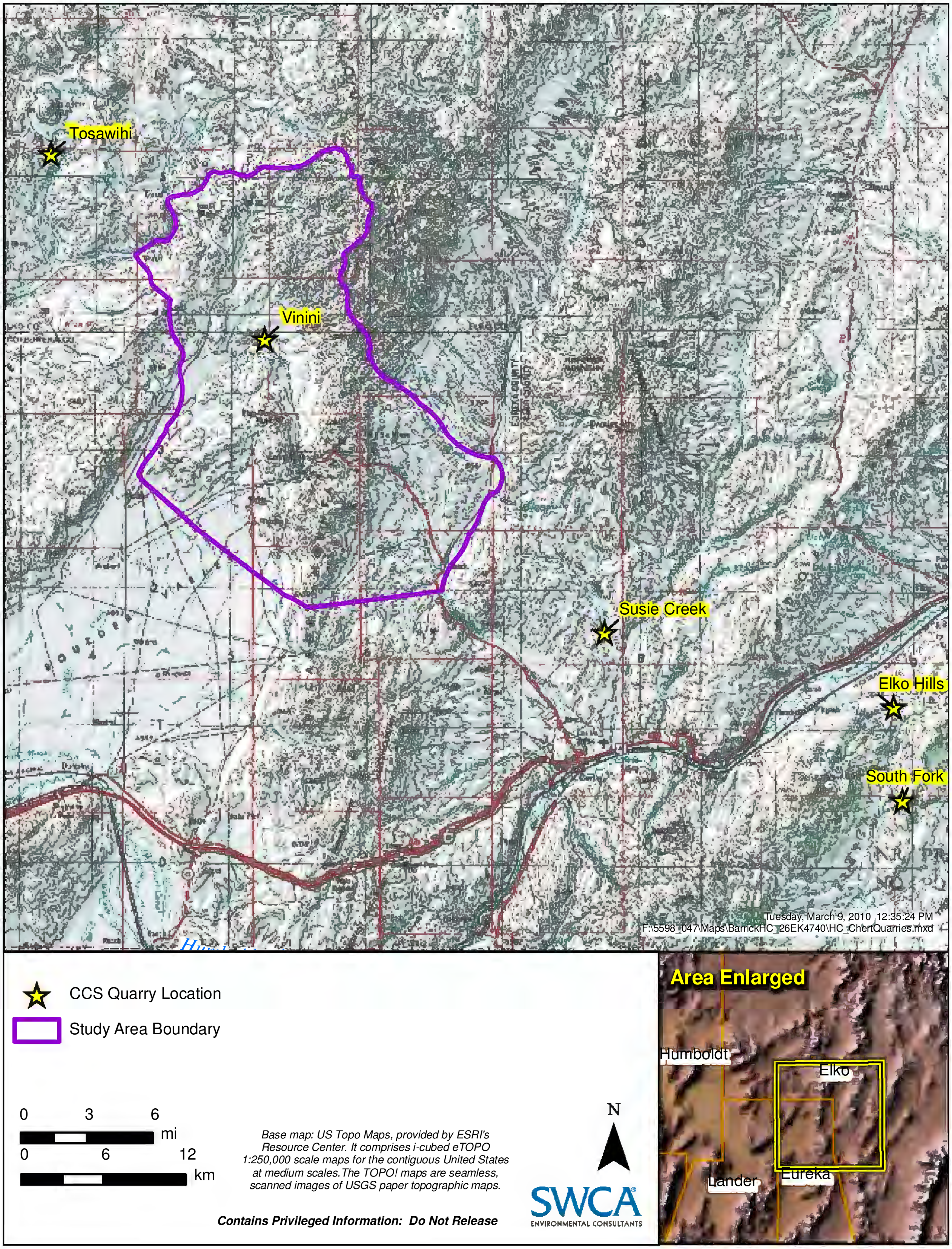

Figure 34. Location of the Tosawihi Quarries and other sources of cryptocrystalline silicate (CCS) materials in relation to the LBB study area.

This tripartite approach is based on general issues related to settlement and mobility pattern studies as well as particular features of the LBB and environs. Because human mobility patterns entail both a combination of distance of annual moves and organization of these moves (frequency, residential composition, economic focus, etc.) we attempt to first determine if there are changes in annual range size over the course of prehistory. Then, because the proximity of the Tosawihi Quarries, with the ready availability of high-quality raw material, has so clearly influenced many of the chipped stone procurement and processing strategies of past occupants of the area, we examine patterns in quarry exploitation in order to provide a background against which other questions may be asked. Finally, we take a comprehensive look at overall chipped stone tool and debitage assemblages of all materials in order to assess potential models of mobility and settlement patterns.

To understand and situate these questions within overall anthropological theory and past research, we begin with a theoretical overview and general summary of past research efforts. We then examine the data regarding Tosawihi Quarries use and diachronic change in annual range size and bifacial manufacture. The results of these analyses indicate that none of the models proposed to date fully and accurately characterize the changes in chipped stone assemblages in the region. Utilizing the observed data from our unique and valuable comprehensive dataset, we are able to propose a new model and research questions for future efforts.

9.1. Theoretical Overview and Past Research

The study of prehistoric lithic technological systems has been a major focus of archaeological research for more than 50 years. This research has yielded numerous insights and general approaches that have become widely accepted (Andrefsky 1994, 1998, 2001; Kelly 1988; Nelson 1991; Parry and Kelly 1987). These studies generally highlight two major related themes: raw material exploitation strategies and lithic production/reduction strategies. Both themes have been argued to be closely related to human mobility strategies. Because stone tools are important components of past technologies, because toolstone is generally distributed in limited areas on the landscape, and because stone is heavy and difficult to transport over long distances, research in lithic artifacts has focused on the ways in which past populations overcame these constraints via various exploitation and technological strategies.

The current paradigm generally posits that mobile hunting and gathering populations, such as those that inhabited the LBB area throughout prehistory, will generally seek out high quality toolstone which will be durable and reliable for use when they are located far from the original source. The general paradigm also posits that these populations will focus their technology on the production and use of bifaces, which are argued to be highly flexible, durable, and portable and ideally suited to mobile populations (Andrefsky 1994; Kelly 1988; Parry and Kelly 1987). The exact strategy employed will then depend on the exact nature of the lithic resource, its location on the landscape within the overall annual round of the population, and the nature of the environment around the resource.

Because of the proximity of the Tosawihi Quarries, and the relatively high quality of the material from these quarries, this material has formed the background for all study of lithic technology and procurement in the LBB area and, indeed, in the north-central Great Basin. The Tosawihi Quarries are located approximately 20 km northwest of the LBB. The distinctive material appears to have lent its name to a group of Shoshone who were known for exploiting it, as Tosawihi means “White Knife” (Elston and Raven 1992). The quarries are extensive, and are now recorded as an archaeological district of approximately 4,000 acres (Hockett 2006b). The environment around the quarries is extremely rugged, with very limited numbers of consumable floral and faunal resources and very limited water (Elston 1992c, 2006; Elston and Raven 1992). The quarries themselves consist of extensive outcrops of high quality chert or opalite material of various colors, though white predominates.

Because of the high quality of the material and proximity to many sites, any examination of lithic procurement and processing within overall settlement systems must consider both the general nature and structure of the settlement system itself as well as the particular draw and attraction of the Tosawihi Quarries as a relatively close source of high quality raw material. In the remainder of this section, we discuss theories of Tosawihi quarry exploitation that have been developed for the area. These are followed by a discussion of overall mobility patterns in the region. Together, these set the context for exploring the question of changes in annual range and overall mobility and settlement practices as they might be reflected in chipped stone tool and debitage assemblages.

9.1.1. Tosawihi Quarry Exploitation

Utilizing the overarching paradigm for the time, and based on intensive research conducted in and around the quarries themselves, Elston posited a model of Tosawihi chert exploitation that takes into account the highly mobile prehistoric populations and the relatively resource-poor location of the quarries (Elston 1990b, 1992a, 1992b, 2002). As argued by Elston, lithic procurement involves costs and risks that vary depending on the material, the location of the source, and the location of other resources relative to the raw material (Elston 1990b). As the costs and risks associated with raw material procurement increase with greater distances from the source, mobile populations will be expected to adjust their technological systems to reduce these costs. Increasing reliance on flexible and versatile formalized tool technologies (such as bifacial technologies) is one strategy (Andrefsky 1998; Kelly 1988; Nelson 1991; Parry and Kelly 1987). A second strategy is reliance on careful testing and initial preparation of raw materials at the source, to reduce the risk of raw material failure at more distant points (Elston 1990b:162). As argued by Elston,

> Lithic procurement is a risky business; considerable time and effort may be required to obtain raw material, which then can prove to be of poor quality and unusable, or which can be ruined through accident or lack of skill. Variability in lithic staging often is patterned by the need to prove material quality and reduce weight before transport… Thus, when a source is distant from the place where tools will be made from blanks and then used, most processing (assaying, primary and secondary core reduction) and early stage manufacture is likely to take place at, or near, the raw material source. (Elston 1990b:161–162)

In other words, under conditions of high residential mobility and/or wide annual foraging ranges, where hunter-gatherers would have anticipated spending long time periods far from sources of high-quality, reliable material such as obsidian, extensive long-term planning would probably have been utilized. Under periods of lower residential mobility, or periods when logistical procurement is emphasized, lower levels of planning would have been adequate, particularly if sources could have been reached by a logistically organized party without high costs (Elston 1990b:160).

Furthermore, various procurement strategies may be employed, depending on the overall organization of the settlement system, the resources available around and at a distance from a source, and other factors. Elston et al. posit four major procurement strategies—encounter, diurnal, residential, and logistical (Elston et al. 1992:54–58). Under an encounter strategy, exploitation of toolstone is embedded in other activities. The toolstone is acquired during the process of moving about the landscape, and little extra effort is put into finding and procuring the material (Elston et al. 1992:55). Under diurnal strategies, a residential base is placed sufficiently close to a toolstone source that a small party can obtain the raw material and return to the base in a single day (Elston et al. 1992:56–57). Under residential strategies, the residential base itself is placed close to the toolstone source to reduce travel time to the resource (Elston et al. 1992:57). Under logistical strategies, small parties conduct "short-term, toolstone-targeted collection forays requiring overnight or longer trips away from the residential base" (Elston et al. 1992:58).

Choice of one or another procurement strategy is expected to vary over time and to be associated with variability in lithic assemblage composition at different sites in the area. For example, based on the relatively limited food and water resources available near the Tosawihi Quarries, Elston et al. propose that logistical procurement strategies were likely for Tosawihi chert. They propose that procurement parties would have been likely to travel to the quarries and prepare early-stage, "export" bifaces for transport and reduction elsewhere (Elston 1992b). Populations more distant from the quarries would be expected to utilize these bifaces and to supplement their raw material supplies with local materials (Elston 1990b). At the most basic level, Elston hypothesizes that “at [sites located] about 10 km from the quarry, we expect a sharp decrease in proportions of cores, blanks, early stage bifaces and debitage” (Elston and Raven 1992:798).

Given the location of the LBB at more than 20 km from the quarries but exhibiting high densities of Tosawihi chert artifacts, the LBB area became an ideal area for examining this hypothesis. During the most intensive phase of research in the LBB area, this research question was explicitly examined (LaFond 1996b). Notably, although high quantities of bifaces and bifacial debitage are present in LBB area assemblages, there is a small but persistent presence of non-bifacial cores and core reduction debitage of Tosawihi chert in the area. Furthermore, early stage bifaces and bifacial debitage of Tosawihi chert were also identified. More recent studies have further supported this trend (Cannon et al. 2008). This research suggests that the Elston model may have been generally accurate but overly generalized. We will examine this question in greater detail in this chapter utilizing the full artifact assemblage from the LBB area.

9.1.2. Mobility Patterns

Since Jennings proposed the “Desert Culture” (Jennings 1953) concept, archaeologists have recognized that the prehistoric inhabitants of the Great Basin were highly mobile populations. Only recently, however, have archaeologists begun to examine the details of human mobility patterns in the past. Residential mobility encompasses a complex range of behaviors, including size of annual range, frequency of residential move, distances of moves, and the nature of each residential occupation (Binford 1980; Kelly 1983, 1992). The choice of a particular strategy will vary depending on the environment and human culture, including social organization, technology, economic strategies, and other factors. Recent archaeological focus has been on attempting to define and refine our understanding mobility patterns across time and space in the Great Basin (G. T. Jones et al. 2003; Madsen 1982; Madsen and Simms 1998)

Models of mobility and settlement patterns in the north-central Great Basin to date can best be described as nascent. The current theories have generally been constructed based on data from single site excavations (James Creek Shelter, Pie Creek Shelter, etc.) often supplemented with general information from a few other sites. Consequently, researchers have been justifiably cautious in drawing large conclusions about overall settlement patterns. Nonetheless, there are a number of current models, which, while preliminary, do provide for a background for testing broad ideas regarding diachronic change in mobility patterns as seen through the lens of chipped stone tools and debitage.

Based on excavations at James Creek Shelter, Elston developed an initial model of settlement patterns and mobility strategies for the region. While admitting that utilizing a single site to infer regional settlement and mobility strategies is problematic (Elston and Katzer 1990:273), Elston and Katzer argue that during the Middle Archaic period (South Fork and James Creek phases), populations had large annual ranges and employed a very general foraging strategy consisting of moving the residential group to small foraging bases, which they term “logistical bases” (Elston and Katzer 1990:273–274). During the subsequent Maggie Creek phase, this pattern changes dramatically. The annual range size seems to have decreased significantly and populations, although still foraging, were forced to more intensively use particular resource areas resulting in longer occupations at any given site. By the final, Eagle Rock, phase, the pattern changed again to be "more along the lines of that during the James Creek phase and earlier" (Elston and Katzer 1990:274).

McGuire, et al., working with data from the Pie Creek and Tule Valley shelters pose a slightly different model. They argue that during the Middle Archaic period populations were "wide ranging and logistically well organized, with highly mobile groups traversing hundreds of kilometers up and down valley corridors" (McGuire et al. 2004:25). Despite the use of the term "logistical," which often implies a settlement system tethered to a base camp, they describe these Middle Archaic period groups as "small, wide-ranging, and residentially mobile bands" (McGuire et al. 2004:130). Thus, they conceive of a large annual range inhabited by residentially mobile foragers, moving from resource patch to resource patch across the landscape. By the Late Archaic period, however, they identify that range size appears to decrease, and overall mobility declines (McGuire et al. 2004:25). In general, they describe several long term trends, including decrease in foraging range, increase in logistical procurement and settlement organization, and an increase in settlement centralization and population growth.

Previous research in the LBB area, although not always directed towards synthetic studies, also identified a number of diachronic trends in mobility and lithic procurement strategies. Overall, the research consistently demonstrated that at a basic level, the LBB area was inhabited throughout all of prehistory by highly mobile foragers who were in the area for short periods of time (Schroedl 1996:791). However, the researchers do argue that a relatively dramatic change in settlement and mobility appears to have occurred at the Eagle Rock phase. They suggest that the amount of mobility increased and the overall foraging range also increased during the Eagle Rock phase (Schroedl 1996:791). However, in other analyses, they do recognize that the Maggie Creek phase also indicates differences in settlement patterns from other time periods (Schroedl 1995:179); they simply argue that the biggest and most dramatic change occurs at the transition to the Eagle Rock phase (Schroedl 1996:706).

Overall, the prevailing theories of diachronic change in mobility strategies in the region differ in terms of the pace, nature, and timing of changes in mobility. On the one hand, McGuire et al. envision generally gradual changes across all periods from reliance on residential foraging over large annual ranges to more use of logistical foraging over small ranges. Elston, to the contrary, postulates phase-to-phase changes, with early populations having large annual ranges, Maggie Creek phase populations relying on reduced ranges and Eagle Rock phase populations returning to an adaptation similar to the Middle Archaic period. Previous researchers in the LBB area have argued that the most dramatic change overall occurs during the Eagle Rock phase, with an increase in mobility and annual range size, while also recognizing that some type of change occurred during the Maggie Creek phase as well.

9.1.3. Chipped Stone Reduction Strategies and Mobility Patterns

Because of the relationship between raw material procurement, chipped stone reduction strategies, and mobility, chipped stone assemblages have long been a major avenue for investigating changes in mobility and settlement systems in the LBB area and the north-central Great Basin. Lithic quarrying and procurement activities have high potential to yield information regarding the technological organization of prehistoric groups. This organization, in turn, is highly related to mobility strategies as the frequency and distance of residential moves will condition the degree of planning and toolstone reduction strategies utilized by a population.

It is important to note, however, that the general concept of "mobility" actually encompasses a number of factors. As discussed above, the concept of residential mobility includes factors such as the size of annual range, frequency of residential move, distances of moves, and the nature of each residential occupation (Binford 1980; Kelly 1983, 1992). Residentially mobile populations can vary in all these factors. Thus, it is possible to have populations who exhibit frequent residential moves within large or small annual ranges, populations who utilize base camps and logistical exploitations strategies within large or small annual ranges, and even populations that employ different strategies at different times of the year. Because each of these strategies could be expected to result in different lithic procurement and processing approaches and different assemblages at different sites, it is important to attempt to at least separate the factors during analysis. We will examine these factors separately, looking at chipped stone evidence for size of the annual range and then chipped stone evidence for overall mobility strategy.

Size of Annual Range

The size of a population's annual range is best assessed through an examination of raw material usage in chipped stone assemblages. In the LBB area and surrounding region, the relative use of Tosawihi chert and other raw materials, such as more local cryptocrystalline materials and obsidian from more distant sources, has also been a focus of considerable research efforts in the area. In the Great Basin as a whole, obsidian artifacts have been used to identify potential mobility patterns and posit general theories of long-range human foraging movements (G. T. Jones et al. 2003). Based on a general hypothesis that increasing population in the region would lead to a decrease in residential mobility (in terms of both frequency of residential moves and size of annual range), Elston hypothesized that at residential sites there should be a decrease over time in proportions of high-quality materials from distant sources and a reduction in reliance on flexible, formal tool types such as bifaces (Elston 1990b:162). Regardless of the exact material type, materials from local versus distant sources have high potential to shed light on mobility patterns in the region.

None of the theories of north-central Great Basin mobility patterns focus exclusively on size of annual range. Nonetheless, based on a close examination of these theories, it is possible to develop contrasting models of changes in annual range size over the prehistory of the region. As described above, Elston developed a model, which he admitted was initial and preliminary, positing that as population increased over time in the region, residential mobility would decrease and the size of the annual range would decrease (Elston 1990b:162). This model, in broad form, has been adopted by other researchers. McGuire et al. (2004), working in the Pie Creek area just to the northeast of the current project region, posit that long-term changes in settlement strategies occurred over the prehistory of the region. They argue that there are several major trends that characterize the Middle to Late Holocene in the region, including "intensified resource use; a decrease in foraging range and logistical procurement strategies; and an increase in settlement centralization and population growth" (McGuire et al. 2004:27). For our purposes here, the key element is the concept of the decreasing foraging range, which implies a great reduction in size of annual range over the prehistoric period.

The general concept that size of the annual range would gradually decrease over the prehistoric period is not unreasonable. There is some evidence to suggest that initial, Paleoindian or Paleoarchaic period occupation of the region did entail high annual ranges. Jones et al. (2003) have reconstructed Paleoarchaic "lithic conveyance zones", which may correspond roughly to foraging territories, pointing out that Paleoarchaic mobility across the Great Basin appears to have been primarily oriented north-south, parallel to the dominant orientation of mountain ranges. The lithic conveyance zones encompass distances of a few hundred kilometers, though Jones et al. argue that assemblages dated by obsidian hydration indicate a slight constriction of foraging ranges as the Paleoarchaic period progressed. They propose that the reduction in foraging range size that is indicated by the lithic sourcing data, as well as the increase in the use of higher elevation areas that was discussed above, represent a shift towards the "processor" end of Bettinger and Baumhoff's traveler-processor continuum as the Paleoarchaic period progressed. In other words, they suggest that, due to gradual warming and drying, diet breadth expanded to incorporate higher-cost resources and that greater amounts of time were spent on resource processing as opposed to traveling between resource patches.

This pattern might then be expected to continue across the Holocene, as population increased and drying trends continued. By the time of ethnohistoric contact, as described by Steward and other researchers, populations appear to have been much more tethered to residential bases and roaming within smaller territories, particularly in the Upper Humboldt region (Elston 1990b:17; Steward 1997:158).

However, this overall trend is not necessarily a given. There were multiple environmental changes over the Holocene and there have been other theories of Holocene settlement. An early model posited by Madsen for the region just east of the Upper Humboldt River area suggested that different strategies were employed over the span of the prehistoric period in the eastern Great Basin (Madsen 1982). Madsen proposed that during the Paleoindian and Early Archaic periods, subsistence and settlement were focused on wetlands and lake-edge resources, and that populations would have been either semi-sedentary or mobile, but nonetheless restricted to lake-edge areas (1982:214–215). This implies a relatively reduced foraging range early in the Holocene. During the Middle Archaic period, however, he suggests that populations began to exploit a wider variety of resources, within an annual round that involved a high degree of residential mobility, implying an increase in foraging range size (Madsen 1982:215–216). Some later populations, particularly during the Formative period, appear to have adopted maize agriculture and a more sedentary settlement strategy (thus reducing their range), but by the Late Prehistoric period, populations had again returned to a foraging strategy possibly with a large annual range.

Although not specifically focusing on foraging range size, a model of Late Prehistoric Numic population movement incorporated many aspects of the Madsen model. The Bettinger-Baumhoff "Traveler-Processor" model was developed to explain the hypothesized expansion of Numic-speaking populations into the Great Basin (Bettinger and Baumhoff 1982). Under this model, pre-Numic (or all pre–Late Prehistoric period) populations were "travelers," peoples who employed "high residential mobility and extensive resource monitoring [to] sustain relatively selective subsistence patterns centered on low-cost, high return resources" (Bettinger 1991; Bettinger and Baumhoff 1982). This model posits employment of multiple small residential camps over much of the Archaic period, with little or no use of residential camps and logistical procurement strategies (in contrast to the Numic, or "processor," strategy). It implies, at least, that there would be little change in foraging range size until the Late Prehistoric period.

The relative proportions of Tosawihi chert and obsidian has great potential for addressing questions of mobility patterns. Although Tosawihi chert overwhelmingly dominates chipped stone assemblages in the LBB area, obsidian occurs regularly but in very limited quantities on sites in the region throughout the prehistoric and ethnographic periods (Elston 1992c; Elston and Budy 1990). Overall, sites in the region exhibit low frequencies of obsidian, and only a small number of assemblages containing obsidian have been reliably dated. However, regional patterns in the acquisition of material from different obsidian sources have been observed (Elston and Budy 1990; LaFond 1996b; Rusco and Raven 1992). Lithic material sourcing has been the most common approach used to illuminate patterns of mobility from archaeological assemblages (G. T. Jones et al. 2003:5), and this line of analysis is continued here.

A recent study of obsidian procurement in the LBB area, based on a small sample of sites and a total obsidian assemblage of less than 20 artifacts yielded interesting diachronic patterns in obsidian exploitation and use (Cannon et al. 2008:255–260). As will be described in greater detail below, this study identified the potential that there were changing patterns in obsidian procurement over time in the region. The diversity of sources and the location of sources appear to change between the Archaic (pre–Eagle Rock) and Eagle Rock phases in the region suggesting changes in overall mobility patterns. Furthermore, differences in source representation between tools and debitage also suggest patterns of overall exploitation and mobility. These insights will be examined below with a significantly larger dataset, representing all obsidian from LBB area excavations.

Degree and Nature of Mobility

The predominant means of exploring mobility through quarry exploitation and toolstone reduction strategies relies on examining the relative emphasis on biface production and use. Numerous studies have demonstrated that bifacial reduction strategies were the predominant choice of populations experiencing frequent residential moves (Andrefsky 1991, 1998; Binford 1979; Kelly 1988; Nelson 1991; Parry and Kelly 1987). Bifaces are highly flexible tools that can serve simultaneously as a source for flakes that can be used as tools, as cutting tools, and as blanks for the further production of more refined tool types (Kelly 1988). Bifaces are also highly portable, an important consideration for mobile populations. Because of their portability, flexibility, and efficiency, bifaces and bifacial reduction technologies appear to have been the predominant choice of prehistoric mobile populations (Parry and Kelly 1987). The relative proportional investment in bifacial versus non-bifacial core reduction technologies appears to measure frequency of residential move with a relatively high degree of confidence (Parry and Kelly 1987). Use of core reduction technologies is argued to be more associated with less mobile populations.

Few other comprehensive and diachronic studies have been conducted to date, and none in the LBB area. Researchers have noticed relative changes in bifacial versus core/flake technology in the broader region. Much of McGuire et al.'s argument for changes in mobility patterns is based on their argument that the use of bifaces relative to non-bifacial cores changes over time. They postulate that the Early Archaic is exemplified by great use of non-bifacial cores, the Middle Archaic by high reliance on bifaces, and the Late Archaic by a return to greater use of non-bifacial core-flake technology (McGuire et al. 2004:25). Elston and Budy also focused on changes in biface versus core-flake technologies, but did not observe as clear a set of trends (Elston and Budy 1990:21). Additionally, as discussed above, the earliest model of Tosawihi quarry exploitation specifically examined biface versus core reduction technology and developed a site-specific model of quarrying behavior. Elston (1992c) argues that quarrying behavior can be modeled in terms of its relative costs and benefits (see also Beck et al. 2002). He argues that for most periods, reliance on biface technologies would have been the focus, due to the efficiency of these tools for mobile populations. Previous researchers in the LBB area have predominantly focused on individual site assemblages, and, noting the apparently consistent high proportion of bifacial technology in all assemblages, have predominantly argued that populations were highly mobile, noting only that the Eagle Rock phase assemblages seem to suggest a higher level of mobility than previous phases (e.g. LaFond 1996b).

It is important to note, however, that the abundance and quality of lithic raw materials, combined with the overall mobility strategy, is expected to play a role in reduction strategies for different raw material types (Andrefsky 1994). When raw materials are high quality, but low in abundance, mobile populations will be expected to rely on formal tools. When raw materials are low in quality, but high in abundance, mobile populations are expected to rely on less formal technologies (Andrefsky 1994:30). The region around the LBB can actually be characterized as having aspects of both situations. Tosawihi chert represents a material of high quality, but low abundance, restricted to the quarries. Obsidian can also be characterized in this fashion. However, there are a range of other material types of lower quality but relatively greater abundance in the region, including Vinini chert and silicified shale, Schroeder Mountain chert, Maggie Creek chert, Susie Creek chert, Hadley Creek chert, and the Elko Hills/South Fork source area (LaFond 1996b:675). These materials are present in LBB area assemblages, though in low quantities. Although each of these sources has a relatively limited distribution, and is low in abundance, combined, they form a fairly abundant source of materials for foragers in the region.

Changes in the relative use of Tosawihi and other chert materials, and, more importantly, changes in the ways Tosawihi chert and other, lower quality but more available materials are used over prehistory might also be expected to be indicative of changing mobility strategies. While it is clear from past research, and abundantly demonstrated below, that Tosawihi chert was the preferred material over all time periods, clues to the nature of mobility strategies might be found in the relative use of other materials and in differences in how these materials are used. Because of the proximity and quality of the Tosawihi chert materials, prehistoric populations in the region might be expected to utilize the available lower quality materials primarily to supplement their toolkits on an as-needed basis. However, the way in which they utilize these materials should be indicative of their mobility strategy. In particular, whether or not they utilized lower-quality materials in the same way as Tosawihi chert should be informative of overall size of annual range and mobility strategy.

9.1.4. Summary: Models and Expectations for Chipped Stone Assemblages in the Little Boulder Basin

While no researchers have proposed a specific model of mobility with expectations for chipped stone assemblages in the LBB area specifically, past research has resulted in the production of a number of general models that are applicable to the area. The LBB, located within 25 km of the Tosawihi Quarries along a major transportation corridor between the quarries and the Humboldt River, was clearly a locality where populations moving through the area stopped and processed Tosawihi chert. There is no doubt that embedded in the overall assemblages in the LBB area there are clues to the nature of how populations moved through the area and how they utilized the available raw materials in their overall chipped stone technology. With the availability of years of excavation data from the LBB area, it is possible to examine these models, evaluate the data, and, in this case, propose a refined model.

Three major conceptions of diachronic change in mobility strategies have been proposed to date. All three are admitted by their authors to be preliminary, and as such, it is not surprising that they vary considerably (Table 50). While none of the researchers propose specific expectations for chipped stone assemblages in the LBB area, based on lithic technology theory, and portions of their overall arguments, it is possible to assign testable expectations for each model. Elston proposes a general model of extraction of materials from the Tosawihi Quarries, hypothesizing that populations would have focused on logistical extraction of early-stage bifaces produced at the quarries, with little additional reduction once material had been transported beyond 10 km the quarries and with very little use of core-flake technology. Against this backdrop, the other models of mobility vary along several lines. One major source of disagreement is the pace and nature of diachronic change in mobility strategies. McGuire and colleagues argue for a gradual change across time periods. Schroedl and fellow researchers see only minor changes until a major change at the Eagle Rock phase. Elston and colleagues argue for similarity between the Middle Archaic period (South Fork and James Creek phases) and the Eagle Rock phases, with a major change during the Maggie Creek phase.

Other major differences lie in concepts of changes in annual range size and mobility strategies. Schroedl et al. see high residential mobility throughout prehistory, with the highest mobility and greatest annual range size during the Eagle Rock phase. Both Elston and McGuire argue that the Middle Archaic is characterized by highly mobile residential bands with wide annual ranges. For Elston, the range size drops greatly during the Maggie Creek phase only to resume as before in the Eagle Rock phase. For McGuire, both range size and emphasis on residential mobility decrease gradually while reliance on logistical mobility strategies increases.

The compilation of a dataset of information from past and recent excavations in the LBB area enables formal testing of these models. Following a discussion of the methodological issues involved in making data collected over numerous years by many researchers comparable, we will examine the models of Tosawihi quarry exploitation, diachronic change in annual range size, and diachronic change in residential mobility as viewed through the lens of bifacial and core-flake technologies in the LBB area.

Table 50. Summary of Extant Models of Mobility Strategies and Expectations for Chipped Stone Assemblages in the Little Boulder Basin

Researchers	Models and Expectations	Time Period		
		Middle Archaic	**Maggie Creek**	**Eagle Rock**
Elston	General Tosawihi Quarry Exploitation	Production of early stage bifaces at quarry, little use of core flake technology, little debitage and manufacture after 10 km.	Production of early stage bifaces at quarry, little use of core flake technology, little debitage and manufacture after 10 km.	Production of early stage bifaces at quarry, little use of core flake technology, little debitage and manufacture after 10 km.
	Mobility Model	Large annual range, residential foraging	Greatly reduced annual range, intensive foraging	Similar to Middle Archaic
Elston et al.	Chipped stone expectations for LBB*	Obsidian from diverse and distant sources, focus on bifacial technology, focus on high quality material (predominantly Tosawihi)	Obsidian from fewer and closer sources, focus on bifacial technology, focus on high quality materials supplemented by local materials.	Similar to Middle Archaic.
	Mobility Model	Large annual range, residentially mobile bands	Declining annual range and mobility, increasing logistical procurement	Continued decline in range and mobility, increased logistical procurement
McGuire et al.	Chipped stone expectations for LBB*	Obsidian from diverse and distant sources, focus on bifacial technology, focus on high quality material (predominantly Tosawihi)	Less obsidian from diverse and distant sources, gradual increase in core-flake technology, increase in use of lower quality materials	Continued decline in obsidian and increase in core-flake and lower quality materials.
	Mobility Model	High mobility	High mobility	Highest range and mobility
Schroedl et al.	Chipped stone expectations for LBB*	Obsidian from diverse and distant sources, focus on bifacial technology, focus on high quality material (predominantly Tosawihi)	Obsidian from diverse and distant sources, focus on bifacial technology, focus on high quality material (predominantly Tosawihi)	Obsidian from diverse and distant sources, focus on bifacial technology, focus on high quality material (predominantly Tosawihi), greatest overall emphasis

*Expectations are predominantly ours, developed on the basis of previous researcher's models and lithic procurement and processing theory.

9.2. Methods

The LBB area has experienced numerous archaeological projects over the years and in order to view all these data as a single coherent and comprehensive dataset, the data needed to be made comparable prior to conducting comparative analyses. This involved a number of steps. The first was to compile and review all previously collected data from the LBB area. Because the data have been analyzed by different individuals, definitions of tool and debitage categories vary widely, which required efforts to ensure that tool and debitage types be defined in comparable manners. New categories based on common attributes were created to simplify and standardize lithic classifications. The second step involved identifying securely dated single-component occupations that contained tool, debitage, and raw material data presented in manners that were conducive to analyses of diachronic change in tool manufacture and raw material usage in the LBB area. Based on the data presented in Chapter 5, occupational phases were assigned to sites as a whole or to individual collection areas within the site. However, the way in which data are provided in many previous excavation reports extraction of data specific to those occupations difficult if not impossible. These factors will be discussed in further detail below. The data compiled using the methods described here are provided in Appendix L, an electronic database submitted to BLM-Elko along with this document.

In order to synthesize all the data from the LBB area into a single coherent and comprehensive dataset, definitions from all previous datasets were reviewed to determine the range of characteristics used to classify tools, cores, and debitage. New categories were assigned based on common attributes to standardize lithic classification (see Table 51 and Table 52). Before the data was synthesized into more general categories, there was a total of 96 categories composed of tools and cores. Once data were reviewed and reassigned based on function and form, there was a total of 21 categories.

Table 51. Correlation of Synthesized Analysis Categories to Previous Analysis Categories of Tools

Analysis Categories	Previous Analysis Categories
Awl	Formal Awl
Chisel	Expedient Chisel
Chopper	Chopper
Compound/Composite Tool	Composite
	Composite Tool
	Compound Tool
	Expedient Composite Tool
Core (Non-bifacial)	Bipolar Core
	Core
	Core bipolar
	Core multidirectional
	Core unidirectional
	Core/Tested Cobble
	Expedient Core
	Expedient Microcore
	Multidirectional Core
	Random/Expedient Core
	Random/Expedient Microcore
	Unidirectional Core
	Unidirectional Microcore
Denticulate	Denticulate
Drill/Perforator	Expedient Drill/Perforator

Table 51. Correlation of Synthesized Analysis Categories to Previous Analysis Categories of Tools

Analysis Categories	Previous Analysis Categories
	Formal Drill-Perforator
	Formal or Expedient Drill or Perforator
	Undifferentiated Formal or Expedient drill/perforator
Graver	Graver
Modified Flake	Flake Tools
	Modified Flake
	Modified Flake
	Modified Flake Tool
	Retouched Flake Tool
Scraper	End Scraper
	Expedient End Scraper
	Expedient Scraper
	Expedient Side Scraper
	Formal End Scraper
	Formal Scraper
	Miscellaneous Formal Scraper
	Miscellaneous Scraper
	Scraper
Stage 1 Biface	Biface Stage 1
Stage 2 Biface	Biface
	Biface Stage 2
	Bifacial Core
	Discoidal Core
	Edged Flake Blank
	Edged Flake Knife
	Knifelike Biface
Stage 3 Biface	Biface fragment ("Blank")
	Biface fragments
	Biface midsection fragment ("Blank")
	Biface Stage 3
	Biface tip and midsection fragment ("Blank")
	Early-Stage Biface
	Early-Stage Quarry Biface
	Expedient Biface
	General Early-Stage Biface
	Early-Stage Projectile Point (PP) Preform
Stage 4 Biface	Biface Stage 4

Table 51. Correlation of Synthesized Analysis Categories to Previous Analysis Categories of Tools

Analysis Categories	Previous Analysis Categories
	General Middle-Stage Biface
	Late-Stage Biface
	Middle-Stage Biface
	Middle-Stage Knifelike Biface
	Middle-Stage Quarry Biface
	PP Proximal Fragment
	PP Midsection
	Biface midsection fragment ("Preform")
	Biface tip and midsection fragment ("Preform")
	Late Stage PP Preform
	Middle-Stage PP Preform
	PP or PP Preform Midsection
	PP or PP Preform Tip
	PP/PP Preform
	PP/PP Preform Midsection
	PP/PP Preform Proximal Fragment
	PP/PP Preform Tip
	PP/PP Preform Whole or Proximal Frag
Stage 5 Biface	Biface midsection fragment ("End product")
	Biface Stage 5
	Biface tip and midsection fragment ("End product")
	Bifacially flaked flake
	General Late-Stage Biface
	Knife
	Late-Stage Knifelike Biface
	Late-Stage Quarry Biface
	Small Hafted Biface
	Late-stage PP Preform
Stage 5 Biface-Shoshonean Knife	Shoshonean Knife
Stage 5 Projectile Point	Projectile Point
	PP Base and Midsection
Tested Cobble	Tested Cobble
Uniface	Uniface
Unknown	Indeterminate Tool
	Indeterminate Tool or Core
Unknown Biface	Biface of Indeterminate Stage/Trajectory
	Plano-Convex Tools

We were able to reduce the number of tool types into a simpler and more comparable set in both tool and core categories. Prior to the exercise, there was a total of 13 different types of core such as random/expedient cores (Villagran et al. 2008) and multidirectional cores (LaFond 1996a), but for the purpose of this study, all cores were reclassified simply as Core (non-bifacial). A few of the previously used core categories were based on biface stages—bifacial core (Birnie 2001) and discoidal core (LaFond 1996a)—and exhibit Stage 2 attributes; these attributes will be discussed in further detail in the tool section below.

Previous analyses had defined a total of 83 different tool categories. These were synthesized into 21 categories. The new tool categories were defined based on form and function. Manufacturing strategy was not easily made comparable across types; thus, if tools were previously classified as expedient or formal, they were regrouped solely based on function and form. Any tool not originally assigned a function or form classification, such as items classified as indeterminate tool or core, was assigned to the new category of Unknown. Furthermore, bifaces under the previous classifications of indeterminate stage/trajectory (LaFond 1996a) and plano-convex tools (Rusco 1982b) were reclassified as Unknown Biface.

Tools were also condensed into general categories of tools and biface stages when possible. General tool types included Awl, Chisel, Chopper, Compound/Composite Tool—which is a combination of Composite Tool (LaFond 1996a) and Compound Tool (Villagran et al. 2008) attributes—Denticulate, Drill/Perforator, Graver, Modified Flake—which includes previous classifications of Flake Tool and Retouched Flake Tool—Scraper, Tested Cobble, and Uniface.

For this analysis, bifaces were classified according to Callahan's five stages of biface reduction (Andrefsky 2005:187), rather than all the other previous categories. Using Andrefsky's (2005:187) description for Callahan's biface reduction stages, the stages are as follows: Stage 1 is characterized by bulky or chunky pieces of tool material typically displaying cortex. Stage 2 is characterized by pieces of tool stone that are still somewhat unformed and chunky. Flakes will be taken off all around the edges forming an irregular biface shape. Cortex may still be present during this stage. Stage 2 can vary in thickness based on the original form of the material being reduced. Stage 3 is characterized by flake scares that run from the edge to the center of material. This stage is considered to represent initial biface thinning, and may exhibit small amounts of cortex. Stage 4 is characterized by flake scars that exhibit patterning and/or travel across the center of the biface. This stage is related to thinning and initial shape of the biface form. Cortex is not a normal characteristic of this stage. Stage 5 is characterized by the final shaping and forming of the biface. Callahan describes this stage as the final stage before hafting and notching; however, for this analysis Projectile Points and Shoshonean Knives were classified as Stage 5 bifaces because they were the in the final stage of biface reduction. Assessing characteristics used in individual excavation reports (see references in Table 5) aided in the reclassification of tools and bifaces. Most analysts gave clear descriptions of how they determined tool categories. LaFond (1996a), among others, includes a discussion explaining how biface reduction stages categories used in LBB area research correlate with Callahan's biface reduction stages.

Debitage was reclassified using a broad but concise set of categories that encompass all other analyzed categories into a single coherent data set. These categories are angular debris, biface reduction flake, biface thinning flake, bipolar flake, core reduction flake, pressure flake, and indeterminate. The indeterminate category is debitage that remained unclassified and is not angular debris. Based on the definitions given by LaFond (1996a), Villagran et al. (2008), and others several categories were condensed into the new categories. Core reduction flakes are recognized as flakes that are flat, have a platform angle approaching 90°, are relatively thick in cross section, have few dorsal flake scars, and have flake scars that are roughly parallel to flake margins. Biface reduction flakes are recognized as flakes that are moderately thick and very curved in cross section, with dorsal surfaces containing numerous flake scars oriented in various directions, complex or abraded platform types and acute platform angles, often with a lip on the proximal ventral surface. Biface thinning flakes are recognized as flakes that are thinner and flatter in cross-section, with dorsal surfaces that have numerous flake scars oriented in various directions, complex or abraded platforms, and platform angles that are relatively acute, often with a lip on the proximal ventral surface. Pressure flakes were recognized as flakes that are small, very thin and relatively flat in cross section, have a very small platform, and lack a discernable bulb of percussion. Bipolar flakes are flakes with evidence of the application of force in two different places but that are otherwise similar to core reduction flakes. After synthesizing categories of flake type, 19 different categories were condensed to seven categories.

Table 52. Correlation of Synthesized Analysis Categories to Previous Analysis Categories of Debitage

Analysis Categories	Previous Analysis Categories
Angular Debris	Angular Debris
Biface Reduction Flake	Contact Removal Flakes
	Diagnostic: Early-Stage Biface Reduction Flake
	Diagnostic: Middle-stage Biface Reduction Flake
	Diagnostic: Undifferentiated Early Reduction Flake
	Outre-passe
Biface Thinning Flake	Diagnostic: Biface Thinning
	Diagnostic: Final Shaping/ Retouch Flake
	Diagnostic: Late-stage Biface Reduction Flake
Bipolar Flake	Bipolar Flakes
	Diagnostic: Secondary Bipolar Flake
Core Reduction Flake	Bipolar Decortication Flakes
	Core Rejuvenation Flake
	Diagnostic: Core Reduction Flake
	Diagnostic: Decortication Flake
Indeterminate	Nonidentifiable Flake Fragment
	Other Debitage
	Unspecified Debitage
Pressure Flake	Diagnostic: Notching Flake

Once all the data were compiled into a single dataset with consistent tool and debitage definitions, it was necessary to produce a dataset that could be used for diachronic analysis. Because not all sites had single occupational phases assigned to them, only those that did where used to address questions concerning diachronic change within the LBB area. This resulted in a total of 21 occupations that can be assigned to a specific time period or phase. However, not all of these sites could be utilized for all diachronic analyses. Because of previous reporting conventions, in many cases, chipped stone material is presented for an entire site, even if within the site there are separate datable occupation areas. Consequently, even for sites with datable components, the chipped stone material from those components is not always reported by component, and therefore it is not possible to link raw material type with chipped stone tool and debitage site for many dated components. There are 13 components out of the 21 dated components with lithic material assigned to single occupational phases. Thus, data can be viewed and represented in two ways: all artifacts such as tools and debitage and artifacts that can be placed into one occupational phase. Based on the research question at hand, different datasets will be used. For questions regarding total frequency of material, tool, or debitage for sites within the LBB area, all data will be assessed. Research questions that address diachronic change will only use the data represented in the 13 collection areas that have single occupational phases. Therefore, total lithic material frequencies from the two datasets are not analogous.

It is important to note that not all phases of prehistoric occupation were amenable to diachronic analysis. As described in Chapter 5, the South Fork and James Creek phases had so few excavated single-component occupations of each phase that, alone, they provide insufficient data for meaningful statistical comparisons. Consequently, we have grouped excavated occupations from these phases together and analyzed the overall Middle Archaic period in comparison to later Maggie Creek and Eagle Rock phases. Although for the moment, this obscures potential differences between the South Fork and James Creek phases, it does enable comparative temporal analysis of this period with later dates.

9.3. Tosawihi Quarry Exploitation

Because of the proximity and high quality of Tosawihi chert, the nature of quarry exploitation forms the background to any other studies of lithic raw material procurement and processing in the region. Simply put, we must understand the exploitation of the quarry before we can ask any other questions regarding chipped stone assemblage variation in the region. To date, Robert Elston has proposed the main systematic model of quarry exploitation. This model focuses on the quarry itself, although it has implications for chipped stone assemblages of Tosawihi chert outside the quarries. Given the high frequencies of tools and debitage from Tosawihi chert in the LBB area, the area forms an excellent locale for exploring both the question of quarry exploitation strategies in general and Elston's specific hypothesis. In this section, we will begin with an examination of Elston's hypothesis that Tosawihi quarrying behavior focused on the production of early-stage bifaces. Following this analysis, we will examine diachronic patterns in biface and core production in the area in order to examine what these data suggest about regional mobility patterns over the course of prehistory.

At a basic level, Elston's model posits that due to the location and nature of the Tosawihi Quarries, exploitation of the quarry would focus on production of early-stage bifaces for transport away from the quarry itself. He posits that at distances of more than 10 km from the quarry there should be a very low proportion of non-bifacial cores, blanks, early stage bifaces and debitage (Elston 1992c:798). While he did concede that in cases of emergencies, bad weather, etc., populations might defer processing, he did essentially argue that there should be little use of non-bifacial cores away from the quarry and little evidence of early stages of production at distances of more than 10 km from the quarry.

As work increased in the region, this early model has been scrutinized and the data have suggested that it may not capture all the dynamics of lithic exploitation in the region. Large amounts of debitage, for example, are clearly present in the LBB area, more than 20 km from the quarries. LaFond noted the presence of cores and other non-bifacial artifacts in the assemblages from earlier LBB area excavations (LaFond 1996b:694). Nonetheless, it remains important to examine the question with the full data set.

Here we utilize data from all LBB area excavations to date to explore the question of whether Tosawihi quarry exploitation focused exclusively on production of early-stage bifaces, or, alternatively, whether non-bifacial core production and use supplemented use of early-stage bifaces. The model can be examined from several perspectives. Data from both chipped stone tools and debitage across the entire

LBB area area can be utilized. Additionally, these data can be examined both for all occupations as a whole as well as from a diachronic perspective.

9.3.1. Testing Elston's Model of Tosawihi Quarry Exploitation

Examining the data from the entire LBB area excavated assemblage, we do observe that bifaces and bifacial manufacture does dominate these assemblages, as predicted by Elston's model. Within the overall assemblage of Tosawihi chert tools, bifaces are by far the most common tool type, forming approximately three-fourths of the total tool assemblage (Table 53). Non-bifacial cores are rare, comprising less than 1 percent of the total assemblage. Even assuming that some of the non-bifacial tools, such as modified flakes, scrapers, etc., were manufactured from a core reduction strategy, the total proportion of core-flake technology in the overall tool assemblage is very low. Although this is not, strictly speaking, identical to the thrust of Elston's theory, it does match his general premise that the focus of quarry extraction is production of bifaces. Non-bifacial core production is nonetheless present; indicating that early stage bifaces were not the only items produced at Tosawihi Quarries and that non-bifacial cores were occasionally produced at the quarries and removed to the LBB area.

Table 53. Frequency and Percent of Chipped Stone Tool Types for Tools Manufactured from Tosawihi Chert, Entire Little Boulder Basin Assemblage

General Type	Count	Percent
Chisel	4	0.05%
Compound/Composite Tool	9	0.11%
Core (Non-bifacial)	49	0.61%
Denticulate	15	0.19%
Drill/Perforator	89	1.10%
Graver	1	0.01%
Modified Flake	517	6.40%
Random/Expedient Microcore	3	0.04%
Scraper	37	0.46%
Stage 2 Biface	284	3.51%
Stage 3 Biface	2,502	30.96%
Stage 4 Biface	1,615	19.98%
Stage 5 Biface	912	11.28%
Stage 5 Biface-Shoshonean Knife	1	0.01%
Stage 5 Projectile Point	826	10.22%
Uniface	2	0.02%
Unknown	493	6.10%
Unknown Biface	723	8.95%
Total	**8,082**	

Examining the biface assemblage specifically is also worthwhile. Under Elston's model, and assuming that the bifaces discarded in the LBB area were discarded during manufacture from one stage to others, we would expect to find bifaces predominantly from Stages 2 and up. The data do indeed indicate that in the overall assemblage, Stage 2 and 3 bifaces are the most common types, forming approximately 45 percent of the total assemblage (Table 54). Interestingly, Stage 2 bifaces are present in very low frequencies, implying either that the LBB area was used for reduction of bifaces from Stage 2 to later stages or that bifaces mostly left the quarry as Stage 2 bifaces, rather than Stage 1 bifaces.

Table 54. Frequency and Percent of Tosawihi Chert Bifaces, Entire Little Boulder Basin Assemblage

Biface Type	Count	Percent
Stage 2 Biface	284	4.63%
Stage 3 Biface	2,502	40.75%
Stage 4 Biface	1,615	26.30%
Stage 5 Biface	912	14.85%
Stage 5 Biface-Shoshonean Knife	1	0.02%
Stage 5 Projectile Point	826	13.45%
Total	**6,140**	

The debitage assemblage generally conforms to the above observations (Table 55). Bifacial reduction debitage forms more than 90 percent of the total assemblage, with non-bifacial debitage forming a very small percent. Such core reduction is indeed present, however, indicating that although it does appear that Elston's theory of staged biface manufacture and export at the Tosawihi Quarries is generally correct, non-bifacial cores did supplement the tool kits of the populations exploiting the quarries. Notably, middle and later stages of biface manufacture appear to have predominated bifacial production in the LBB area. This supports the observation above that bifaces may well have arrived in the LBB area in middle to later stages (Stage 3 and up), and they may have left the quarries more in the form of Stage 2 and 3 bifaces than as Stage 1 bifaces.

Table 55. Frequency and Percent of Tosawihi Chert Debitage Flake Types (Diagnostic Debitage Only), Entire Little Boulder Basin Assemblage

Flake Type	Count	Percent
Decortication Flake	1,339	0.23%
Secondary Bipolar Flake	27	0.00%
Core Reduction Flake	1,417	0.24%
Undifferentiated Early Reduction Flake	131,288	22.43%
Early-Stage Biface Reduction Flake	35,548	6.07%
Middle-stage Biface Reduction Flake	161,975	27.67%
Late-stage Biface Reduction Flake	248,089	42.39%
Final Shaping/ Retouch Flake	5,195	0.89%
Notching Flake	402	0.07%
Total	**585,280**	

However, although the general outlines of Elston's model do appear supported, it is worth noting that they are not supported in all details. The huge frequencies of debitage alone contradict his assertion that after 10 km there should be a great decline in debitage frequencies as manufacture also declined. Indeed, the LBB area demonstrates that reduction of Tosawihi chert was a major activity for the occupants of the area. These data alone suggest that it is possible to refine Elston's model. It appears that although visitors to the Tosawihi Quarries did concentrate primarily on producing staged bifaces for export, it also appears that they continued to reduce these bifaces well beyond the first 10 km from the quarries. Additionally, they clearly supplemented the export bifaces with occasional non-bifacial cores. Consequently, it is likely that in the general sense there was reduced fear of material failure or manufacturing error. Prehistoric inhabitants of the region clearly anticipated being able to return to the quarries and therefore, continued major reduction activities even beyond the point of easy return (approximately 10 km). Thus, utilizing non-diachronic data from across the entire LBB area assemblage, it is clear that return to the quarries was anticipated and that the quarries were well within the annual foraging range or logistical foraging range for past occupants of the LBB area.

9.3.2. Exploring Diachronic Change in Tosawihi Quarry Exploitation

The question remains, however, of the degree to which this pattern holds true when examined from a diachronic perspective. The analysis above grouped all time periods into a single dataset. Although large and robust, it obscures diachronic change and potentially hides variability that may be due to change over time. Despite the fact that we have a much more limited dataset of dated single-component occupations, we can use these data to examine changes in biface versus core-flake technology in Tosawihi chert and changes in stages of bifaces over time. These data will also be relevant in the discussion of mobility patterns below, but because they shed direct light on potential changes in Tosawihi quarry exploitation over time, they are examined first in detail here.

The first avenue is to examine diachronic change in the proportion of core-flake technology in Tosawihi chert. Cores and flake tools form small but persistent portions of the Tosawihi tool assemblage over time in the LBB area (Table 56). Cores never account for more than 3 percent of the assemblage, and flake tools never more than 15 percent. However, there are notable fluctuations between periods. The Maggie Creek phase has a lower proportion of cores and flake tools than either previous phase. This pattern is particularly clear when cores and flake tools are grouped together (Figure 35). Although some flake tools may have been made from flakes from bifacial cores, grouping them with cores does provide a general observation about relative emphasis on bifaces as tools, versus cores and bifaces as cores. In this figure, we see that there is a notable drop in core/flake technology during the Maggie Creek phase relative to the other period/phases. A statistical test indicates that the change in proportion of biface and core-flake technology between the periods is significant (chi-square = 103, $df = 2$, $p < 0.001$). Core/flake technology appears to have been most frequently utilized during the Eagle Rock phase.

Table 56. Frequency and Percent of Chipped Stone Tool Types of Tosawihi Chert by Period/Phase for Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic Period		Maggie Creek Phase		Eagle Rock Phase	
Tool Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Biface/Projectile Point	161	91.48%	1,339	96.54%	296	83.15%
Core	5	2.84%	1	0.07%	5	1.40%
Flake Tool	10	5.68%	33	2.38%	52	14.61%
Drill/Perforator	0	0.00%	14	1.01%	3	0.84%

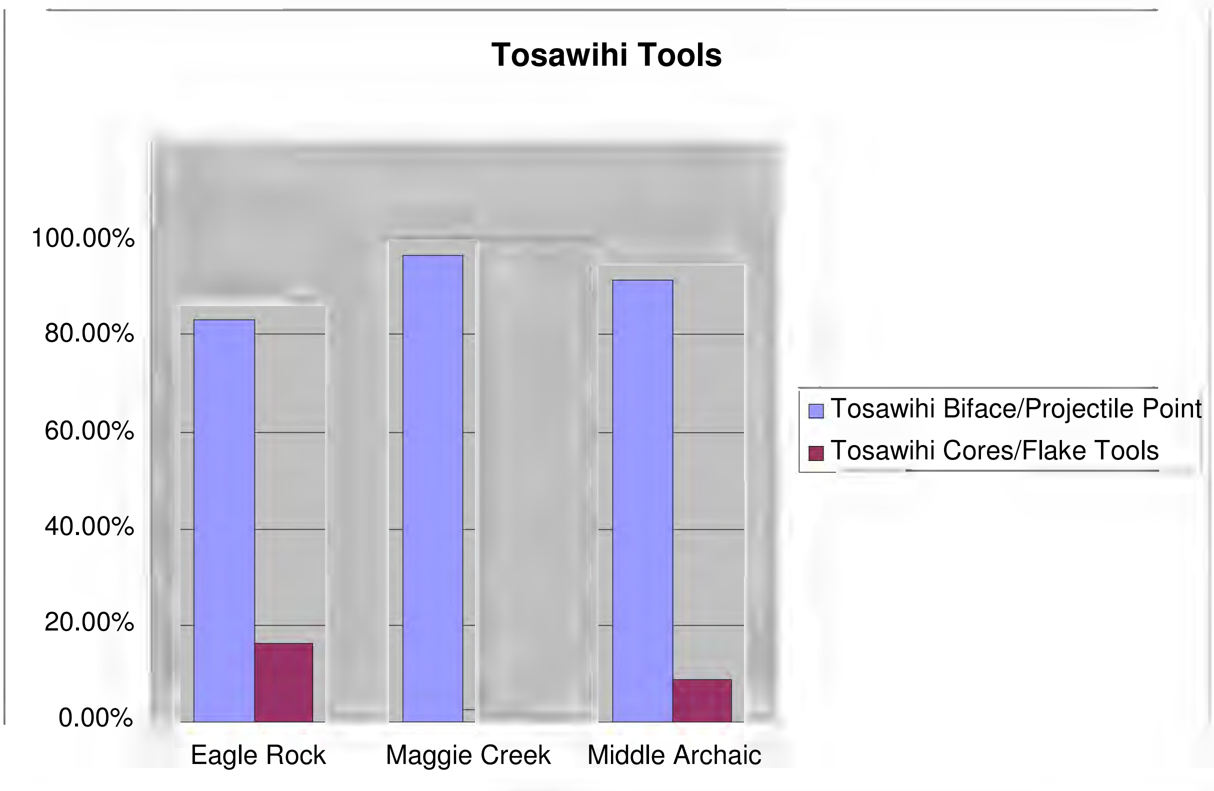

Figure 35. Bar chart of relative proportions of bifaces and cores/flake tools of Tosawihi chert for dated single-component occupations in the Little Boulder Basin.

The pattern is not as pronounced when examined in the debitage assemblage (Table 57). The proportion of core/flake technology is so consistently low, generally less than 2 percent, that it is very difficult to draw any conclusions. The difference in core technology in the tool assemblage versus the debitage assemblage may also yield some insights. It appears that cores were taken from the Tosawihi Quarries and used/discarded in the LBB area. However, the amount of debitage production from these cores is very low. This may reflect the simple fact that biface production produces more debitage than core/flake technology as the latter generally requires small amounts of percussion and indirect pressure flaking. It may also be the case that non-bifacial cores were conserved and curated to locations outside the LBB area in order to maintain flexibility in the toolkit.

Table 57. Frequency and Percent of Tosawihi Chert Debitage Types by Period/Phase for Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic Period		Maggie Creek Phase		Eagle Rock Phase	
Debitage Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Bifacial	12,258	99.93%	19,878	98.68%	42,067	99.17%
Core/Bipolar	8	0.07%	266	1.32%	353	0.83%

It is also possible to examine diachronic changes in the stages of biface manufacture for Tosawihi chert bifaces in the LBB area. Under a very simplistic reading of Elston's model, we would expect very little diachronic change in stages of manufacture. Rather, during all periods we would expect to see predominantly post–Stage 1 bifaces in the area, as was suggested by the overall tool assemblage. Comparison of biface stages for the dated single-component occupations, however, does not support this expectation (Table 58). For the Middle Archaic period, early stage bifaces (Stages 1–3) form approximately 60 percent of the assemblage, with late stages forming 40 percent. This proportion begins to change in the Maggie Creek phase, with later stage bifaces increasing in proportion to over 55 percent of the assemblage. By the Eagle Rock phase, late stage bifaces (Stages 4, 5, and projectile points) form nearly 70 percent of the assemblage. The difference in proportion of Stages 1–3 and late stage (Stages 4, 5, and projectile points) bifaces over the three time periods is statistically significant (Chi2= 26.3, df= 2, $p<0.001$). Unless populations in different periods were more inclined to either discard or have manufacturing errors at different stages disproportionately, these data suggest that there were significant changes in the types of bifaces brought into the LBB area from the Tosawihi Quarries. It appears that over time, greater quantities of later stage bifaces were transported into the LBB area, suggesting that manufacture at the quarries may have not simply focused on early stage export bifaces but instead focused on even greater reduction and production of more finished bifaces. This pattern has significant implications for mobility strategies and will therefore be discussed from that perspective below.

Table 58. Frequency and Percent of Biface Types by Period/Phase for Dated Single-component Occupations in the Little Boulder Basin, Excluding Indeterminate Stage Bifaces

	Middle Archaic		Maggie Creek		Eagle Rock	
Biface Type	**Count**	**%**	**Count**	**%**	**Count**	**%**
Stage 1 Biface	0	0.00%	0	0.00%	1	0.45%
Stage 2 Biface	1	0.80%	117	9.37%	13	5.86%
Stage 3 Biface	75	60.00%	422	33.79%	58	26.13%
Stage 4 Biface	25	20.00%	316	25.30%	73	32.88%
Stage 5 Biface	11	8.80%	243	19.46%	43	19.37%
Projectile Point	13	10.40%	151	12.09%	34	15.32%

9.3.3. Summary: Tosawihi Quarry Exploitation over Time

Elston argued that the main focus of Tosawihi quarry exploitation would be production of early stage export bifaces with little non-bifacial core technology and little change over time. At a broad level, this hypothesis is borne out by the data. Bifaces and debris from bifacial reduction are the most common tool and debitage types in the LBB area. However, core technology is reflected in the assemblage indicating that this technology was at least used to supplement bifacial technology, perhaps to add a measure of additional flexibility in raw material procurement strategies. Furthermore, the overall data do indicate that there are diachronic changes in the relative proportion of core-flake technology in LBB area assemblages of Tosawihi chert. Thus, despite the rugged location of the quarries it is evident that populations at different times in the past nonetheless chose to approach this toolstone source in differing manners. Furthermore, the slow and dramatic increase in the production of later and later stage bifaces at the quarries (as reflected in biface assemblages at LBB area sites) suggests that there may have been very significant changes in mobility strategies over the region. In subsequent sections we will examine the implications for mobility strategies in the chipped stone assemblages of all material types.

9.4. Diachronic Patterns in Annual Range Size as Viewed Through Raw Material Exploitation

Raw material procurement strategies have tremendous potential to provide information regarding the distance and direction of residential moves and foraging patterns. Many raw material types, particularly certain chert types and obsidian, have relatively constricted geographic source occurrences and can be identified by morphology or chemical content. Consequently, when these types are identified at sites more distant from the source, it is possible to begin to identify the range and direction of past mobility patterns.

In the LBB area, the close proximity (approximately 20 km) of the Tosawihi Quarries and the high frequencies of this material on sites in the area makes Tosawihi chert exploitation a natural avenue of study for examining mobility patterns. Based on a general hypothesis that increasing population in the region would lead to a decrease in residential mobility (in terms of both frequency of residential moves and size of annual range), Elston hypothesized that there should be “a reduction over time in proportions of distant, high-quality materials such as obsidian and fine chert” (Elston 1990b:162).

However, it is not clear whether this is the case. At James Creek Shelter, proportions of distant Tosawihi chert decreased from South Fork phase through the Maggie Creek phase, but actually increased during the final Eagle Rock phase (Zeier and Elston 1990:Table 50). Furthermore, there was little reduction in biface thinning flakes over time in the assemblage, suggesting a near-constant reliance on formal tool technologies (Zeier and Elston 1990:Table 50). The Pie Creek Shelter data indicate an increase in reliance on formal tool technologies over time (McGuire et al. 2004:Figure 40), and obsidian and light cryptocrystalline silicate materials (possibly Tosawihi chert) consistently form relatively high proportions of the debitage assemblage at the site over time (McGuire et al. 2004:Table 13).

Thus, it is clear that diachronic patterns in raw material exploitation in the region are complex, suggesting that there were significant changes over prehistory in the range and nature of mobility patterns. Therefore, prior to proposing any models of raw material exploitation, it is necessary to examine models of prehistoric settlement and mobility for the north-central Great Basin. More specifically it is important to tease out a major factor in mobility: size of foraging territory. As described above, mobility entails a variety of factors, including size of range, frequency of move, and organization of settlement (e.g. logistical moves, residential moves, etc.). Although all of these factors have been explored to one degree or another in various theories of Great Basin mobility patterns, the separate issues are often mixed together. Researchers frequently attempt to describe all aspects of mobility at once; arguing, for example, that during a particular period populations were highly mobile residential foragers tethered to big game resources. This mixing of size of range, settlement system, resource location, and other mobility factors in theories of mobility makes it difficult to sort out whether observed changes in material culture is due to changes in annual range, changes in frequency of residential moves, or changes in settlement systems. Thus, here we focus simply on the size of the annual range, which can be examined through the frequencies of lithic raw materials with known source locations.

As described above, there are three competing models regarding foraging range size over the prehistoric period in the north-central Great Basin. One hypothesis is that range size gradually decreased over the course of the Holocene. Another is that it was highly variable, with low range size growing and shrinking in response to environmental factors, larger during the Middle Archaic period and the Eagle Rock phase, smaller during the Maggie Creek phase. A final hypothesis holds that annual range size was relatively large and constant over the Archaic period, with an abrupt increase in size during the Eagle Rock phase.

These hypotheses are testable with lithic raw material data from the LBB area. During periods associated with large annual foraging ranges, we would expect to see higher frequencies of materials from distant sources and, possibly, a greater diversity of materials from distant sources. When foraging range is reduced, we expect to see lower frequencies of materials from more distant sources and less diversity of materials from distant sources as populations would come to rely on local raw materials for stone tool manufacture.

For the LBB area, these changes are most likely to be visible in two major stone types: Tosawihi chert and obsidian. The relatively close proximity of the Tosawihi Quarries (20 km from the LBB) and the high quality of the material there can be expected to play a major factor in the selection of raw material in the LBB area. The proportion of this material overall, relative to other materials, and, in particular relative to obsidian should be revealing of changes in annual range size.

9.4.1. General Raw Material Exploitation

As many researchers have noted, Tosawihi chert is the primary raw material exploited in the LBB area. Looking at the overall excavated assemblage of chipped stone tools and debitage, Tosawihi chert forms between 80 and 95 percent of the overall assemblage as is shown in Table 59 and Table 60 (material type designations in these tables follow LaFond 1996a). Few other materials are used in any significant frequencies at all, with the exception of obsidian and Vinini chert, which was obtained in a quarry within the LBB itself (see Figure 34 above). The near proximity of this high quality material clearly influenced lithic raw material procurement for inhabitants of the LBB area as much as their annual range. Indeed, the LBB area may well represent area place where logistical parties sent to the Tosawihi Quarries camped on their way back to points south and east.

Table 59. Frequency and Percent of Raw Material Types for Chipped Stone Tools, Entire Little Boulder Basin Excavated Assemblage

Material Type	Count	Percent
Tosawihi Chert	7,927	80.47%
Basalt	18	0.18%
Unidentified Chalcedony	63	0.64%
Chalcedony Type 13	163	1.65%
Unidentified Chert	519	5.27%
Chert Type 93	2	0.02%
Lake Range Quarry Chert	1	0.01%
Schroeder Mountain Chert	90	0.91%
Vinini Chert	117	1.19%
Obsidian	189	1.92%
Unidentified Quartzite	17	0.17%
Vinini Silicified Shale	745	7.56%
Total	**9,851**	

Table 60. Frequency and Percent of Raw Material Types for Chipped Stone Debitage, Entire Little Boulder Basin Excavated Assemblage

Material Type	Count	Percent
"Miscellaneous Chert"	40	0.00%
"Other Toolstone"	424	0.05%
Basalt	115	0.01%
Chalcedony	9	0.00%
Chalcedony Type 13	7,061	0.81%
Chalcedony, clear/mottled	2	0.00%
Chert Type 73	90	0.01%
Chert Type 8	50	0.01%
Chert Type 86	350	0.04%
Chert Type 93	6	0.00%
Chert Type 98	53	0.01%

Table 60. Frequency and Percent of Raw Material Types for Chipped Stone Debitage, Entire Little Boulder Basin Excavated Assemblage

Material Type	Count	Percent
Chert, brown	1	0.00%
Chert, mottled gray	0	0.00%
Elko Hills Chalcedony	648	0.07%
Elko Hills/South Fork Chert	778	0.09%
Hadley Chert	50	0.01%
Jasper	37	0.00%
Macroquartz	14	0.00%
Material Not Specified	8,376	0.96%
Mount Hicks Obsidian	2	0.00%
Obsidian	1,275	0.15%
Opaque Obsidian	1	0.00%
Translucent Obsidian	6	0.00%
Unsourced Obsidian	19	0.00%
Brown's Bench Obsidian	2	0.00%
Paradise Valley Obsidian	12	0.00%
Malad Obsidian	7	0.00%
Topaz Mountain Obsidian	1	0.00%
Quartzite	30	0.00%
Quartzite Type 107	48	0.01%
Schroeder Mountain Chert	4,391	0.50%
Sheep Creek Chert	6	0.00%
South Fork Quartzite	43	0.00%
Susie Creek chert	4	0.00%
Tosawihi Chert	795,151	91.27%
White Tosawihi chert	158	0.02%
Tosawihi Opalite	24,059	2.76%
Unidentified Chalcedony	136	0.02%
Unidentified Chert	4,242	0.49%
Unidentified Quartzite	304	0.03%
Unidentified Silicified Shale	6	0.00%
Unknown Group 3 Obsidian	2	0.00%
Unspecified	50	0.01%
Vinini Chert	4,148	0.48%
Vinini Silicified Shale	18,963	2.18%
Total	**871,170**	

Nevertheless, it should still be possible to examine changes in foraging range utilizing lithic raw materials, despite the overall dominance of Tosawihi chert in the LBB area assemblages. In this case, what we can study is the relative proportion of Tosawihi chert to both more local materials (such as Vinini chert) and more distant materials such as obsidian. We can also examine the proportions of different obsidian types over time. All of these proportions should be related to changing size of annual range.

9.4.2. Tosawihi Chert Relative to All Other Materials

Although it is clear that Tosawihi chert was a preferred raw material for occupants of the LBB area, and past research has generally demonstrated that it is used in high frequencies over all phases of prehistory, there may well be diachronic variation in exploitation of Tosawihi chert. As noted above, the proportion of Tosawihi chert in the James Creek Shelter assemblage does change over time (Zeier and Elston 1990:Table 50). Variation in proportion of Tosawihi chert in an assemblage should be at least broadly reflective of changes in annual range size. Although variation in exploitation of any particular raw material might simply reflect changes in foraging direction, given that Tosawihi chert is present in assemblages of all time periods in the LBB area, it is clear that it was always within the foraging direction of groups. Lower proportions of Tosawihi chert are reflective of reaching the quarries less often which, by and large, will be a result of a shrinking overall annual range size that either brings populations into contact with the quarries less frequently or reduces the number of specific trips that can be taken to the quarries. In this section, we will examine the proportion of Tosawihi chert in dated, single-component tool and debitage assemblages relative to all other materials individually and to all non-Tosawihi materials as a group.

Examining diachronic changes in material types in the dated, single-component LBB area debitage assemblage, numerous relative differences between the Middle Archaic, Maggie Creek, and Eagle Rock phases are apparent (Table 12). Tosawihi chert dominates all phases. The Middle Archaic debitage assemblage consists of about 85 percent Tosawihi material. Local material used during this phase includes Schroeder Mountain chert (9%) and Vinini silicified shale (3%). Review of the Maggie Creek phase shows Tosawihi chert at just over 65 percent of the total debitage assemblage. The drop in proportional use of Tosawihi chert suggests an increased use of more localized materials during the Maggie Creek phase 2 suggests an increased use of Vinini chert (4%) during the Maggie Creek phase, as well as Vinini silicified shale (21%) and Chalcedony Type 13 (6%). This suggests that people were more likely to use material readily available to them during this time, but they still sought out higher quality material (i.e., Tosawihi chert). The Eagle Rock phase debitage assemblage is approximately 98 percent Tosawihi chert, suggesting that Tosawihi chert was the nearly the only material sought after during that time.

Similar patterns are present in the tool assemblage (Table 12). People of all phases relied heavily on Tosawihi chert—more than 60 percent of tools associated with each phase are Tosawihi material. The Middle Archaic tool assemblage consists of approximately 69 percent Tosawihi chert. Material from this phase was a mixture of various obsidian sources (4%), Vinini silicified shale (10%), Vinini chert (4%), unidentified chert (7%), unidentified chalcedony (1%), and Schroeder Mountain chert (6%). Based on these percentages, inhabitants of the region during the Middle Archaic phase apparently used material that was available to them to make tools, but they also sought out higher quality material. The Maggie Creek phase tool assemblage is 65 percent Tosawihi chert, similar to the Middle Archaic assemblage; however, an increased use of Vinini silicified shale (25%) material for tools is apparent during this phase. Other materials used at that time include unidentified chalcedony (1%), unidentified chert (3%), and Chalcedony Type 13 (4%). There appears to be a drop in obsidian usage during this phase. These percentages suggest that Tosawihi chert was heavily used for tools by inhabitants during this phase, but they still sought out other material. During the Eagle Rock phase, it appears that Tosawihi chert was heavily used for producing tools: 90 percent of the tool assemblage for this phase is Tosawihi chert. There were a few other material types used in this phase, including Chalcedony Type 13 (1%), unidentified chalcedony (1%), and unidentified chert (2%); however, there is an increase in obsidian (5%) use for tool production. These percentages suggest that inhabitants of this phase relied heavily on Tosawihi chert but would occasionally use other material.

Analyzing the frequency of Tosawihi chert to non-Tosawihi chert for each period of time is an important process in understanding mobility patterns and annual range. Comparing high-quality material (i.e., Tosawihi) to low-quality (non-Tosawihi) within the tool and debitage assemblages for each period should help to build a clearer picture of tool stone importance in regards to annual range. This is reflected in the debitage collection by focusing on the fact the debitage is used to create new tools, whereas tools can be seen as discarded items. So, if there is a high proportion of Tosawihi debitage on a site in comparison to tools of other material types, it suggests that Tosawihi was more curated. If there is an equal proportion of material between debitage to tools it suggest that there is little planning or concern in raw material and curation

Examining the debitage-to-tool percentages for these phases showed that the Middle Archaic appears to be unique in that the percentages for tools to debitage are relatively different. During the Middle Archaic period, the proportion of Tosawihi chert in the tool assemblage is 67 percent, whereas it is 85 percent in the debitage assemblage. This suggests that there was a higher production of tool manufacture using Tosawihi during the Middle Archaic phase, which created a high percentage of debitage. This indicates that people produced more Tosawihi tools to replace other non-Tosawihi tools during the Middle Archaic, indicating a reliance on this high quality material and a clear regular expectation that this material would be found. During the Maggie Creek period, the production of Tosawihi chert in the tools assemblage is 65 percent and 68 percent of the debitage collection is comprised of Tosawihi chert. These percentages for tools and debitage indicate that Tosawihi chert was sought out as main tool material, which suggests that people of the Maggie Creek period had a larger annual range. However, there is reliance on other tool stone material, which suggests that people of the Maggie Creek period used whatever material was available if needed. The Eagle Rock phase debitage is 98 percent Tosawihi, which suggests that, as in the Middle Archaic, tools were produced from Tosawihi chert to replace non-Tosawihi tools. Eagle Rock period indicates that there was a strong reliance on this high quality material, with little use of other material. The reliance on Tosawihi chert for the period reflects that people during this period were highly mobile with a large annual range.

Comparing the frequency of Tosawihi chert relative to all other material types for debitage and tools, you can see the diachronic change in usage of Tosawihi chert (Figure 36 and Figure 37). During the Middle Archaic, Tosawihi chert accounts for more than 85 percent of all debitage found within the LBB area and about 67 percent of all tools found were produced from Tosawihi material. During the Maggie Creek phase there is a drop in debitage to a 65 percent reliance on Tosawihi chert, with a correlative increase in other tool materials. Tools made from Tosawihi chert account for 65 percent of the Maggie Creek LBB area assemblage. During the Eagle Rock phase, frequency of Tosawihi chert jumps to about a 99 percent for debitage and 90 percent for tools. These percentages suggest that the size of annual range for the Middle Archaic and Eagle Rock phase are relatively large. However, these phases are different from each other; there is a greater reliance on Tosawihi chert in the Eagle Rock phase. The Maggie Creek phase frequency of debitage and tool materials suggests a more constricted annual range. This can be seen in Table 61 and Table 62 by the decrease in Tosawihi usage and increase in other tool stone materials. Based on the general hypothesis that populations increased over time, which leads to a decreased annual range, there should be an associated decrease in distant high quality material types during later periods. This hypothesis is not supported by this dataset; these results suggest that annual ranges inferred for the Middle Archaic and Maggie Creek phase do follow this trend, but that the Eagle Rock phase sees an increase in residential mobility. Overall, this dataset indicates Middle Archaic and Eagle Rock phase populations had larger annual ranges in comparison with the Maggie Creek phase.

Table 61. Count and Percentage of Material Type by Time Period for Debitage from Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic		Maggie Creek		Eagle Rock	
Material Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
"Other Toolstone"	3	0.02%	144	0.19%		0.00%
Basalt		0.00%	18	0.02%	3	0.01%
Chalcedony Type 13	77	0.51%	4,164	5.57%	99	0.26%
Chalcedony, clear/mottled		0.00%		0.00%	6	0.02%
Chert Type 73		0.00%	90	0.12%		0.00%
Chert Type 86		0.00%	5	0.01%		0.00%
Chert Type 93		0.00%		0.00%	2	0.01%
Chert Type 98		0.00%	55	0.07%		0.00%
Elko Hills Chalcedony		0.00%	38	0.05%		0.00%
Elko Hills/South Fork Chert		0.00%	2	0.02%	116	0.30%
Hadley Chert		0.00%	13	0.02%	2	0.01%
Malad Obsidian		0.00%		0.00%	7	0.02%
Mount Hicks Obsidian	2	0.01%		0.00%		0.00%
Obsidian	98	0.65%	83	0.11%	160	0.41%
Other Toolstone		0.00%		0.00%	3	0.01%
Paradise Valley Obsidian	9	0.06%		0.00%		0.00%
Quartzite Type 107		0.00%	50	0.07%		0.00%
Schroeder Mountain Chert	1,372	9.12%	5	0.01%	2	0.01%
South Fork Quartzite		0.00%	11	0.01%	26	0.07%
Tosawihi Chert	12,842	85.34%	51,443	68.81%	38,466	98.54%
Unidentified Chalcedony		0.00%	6	0.01%	5	0.01%
Unidentified Chert	110	0.73%	154	0.21%	58	0.15%
Unidentified Quartzite	14	0.09%	3	0.00%	59	0.15%
Vinini Chert	99	0.66%	2,694	3.60%	10	0.03%
Vinini Silicified Shale	422	2.80%	15,783	21.11%	10	0.03%
Total	**15,048**	**100.00%**	**74,761**	**100.00%**	**39,035**	**100.00%**

Table 62. Count and Percent of Material Type by Time Period for Tool and Core Assemblage from Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic		Maggie Creek		Eagle Rock	
Material Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
"Other Toolstone"		0.00%	27	1.21%		0.00%
Basalt	0	0.00%	1	0.04%	1	0.25%
Brown's Bench Obsidian	3	0.97%		0.00%	1	0.25%
Chalcedony Type 13		0.00%	92	4.13%	5	1.24%
Chert Type 86		0.00%	3	0.13%		0.00%
Chert Type 98		0.00%	1	0.04%		0.00%
Elko Hills/South Fork Chert		0.00%	1	0.04%	2	0.50%
Elko Hills Chalcedony	1	0.32%	1	0.04%		0.00%
Malad Obsidian		0.00%		0.00%	3	0.74%
Obsidian	5	1.62%	14	0.63%	17	4.21%
Other Toolstone		0.00%		0.00%	1	0.25%
Paradise Valley Obsidian	4	1.30%		0.00%		0.00%
Schroeder Mountain Chert	17	5.52%	1	0.04%		0.00%
Tosawihi Chert	212	68.83%	1,455	65.39%	361	89.36%
Unidentified Chalcedony	3	0.97%	18	0.81%	5	1.24%
Unidentified Chert	21	6.82%	77	3.46%	7	1.73%
Unidentified Quartzite		0.00%	2	0.09%	1	0.25%
Vinini Chert	12	3.90%	2	0.09%		0.00%
Vinini Silicified Shale	30	9.74%	530	23.82%		0.00%
Total	**308**	**100.00%**	**2,225**	**100.00%**	**404**	**100.00%**

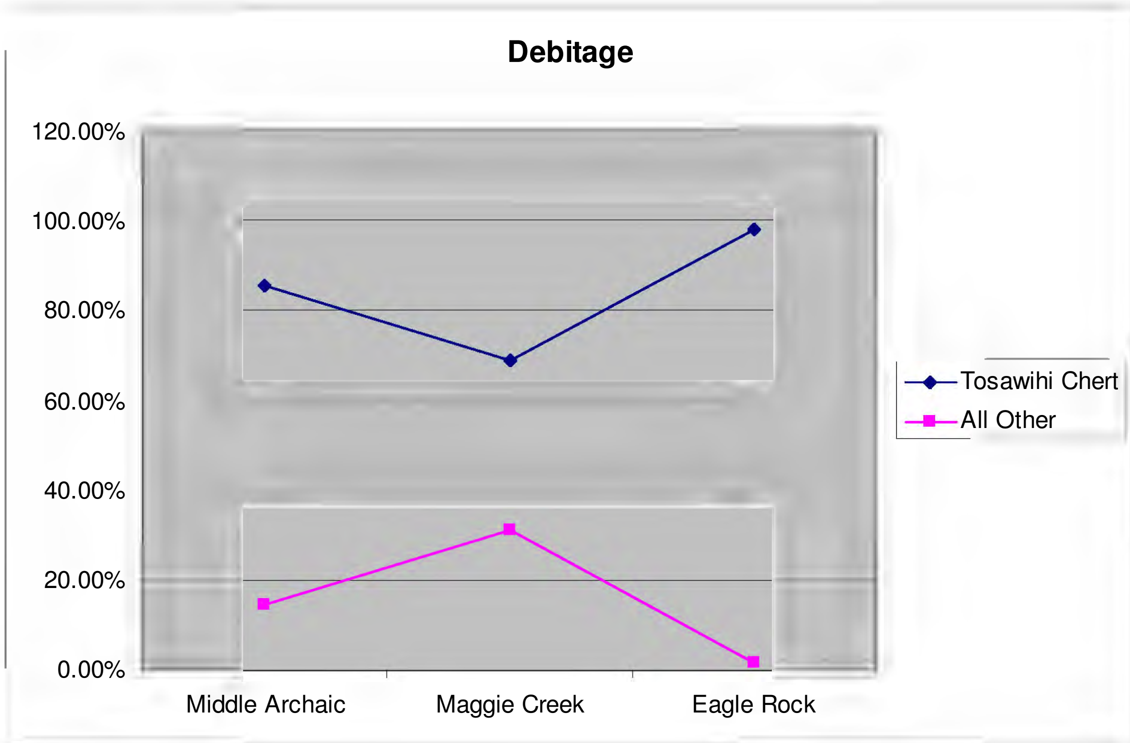

Figure 36. Line chart representing the proportions of Tosawihi Chert and all other raw materials in the debitage assemblage, from dated single-component occupations in the Little Boulder Basin.

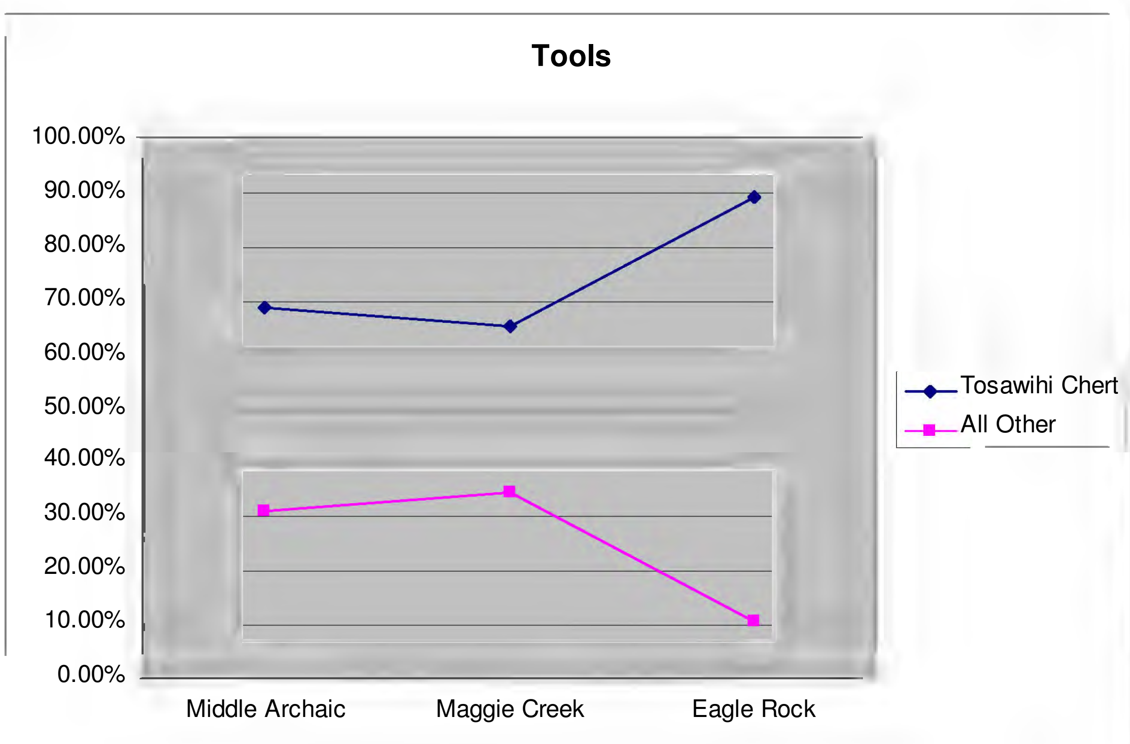

Figure 37. Line chart representing the proportions of Tosawihi Chert and all other raw materials in the tool assemblage from dated single-component occupations in the Little Boulder Basin.

9.4.3. Tosawihi Chert Relative to Obsidian

As previously discussed, examining the relative proportion of Tosawihi chert to distant but relatively high-quality obsidian present in LBB area assemblages provides an indication of how mobility and range size changed through time. During periods featuring comparably large annual ranges and high mobility, we would expect to see the proportion of obsidian to increase relative to Tosawihi chert. On the other hand, periods where mobility is low or range size decreased, the proportion of obsidian relative to Tosawihi chert should likewise decrease. The relative proportions of Tosawihi chert and obsidian by period for the dated tool assemblage are given in Table 63.

Table 63. Tosawihi Chert Relative to Obsidian, Tool Assemblage, Single-component Occupations, Little Boulder Basin

	Eagle Rock		Maggie Creek		Middle Archaic	
Material Type	**Count**	**Percentage**	**Count**	**Percentage**	**Count**	**Percentage**
Tosawihi Chert	361	95.50%	1,455	99.05%	212	97.70%
Obsidian	17	4.50%	14	0.95%	5	2.30%
Total	**378**		**1,469**		**217**	

These relative proportions of Tosawihi chert and obsidian across time in the LBB area do show striking differences which may speak to substantial shifts in range size and mobility. The changes in proportions of Tosawihi chert and obsidian over the three time periods in the tool assemblage are statistically significant (Chi2= 22.5, df= 2, $p<0.001$). For the Eagle Rock phase, the relative percentage of obsidian increases substantially. This suggests that range size was the highest among the periods represented. The Middle Archaic also exhibits a high proportion of obsidian relative to Tosawihi chert when compared to the low proportion of obsidian present in the Maggie Creek assemblage. These results are consistent with previous theories that say that range size and mobility was high during the Middle Archaic period and Eagle Rock phase but changed substantially during the Maggie Creek phase (Elston and Katzer 1990:274). These results depart from the idea, however, that the Eagle Rock phase represents a shift back to Middle Archaic lifeways. Instead, they highlight the possibility that the Eagle Rock phase represents a very different lifeway in which overall range size may have increased substantially.

9.4.4. Obsidian Use

Obsidian sourcing results compiled from the LBB area can be used to illuminate diachronic patterns of mobility and changes in probable annual range size. Obsidian sourcing was performed using X-ray fluorescence analysis throughout the compiled LBB area research. This section utilizes all reliably dated and sourced obsidian artifacts recovered from the LBB area to shed light on how obsidian source use changed through time in the region. After discussing past research, we examine the data compiled through years of excavations to investigate patterns in obsidian use over time in relation to diachronic patterns in the potential size of annual range.

Diachronic patterns in obsidian source use have been observed previously by researchers in the LBB area (Cannon et al. 2008; Elston and Budy 1990). One prominent pattern, already mentioned, is the dominance of obsidian from Paradise Valley, and secondarily, Brown’s Bench. Prior to P-III’s 1992 data recovery field season, Schroedl (1996:84) summarizes that obsidian recovered from the LBB area was sourced exclusively to northern Great Basin and Snake River Plain locations, particularly Paradise Valley and

Brown's Bench. These two sources are consistently present throughout LBB area assemblages (Hughes 1990; Schroedl 1994:35–36; Tipps 1996:1.35). An exception, however, may be at the Tosawihi Quarries, where Paradise Valley dominates in all but the Late Prehistoric period (Eagle Rock phase) whereby obsidian from Brown's Bench is more prevalent among the sourced artifacts and overall, obsidian is sourced to a higher diversity of discrete obsidian sources than earlier in time (Tipps 1996:1.35).

At sites throughout the LBB area, researchers have consistently noted a trend of increasing obsidian source diversity during the Eagle Rock phase (Schroedl 1996:84; Tipps 1997a:103). Some sources including Timber Butte, Malad, and Owyhee (Toy Pass) have been found exclusively in Eagle Rock assemblages (Tipps 1997a:103).

Raw material variability during the Eagle Rock phase in general has been found to be characterized by the almost exclusive use of high-quality Tosawihi chert and obsidian (Stratford and LaFond 1995:30). This pattern has been argued to indicate Eagle Rock phase inhabitants of the LBB area had regular and consistent access to these "non-local" toolstones (Andrefsky 1994:30; Stratford and LaFond 1995:30). Assemblages from earlier phases in the LBB area consistently exhibited small quantities of a variety of raw materials of varying local availability and quality (Stratford and LaFond 1995:30). Prior to the Late Archaic, obsidian assemblages have been found to be heavily dominated by material from Paradise Valley. In addition, the overall proportion of obsidian dated to the Maggie Creek phase has been found elsewhere to decrease substantially (Elston and Budy 1990).

Data compiled from all excavations can be used to investigate whether the previously observed trends continue. A total of 387 obsidian artifacts were recovered and sourced during data recovery efforts in the last 20 years in the LBB area (Table 64). The location of the LBB in relation to major obsidian sources represented in the assemblages is shown in Figure 38. These data indicate that populations obtained obsidian from a diverse number of sources in a large area. This fits with the general results seen in past research. The significant question is whether there was any change over time in source exploitation, as these changes should be informative of the size of a population's annual range.

Table 64. Obsidian Sourcing Results in the Little Boulder Basin

Source	Debitage	Tools	Total (%)
Paradise Valley	126 (59.1%)	101 (58.0%)	**227 (58.7%)**
Brown's Bench or Brown's Bench Area	26	28	**54 (14.0%)**
Owyhee (Toy Pass)	15	5	**20 (5.2%)**
Malad	9	8	**17 (4.4%)**
Majuba Mountain		5	**5 (1.3%)**
Topaz Mountain	3	1	**4 (1.0%)**
Bidwell Mountain		1	**1 (<1.0%)**
Box Spring		1	**1 (<1.0%)**
Double H Mountains	2	1	**3 (<1.0%)**
Massacre Lake	1		**1 (<1.0%)**
Montezuma Range	1		**1 (<1.0%)**
Mount Hicks	2	1	**3 (<1.0%)**
Timber Butte		3	**3 (<1.0%)**
Queen		1	**1 (<1.0%)**
Wild Horse Canyon		1	**1 (<1.0%)**
Unknown	10	4	**14 (3.6%)**
Unknown Group 1 (similar to Montezuma Range)		2	**2 (<1.0%)**
Unknown Group 3 (Double H Mountains?)	6	6	**12 (3.1%)**
Unknown Group 9		1	**1 (<1.0%)**
Unknown Group A	2		**2 (<1.0%)**
Unknown Group B		2	**2 (<1.0%)**
Unknown Group C	6		**6 (1.6%)**
Unknown Group D	3	1	**4 (1.0%)**
Unknown Group E	1	1	**2 (<1.0%)**
Total	**213 (55.0%)**	**174 (45.0%)**	**387 (100.0%)**

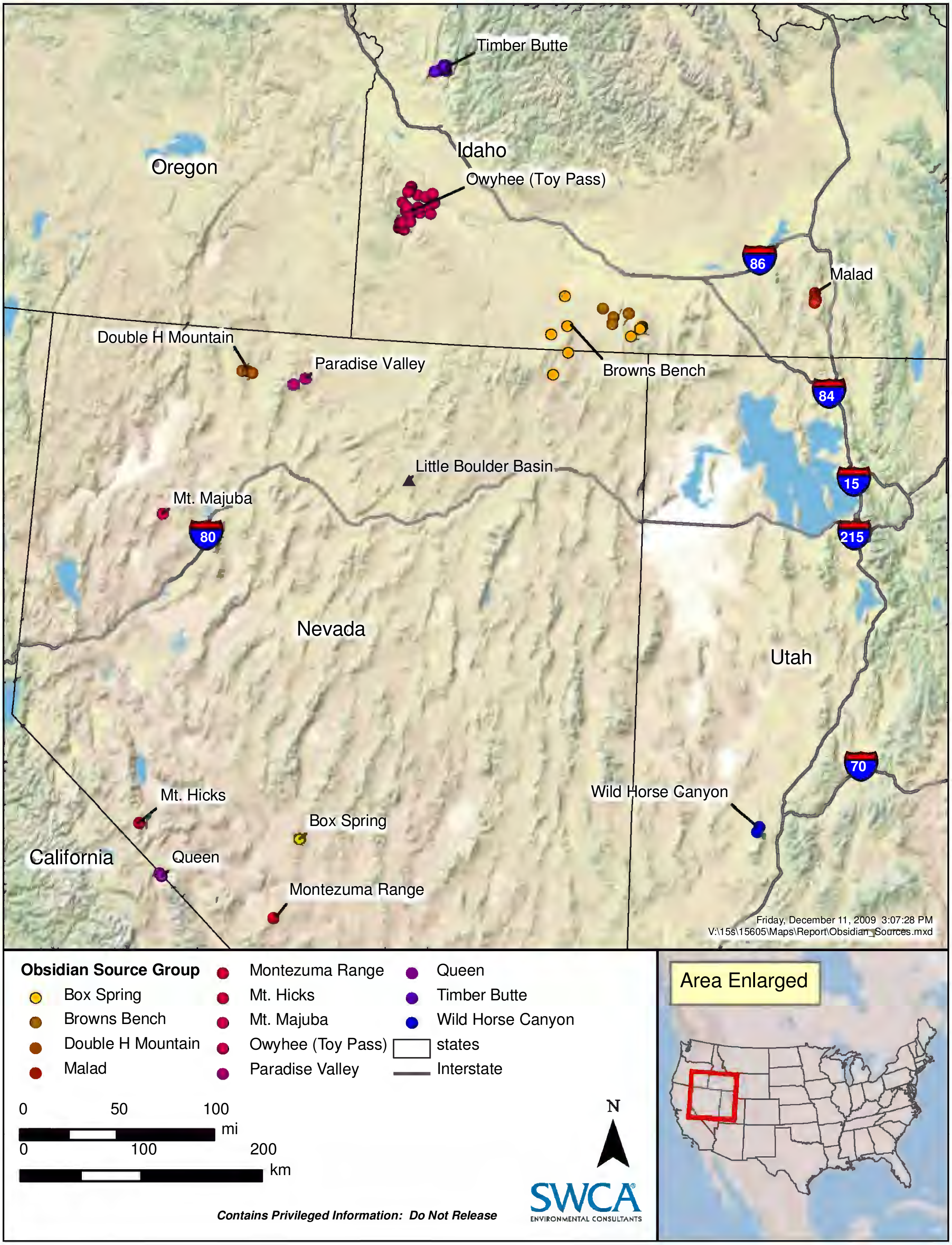

Figure 38. Obsidian sources in relation to the Little Boulder Basin.

Change through Time in Obsidian Use in the Little Boulder Basin

Of the total sourced, 114 obsidian specimens can be reliably assigned to the Eagle Rock, Maggie Creek, or Middle Archaic period/phases according to the methods described in Chapter 5 Table 65). Obsidian samples dated using only obsidian hydration analyses are not included in this total but are discussed later in this section. In all, obsidian samples assigned to discrete temporal components from the LBB area have been sourced to a total of 10 named sources or source areas and an additional four source groups with unknown source locations (see Table 65).

Obsidian from Paradise Valley, the closest known source to the LBB area, being located 110 km to the west-northwest from the LBB, dominates dated assemblages for all three time periods (see Table 65). This is consistent with previous site-specific findings in the LBB area (Ataman et al. 1995; Cannon et al. 2008:256; LaFond 1996b:680), as well as for the obsidian assemblage as a whole (see Table 64). Obsidian from the Brown's Bench Area, located approximately 140 km north of the LBB, has previously been found to be the next most common source present in the area (LaFond 1996b:680). Brown's Bench obsidian comprises 14 percent of the overall LBB area collection. For the reliably dated obsidian artifacts overall, however, Brown's Bench or Brown's Bench Area, comprise 10.5 percent of the sample and instead, Owyhee (Toy Pass) obsidian is the second most common obsidian represented with 11.4 percent present (see Table 65). Malad obsidian is comparatively prevalent, comprising 9.6 percent of the assemblage. Overall, these three northern sources, all located in Southern Idaho or at the Utah-Idaho border (Figure 38), consistently make up the most prevalent sources aside from Paradise Valley (see Table 64 and Table 65). All other sources comprise less than 5 percent each of the sample of interest (see Table 65).

The distributions of the three northern sources besides Paradise Valley that make up the bulk of the assemblage, however, do vary substantially across period. Although Brown's Bench is present in both the Middle Archaic and Eagle Rock assemblages, both Owyhee and Brown's Bench are present only during the Eagle Rock phase (see Table 65). This striking difference in source utilization will be discussed further later under the heading *Obsidian Source Locations Used Through Time*.

Table 65. Obsidian Sourcing Results in the Little Boulder Basin by Time Period (Tools and Debitage)

Source	Distance from LBB (km)	Middle Archaic	Maggie Creek	Eagle Rock	Total
Paradise Valley	110	20 (58.8%)	8 (88.9%)	34 (47.9%)	**62 (54.4 %)**
Owyhee (Toy Pass)	215			13 (18.3%)	**13 (11.4%)**
Brown's Bench Area (Brown's Bench and Unknown 10)	140	8 (23.5%)		4 (5.6%)	**12 (10.5 %)**
Malad	365			11 (15.5%)	**11 (9.6%)**
Unknown	N/A			4 (5.6%)	**4 (3.5%)**
Mount Hicks	365	2 (5.9%)		1 (1.4%)	**3 (2.6%)**
Unknown Group B	N/A	2 (5.9%)			**2 (1.7%)**
Box Spring	310		1 (11.1%)		**1 (<1.0%)**
Double H Mountains	140	1 (2.9%)			**1 (<1.0%)**
Majuba Mountain	205	1 (2.9%)			**1 (<1.0%)**
Montezuma Range	375			1 (1.4%)	**1 (<1.0%)**
Wild Horse Canyon	400			1 (1.4%)	**1 (<1.0%)**
Unknown Group 1	N/A			1 (1.4%)	**1 (<1.0%)**
Unknown Group D	N/A			1 (1.4%)	**1 (<1.0%)**
Total		**34 (100.0%)**	**9 (100.0%)**	**71 (100.0%)**	**114 (100.0%)**

As previously discussed, the obsidian included of interest in most of these analyses is that which can be reliably assigned to a specific phase based on dated proveniences. An additional 129 obsidian artifacts sourced to Paradise Valley have been recovered from the LBB area and subjected to obsidian hydration analyses. Using a hydration relative chronology developed by Schroedl (1995) these, too, can be assigned to specific phases. When added to the assemblage in Table 65, the Paradise Valley totals by phase are represented in Table 66. Obsidian hydration ranges are similarly available for Malad (Late Prehistoric and Late Archaic) (SWCA Environmental Consultants 2010:563,Table 8.33), Wild Horse Canyon (Seddon 2005), and Brown's Bench (McGuire et al. 2004:67–68) obsidian sources.

When artifacts from the above named sources are added to the assemblage, save Wild Horse Canyon which is already accounted for in Table 65, the resulting totals are represented in Table 66. For Brown's Bench, obsidian hydration ranges corresponding to the Eagle Rock and Maggie Creek phases in the LBB area are grouped together by the researchers so discrete phase assignment is not possible here (McGuire et al. 2004:67). The Middle Archaic, however, corresponds to Component II and III obsidian hydration ranges at Pie Creek. Using these ranges, five obsidian specimens can be added to the Middle Archaic for Brown's Bench. In addition, for Malad, reliable obsidian hydration ranges are available for the Late Prehistoric and Late Archaic periods only (SWCA Environmental Consultants 2010:Table 8.33). An additional five obsidian artifacts in this assemblage can be reliably placed in the Eagle Rock phase based on the Malad relative chronology.

Table 66. Obsidian Sourcing Results in the Little Boulder Basin by Time Period with All Reliably Dated Obsidian Artifacts Added

Obsidian Source	Middle Archaic	Maggie Creek	Eagle Rock	Total
Paradise Valley	70 (78.6%)	40 (97.6%)	81 (65.8%)	**191 (75.5%)**
Brown's Bench	13 (14.6%)		4 (3.2%)	**17 (6.7%)**
Malad			16 (13.0%)	**16 (6.3%)**
Other	6 (6.7%)	1 (2.4%)	22 (18.0%)	**29 (11.4%)**
Total	**89 (100.0%)**	**41 (100.0%)**	**123 (100.0%)**	**253 (100.0%)**

Since accurate relative chronologies are not available for each individual source or phase within sources present in the LBB area, most analyses in this section will utilize data from Table 65. Table 66, however, presents interesting results. For one, the Maggie Creek assemblage sample size is increased dramatically while still only being composed almost exclusively of Paradise Valley. The proportions of Paradise Valley across all three time periods increases substantially which is to be expected for the region but may not be representative of the actual relative proportions if all additional obsidian artifacts not accounted for because they lack available relative chronologies (an additional 78 artifacts) could be accurately added to the data. Another interesting result is that although a Malad relative chronology was available for Eagle Rock and Middle Archaic artifacts, Malad is still only represented in the Eagle Rock assemblage.

New Insights into Obsidian Use through Time

Obsidian Source Diversity and Evenness

Even though Paradise Valley obsidian is consistently the dominant obsidian from LBB area assemblages (see Table 64 and Table 65), investigating changes in the range of obsidian sources utilized through time in the LBB area highlights possible changes in diachronic range size and mobility. In particular, measures of relative obsidian source diversity through time of obsidian specimens are assumed here to be representative of diachronic patterns of mobility and range size.

Obsidian source diversity is used as a relative measure of mobility because in general, assemblages from groups with high residential mobility are expected to have access to a greater number of obsidian sources. In contrast, assemblages from groups practicing relatively lower levels of residential mobility, and perhaps more logistical mobility, are expected to have access to fewer sources throughout their annual range.

Obsidian source diversity as measured in richness and using the Shannon-Weaver diversity index (SWDI), which takes into account richness and abundance, is presented in Figure 39 and Table 67 and illustrates the diachronic changes in the number of sources used according to time period in the LBB area. The Eagle Rock obsidian assemblage is the most diverse, exhibiting the highest richness and SWDI among the time periods. The Middle Archaic assemblage is comparably diverse but values are lower than that of the Eagle Rock phase. The Maggie Creek phase, as expected, exhibits the lowest diversity. Although this suggests a striking difference in the number of sources present across time in the LBB area, this may also be a product of higher source richness depending on sample size for Table 65. For evenness, the Eagle Rock and Middle Archaic exhibit similarly even representation across sources. The Maggie Creek phase's two sources are less even, suggesting that there is a much higher presence of Paradise Valley during this phase. This is consistent with previous findings in the LBB area and with Table 65.

Table 67. Diachronic Diversity, Evenness, and Average Distance to Source

Phase/Period	Sample Size	Richness	Evenness	SWDI	Simpson Diversity	Average Distance (km)
Eagle Rock	71	10	0.68	1.58	0.29	188.5
Maggie Creek	9	2	0.50	0.35	0.80	132.2
Middle Archaic	34	6	0.66	1.19	0.41	137.3

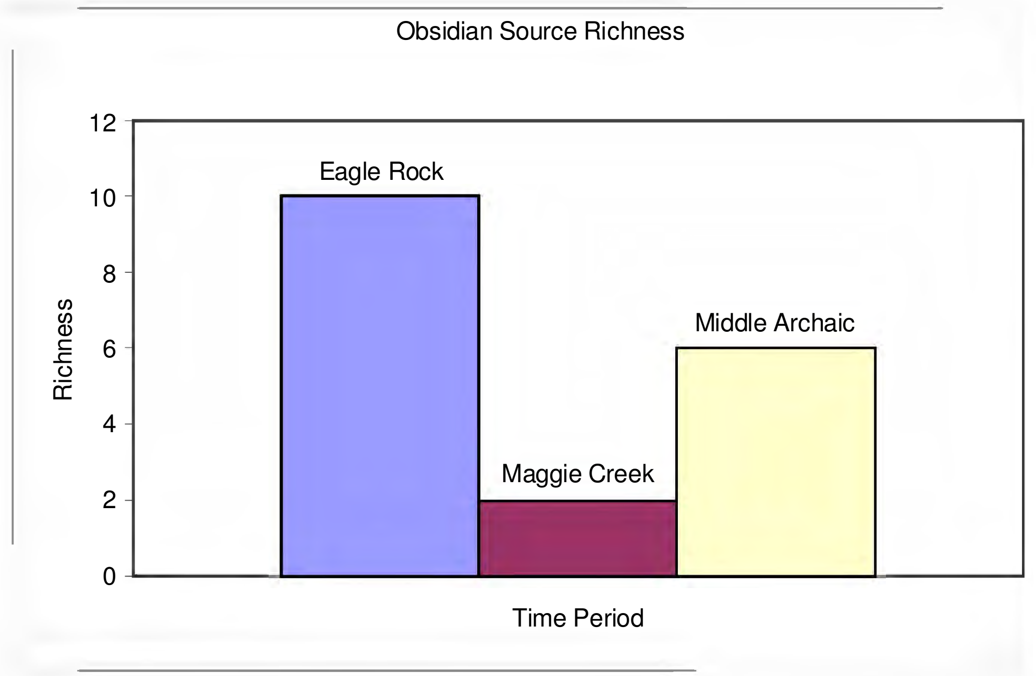

Figure 39. Obsidian source richness through time in the Little Boulder Basin.

In order to determine whether variation in obsidian source diversity through time correlates with sample size, a regression of the richness per dated provenience sample size was performed for Eagle Rock phase and pre–Eagle Rock phase assemblages (Figure 40). Maggie Creek and Middle Archaic groups were combined for the pre–Eagle Rock phase. The regressions have interesting results but the difference between the two groups was not found to be statistically significant. Even so, they do suggest that although the Eagle Rock phase assemblage as a whole exhibits a higher overall obsidian source diversity with more sources being visited, pre–Eagle Rock phase may exhibit more diversity per dated provenience. This possible difference suggests that pre–Eagle Rock phase inhabitants may have visited sources in a more patterned manner, visiting the same sources during annual rounds whereas a more diversity of sources was accessed during the Eagle Rock phase.

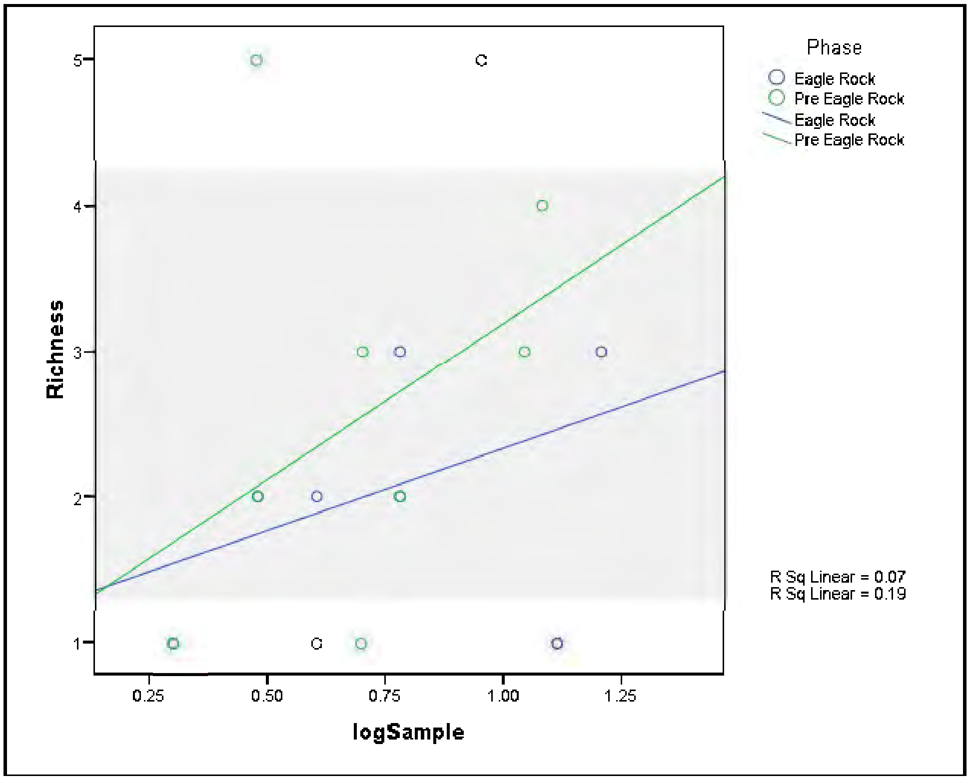

Figure 40. Obsidian source richness and sample size (log).

Average Distance to Source

Comparisons of average distance to source through time in the LBB area gives a relative measure of mobility and possible average annual range size. Average distances for the three time periods are presented in Table 67. The Eagle Rock phase exhibits a higher average distance to source at 188.5 km compared to 132.2 and 137.3 km for the Maggie Creek and Middle Archaic, respectively. These results suggest that on average, obsidian during the Eagle Rock phase may be coming from farther distances than during the Maggie Creek and Middle Archaic. Also, Maggie Creek and Middle Archaic obsidian, on average, may be coming from similar distances from the LBB. The annual range size during the Eagle Rock phase seems to have increased substantially from earlier times.

Paradise Valley and Non–Paradise Valley Obsidian Use

As previously discussed, Paradise Valley obsidian is by far the most prevalent obsidian consistently found at sites in the LBB area throughout prehistory. Other researchers have, however, documented a shift to the inclusion of more non–Paradise Valley obsidian sources during the Eagle Rock phase (Schroedl 1996:84; Tipps 1997a:103). A chi-square table of all dated Paradise Valley and non–Paradise Valley obsidian artifacts for the Eagle Rock and pre–Eagle Rock phase is presented in Table 68 and is accompanied by percentage values within phase. The chi-square results were not significant at the 90 percent confidence interval (df= 1). This suggests, for the dated obsidian sample used here, differences observed in the use of Paradise Valley and non–Paradise Valley obsidian in the Eagle Rock phase and pre–Eagle Rock phase are not statistically significant.

Table 68. Comparing Paradise Obsidian from Eagle Rock and Pre–Eagle Rock Components (Tools and Debitage)

Source	Eagle Rock Phase	Pre–Eagle Rock Phase
Paradise Valley	34 (47.9%)	28 (65.1%)
Non–Paradise Valley	37 (52.1%)	15 (34.9%)

Obsidian Source Locations Used through Time

An additional pattern that has been previously observed at sites in the LBB area (J. B. Jones 1996a:35–36; Schroedl 1998:65) is the possible preferential use of northern sources during the Eagle Rock phase compared to sources from a wider area encompassing southern regions of the Great Basin earlier in time. Such a pattern may indicate a change in land use through time in the LBB area.

In Table 69 obsidian from the Eagle Rock phase and pre–Eagle Rock phase is separated by sources north and south of the LBB area in order to examine a possible change in regional obsidian source exploitation. Sources north of the LBB area in the sample are those located in the northern Great Basin and Snake River Plain and include Paradise Valley, Owyhee (Toy Pass), Brown's Bench, Malad, and Double H Mountains (Figure 38). Obsidian sources in the south are those located in the western and eastern Great Basin, south of the LBB area, and include Mount Hicks, Box Spring, Majuba Mountain, Montezuma Range, and Wild Horse Canyon.

Table 69. Comparing Obsidian from Sources North and South of the LBB

Location	Eagle Rock Phase	Pre–Eagle Rock Phase
North of the LBB	62 (95.4%)	37 (90.2%)
South of the LBB	3 (4.6%)	4 (9.8%)

Based on relative percentages, the Eagle Rock phase assemblage does exhibit a higher proportion of obsidian artifacts from northern sources compared with pre–Eagle Rock phase. This may indicate that overall, sources from the north were utilized more during the Eagle Rock phase than prior. Also, as discussed earlier, new sources were in fact utilized from northern source locations during the Eagle Rock phase with Malad and Owyhee, both located in the Snake River Plain, associated only with Eagle Rock occupations. This may also be indicative of a change towards logistical mobility regions north of the LBB late in time. A similar pattern has been observed from other regions of the eastern Great Basin (Allison 2002; Hughes 1994:6–7; SWCA Environmental Consultants 2010:540) and was described earlier for the LBB area (Cannon et al. 2008:257; Tipps 1997a:103).

Diachronic Obsidian Source Variation between Tools and Debitage

Researchers throughout the Great Basin and adjoining areas of western North America have documented differences in obsidian source profiles for debitage and tools from the same assemblages (Table 70). In general, debitage is often dominated by obsidian from close sources, whereas projectile points and other formal tools are from a variety of sources including very distant ones (Cannon et al. 2008:257; Eerkens et al. 2007:588; G. T. Jones et al. 2003; Simms and Isgreen 1984). In general, obsidian debitage represents a combination of stages of reduction and reworking with reduction generally being dominated by local sources whereas tools may be transported long distances as curated items in mobile societies and thus would exhibit more distant and exotic source profiles.

Table 70. Obsidian Sources Represented in Tools and Debitage

	Middle Archaic		**Maggie Creek**		**Eagle Rock**	
Source	**Debitage**	**Tools**	**Debitage**	**Tools**	**Debitage**	**Tools**
Paradise Valley	11	9	1	7	22	12
Owyhee (Toy Pass)					12	1
Brown's Bench Area (Brown's Bench and Unknown 10)	3	5				4
Malad					7	4
Unknown					3	1
Mount Hicks	2					1
Unknown Group B		2				
Box Spring				1		
Double H Mountains	1					
Majuba Mountain		1				
Montezuma Range					1	
Wild Horse Canyon						1
Unknown Group 1						1
Unknown Group D						1
Total from Distant Sources	*6*	*8*	*0*	*1*	*23*	*14*
Total	**17**	**17**	**1**	**8**	**46**	**26**

Although not statistically significant at the 90 percent confidence interval, possible differences between Paradise ("Local") and non-Paradise ("Distant") obsidian are observed between debitage and tool assemblages between the Eagle Rock and pre–Eagle Rock periods (Table 71 and Table 72). During the Eagle Rock phase, both tools and debitage exhibit near even representation in tools and debitage. This suggests that relatively local and distant obsidian sources were being utilized similarly during the Eagle Rock phase, perhaps both being relatively similar in availability during the annual range. For the pre–Eagle Rock phase assemblage, both tools and debitage exhibit similar proportions of Paradise and non-Paradise obsidian with Paradise obsidian making up approximately two-thirds of both the Paradise debitage and tool groups. This may suggest that local and non-local obsidians were similarly reduced but Paradise Valley obsidian is in higher quantities for both tools and debitage suggesting it was available much more frequently than more distant sources.

Table 71. Comparing Paradise Obsidian Debitage from Eagle Rock and Pre–Eagle Rock Components

Source	Eagle Rock Phase	Pre–Eagle Rock Phase
Paradise Valley	22 (47.8%)	12 (66.7%)
Non–Paradise Valley	24 (52.2%)	6 (33.3%)

Table 72. Comparing Paradise Obsidian Tools from Eagle Rock and Pre–Eagle Rock Components

Source	Eagle Rock Phase	Pre–Eagle Rock Phase
Paradise Valley	12 (46.2%)	16 (64.0%)
Non–Paradise Valley	14 (53.8%)	9 (36.0%)

9.4.5. Summary: Annual Range Size

Raw material exploitation varies considerably over prehistory in the LBB area, indicating that annual range size was different for each time period. The most robust and direct evidence is provided by the obsidian assemblages. Based on diversity and distance to sources, it is clear that Middle Archaic period populations had a relatively wide annual range; this was restricted greatly during the Maggie Creek phase, and then range size expanded to the greatest level during the Eagle Rock phase. Each period or phase is distinct. Exploitation of Tosawihi chert varies in a similar manner. Viewing this source as non-local and somewhat more distant, it is clear that use of the material is high in the Middle Archaic period, lower in the Maggie Creek phase, and highest in the Eagle Rock phase. Although diachronic variation in exploitation of Tosawihi chert may also be related to other factors, it is clear that there were significant fluctuations in the size of the annual range for inhabitants of the LBB area over prehistory, and that this fluctuation was neither simple nor unilinear. As will be demonstrated below, these changes appear to be related to other changes in assemblages that also reflect shifts in mobility and settlement patterns.

9.5. Diachronic Change in Mobility Patterns as Viewed through Bifacial and Core-flake Technologies

The data examined to this point indicate that, contrary to the rough and preliminary models developed previously for the region, there is no simple set of transformations in stone tool manufacture suggesting that changes in mobility patterns over prehistory were complex. Evidence suggests that range size varied between all periods and that exploitation of the Tosawihi Quarries also changed over time, with small but consistent use of non-bifacial core technology and variations in the degree of core technology used for Tosawihi chert. It therefore remains to focus directly on the potential indicators of mobility and settlement strategies in the archaeological record for the LBB area.

As discussed in Section 9.2, the use of bifacial versus non-bifacial core technology provides one of the best avenues for examining mobility. As many researchers have noted, if the distribution of raw material is held constant, more mobile populations will tend to utilize bifacial technologies and less mobile populations will tend to utilize non-bifacial core/flake technologies. As will be discussed in greater detail below, not all researchers find this relationship entirely straightforward, and there is an emerging consensus that non-bifacial core technology is not as inefficient as first envisioned (Kuhn 1994; Prasciunas 2007). Nonetheless, every researcher has noted that assemblages in the LBB area and north-central Great Basin in general do rely heavily on bifacial technology. Other archaeological indicators of mobility (house construction, feature and storage use, site structure and cleaning) identified in past excavations are all suggestive of highly mobile populations. Thus, with the caveats in mind, we can explore potential changes in mobility through changes in bifacial and non-bifacial core manufacture.

In this section we will examine three aspects of chipped stone assemblages in the LBB area that should reflect changes in mobility. As discussed in Section 9.3.2, we will examine changes in the stages of Tosawihi chert bifaces that reflect changes in extraction practices at the quarry. These changes appear to suggest that there was a gradual increase in overall mobility and range size over time. We will then examine the use of non-bifacial relative to bifacial core technologies. We will examine the overall relative reliance on these technologies as well as differences in the ways in which Tosawihi chert is utilized in comparison to other, less high quality but more abundant, materials are utilized. Overall, the data suggest that each period differed from the other and contribute to evaluating the models of mobility that have been proposed and enable development of a new model.

9.5.1. Biface Staging at the Tosawihi Chert Quarry and Little Boulder Basin

In Section 9.3 we examined Elston's model of Tosawihi quarry extraction behavior. Under this model, Elston proposed that the main form of extraction by prehistoric populations would be to make early stage "export" bifaces at the quarry. Our test of the model with data from the LBB area demonstrated that it generally held, although it was clear that some non-bifacial cores were also extracted on a consistent basis over the course of prehistory. However, an examination of diachronic patterns in biface stages in the LBB area did suggest that quarrying behaviors changed over time with significant implications for mobility patterns, and, in particular annual range size.

Changes in biface manufacture at quarrying sites should be reflective of changes in anticipated post-quarrying travel distance, which is a good proxy measure of annual range size. In a study of quarrying behavior and biface manufacture, Beck et al. have demonstrated that because of the simple fact that rocks are heavy and difficult to transport over long distances, if the anticipated transportation distance increases, people will conduct more stages of manufacture at the quarry itself (Beck et al. 2002:495). The implication of this observation for sites more distant from the quarry in question, such as sites in the LBB area, is that as annual range size increases, there should be a greater proportion of later stage bifaces at sites more distant from the quarry. In other words, if bifaces are leaving the quarry in later stages because travel distance is increasing, sites more distant from the quarry should exhibit later stages of bifacial stages. Therefore, the proportion of early versus late stage bifaces in the LBB area should reflect changes in annual range size, a significant component of mobility.

As noted in Section 9.3.2, there is a dramatic change in the proportion of early versus late stage bifaces over time in the LBB area (Figure 41). Over time, the proportion of late stage bifaces (Stages 4, 5, and projectile points) rises from 40 percent of the assemblage in the Middle Archaic period to almost 70 percent of the assemblage in the Eagle Rock phase. These data strongly indicate that annual range size increased over the course of prehistory.

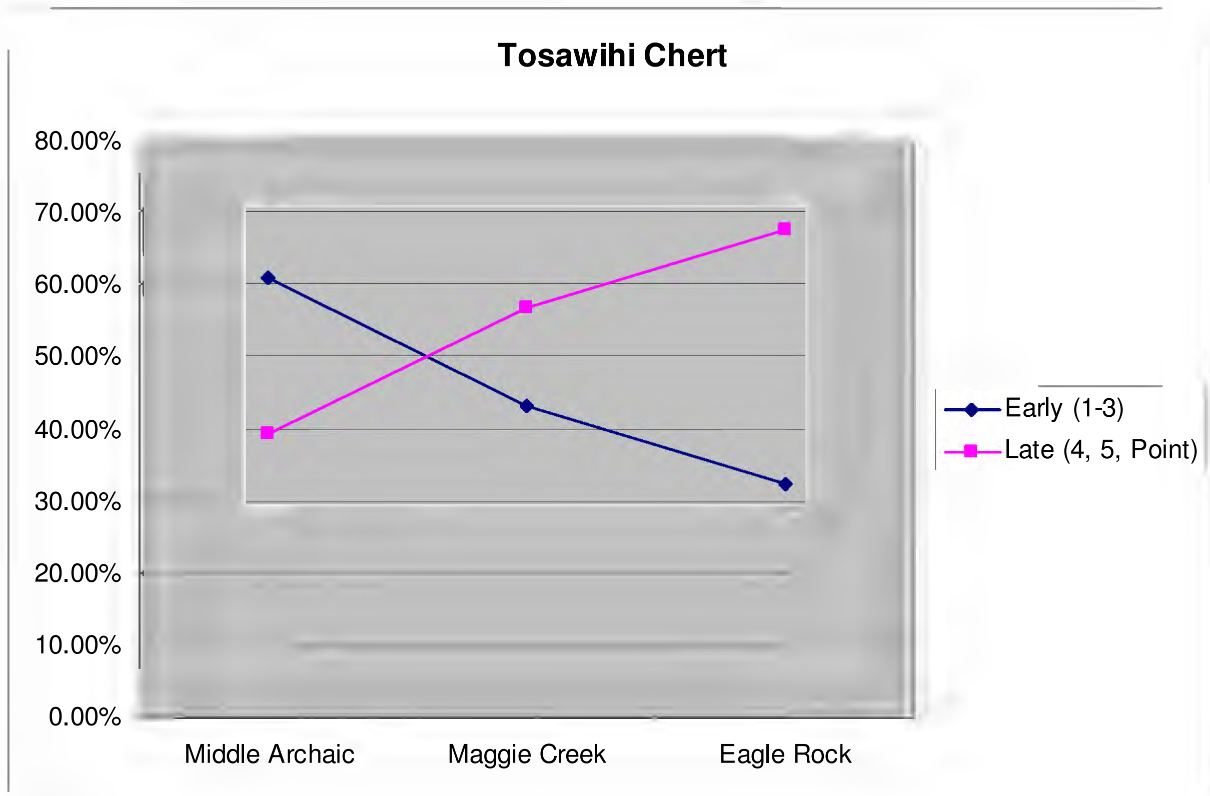

Figure 41. Line chart comparing the proportion of early stage (1–3) versus late stage (4, 5, and projectile point) Tosawihi chert bifaces by time period for dated, single-component occupations in the Little Boulder Basin.

Notably, these data suggest a gradual increase, with range size increasing in the Maggie Creek phase as well as in the Eagle Rock phase. As will be discussed in greater detail below, other measures of annual range size do not necessarily support this gradual trend. As described in the section on relative use of obsidian, the proportion of obsidian and diversity of sources goes down in the Maggie Creek phase, suggesting a reduction in annual range size during this period. Thus, it is clear that the change in biface manufacture may not simply reflect a change in annual range size. Indeed, when all the data are considered in tandem, it appears more likely that the increased emphasis on production of later stages of manufacture during the Maggie Creek phase (relative to the previous Middle Archaic period), may reflect other changes in mobility.

9.5.2. Relative Use of Bifacial and Non-bifacial Technologies

Although problematic, reliance on bifacial technologies can be utilized as a robust proxy measure of overall population mobility. All previous researchers have noted that reliance on bifacial technologies predominates assemblages from all time periods in the LBB area and, indeed, in the north-central Great Basin in general suggesting high levels of mobility. These data generally conform with other measures of high mobility (few habitation sites, low degrees of secondary refuse disposal, low degrees of storage, low frequencies of formal feature construction) observed in the area. Thus, it is clear that all populations were highly mobile and that any observed changes in mobility will be in matters of degree and type of mobility rather than dramatic changes from foraging to sedentism.

The overall assemblage of chipped stone tools, regardless of material type, does support this overall observation (Table 73). Bifaces of various stages, including projectile points, consistently form 80 percent or more of the total assemblage and cores form very small proportions. However, there is clear variation in the proportion of cores, with cores forming more than 10 percent of the Middle Archaic period assemblage, and fluctuations in flake tools such as utilized flakes and modified flakes over time.

Table 73. Frequency and Percent of Tool Type by Time Period, Regardless of Material Type, for Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic		Maggie Creek		Eagle Rock	
Tool Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Modified Flake	17	6.39%	41	1.91%	34	8.52%
Stage 1 Biface	0	0.00%	0	0.00%	1	0.25%
Stage 2 Biface	1	0.38%	136	6.32%	13	3.26%
Stage 3 Biface	102	38.35%	784	36.43%	58	14.54%
Stage 4 Biface	35	13.16%	490	22.77%	85	21.30%
Stage 5 Biface	16	6.02%	364	16.91%	53	13.28%
Projectile Point	23	8.65%	208	9.67%	39	9.77%
Unknown Stage Biface	40	15.04%	102	4.74%	77	19.30%
Core	30	11.28%	4	0.19%	8	2.01%
Utilized Flake	0	0.00%	3	0.14%	20	5.01%
Denticulate	0	0.00%	2	0.09%	1	0.25%
Drill/Perforator	0	0.00%	15	0.70%	5	1.25%
Scraper	2	0.75%	3	0.14%	5	1.25%
Total	**266**		**2,152**		**399**	

These variations are most clearly seen if tool types are grouped into more general categories such as bifaces (including projectile points), cores, and flake tools (e.g. modified flakes, utilized flakes, scrapers, denticulates) (Figure 42). When grouped in this way, it is clear that the use of cores is highest in the Middle Archaic period, extremely low (less than 1%) in the Maggie Creek phase, and higher again in the Eagle Rock phase. The proportion of flake tools also varies, with such tools highest in the Eagle Rock phase and Middle Archaic period and lowest in the Maggie Creek phase. These differences in proportion are statistically significant (Chi2= 333, df= 4, p<0.001). Although some or even many of these flake tools may be manufactured from bifacial reduction flakes, these more expedient tools will generally be utilized by less mobile populations and remain a decent proxy indicator of mobility.

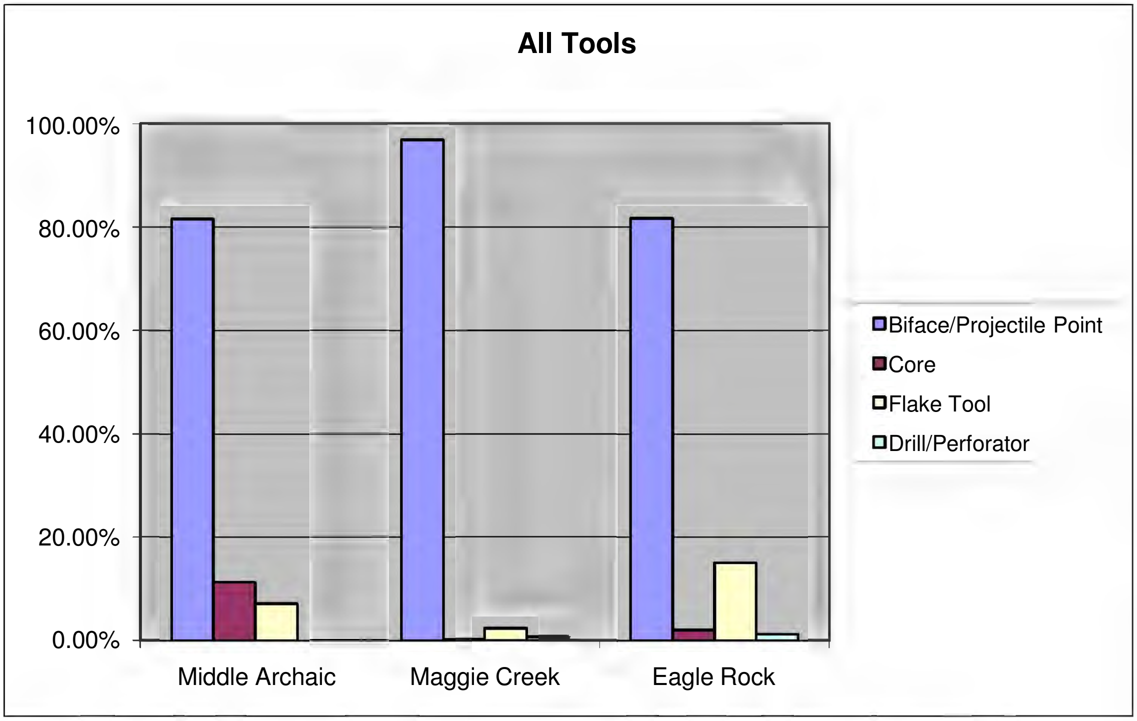

Figure 42. Bar chart of the proportion of bifaces, cores, flake tools, and drills/perforators by time period for dated single-component occupations in the Little Boulder Basin.

This pattern is not repeated in the debitage assemblage. Ignoring non-diagnostic flake types (such as angular debris and unidentifiable flakes), the proportion of biface reduction in the datable assemblage is high (Table 74). There is, however slight variation in the proportion of core and bipolar reduction. This proportion is lowest in the Middle Archaic period (0.53%), highest in the Maggie Creek phase (1.24 %), and second-highest in the Eagle Rock phase (0.94%).

Table 74. Frequency and Percent of Diagnostic Debitage Types by Phase/Period, from Dated Single-component Occupations in the Little Boulder Basin

	Middle Archaic		**Maggie Creek**		**Eagle Rock**	
Debitage Type	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Biface Reduction	11,327	78.68%	21,987	77.02%	31,971	74.07%
Biface Thinning	2,992	20.78%	6,161	21.58%	10,711	24.81%
Pressure Flake	0	0.00%	44	0.15%	77	0.18%
Core Reduction	45	0.31%	333	1.17%	398	0.92%
Bipolar Reduction	32	0.22%	22	0.08%	7	0.02%
Total	**14,396**		**28,587**		**43,164**	

The difference in patterns between the tool and debitage assemblage is interesting and revealing. It appears that Maggie Creek phase occupants were engaged in the highest levels of core/flake manufacture in the LBB area of any time period, but they deposited the lowest proportions of core tools on the sites as a whole. This strongly suggests that although they appear to have had a huge investment in bifacial technology in general that during their stay in the LBB area, they were very willing to supplement this with expedient manufacture from core-flake technology.

All together, the diachronic data indicate changes in emphasis on non-bifacial manufacture suggesting diachronic variation in levels of mobility. Notably, no periods are identical in proportions of bifacial technology. The Middle Archaic period evidences the greatest reliance on core technology and a relatively high use of informal flake tools. The Maggie Creek phase has very low levels of core and flake tool usage and data suggesting high reliance on biface technology. However, it is clear that Maggie Creek phase occupants of the LBB area engaged in the most core-flake production, although still very small, of any group for any time period. The Eagle Rock phase shows a return to use of core-flake technology in the tool assemblage, though at levels slightly lower than for the Middle Archaic. These data suggest that although mobility levels were high across all time periods, the level of mobility and the nature of the mobility were different in each period or phase. A full evaluation of the implications for settlement and mobility requires examining data on the use of Tosawihi relative to non-Tosawihi materials along with a full integration of all the data examined thus far.

9.5.3. Patterns of Biface and Core-flake Technology between Tosawihi and Other Raw Materials

Although relative proportions of core-flake and bifacial technologies are considered generally reflective of relative differences in mobility, the most revealing patterns may be found in the differential use of materials of different quality. Andrefsky has noted that quality and distribution of available raw material will result in different reduction strategies for mobile populations (Andrefsky 1994). The pattern varies depending on the quality and availability of raw materials; high quality materials with restricted availability will often be used for bifaces and other formal tools, whereas lower-quality materials with wide availability will often be used for informal tools and core-flake technologies. The region around the LBB can actually be characterized as having aspects of both situations. Tosawihi chert represents a material of high quality, but low abundance, restricted to the quarries. Obsidian can also be characterized in this fashion. However, Vinini chert and silicified shale, Schroeder Mountain chert, Maggie Creek chert, Susie Creek chert, Hadley Creek chert, and the Elko Hills/South Fork source area (LaFond 1996b:675) all represent lower-quality but much more relatively abundant materials (when considered as a group). These raw materials are present in LBB area assemblages, though in low quantities. Although each of these sources has a relatively limited distribution and is low in abundance, combined, they form a fairly abundant source of materials for foragers in the region. Differences in the way Tosawihi chert is used relative to lower-quality materials should be revealing of differences in mobility patterns.

Although we cannot determine the exact annual ranges and mobility directions and patterns from data in the LBB area alone, it should be possible to infer changes in mobility through the differential (or non-differential) usage of Tosawihi chert and other materials (excluding obsidian). Although the other sources listed above do vary in their distance from the LBB, with most located outside the LBB, they are as a group much more easily available to populations than Tosawihi, which has a single location. Furthermore, although all are lower quality in general than Tosawihi chert, they do not vary significantly in quality amongst themselves. Therefore, they are all likely to have been viewed as lower-quality and more readily available than Tosawihi chert to any group moving through the general region. They can therefore be used as a proxy measure for use of lower quality, readily available material. In other words, given that there is little difference in quality between the non-Tosawihi raw materials, and these materials are distributed more readily and widely available in the region they can be used to measure prehistoric approaches to low-quality, widely available materials.

Prehistoric populations would be expected to deploy a particular reduction strategy for non-Tosawihi, lower quality, widely available, materials depending on their mobility. Highly mobile populations with wide annual ranges might be expected to reserve high quality materials such as Tosawihi for biface and formal tool manufacture and only use lower quality, widely available materials to supplement the tool kit with informal core and flake tool technology. Populations with lower levels of mobility and/or more restricted annual ranges might be expected to utilize lower quality materials more frequently and for all types of tool manufacture, because travel to the higher quality source would be time consuming. Overall, key insights are likely to be gained by comparing the use of high quality, restricted range materials with lower-quality abundant materials. In the case of the LBB area, this entails comparing manufacturing strategies between Tosawihi chert and all other material (excluding the small numbers of obsidian artifacts).

Comparison of general tool categories by period and material type reveals that there are dramatic differences between periods in use of Tosawihi and non-Tosawihi materials (Table 75). During the Middle Archaic period and the Eagle Rock phase, Tosawihi chert and non-Tosawihi materials show differences in the amount of non-bifacial core and flake tool production, with non-Tosawihi materials used in higher proportions for this expedient manufacture. During the Maggie Creek phase, however, the proportions of tool types by material type is almost identical, varying by less than 1 percent across all categories.

Table 75. Frequency and Percentage of General Tool Types by Time Period and Material Type from Dated Single-component Assemblages in the Little Boulder Basin

		Middle Archaic		Maggie Creek		Eagle Rock	
Material	**Tool Type**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Tosawihi Chert	Biface/Projectile Point	161	91.48%	1,339	96.54%	296	83.15%
Tosawihi Chert	Core	5	2.84%	1	0.07%	5	1.40%
Tosawihi Chert	Flake Tool	10	5.68%	33	2.38%	52	14.61%
Tosawihi Chert	Drill/Perforator	0	0.00%	14	1.01%	3	0.84%
Total of Tosawihi Chert		**176**	**100.00%**	**1,387**	**100.00%**	**356**	**100.00%**
Other Material	Biface/Projectile Point	56	62.22%	745	97.39%	30	69.77%
Other Material	Core	25	27.78%	3	0.39%	3	6.98%
Other Material	Flake Tool	9	10.00%	16	2.09%	8	18.60%
Other Material	Drill/Perforator	0	0.00%	1	0.13%	2	4.65%
Total of Other Material		**90**	**100.00%**	**765**	**100.00%**	**43**	**100.00%**

This pattern is most easily seen graphically (Figure 43, Figure 44, Figure 45). During the Middle Archaic period, 90 percent of the Tosawihi chert is used for bifaces, with cores and flakes made on less than 10 percent of this type. Non-Tosawihi materials, while still used for bifaces, are much more frequently utilized for cores and flake tools. The difference in proportion of cores, flake tools, and bifaces (omitting drills/perforators due to low frequencies) between Tosawihi chert and non-Tosawihi chert during the Middle Archaic period is statistically significant (Chi2= 35.8, df= 2, p<0.001). During the Eagle Rock phase, this pattern repeats. Although the difference isn't as strong, it is still statistically significant (Chi2= 7.36, df= 2, p<0.03). Non-Tosawihi material is proportionally more utilized for cores and flake tools than Tosawihi chert and less frequently used for bifaces, although the difference is not quite as wide. During the Maggie Creek phase, however, Tosawihi and non-Tosawihi materials are used in almost the exact same proportions, and there is no statistically significant difference in the proportions of tool types by raw material (Chi2= 2.89, df= 2, p= 0.236). As observed above, bifaces are the most common tool type during the Maggie Creek phase, suggesting high mobility during that time period. However, in marked contrast to earlier and later phases, it appears that Maggie Creek phase occupants used lower-quality and abundant materials in the same manner as Tosawihi chert.

This pattern is matched in the debitage assemblages. During the Middle Archaic period, about 99% of Tosawihi Chert debitage is bifacial while 3% of non-Tosawihi Chert is core or bipolar manufacture. During the Eagle Rock phase this difference is even more distinct, with 99% of Tosawihi Chert debitage from bifacial strategies but nearly 7% of non-Tosawihi Chert used for core and bipolar manufacture. However, during the Maggie Creek phase bifacial manufacture accounts for about 98% of both Towsawihi and non-Tosawihi debitage, with core/bipolar manufacture found on about 1-2% of both Tosawihi and non-Tosawihi debitage. In other words, while nearly all debitage assemblages of any material type are dominated by bifacial manufacture, in the Middle Archaic period and Eagle Rock phase, non-Tosawihi materials were more frequently used for core/bipolar manufacture. During the Maggie Creek phase, however, both Tosawihi and non-Tosawihi materials are used for the same types of manufacture in essentially the same proportions.

The dramatic difference in Tosawihi versus non-Tosawihi material usage across time periods in the LBB area has fundamental implications for interpreting changes in mobility and settlement patterns. Although the Eagle Rock phase and Middle Archaic periods differ slightly in patterning, raw material usage in these periods does generally fit the expectation for high mobility populations. In both time periods, populations clearly rely heavily on Tosawihi chert for most formal tool manufacture and they supplement this with readily available, lower quality materials used for informal tool manufacture. In the Maggie Creek phase, however, populations clearly view both lower quality, abundant materials and the higher quality, restricted Tosawihi chert in the same manner. Taken in isolation, this pattern might suggest lower levels of mobility during the Maggie Creek phase. However, all other measures of mobility (reliance on bifaces, use of high quality Tosawihi chert overall), suggest that at least some aspect of mobility remained high during the Maggie Creek phase. Consequently, we must conclude that while Maggie Creek phase occupants employed a relatively high level of mobility, some aspect of this mobility was significantly different from earlier and later time periods.

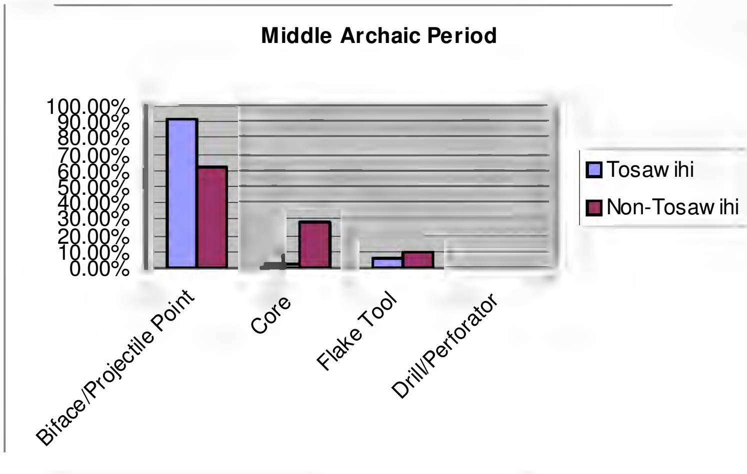

Figure 43. Bar chart of the proportion of Tosawihi chert and non-Tosawihi chert by general tool type for Middle Archaic period occupations in the Little Boulder Basin.

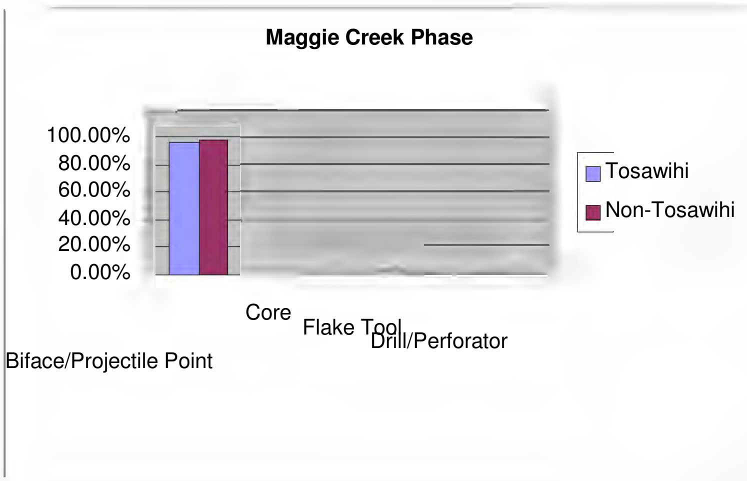

Figure 44. Bar chart of the proportion of Tosawihi chert and non-Tosawihi chert by general tool type for Maggie Creek phase occupations in the Little Boulder Basin.

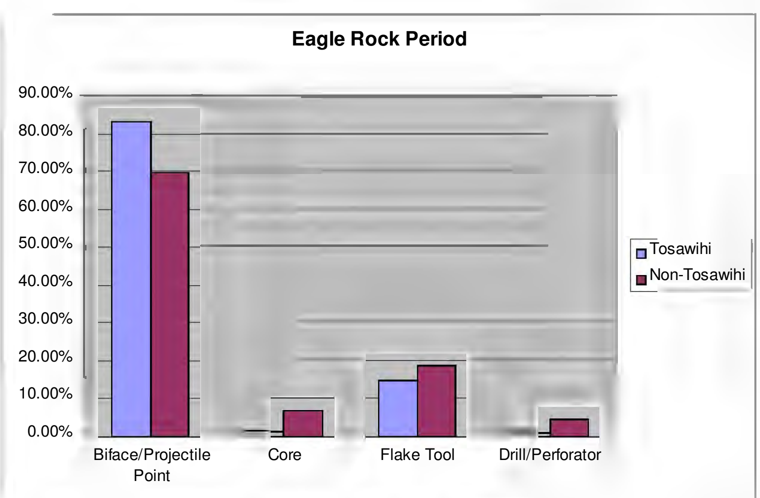

Figure 45. Bar chart of the proportion of Tosawihi chert and non-Tosawihi chert by general tool type for Eagle Rock phase occupations in the Little Boulder Basin.

The key differences may well be explained by differences in size of annual range. As described above, with the exception of biface stages, all indicators of annual range suggest that Maggie Creek phase occupants of the LBB area had the lowest annual range size of any time period. Proportion and diversity of obsidian drops during this period, and reliance on Tosawihi chert for manufacture in the LBB area (as evidenced in the debitage assemblage, see Figure 2), while still high, is the lowest of any time period. Mobility however, appears to have remained high as evidenced by the great commitment to biface manufacture. The increase in reduction of Tosawihi bifaces at the quarry during this period is likely to be related to this high mobility, as populations at least expected to be away from the quarry for longer periods, and thereby completed more reduction at the quarry as a hedge against material failure or manufacturing error further away. The pattern is likely explained by this combination of high mobility within a reduced range. In other words, under conditions of high residential mobility within a reduced range (relative to earlier and later periods), Maggie Creek phase occupants applied the same principal of formal tool manufacture and careful planning and curation to all materials they encountered. They appear to have taken advantage of materials on an embedded or encounter basin, including Tosawihi chert, but utilized a careful and efficient manufacturing strategy for all materials, designed to reduce risk of material failure or manufacturing error and ensure that logistical supply trips for any material type would not be needed or at least could be minimized.

9.5.4. Summary: Chipped Stone Evidence of Diachronic Changes in Mobility Patterns in the Little Boulder Basin

Although not necessarily as straightforward as initially conceived, there is a general relationship between reliance on bifacial technology and mobility. With increasing levels of mobility and anticipated time away from high-quality material sources, populations are expected to use those sources increasingly under a bifacial reduction strategy. During all periods in the LBB area, bifacial technology is the predominant reduction strategy employed, indicating that in general terms, all populations were mobile and non-sedentary. However, small but significant variations in reliance on core-flake technology does suggest that each time period entails differences in mobility strategies.

Of all three periods examined, the Maggie Creek phase is most distinct. This period evidences the highest overall commitment to biface production in the tool assemblage. Furthermore, it is clear that Tosawihi chert was reduced into later stages of manufacture at the quarries compared to the previous period, suggesting either a larger range size or a greater emphasis on planning. As the other evidence for range size suggests that the Maggie Creek phase occupants had the smallest range size of any time period, it is most likely that the increased reduction of Tosawihi chert at the quarry relative to the previous period is likely the result of anticipating long time periods away from the quarry and therefore utilizing increased planning to avoid material or manufacturing failure. Most notably, Maggie Creek phase occupants utilized high quality, reduced availability Tosawihi chert and lower quality, abundant non-Tosawihi chert in exactly the same manner. In combination with other evidence of reduced range size, these data suggest that Maggie Creek phase populations were highly mobile, but within a very reduced range. They appear to have expected to encounter materials such as Tosawihi and other cherts on a fairly regular basis, but they treated all materials primarily under a careful, bifacial manufacturing strategy designed to reduce risk of material failure and need to resupply.

Evidence from the Middle Archaic period and the Eagle Rock phase differ both from the Maggie Creek phase and each other. Both periods evidence high reliance on bifacial technology and a tendency to reserve high quality Tosawihi chert for bifacial technology and supplement this with core-flake technology made from lower quality but more widely available materials. Populations were clearly mobile during both periods. Exploitation of the Tosawihi Quarries, however, differed significantly. During the Middle Archaic period, while it is clear that staged export bifaces were manufactured, this manufacture concentrated on earlier stages. During the Eagle Rock phase, later stages of manufacture were completed at the quarries as evidenced by the highest overall proportion of late-stage bifaces for any time period in the dated assemblages. These data suggest significant differences in range size and planning. It appears likely that Middle Archaic period populations, while planning to avoid failure, anticipated more regular opportunities to visit the Tosawihi Quarries and resupply. In the Eagle Rock phase, however, populations carefully planned to reduce weight and risk and avoid failure, suggesting an increased travel distance and/or more time away from the quarries. These indicate that the manner of mobility, along with the range size also differed between the Middle Archaic period and the Eagle Rock phase.

It is important to note that all of these interpretations have been based on the assumption that bifacial cores are the most efficient means of transporting toolstone. This assumption is most notably based on an argument made by Robert Kelly (1988), who proposes that bifacial cores maximize the amount of usable edge that a core can produce while minimizing the weight that must be transported. However, several significant experiments and articles have challenged Kelly's argument. Kuhn (1994) suggests that in some cases, it may have been more efficient to transport small flake blanks or functionally specific tools than bifacial cores. Additionally, Kuhn suggests that cores may often be included in toolkits due to their functional properties, as they can meet a variety of needs that smaller flake tools cannot such as use as "hammers, anvils, pestles, or pounders, or chopping tools" (Kuhn 1994:437). While small flakes and tools may optimize utility relative to cost of transportation, functional concerns may result in the inclusion of cores and larger flakes in toolkits, even at some distance from the raw material source or in a system with high logistical mobility. This may explain the frequent inclusion of bifacial cores in mobile toolkits, as noted by Kelly.

Prasciunas (2007) also disputes whether bifacial cores were more efficient than other means of transporting lithic materials. She calculated the total amount of usable flake edge produced by a core relative to its initial weight, and then compared these ratios for bifacial and amorphous cores. She found no significant differences in the ratios, indicating that bifacial cores may not have maximized the utility of transported material. Reasons other than maximizing efficiency may thus determine varying degrees of reliance on bifacial technology, including the following: anticipated tool function; tool multifunctionality, maintainability, and durability; and increased utility, because a biface still remains once the bifacial core has been exhausted. Caryn Berg (personal communication, 2007) notes that Parry and Kelly (1987) show that even if bifacial cores are not the most efficient means of transporting toolstone, a higher ratio of core reduction to biface production still tends to occur among less mobile populations.

Emerging research therefore, suggests that while the general concept advocated by Kelly (1988) that bifaces are a preferred technological strategy for mobile populations is generally correct, it may be somewhat over-generalizing. Although it is clear that bifaces are utilized in high frequencies by mobile hunter-gatherers, it is also clear that transportation and use of non-bifacial cores is not necessarily so much less efficient that such technology is not employed. Furthermore, it is clear that non-bifacial cores also have advantages in use as particular tool types that would make use of non-bifacial cores advantageous in a technological system. Indeed, the most overall flexible strategy might be to leave a given quarry with a combination of finished tools, early stage bifaces, and non-bifacial cores. Because non-bifacial cores are not necessarily vastly more heavy and less efficient than bifaces (Prasciunas 2007), transporting them may have conveyed some advantages without adding undue weight to a mobile group's supplies.

Nonetheless, in light of this theoretical background, the overall patterns are not surprising. It is clear that all prehistoric populations were mobile and relied predominantly on bifacial technology. However, populations during all three time periods still utilized core flake technologies in varying degrees to supplement their overall toolkit. This suggests, but does not confirm, that the ideal strategy for a mobile population would be to transport a combination of bifaces supplemented by small quantities of non-bifacial cores.

Given the utility of this general pattern for mobile populations, the differences in proportion of non-bifacial core technology and raw material usage over time in the LBB area indicate that changes in mobility patterns were neither unidirectional nor simple. Each time period has a unique chipped stone assemblage that indicates continual changes in mobility and settlement over time. These data are best considered together and comprehensively.

9.6. Conclusions: Chipped Stone Assemblage Variability in the Little Boulder Basin and Implications for Prehistoric Settlement and Mobility Strategies

Comprising the largest single class of artifacts in the LBB area, chipped stone tools and debitage provide a wide range of information on prehistoric technology, raw material procurement, mobility and settlement, and overall economic practices. Interpreting the complex variability in chipped stone assemblages from the LBB area and the broader region has proven difficult, in large part because any single site represents one piece of a much larger picture of settlement for any prehistoric group. Although the data from the LBB area still only provide insight into sites from a particular and rather restricted geographical area, the accumulated data of many years of excavation at many sites does allow for new insights into changing prehistoric adaptations in the north-central Great Basin.

In this chapter, we have examined several major aspects of chipped stone assemblage variability. Based on information and models from past research, we have examined Tosawihi quarry exploitation, both in general and at a diachronic level. We have also explored variability in raw material procurement, with particular focus on the implications of variation in obsidian procurement strategies for size of annual range. We have also looked at evidence from technological strategies, particularly the relative use of bifacial and non-bifacial core-flake strategies, for evidence of mobility. Notably, there is no singular direction of variation in these attributes of chipped stone assemblages. Variation within a given stone tool assemblage is not always matched by expected variation in debitage assemblages. Certain traits that appear to indicate, for example, increasing range size are matched by other traits that, taken alone, suggest decreasing range size. In other words, we found that there is a high degree of complexity in chipped stone assemblages. No single attribute provides full insights into the variation, and it remains likely that we are not observing all sources of variation at these sites alone. Nonetheless, the full dataset provides an ability to evaluate previous models of past settlement and mobility and pose a new model for the region.

9.6.1. Evaluating Past Models of Chipped Stone Assemblage Variability and Mobility

Previous models of prehistoric mobility in the north-central Great Basin were all admittedly preliminary. Based on data from one or a few sites, these researchers are to be appreciated for their attempts to begin to interpret past behavior. Interestingly, in many ways the data from the LBB area support aspects of all the major models, indicating that the researchers had noted numerous aspects of variability in chipped stone assemblages and mobility. Nonetheless, the comprehensive analysis suggests that no single model captured all the variability observed in the region.

Previous models are discussed in detail in Section 9.1. In brief, they differ in a number of respects. One view holds that change over time was constant and gradual, with a continuing decrease in range size and residential mobility and a gradual increase in reliance on logistical strategies. Another view holds that the Middle Archaic period and Eagle Rock phases were very similar and represent wide ranging foragers, and that range size and intensive foraging took place during the Maggie Creek phase. A final model holds that the most dramatic change is observed in the Eagle Rock phase which represents the highest amount of mobility and range size.

The results of the comprehensive analysis indicate that while aspects of all models are correct, the overall picture is more complex than any single model. The data on annual range size from obsidian and other materials indicates that there was definitely not a gradual reduction in range size over time. Range size appears to have been large in the Middle Archaic period, dramatically restricted in the Maggie Creek phase, and largest in the Eagle Rock phase. Data on residential mobility provided by biface and core-flake evidence indicates that residential mobility appears to have been high in all periods, although there may have been some logistical mobility in the Eagle Rock phase as evidenced by the very high proportions of Tosawihi chert in this phase. Additionally, the biggest overall change is not in the Eagle Rock phase as suggested by one model. Rather, the Maggie Creek phase is the most distinct. Nonetheless, each period has unique characteristics. Elston's model does appear to match the evidence most closely in that the Middle Archaic period and Eagle Rock phases are most similar and the Maggie Creek phase most distinct. However, the evidence for annual range size, reliance on Tosawihi chert, and degree of biface staging at the Tosawihi Quarries, are very different in Eagle Rock phase and the Middle Archaic period. This indicates that while mobility and settlement during these periods may have been similar, they were not identical. Therefore, no previous model fits all the data. We propose, instead, a revised model.

9.6.2. A Revised Model of Chipped Stone Assemblage Variability and Mobility in the Little Boulder Basin and the North-central Great Basin

Although the LBB area undoubtedly represents only a small proportion of overall mobility strategies, and refining and testing of any models will require data from sites in different localities, the area nonetheless can be used to infer patterns of mobility over the past. This exercise is necessarily predominantly interpretive. Because we are only looking at a small portion of the overall picture and because there are uncertainties in the way in which chipped stone data represents mobility strategies, the most we can do is take the available data and our best understanding of chipped stone theory and pose the most likely explanation for the variability. Minimally, however, this exercise generates highly testable research questions for future investigations. In this section, we will examine the data and implications for mobility on a period-phase basis.

The Middle Archaic Period

Chipped stone assemblages associated with Middle Archaic period occupations in the LBB area appear to represent debris from populations with a large annual range who are highly residentially mobile. The data from obsidian sources indicate that they had access to sources from a large area. Raw material selection favored high quality Tosawihi chert and the production of bifaces as might be expected for groups with high levels of mobility. However, the small but consistent use of Tosawihi chert for core-flake reduction suggests that there was some expectation that the quarries would be encountered fairly regularly and thus less need to ensure that the material was used perfectly efficiently. Middle Archaic period populations also supplemented their supply of Tosawihi chert with more widely available, but lower quality, other cherts and chalcedonys, but they predominantly utilized these materials for core-flake reduction. Overall, the data from the Middle Archaic period fit expectations for residential foragers, moving from resource area to resource area within a generally large annual range.

The Maggie Creek Phase

The pattern of chipped stone debris and undoubtedly the associated mobility and economic strategy underlying this pattern changes radically in the Maggie Creek phase. Data from obsidian sourcing indicates that the number and distance of sources drops precipitously in this period, with only small amount of obsidian present and nearly all of it from a single source, Paradise Valley. This alone suggests a great reduction in range size. Furthermore, use of non-Tosawihi materials such as Elko Hills/South Fork chert and other types increases, also suggesting a constriction in annual range requiring more reliance on local materials. Mobility, however, appears to have remained high. This period shows an increase in reliance on bifacial manufacture relative to the Middle Archaic, and increased levels of biface staging at the Tosawihi Quarries. Both factors suggest that planning for frequent moves and time away from the Tosawihi Quarries affected the overall assemblages. Most strikingly, high quality Tosawihi chert and lower quality materials are all reduced in nearly the same manner, emphasizing bifacial manufacture. Combined with evidence from the debitage assemblage suggesting some small use of core-flake technologies at sites, these data suggest that populations planned their tool assemblages carefully, expecting to be away from any raw material and utilizing bifaces to ensure that their tool kit would be as reliable as possible. Overall these data suggest populations that remained highly residentially mobile but within a greatly reduced range.

The Eagle Rock Phase

During the Eagle Rock phase it appears that mobility patterns changed again. Evidence from obsidian procurement indicates that the overall foraging range was the greatest during this period. Obsidian source distance is the greatest and the overall diversity of sources is also the highest for any period, suggesting populations were ranging over a wide portion of the landscape. Like all periods, the populations relied on bifaces predominantly, but an increased investment in producing later stage bifaces at the quarry indicates that populations either expected to travel long distances or to be away from the quarry for long periods of time. Notably, this period has evidence for the greatest reliance on Tosawihi chert of any time period, indicating that it was preferentially obtained. This latter pattern is perhaps the most difficult to explain. Given the wide-range of Eagle Rock phase populations, the overall reliance on Tosawihi chert is slightly unexpected, as these populations might be able to reach other sources of high quality materials more easily. It may be that Eagle Rock phase occupations in the LBB area reflect a much more specialized occupation, perhaps a stopping point after obtaining chert at the Tosawihi Quarries, either logistically or embedded in residential moves. Overall, the chipped stone evidence suggests populations with a very high annual range, high levels of mobility. This mobility may have been either residential or logistical or some combination of the two during different times of the year.

9.7. Model Implications, Data Needs, and Directions for Future Research in the North-central Great Basin and Future Eligibility Determinations in the Little Boulder Basin

This revised model provides a number of directions, questions, and testable hypotheses for future research. These future research questions should guide research in the region, as well as in the LBB area itself. Because the LBB area is a relatively constrained area in terms of geography and available resources, many of the future research questions are best addressed with data from outside the area, to supplement and test the patterns and implications of the LBB area data. Nonetheless, research questions and data needs do remain for the LBB area. These should guide any future determinations of site eligibility in the area, at least in terms of questions applicable to chipped stone assemblages. In this final section, we discuss research questions and data needs both by individual time period and for diachronic research questions. We conclude with a summary of remaining research questions and data needs for chipped stone assemblages in the LBB area.

9.7.1. Middle Archaic Period Research Questions

Middle Archaic period occupations are expected to consist of the remains of highly mobile residential foragers traveling over a large annual range. The model posits groups who move from resource area to resource area, employing a fairly generalized foraging strategy. Consequently, one implication is that there should be little significant difference between Middle Archaic period site types and assemblages. Middle Archaic period sites should be generally quite similar in terms of tool and debitage assemblages with any variations explained solely by available local resources. There should be little evidence for long-term occupations, and beyond easily explicable variations in resources (e.g., quarry sites near raw material sources, sites emphasizing fishing near high concentrations of fish, etc.) there should be little functional differentiation between sites. Since these populations would carry a general tool kit designed to be ready for all contingencies, site assemblages should not vary significantly. Research can be directed to test this model at a variety of levels.

Notably, however, our model for this time period is broad and includes two defined phases: South Fork and James Creek. Because the number of discrete, dated, single-component occupations of these phases is very low, we were forced to group data from both phases into the larger period. Therefore, the question still remains as to whether there is any meaningful variation in mobility and chipped stone assemblages in this time period between the South Fork and the James Creek phases.

Research questions for the Middle Archaic period can, therefore, be phrased as follows:

- Are there differences in chipped stone assemblages between South Fork and James Creek phase occupations?
- Do all Middle Archaic period occupations represent generalized mobile foragers or are there different functional site types beyond sites focusing on a particular local resource? Are there any Middle Archaic period occupations that represent true extractive sites or logistical exploitation sites?
- Are all Middle Archaic period occupations relatively short-term or is there evidence of longer term occupations?

9.7.2. Maggie Creek Phase Research Questions

The Maggie Creek phase appears to represent a highly distinct mode of occupation during the past in the region. Annual range size seems to have decreased while populations remained mobile foragers. Occupation duration and intensity of exploitation may have increased. Consequently, while some research questions are similar to those of the previous period, others focus on the distinct nature of mobility during this phase.

- What is the annual range size during the Maggie Creek phase?
- What causes the change in mobility and range size during the Maggie Creek phase? Environmental change? Population increase?
- Do all Maggie Creek phase occupations represent generalized mobile foragers or are there different functional site types beyond sites focusing on a particular local resource? Are there any Maggie Creek phase occupations that represent true extractive sites or logistical exploitation sites?
- What is the length of occupation for Maggie Creek phase sites?

- Do all Maggie Creek phase sites have chipped stone assemblages with no significant variation between use of Tosawihi chert and non-Tosawihi chert? In particular, is the observed pattern a result of having excavated Maggie Creek phase sites in similar settings or does the pattern hold regardless of site setting?

9.7.3. Eagle Rock Phase Research Questions

During the Eagle Rock phase, populations seem to return to mobile foraging over a wide annual range. However, differences in this phase from previous phases appear to indicate that mobility and occupations were not identical to those of the Middle Archaic period. Mobility may entail highly mobile foraging, logistical foraging, or a combination perhaps spread over the course of the year. The LBB area in particular may represent a locale where logistical foraging parties stopped and reduced materials while returning from supply trips to the Tosawihi Quarries. Some aspects of the Eagle Rock phase assemblages raise the possibility that the historically observed Shoshone settlement pattern may have developed during this time. However, it is not clear if this pattern held for pre-Contact populations or if it was a result of population displacement following historical contact. Better defining Eagle Rock phase mobility patterns should be a focus of future research.

- Is there evidence of logistical foraging during the Eagle Rock phase? Do any sites indicate clear evidence of specialized collecting?
- Are there significant functional differences between site types during the Eagle Rock phase? Are there, for example, base or residential camps, possibly along major rivers and streams, as noted for the historical Shoshone inhabitants of the region?
- Does the Shoshone pattern of occupation develop early or late in the region? Is this pattern a result of Euroamerican contact and possibly depopulation due to disease?
- Does the LBB area represent a specialized locale during the Eagle Rock phase, perhaps as a place for quarry supply parties to stop on their return from the Tosawihi Quarries? Notably, addressing this question requires data from outside the LBB area. Large numbers of Eagle Rock phase occupations already excavated in the LBB area provide evidence of occupation within the LBB area during the Eagle Rock phase. To answer the question, we need to compare non-LBB Eagle Rock phase sites with Eagle Rock phase sites in the LBB to determine if there is any difference in chipped stone assemblages or other data.
- How does evidence about Eagle Rock phase mobility that might be provided by ceramic sourcing analysis compare to that provided by the chipped stone data?

9.7.4. Diachronic Research Questions

Many of the significant aspects of chipped stone assemblages in the LBB area are highlighted when periods or phases are compared and change over time is observed. The model developed above posits that each period or phase is distinct, with unique attributes and practices. Additional research questions can be posed to further illuminate and explore these differences. All of these questions require data from outside the LBB area itself as the LBB data are limited to a very small number of site types.

- Are the observed differences in usage of Tosawihi and non-Tosawihi chert over time visible outside the LBB area?
- Is the increase in later stage bifaces seen in the LBB area matched by changing of stages at the quarry itself?
- Does the pattern of Tosawihi chert exploitation observed in the LBB area hold steady or change at different distances from the quarries? What are reduction strategies for sites 10 km from the

quarries? 30 km? 50 km? What about reduction strategies at the Tosawihi Quarries themselves? Might those strategies have been structured by factors other than simply transport distance (e.g., social or political factors)?

- Can we refine the differences in chipped stone assemblages between the Middle Archaic period and the Eagle Rock phase, particularly with assemblages outside the LBB area?
- Non-Tosawihi raw materials other than obsidian remain poorly defined in the region. Many details of raw material procurement and processing are lost because we have poor definitions of types and poor descriptions of type distribution and location. What are the total range of non-Tosawihi raw materials, their utility and quality, and their distributions on the landscape of the north-central Great Basin?

9.7.5. Conclusion: Data Needs and Eligibility Criteria for Chipped Stone Assemblages in the Little Boulder Basin

Years of excavation in the LBB area have resulted in a large and robust data set that has greatly refined our understanding of sites, mobility, and chipped stone assemblages. We no longer need to address basic questions of resource procurement, Tosawihi chert exploitation, or potential change over time. As this chapter has demonstrated, we have sufficient existing data to answer a number of questions and pose a testable model, not just for the LBB area but the north-central Great Basin as a whole. Many of these research questions are now best addressed either through investigation of sites outside the LBB area or through comparison of existing non-LBB area site data with existing data from sites in the LBB area.

As a result, our data needs for future research in the LBB area itself are greatly reduced and much more specialized. Additionally, existing but non-published data could be used to answer some of the questions for the area. Consequently, a more narrow range of field data needs are required for future research, at least in terms of chipped stone data. Here we discuss a number of research questions that could be addressed with existing but non-published data, followed by defined needs for new data from the LBB area.

Existing data could be used to test many aspects of the new model of chipped stone assemblages and variability in mobility in the LBB area. For many years, previous researchers reported chipped stone data at a site level, rather than on an occupation or activity area basis. Consequently, our analysis and model relied on a subset of occupations. However, it is our understanding that the original, raw data, from each activity area at each site does exist. If the original data can be obtained, data from dated, single-component occupations can be used simply to check, test, and if need be, refine the model itself. Thus, it may be possible to mitigate many effects on unexcavated sites in the LBB area through analysis and comparison of existing data, if obtained, with the data discussed in this report. In other words, in cases where a given eligible site appears to provide no significantly different data than previously excavated sites, mitigation of this site would be better and more efficiently accomplished through analysis of existing but non-published data from the same time period(s).

Nonetheless, there do remain a number of data needs for addressing chipped stone research questions in the LBB area. These can best be met by focusing on the following types of sites:

- Any sites with high probability of Middle Archaic (South Fork and James Creek) occupations. We have few excavated sites or components from these phases and our model is fairly general for this time. Any clear South Fork or James Creek phase occupations (rather than generalized Middle Archaic Occupations), will merit further field investigation.
- Any Maggie Creek phase sites that appear significantly different from previously excavated sites in the area. Key identifiers would be: Evidence of differential use of Tosawihi chert and non-

Tosawihi chert; locations in settings significantly different from excavated LBB area Maggie Creek phase Sites; sites with evidence of specialization in activities.

- Sites of any phase with high potential to provide data on use of raw materials other than Tosawihi chert. Such sites would be identified by having high proportions of chert types other than Tosawihi, or high proportions of obsidian.

Although research questions for the LBB area and broader region are by no means completely answered, it is clear that years of research have greatly refined these questions. We have answered many basic questions about raw material use, we have defined clear patterns in chipped stone assemblage variation and posited a model of mobility based on those patterns, and we have clearly identified new questions and new data needs. Future research will require a focus on utilizing non-published data from previously excavated sites, targeted investigations at very specific site types or sites of very specific phases, and comparative data from outside the LBB area itself.

10. RESEARCH SYNTHESIS AND MANAGEMENT RECOMMENDATIONS

Michael D. Cannon and Matthew T. Seddon

When cultural resources inventory in the LBB area was first initiated in the late 1980s, little was known about its archaeology. Although surveys and excavations had occurred at sporadic locales (see Elston and Budy 1990:19), no synthetic work had been completed. Indeed, until 1990 there was no published cultural chronology for the Upper Humboldt River region (Elston and Budy 1990:264). A general understanding of Great Basin prehistory was well established by this time, but archaeological understanding of specific adaptations, particularly in the Upper Humboldt region, was rudimentary at best. In light of this situation, nearly any archaeological site with a sufficient density of artifacts and some potential to contain intact occupation surfaces had the potential to address significant research questions, and sites with large artifact assemblages, potential for buried components, and chronologically diagnostic artifacts or the potential for such artifacts were routinely recommended eligible for the NRHP. As was discussed in Chapter 3, the 1991 historic context for the LBB area, which was written during this time, specified a large number of general research questions for the area that remained to be answered in light of the limited archaeological investigations that had occurred up to that point (Schroedl 1991). Nearly all of the sites that have been identified in the LBB area were evaluated around this time with respect to these general research questions, and the research design used for evaluating sites in the area has not been revisited since.

Since the early 1990s, however, the amount of systematic archaeological research that has been conducted in the LBB area has increased substantially. As of 2010, more than 50 open sites have been excavated and reported in the area, over 5,700 m^2 of excavation has occurred at these sites, encompassing at least 120 discrete site loci, and nearly 1,000,000 pieces of debitage and 11,000 chipped stone tools have been analyzed from these excavations (see data in Appendix M, the electronic database provided to BLM-Elko along with this report). In addition to the work that has been completed at these LBB area sites, excavations at James Creek Shelter (Elston and Budy 1990) and Pie Creek Shelter (McGuire et al. 2004), both of which are located near the LBB area, have also made very important contributions.

This research has substantially advanced our understanding of the prehistory of the LBB area. Many of the original research questions posed for the area have been addressed, and archaeological materials that have been recovered but not yet analyzed could be used to address some other remaining research questions. In addition, new research questions have been raised. In light of these developments, it is both appropriate and necessary to revisit the original research context developed for the region.

In this volume we have used existing data from excavations in the LBB area to evaluate older research questions and develop new ones. Our efforts have focused on the research questions that have received the most attention to date and that had the greatest potential to address major issues raised in the 1991 historic context and thereby provide directions for future research. Our efforts have focused on issues related to chronology and the "multicomponent" problem (Chapter 5), site formation processes and paleoenvironment (Chapter 6), subsistence (Chapter 7), site structure and function (Chapter 8), and lithic source use, technology, and mobility (Chapter 9). Analyses presented here that are relevant to each of these issues have resulted in the development of new questions to guide future research and, importantly, future NRHP eligibility evaluations or revaluations of prehistoric sites remaining in the area.

In this chapter, we first summarize the main conclusions about the prehistory of the LBB area that can be drawn from the analyses of the comprehensive dataset compiled for this document. We then revisit and summarize the new research questions developed throughout this document and present criteria for evaluating evaluating the NRHP eligibility of sites going forward. To do this, we begin by examining the existing sample of excavated LBB area sites to determine if there are any gaps in our data collection from the area. Following this analysis, we summarize the research questions developed in each previous chapter of this volume, with a specific emphasis on remaining data needs. To the extent that sites in the LBB area will be evaluated or reevaluated for NRHP eligibility under Criterion D in the future, these data needs should determine which sites remain eligible. Finally, we summarize these data needs and develop a process for determining eligibility of remaining sites, we propose mitigation strategies that may be appropriate for the region in the future—to the extent that mitigation of adverse effects is necessary—and we consider other issues related to future management of cultural resources in the area.

10.1. Summary of New Research Results

The analyses presented in this document incorporate data from over 50 excavated sites in the LBB area, providing the first truly comprehensive examination of the area's prehistory. These analyses also provide perhaps the most complete view of the prehistoric archaeology of any area within the Great Basin that is as large as the LBB study area. As discussed in the following sections of this chapter, much still remains to be learned about the area in the future. However, a considerable amount of knowledge about the area now exists, and this knowledge is briefly summarized here.

Abundant chronological data from the area, discussed in Chapter 5, provide what is likely a reasonably complete picture of the occupational history of the LBB area, at least in general outline. The distribution of radiocarbon dates from the area suggests that sustained human occupation began around 1200 B.C. and continued without major interruption through the period of Euro-American settlement. Projectile points further provide evidence for at least sporadic use of the area prior to 1200 B.C. The lack of radiocarbon dates from before this time, and the more general paucity of evidence for substantial occupation prior to 1200 B.C., may be due to insufficient preservation of earlier materials and/or insufficient testing of deeply buried deposits, issues that are discussed further below. At face value, however, the available data suggest that humans used the area only lightly until well into the late Holocene.

Based on the synthesis of available chronological data that is discussed in Chapter 5, and in light of recent work conducted at Pie Creek Shelter, a slightly revised phase sequence for the area is presented here. The main revisions to the previously used phase sequence are a change in the beginning date of the South Fork phase from 4600 B.C. to 2600 B.C. and the addition of the Pie Creek phase immediately before the South Fork phase. Revisions to the projectile point chronology and the obsidian hydration chronology that have previously been used in the area are also suggested.

It has been well established that multicomponent deposits are very common in the LBB area, and much previous work has focused on attempting to more successfully limit excavation efforts to single-component deposits, which enable change over time to be examined. Employing an explicit and consistent set of criteria for identifying assemblages as single-component, only a small proportion of the previously excavated assemblages from the study area—no more than about a third—can be identified as such. Moreover, it appears that the "typical" site or site locus in the LBB area will have evidence for occupation during about two phases, and values much higher than this are not uncommon. The geoarchaeological work that has been performed in the area (see Chapter 6) suggests that, in most geomorphological settings, archaeological deposits are likely to be shallow and to lack stratigraphic distinctions, a fact that likely goes a long way towards explaining the prevalence of multicomponent archaeological assemblages in the area.

Also discussed in Chapter 5 is that, of those assemblages from the study area that can be identified as single-component, by far the largest number date to the Eagle Rock phase. Very few date to the Maggie Creek phase, and no assemblages can be identified as single-component and dating to any of the James Creek, South Fork, or Pie Creek phases individually, though some can be identified as "single-component" Middle Archaic assemblages. A major reason why many previously excavated LBB area sites and site loci cannot be identified as single-component is that they lack sufficient dating information for evaluating their occupational history. In light of this, it is obvious that the very first goal of any future excavation project should be to recover as much dating information as possible.

An analysis of potential predictor variables shows that there are no clear-cut ways to determine whether a site or site locus is single-component prior to excavation based either on environmental variables or on characteristics of surface archaeological assemblages. It is demonstrably not the case that sites or site loci with larger or denser surface artifact assemblages are more likely to be multicomponent, as some have previously suggested may be the case. On the other hand, the number of archaeological features found at a site or site locus does appear to substantially improve the ability to identify deposits as single-component, likely because features typically provide abundant dating information in the form of radiocarbon dates and associated artifacts. The most productive approach to identifying single-component deposits may therefore be simply to focus on locating archaeological features, and there fortunately are some variables that do seem to be able to predict whether a site or site locus will contain archaeological features. In particular, the presence of ground stone artifacts and/or ceramics, as well as site location in upland settings where soils of the Chen-Pie Creek-Ramires association occur, appear to be indicative of the presence of features with better than random chances.

Turning to issues of subsistence, the comprehensive analysis of faunal remains that is presented in Chapter 7 supports the previously made argument that large mammal encounter rates declined around A.D. 1300, or between the Maggie Creek and Eagle Rock phases, leading to a reduction in overall foraging efficiency and an expansion of diet breadth. The comprehensive analysis of macrobotanical remains presented here is likewise consistent with an expansion of diet breadth and decline in foraging efficiency at this time. However, a new result also emerges from the analyses of faunal and floral data presented here, which is that, during the Middle Archaic period, diets appear to have been about as broad, and foraging efficiency about as low, as during the Eagle Rock phase. Previous analyses have not explicitly considered variability in subsistence between the Maggie Creek phase and earlier periods, but it now seems clear that the Maggie Creek phase stands out in comparison to both the preceding Middle Archaic period and the following Eagle Rock phase in terms of diet breadth and foraging efficiency.

An analysis of ground stone tools from the LBB area indicates greater investment in milling technology during both the Middle Archaic period and the Eagle Rock phase than during the Maggie Creek phase. This is evidenced by patterns in overall abundances of milling implements and in the degree to which they were intentionally shaped. These temporal patterns seen in milling technology are consistent with the argument that has been previously made that people adjusted their investment in various forms of technology in response to changes in resource selection and foraging efficiency, such as those that are evidenced by the floral and faunal data just discussed. Ceramic data from the LBB area also seem to be consistent with such a change in technological investment in that pottery from the area appears to date solely to the Eagle Rock phase and may be associated with increased use of seeds during this time. However, the fact that LBB area ceramics are only loosely dated presently limits the degree of confidence that can be placed in this conclusion.

In an analysis of thermal features from the LBB area, two hypotheses were tested: that hearths with rocks are associated with large mammal remains, whereas hearths without rocks are associated with small mammal and plant remains, and that the frequency of hearths without rocks increased over time, particularly around A.D. 1300 when other changes in subsistence-related technology are evident. The frequency of small hearths does indeed increase in the Eagle Rock phase, again perhaps indicating increased investment in technologies used to handle low-return resources. However, based on available evidence, there appears to be no strong association between the types of food resources processed in thermal features and the presence or absence of rocks in those features.

The analysis of site structure and function presented in Chapter 8 leads to several important insights into settlement and mobility in the LBB area. For one, all sites, from all time periods, appear to represent remains left by small groups of highly mobile hunters and gatherers who occupied sites for short periods of time. No structures have been identified on any sites of any time period in the LBB area. The numbers of features on sites are generally low, and even sites with high numbers of features are likely to have been re-occupied repeatedly. Features are almost always very simple, unlined fire pits. A few appear to have been rock lined, but none approach the complexity of lined fire pits, deep bell-shaped or other storage pits, and other feature types seen in other areas of the Great Basin and Intermountain West. In addition, no secondary refuse areas have been identified, and site structure—as defined by features and artifact distributions—is extremely simple and easily interpreted as representing short occupations by small, mobile, groups, probably extended families.

Variation among sites in potential indicators of site function is slight and centers on differences in densities of artifacts and faunal material. Although most sites are likely best characterized as small, generalized camps, two other site types may be present. One is characterized by high densities of debitage (generally greater than 2,000 flakes per cubic meter) and tools (generally greater than 10 tools per cubic meter). These sites may represent areas where stone tool production and repair (possibly associated with hunting) were a particular focus. The second is characterized by higher densities of ground stone (generally two or more ground stone artifacts) and high faunal richness (generally more than 3 taxa). These sites may represent areas where food collection and processing were emphasized to a relatively greater degree. It is notable that distribution of these site types is not as patterned spatially as might be expected. General camps and tool processing sites appear to be located across a variety of settings, distances to water, and vegetation zones in the LBB area. This is not entirely surprising, however, as a general camp might be expected in a variety of locales, and intensive tool processing (particularly when most of the raw material is from distant quarries), can be carried out anywhere. Importantly, though, food processing sites appear restricted to particular ridge tops and the big sagebrush vegetation zone. One might expect food processing sites to be situated in a restricted range of locales, so the pattern observed in the LBB area lends credence to the idea that the food processing site is a valid type.

Regarding temporal variation, the distinction between tool production and food processing sites seems to be clearest during the Middle Archaic period and the Maggie Creek phase. This suggests that site functions may have been more varied during these periods than during the Eagle Rock phase, when distinctions between sites are not nearly as stark. It may be the case that use of the LBB area during the Eagle Rock phase was, in fact, much more homogenous than during earlier periods. However, low numbers of single-component pre–Eagle Rock phase sites make these observations tentative.

Chipped stone artifacts comprise by far the most substantial portion of the LBB area archaeological dataset. A variety of specific analyses of chipped stone tools and debitage are presented in Chapter 9, and based on the cumulative results of these, in conjunction with the insights provided by the site structure and function analysis, a model of chipped stone assemblage variability and mobility is proposed here. This model is best considered to be a hypothesis to be tested through future research, and as such, it provides a useful framework for many of the NRHP eligibility factors discussed later in this chapter. The model is essentially a proposed reconstruction of changes in mobility and chipped stone technology over time, as follows.

Chipped stone assemblages associated with Middle Archaic period occupations in the LBB area appear to represent debris from populations with a large annual range who were highly residentially mobile. Obsidian sourcing data indicate that they had access to sources from a large area. Raw material selection favored high quality Tosawihi chert and the production of bifaces, as might be expected for groups with high levels of mobility. However, the small but consistent use of Tosawihi chert for core-flake reduction suggests that there was some expectation that the Tosawihi Quarries would be encountered fairly regularly, creating less of a need to ensure that the material was used perfectly efficiently. Middle Archaic period populations also supplemented their supply of Tosawihi chert with other more widely available, but lower quality, cherts and chalcedonys, but they predominantly utilized these materials for core-flake reduction. Overall, the data from the Middle Archaic period fit expectations for residential foragers who moved from resource area to resource area within a generally large annual range.

During the Maggie Creek phase, chipped stone assemblages, and undoubtedly the underlying mobility and economic strategies, changed radically. Data from obsidian sourcing indicates that the number and distance of sources dropped precipitously in this period, with only a small amount of obsidian present and nearly all of it from a single source, Paradise Valley. This alone suggests a great reduction in range size. Furthermore, use of non-Tosawihi materials such as Elko Hills/South Fork chert and other types increased, also suggesting a constriction in annual range requiring greater reliance on local materials. Mobility, however, appears to have remained high. This period shows an increase in reliance on bifacial manufacture relative to the Middle Archaic, and increased levels of biface staging at the Tosawihi Quarries. Both of these factors suggest that planning for frequent moves and time away from the Tosawihi Quarries affected the overall assemblages. Most strikingly, high quality Tosawihi chert and lower quality materials were all reduced in nearly the same manner during the Maggie Creek phase, emphasizing bifacial manufacture. Combined with evidence from the debitage assemblage suggesting some small use of core-flake technologies, these data suggest that populations planned their tool assemblages carefully, expecting to be away from any raw material for extended periods and utilizing bifaces to ensure that their tool kit would be as reliable as possible. Overall, these data suggest populations that remained highly residentially mobile but within a greatly reduced range.

It appears that mobility patterns changed again during the Eagle Rock phase. Evidence of obsidian procurement indicates that the overall foraging range was the greatest during this period. The average distance to represented obsidian sources is the greatest of any period, and the overall diversity of sources is also the highest, suggesting that populations were ranging very extensively. Like all periods, people relied primarily on bifaces, but an increased investment in producing later-stage bifaces at the quarry indicates that populations either expected to travel long distances or to be away from the quarry for long periods of time. Notably, the Eagle Rock phase has evidence for the greatest degree of reliance on Tosawihi chert of any time period, suggesting that it was preferentially obtained. This latter pattern is perhaps the most difficult to explain. Given the evidently extensive foraging range of Eagle Rock phase populations, the overall reliance on Tosawihi chert is slightly unexpected, because it should have been possible to reach other sources of high quality materials more easily. It may be that Eagle Rock phase occupations in the LBB area reflect a much more specialized type of occupation, such that this area was perhaps used during this period only as a stopping point after chert was obtained at the Tosawihi Quarries. Overall, the chipped stone evidence suggests populations with a very high annual range and high levels of mobility. This mobility may have been either residential or logistical or some combination of the two during different times of the year.

The increased investment in ground stone milling implements that appears to have occurred during the Eagle Rock phase may present contradictory evidence regarding mobility during this period. As was discussed in Chapter 7, an increase during the Eagle Rock phase in the degree to which milling stones were formally shaped has been interpreted as reflecting both increased investment in technology associated with low-return food resources, and decreased mobility leading to greater use of "curated" technologies. However, because the majority of LBB area milling stone assemblage from all time periods represents a largely expedient technology (despite relatively marginal changes in proportions of "curated" milling tools among periods), and because patterns in ground stone data so strongly co-vary with patterns in other lines of evidence that independently indicate changes in the importance of low-return resources, it may be more likely that investment in ground stone technology is telling us more about subsistence, per se, than about mobility, and that the chipped stone tool data just discussed provide more useful indicators of the various components of mobility.

Of perhaps greater import are the remarkable parallels that occur between the subsistence-related data discussed in Chapter 7, on the one hand, and the chipped stone data discussed in Chapter 9, on the other. Simply put, the Maggie Creek phase stands out in relation to both the previous Middle Archaic period and the following Eagle Rock phase in exhibiting evidence for higher foraging efficiency and correspondingly narrower diets, as well as evidence for a greatly reduced overall range size. It was argued in Chapter 7 that the explanation for the patterns in foraging efficiency and diet breadth that currently seems best supported is that favorable climatic conditions for artiodactyl prey during the period of time that corresponds to the Maggie Creek phase enabled higher foraging efficiency for human predators, which, in turn, predictably led to relatively narrow diet breadth, as well as associated changes in subsistence-related technologies such as ground stone tools and projectile points. The reduced foraging ranges that people evidently traversed during the Maggie Creek phase may also be predictably related to climatic variability in one of several ways.

First, it is possible that, if human population densities throughout the Upper Humboldt region were highest during the Maggie Creek phase—something that may have resulted, at least in part, from the higher effective precipitation that characterized this span of time (e.g., Grayson 2000, 2006)—then foraging ranges may have been somewhat constricted due to "demographic packing" (e.g., Binford 2001). Such a constraint might also account for the somewhat limited use of the Tosawihi Quarries that appears to have occurred during the Maggie Creek phase relative to other periods, which is evidenced by higher proportions of non-Tosawihi cherts and chalcedonies during this time, as well as for the use of bifacial reduction for those non-Tosawihi materials, which suggests that people expected to have limited access to all toolstone sources for extended periods. It is presently difficult to evaluate this hypothesis, however, because, as has been discussed elsewhere in this document, measures of changes in human population density in the LBB area are ambiguous at best.

Another hypothesis is that climatic variability resulted in changes in the costs and benefits of residential mobility. Specifically, Kelly (1995:132–148) has developed a model of foraging and mobility that shows that, as the foraging returns that an individual can obtain at his or her current residential location decline, the more economical it becomes to move to another location. At a landscape level, this translates into the prediction that, as average returns across an environment decline, the frequency of residential moves is likely to increase (Kelly 1995:135). Thus, from this perspective, the higher foraging returns that hunter-gatherers in the LBB area were evidently able to obtain during the Maggie Creek phase—most likely, again, due to favorable climatic conditions—would be expected to result in less frequent residential moves. Though reduced frequency of residential moves is, as was discussed in Chapter 9, an aspect of mobility that is distinct from reduced range size—the specific variable that is directly indicated by the lithic data in question—it may have resulted in reduced range size if the average distance per move did not change appreciably: fewer moves of the same distance per year would lead to less distance being covered each year.

To be sure, these attempts at developing comprehensive hypotheses that might account for the full suite of changes observered over time in the LBB area archaeological record—or at least a substantial portion of those changes—are only preliminary, and they are presented here as no more than such. Because the purpose of this document is to delineate areas for future research, we conclude here simply by noting that testing possible "big picture" explanations for major adaptive shifts in LBB area prehistory such as these would be a very worthwhile goal for the next generation of archaeological research in the region.

10.2. Geographic Representativeness of the Current Excavated Site Sample

As we have noted elsewhere in this document, the LBB area sites that have been excavated to date cannot be considered to be a random sample of all sites in the area. Archaeological sites have been selected for excavation based largely on planned mine developments rather than on a primarily research-driven agenda. Consequently, although quite a few sites have been excavated, they do not necessarily represent a sample that is representative of all possible settings. Therefore, to fully evaluate any of the new research questions that have been developed in this revised context, and to ensure that sites are not ignored or missed that might provide new information simply because they are located in under-investigated or uninvestigated localities, it is worth examining the range of sites that have so far been investigated to determine if there are any environmental settings that should receive additional attention in the future.

Two main factors are worth examining: site elevation and site setting. The LBB itself is small and relatively homogenous in terms of its overall environment. At about 8–10 km in maximum dimension, with most sites located within 5 km of each other, there is little dramatic environmental change across the area. However, there are differences in elevation as the basin rises to nearby ranges, and there are also variations in site setting. Numerous small creeks cross the area, and the landscape is composed of ridges, terraces, floodplains, and other micro-environments. A careful examination of the location of excavated, single-component occupations by time period, elevation, and setting is worth close examination. This study also reveals discrepancies in excavated sites of particular time periods.

Although excavation has occurred across a wide range of elevations and settings in the LBB area, the identification and excavation of single-component occupations is not as widely spread across the landscape. As noted in Chapter 5, all of our counts of single-component occupations are based on a revised and conservative analysis of excavated sites and activity areas. The excavated single-component occupations can be grouped into three categories based on arbitrary elevation zones within the LBB area: sites below 1,600 m (5,249 feet) above sea level (asl), sites between 1,601 and 1,700 m (5,250–5,577 feet) asl, and sites above 1,701 m (5,578 feet) asl. The area below 1,600 m asl generally corresponds to the lower reaches of Bell and Rodeo creeks and below the confluence of these creeks. The area above 1,701 m asl consists of areas in foothills and ridges at the margins of the LBB area. Excavated single-component occupations are, notably, concentrated in between these two extremes (Table 76).

Table 76. Frequency of Excavated Single-component Occupations by Time Period and Elevation

	Elevation (meters above sea level)			
Time Period	**< 1,600**	**1,601–1,700**	**>1,701**	**Total**
Eagle Rock Phase	2	10	7	19
Maggie Creek Phase	0	5	0	5
Middle Archaic Period	0	3	6	9
Total	2	18	13	33

The (unintended) concentration of excavated single-component occupations between 1,601 and 1,700 m asl indicates that there is a need for additional excavated components at lower and higher elevations. Lower elevations (< 1,600 m asl) are particularly under represented, with only two Eagle Rock phase components from these elevations. Maggie Creek phase occupations from either lower or upper elevations are needed as well, as all Maggie Creek phase components investigated to date have lain between 1,601 and 1,700 m asl. Interestingly, Middle Archaic period occupations are fairly well represented from above 1,701 m asl, but poorly represented or absent below 1,700 m asl. Based on these data, it appears that there is a need for additional excavated components of any age from below 1,600 m asl, for Maggie Creek phase components from below 1,600 m asl or above 1,701 m asl, and for Middle Archaic period occupations from below 1,701 m asl.

General site setting is also relevant. Site setting has been characterized by researchers in a variety of ways, but there are essentially five general settings in the LBB area. These are terraces, land form "tops" (e.g., ridge, knoll, saddle), slopes, floodplains, and spring or near spring ("spring satellite") sites. Sites have also been identified that straddle a number of these settings. Excavated single-component occupations are also unevenly distributed across these settings (Table 77).

Table 77. Frequency of Excavated Single-component Occupations by Time Period and Geographic Setting

	Setting						
Time Period	**Terrace**	**Ridge, Knoll, Saddle**	**Slope**	**Floodplain**	**Spring/Near Spring**	**Crossing settings**	**Total**
Eagle Rock Phase	2	4	6	1	0	6	19
Maggie Creek Phase	0	2	2	0	0	1	5
Middle Archaic Period	0	1	2	0	5	1	9
Total	2	7	10	1	5	8	33

It is clear that there are a number of under-investigated areas in general, along with time periods having underrepresentations of particular settings. Few sites on terraces appear to have been investigated. However, the majority of sites identified as "crossing settings" include terraces within their setting. Thus, this discrepancy appears most stark for the Maggie Creek phase and Middle Archaic period. Floodplain sites are underrepresented for all time periods, with only a single Eagle Rock phase example investigated. Spring and near spring sites appear to have been only associated with excavated Middle Archaic period components, thus Eagle Rock phase or Maggie Creek phase sites near springs would be worth additional investigation. The overall small numbers of Maggie Creek phase and Middle Archaic period occupations also result in underrepresentations of sites in particular settings. Middle Archaic period occupations are overwhelmingly represented by sites at or near springs. Maggie Creek phase occupations are predominantly located on ridge or knoll locations, with few sites investigated at other localities. Overall, it appears that single-component occupations from floodplains, Eagle Rock or Maggie Creek phase occupations at or near springs, Maggie Creek phase occupations on terraces, or Middle Archaic period occupations away from springs merit consideration for further investigation.

As is very clear from the total columns on these tables, certain time periods are also, in general, underrepresented. Maggie Creek phase and Middle Archaic period single-component occupations are few in number and generally concentrated in a few spots, reflecting their identification and excavation in those spots more than any necessary preference for occupation in these localities in the past. Only the Eagle Rock phase has a robust sample, reflecting the possibility that occupation of the LBB area was most intense during this phase. Thus, in many ways, any clear Middle Archaic period occupation merits further investigation. Maggie Creek phase occupations from most locations other than ridge or knoll or saddle settings also appear to merit further investigation, as well as sites of this time period from elevations other than between 1,600 and 1,700 m asl. Eagle Rock phase components, however, are generally well represented across settings, with only occupations from floodplains, near springs, or under 1,600 m asl underrepresented. Of course, these are only broad parameters for evaluating sites. If other research questions can be answered by a site or site locus, as will be discussed below, there may be other reasons to consider a site or component useful for research purposes.

10.3. Research Questions and Data Needs

As was discussed in Chapter 3, research topics for prehistoric sites in the LBB area can be usefully grouped into five research domains, building on the formulation presented in the original 1991 historic context for the area. These are: 1) chronology and the "multicomponent" problem, 2) site formation processes and paleoenvironment, 3) subsistence, 4) site structure and function, and 5) lithic source use, technology, and mobility. In previous chapters, we have examined and updated past research within these domains and have identified new research questions, priorities, and data needs as a result. In this section, we summarize these, with a focus on identifying additional data needs for future research in the LBB area.

Notably, although we have taken a comprehensive approach in identifying research questions, not all of these questions can be addressed with data from the LBB area. For example, for certain research questions involving use of the Tosawihi Quarries, we now need information from sites at the quarries themselves and at different distances from them, rather than from additional sites within the LBB area. Additionally, existing data already collected in the LBB area but not yet fully analyzed may be able to address some research questions. For example, while we have developed a new model of mobility for the region, we could test this model further using data from the LBB area that exist but are unpublished, particularly lithic data from sites for which those data are reported only at the site level rather than at the site locus or activity area level.

10.3.1. Chronology and the "Multicomponent" Problem

Issues related to chronology and the "multicomponent" problem are analyzed in Chapter 5. Though not phrased as research questions there, research priorities for the future are identified. From those priorities, the following set of questions can be developed:

- Do inferences about the chronology of occupation at specific sites or site loci change when projectile points are re-classified using a consistent, explicit, and well-thought out typological system? What new information about temporal and/or functional relationships among point types emerges from such an analysis?
- How might the Paradise Valley obsidian hydration chronology for the LBB area change with the addition of data from a larger sample of projectile points? Can hydration measurements discriminate among the phases of the Middle Archaic with larger samples?
- Are ceramics in the LBB area truly diagnostic of the Eagle Rock phase? Are earlier ceramics, particularly Fremont or Fremont-age ceramics present in the area?
- Can we continue to improve our ability to identify single-component occupations?

Data needs for addressing these research questions are as follows. Re-classification of projectile points and evaluation of projectile point typology will require analysis of existing collections of projectile points from the LBB area, in addition to any new projectile point assemblages that may be recovered in the future. Documented associations between projectile points and other datable materials, as well as obsidian projectile points that can be submitted for hydration analysis, will also be critical. In order to further refine the Paradise Valley obsidian hydration chronology for the LBB area, currently based on a sample of only 25 projectile points, hydration analysis of additional projectile points is likewise necessary. In fact, it would be worthwhile to conduct sourcing and hydration analysis on all obsidian projectile points from the area that are identifiable to type, including those from existing collections that have not yet been analyzed and any that are found during future work in the area. Hydration analysis of the as-of-yet unanalyzed Paradise Valley obsidian specimens from James Creek Shelter would likely also help refine the regional hydration chronology.

A more general need related to radiocarbon dating is that, to the extent that it is possible to do so, radiocarbon dates should be obtained in the future from animal bones or, even better, seeds or annual plant remains. If seeds, annual plant remains, or animal bones are not available, then it is advisable to submit multiple, separate charcoal samples for dating so that the consistency of dates, at least, can be evaluated.

Additional analysis of ceramics is also sorely needed. Ceramics from the LBB area are only loosely associated with the Eagle Rock phase based primarily on typological grounds, and they are frequently not reported in a manner than enables associations with dated features to be evaluated. Further evaluation of the age of pottery from the area, through thermoluminescence dating, in particular, would improve the utility of ceramics as chronological indicators and would also advance our understanding of the use of pottery in the region. It should be noted that data that have already been recovered could likely be used to address this research question to a large degree, because sherds in existing collections may be suitable for luminescence dating. Going forward, every reasonable effort should be made to recover and date ceramics from LBB area sites.

In terms of better identifying single-component occupations and increasing our overall understanding of chronology, there is a great need for single-component occupations dating prior to the Eagle Rock phase. There is uneven coverage of time periods in the available sample of single-component sites or site loci from the LBB area. A reasonably large sample of excavated single-component Eagle Rock phase assemblages exists from the area, but earlier periods are very underrepresented, limiting our ability to explore change over time. There is thus a clear need for the identification and excavation of additional single-component deposits that date to the Maggie Creek and earlier phases in future work. To identify those pre–Eagle Rock phase single-component deposits that will likely best advance our understanding of the prehistory of the LBB area, efforts should focus on locating deposits that appear likely to be able to provide abundant dating information so that their occupational history can be adequately evaluated. Deposits with sparse artifact assemblages and deposits that lack subsurface archaeological features are unlikely to be able to provide such information. The presence of ground stone artifacts and occurrence in upland settings on soils of the Chen-Pie Creek-Ramires association appear to be useful indicators of whether features are present at pre–Eagle Rock phase sites and site loci.

Conversely, it would appear that a sufficient number of multicomponent sites have already been excavated and that anything that can be learned from such sites can be learned from those already excavated. Likewise, it may be the case that a sufficient number of single-component Eagle Rock phase assemblages have been recovered, and that excavation of additional single-component Eagle Rock phase sites or site loci is warranted only when they appear to be able to provide unique information not already available from existing assemblages.

10.3.2. Site Formation Processes and Paleoenvironment

The research domain covering site formation processes and paleoenvironments was examined in Chapter 6. This examination resulted in the identification of a variety of remaining research questions and data needs. The questions are:

- Does the LBB area have unique paleoenvironmental characteristics that might help us better understand the prehistory of the area?
- What techniques and factors would increase the utility of geophysical remote sensing for finding sites and features?
- Are deeply buried sites located along the floodplain of Rodeo Creek or in other floodplain settings?
- How have the shallow archaeological deposits that characterize the LBB area been affected by modern activities such as drill seeding?

Major data needs relate to three main sub-domains: paleoenvironment, geophysical remote sensing, and floodplain geoarchaeology.

Because virtually no paleoenvironmental data have been collected from the LBB area, almost any such data that are collected during the foreseeable future would advance our understanding of past environments in the area. Sources of paleoenvironmental data that have proven useful in other Great Basin contexts, and that may be available in the LBB or the immediately surrounding area, include packrat middens, spring or other wetland sediments (which can provide charcoal and pollen samples), and paleontological animal bone assemblages.

As discussed elsewhere (Cannon et al. 2008), additional steps must be taken before geophysical data can truly be of use in archaeological research and cultural resource management in the area. In particular, a robust test case involving a site or sites where archaeological features are known to be present or are likely to be present should be conducted to evaluate what geophysical signature, if any, archaeological features of various types have in the area. Experimental replication of archaeological features and burial in sediments of the sort found in the area might also suffice for this purpose. Research along these lines should also involve further experimentation with survey parameters such as instrument height and orientation. Finally, geoarchaeological research should be conducted in direct connection with geophysical surveys to determine what geological factors are responsible for the most obvious patterns that occur in remote sensing data from the area.

Deep testing, likely through backhoe trenching or coring, should be conducted in a systematic manner at least along the floodplain of Rodeo Creek between Brush and Bell creeks, the one area that appears to have the greatest potential for containing middle Holocene or earlier buried archaeological material and/or stratified archaeological deposits of any age. It may also be useful to conduct such deep testing in other floodplain areas in and around the LBB. Given the extensive excavation that has occurred throughout the area, a sufficient amount of deep testing in floodplain settings should once and for all resolve the questions of whether early archaeological materials are present in buried contexts and whether stratified, single-component occupations are likely to be present.

10.3.3. Subsistence

Subsistence-related issues were analyzed in Chapter 7. This led to a large number of research questions with associated data needs:

- With larger sample sizes, are there statistically significant differences in vertebrate taxonomic richness among time periods?
- Are changes in mean utility or some other economic measure related to artiodactyl body part representation consistent with the evidence for variability in foraging efficiency that is provided by artiodactyl taxonomic relative abundance?

- Do patterns in artiodactyl age structure suggest that hunters experienced resource depression?
- Did the intensity of bone processing increase when other lines of evidence suggest that foraging efficiency declined?
- Is there spatial variability in faunal assemblages within the LBB area that is understandable in terms of the geographic distribution of different types of resources and/or different functional site types?
- Are there statistically significant differences in plant taxonomic richness among time periods?
- Is there spatial variability in macrobotanical assemblages within the LBB area that is understandable in terms of the geographic distribution of different types of resources and/or different functional site types?
- What do patterns in floral and faunal data suggest about settlement patterns in light of the division of labor model presented by Zeanah (2004)?
- With larger sample sizes, does the degree of investment in milling technology exhibit temporal patterns that are consistent, in light of the tech investment model, with those observed in faunal and floral data? How about when mano length is considered (e.g., Hard et al. 1996) in addition to degree of shaping?
- Why are the majority of the ground stone milling tools from the LBB area relatively informally shaped ("expedient"), even from time periods when other lines of evidence suggest that the amount of time spent using them was relatively high?
- Are there differences in the functional types of ground stone tools present in Middle Archaic, Maggie Creek, and Eagle Rock occupations? What do the types of ground stone tools recovered indicate about the activities performed during these occupations?
- Are ground stone artifacts, ceramics, and thermal features all truly typically located in close spatial proximity to each other?
- When do ceramics first appear in the archaeological record in the LBB? Are ceramics present in Maggie Creek (pre–A.D. 1300) occupations, and, if so, what is their relationship to "Fremont" ceramics that are present elsewhere in northeastern Nevada (e.g., Hockett and Morgenstein 2003)?
- Does investment in ceramic technology change over time? Are grayware ceramics truly present at LBB sites?
- Within the LBB area as a whole, where were clay sources available prehistorically, and how does the distribution of sites with ceramic artifacts relate to the distribution of those sources?
- How does the distribution of sites with ceramics within the LBB area inform on settlement patterns in light of the division of labor model presented by Zeanah (2004)?
- What types of food resources were processed in thermal features? Do associations exist between specific feature types and specific resource types? Are there temporal or spatial patterns in the types of resources processed in thermal features?
- Are there ways in which thermal features used for heat treating lithic materials can be distinguished from those used for processing food resources?
- Are there associations between fire-cracked rock attributes and independent indicators of mobility/occupational duration?

- What caused the changes over time in subsistence-related aspects of the archaeological record that are evident in the LBB area? Were changes in mobility and settlement patterns that are evidenced by chipped stone data part of broader, associated adaptive shifts?
- How do such changes, particularly those that occur around A.D. 1300, relate to the postulated spread of Numic-speaking peoples into the LBB?
- Is there evidence for contemporaneous subsistence-related changes in portions of the Great Basin adjacent to the LBB area or elsewhere?

Approximately two decades of research at the sites in the LBB area has resulted in a sufficiently large data set to begin developing and testing models of subsistence change through time. However, the poor preservation of some materials and difficulty in separating occupations at multi-component sites has led to a smaller data set than would be desirable. There are, therefore, a number of data needs for addressing subsistence research questions in the LBB area. These needs can be met by focusing on the following:

- Any pre–Eagle Rock, dated, single-component deposits containing faunal remains, macrobotanical remains, ground stone, and/or thermal features. The majority of the sites excavated thus far in the LBB area are either not well dated or represent multiple occupations from different time periods. Many of the subsistence research questions outlined above require sufficient data from single-component contexts, particularly those from time periods prior to the Eagle Rock phase, to draw conclusions regarding changes in subsistence practices through time.
- Any deposits of any age containing ceramics. As discussed above (Section 10.3.1), recovering and securely dating ceramics from the area should be a high priority for future research.

10.3.4. Site Structure and Function

Questions regarding site structure and function are posed and examined in Chapter 8. Remaining research questions in this domain can be addressed with a variety of data, from both within and outside of the LBB area.

- Is there a bipartite site type distribution in the Middle Archaic period characterized by small generalized camps and specialized plant and animal processing sites? Or, are more site types present?
- Are there any larger, multi-family group occupations during the Middle Archaic period or are all sites with multiple features simply sites that have been reoccupied repeatedly during the Middle Archaic?
- Is there a bipartite site type distribution in the Maggie Creek phase characterized by small generalized camps and specialized hunting and animal processing sites? Or, are more or fewer site types present?
- Is there a tripartite site distribution in the Eagle Rock phase characterized by small generalized camps, specialized hunting and tool production/repair camps, and specialized botanical and faunal processing sites? Or, are more or fewer site types present?
- Are there any larger, multi-family group occupations during the Eagle Rock phase?
- Are site types and inter-site differentiation greater prior to the Eagle Rock phase with less inter-site variability during the Eagle Rock phase?
- Are food processing sites consistently restricted to particular portions of the landscape?

Notably, for many of these research questions, data are now needed from outside the LBB area. The area was clearly populated by hunters and gatherers with a wide annual range during nearly all time periods (see Chapter 9). Sites in the LBB area represent only a portion of the overall settlement pattern and strategy for these populations. For the Eagle Rock phase in particular, for which we now have a large body of single-component sites, additional data from the LBB area should focus on any sites that are dramatically different from those already known. This would entail any sites with evidence or high potential for structures, any sites with an artifact density greater than 5,000 per cubic meter (which would indeed be extreme on the surface), and any sites that appear to represent something other than a site where chipped stone tools were repaired or produced and general camp activities occurred. Eagle Rock phase sites with more than three pieces of ground stone, and therefore potentially representing food processing sites (none so far have exhibited this amount of ground stone) may meet this criterion as well. For other phases, however, additional sites can help to test the model considerably, as the number of sites present is low and our confidence in the typology for these periods is very tentative.

10.3.5. Lithic Source Use, Technology, and Mobility Patterns

Research questions involving lithic technology are addressed in Chapter 9. The analyses presented there indicated that, though much progress has been made, a variety of unanswered research questions remain. As above, not all of these can be addressed with data from the LBB area, and some may be addressed with existing data.

- Are there differences in chipped stone assemblages between South Fork and James Creek phase occupations?
- Do all Middle Archaic period occupations represent generalized mobile foragers or are there different functional site types beyond sites focusing on a particular local resource? Are there any Middle Archaic period occupations that represent true extractive sites or logistical exploitation sites?
- Are all Middle Archaic period occupations relatively short-term or is there evidence of longer term occupations?
- What is the annual range size during the Maggie Creek phase?
- What causes the change in mobility and range size during the Maggie Creek phase? Environmental change? Population increase?
- Do all Maggie Creek phase occupations represent generalized mobile foragers or are there different functional site types beyond sites focusing on a particular local resource? Are there any Maggie Creek phase occupations that represent true extractive sites or logistical exploitation sites?
- What is the length of occupation for Maggie Creek phase sites?
- Do all Maggie Creek phase sites have chipped stone assemblages with no significant variation between use of Tosawihi Chert and non-Tosawihi Chert? In particular, is the observed pattern a result of having excavated Maggie Creek phase sites in similar settings or does the pattern hold regardless of site setting?
- Is there evidence of logistical foraging during the Eagle Rock phase? Do any sites indicate clear evidence of specialized collecting?
- Are there significant functional differences between site types during the Eagle Rock phase? Are there, for example, base or residential camps, possibly along major rivers and streams, as noted for the historical Shoshone inhabitants of the region?

- Does the Shoshone pattern of occupation develop early or late in the region? Is this pattern a result of Euroamerican contact and possibly depopulation due to disease?
- Does the LBB area represent a specialized locale during the Eagle Rock phase, perhaps as a place for quarry supply parties to stop on their return from the Tosawihi Quarries? Notably, addressing this question requires data from outside the LBB area. Large numbers of Eagle Rock phase occupations already excavated in the LBB area provide evidence of occupation within the LBB area during the Eagle Rock phase. To answer the question, we need to compare non-LBB area Eagle Rock phase sites with Eagle Rock phase sites in the LBB area to determine if there is any difference in chipped stone assemblages or other data.

Data needs related to the above questions include:

- Any sites with high probability of Middle Archaic (South Fork and James Creek) occupations. We have few excavated sites or components from these phases and our model is fairly general for this time. Any clear South Fork or James Creek phase occupations (rather than generalized Middle Archaic occupations), will merit further field investigation.
- Any Maggie Creek phase sites that appear significantly different from previously excavated sites in the area. Key identifiers would be: evidence of differential use of Tosawihi Chert and non-Tosawihi Chert; locations in settings significantly different from excavated LBB area Maggie Creek phase sites; and evidence of specialization in activities.
- Sites of any phase with high potential to provide data on use of raw materials other than Tosawihi Chert. Such sites would be identified by having high proportions of chert types other than Tosawihi, or high proportions of obsidian.

10.4. Proposed New Eligibility Factors

Based on the above research questions and data needs it is possible to summarize the types of data that would be need to be present, or be highly likely to be present, to enable a site in the LBB area to address research questions and thus be eligible for the NRHP under Criterion D. Although many questions are posed above, in many cases the questions would likley best be answered using either existing data from previously excavated sites or data from outside the LBB area. For an unexcavated site within the LBB area to be able to provide data applicable to any of the research questions listed above, it must have specific characteristics, referred to here as "eligibility factors". These eligibility factors are described next.

As discussed in this report, and nearly all later excavation reports for the region, the first criterion is that a site should have, or be likely to have, a datable single-component occupation. Undated occupations or multicomponent occupations have been shown to be of limited interpretive potential in the area. Following the identification of such components, a number of types of sites will clearly be able to address research questions. These include:

- Any single-component occupation below 1,600 masl
- Any Middle Archaic period (South Fork, James Creek, or both) occupation below 1,701 masl
- Any single-component occupations from floodplains
- Any Eagle Rock occupations at or near springs
- Sites with paleoenvironmental data. These would include sites with packrat middens, spring or other wetland sediments (which can provide charcoal and pollen samples), and paleontological animal bone assemblages.

- Sites with high potential to serve as a test case for refining geophysical remote sensing. Such a robust test case would involve a site or sites with as many as possible of the following characteristics:
    - archaeological features or direct indications of features such as fire-cracked rock are known to be present
    - artifacts often associated with archaeological features, particularly ceramics and ground stone, are present
    - surface sediments are such that they will result in minimal background noise and "false positives" (particularly, they consist of relatively deep deposits of sands or finer sediments; sites with bedrock at or near the surface and sites in rocky alluvial terrace settings are known to be problematic)
- Any site along the floodplain of Rodeo Creek between Brush and Bell creeks, or in other suitable floodplain locations, should be considered for deep testing, particularly if the site setting is conducive to resolving the question of whether deeply buried sites are present in this locale.
- Any site at which there are indications of stratigraphically separated occupations. Such sites are currently unknown in the LBB area, but any that might be identified would have a much better chance of containing single-component occupations than the typical LBB area site.
- Any sites with high probability of Middle Archaic (South Fork and James Creek) occupations. We have few excavated sites or components from these phases and our model is fairly general for this time. Any clear South Fork or James Creek phase occupations (rather than generalized Middle Archaic occupations), will merit further field investigation.
- Additional single-component Maggie Creek phase sites are needed. The sample size for this period is so low that any site, not simply sites located in places described above, is needed.
- Sites of any phase with high potential to provide data on the use of raw materials other than Tosawihi Chert. Such sites would be identified by having high proportions of chert types other than Tosawihi, or high proportions of obsidian.
- Any pre–Eagle Rock phase, dated, single-component occupations containing faunal remains, macrobotanical remains, ground stone, ceramics, and/or thermal features that represent a single datable component.
- Any sites with evidence of pottery manufacture, especially sites with high quantities of pottery and a high probability of having datable features.
- Sites with a high potential to yield information regarding the proximity of ground stone, ceramics, and thermal features. Such sites would be identified by the presence of ground stone or ceramics along with any other characteristics indicating a high probability of features.
- Any Eagle Rock phase site that appears significantly different from the other sites excavated thus far. In this case, that would entail any sites with evidence or high potential for structures, any sites with an artifact density greater than 5,000 per cubic meter (which would indeed be extreme on the surface), and any sites that appear to represent something other than a site where chipped stone tools were repaired or produced and general camp activities occurred. Eagle Rock phase sites with more than three pieces of ground stone (none so far have exhibited this amount of ground stone) may meet this criterion as well.

To clarify how new research questions and the above list of eligibility factors might be used in the future to evaluate or reevaluate the eligibility of LBB area archaeological sites for the NRHP under Criterion D, a flow chart illustrating a proposed decision-making process is presented in Figure 46. In the first instance, multicomponent sites or occupation areas, which to date have composed a large majority of all excavated sites and occupation areas, should no longer be considered NRHP-eligible due to their limited ability to provide data that are useful for exploring change over time. Furthermore, only specific types of Eagle Rock phase sites or components (those located at or near a spring, with high quantities of pottery, with evidence of structures, with more than three pieces of ground stone, or with more than 5,000 artifacts per cubic meter) should be considered NRHP-eligible due to the large number of Eagle Rock phase components that have been excavated to date. Remaining sites should have a high potential for single-component Maggie Creek phase or Middle Archaic occupations, be located in a specific setting, or be able to provide very specific types of data to be considered NRHP-eligible.

10.4.1. Contributing and Non-Contributing Areas within Eligible Sites

As should be clear from the analyses presented throughout this document, most LBB area prehistoric sites are complicated in that they were repeatedly occupied over hundreds or thousands of years, resulting in a sitiation where multicomponent deposits may exist alongside "cleaner" single-component site loci. In addition, many sites are large and composed of multiple more or less discete concentrations of artifacts and, in some cases, features, and these various intra-site loci can vary greatly in their potential for providing data applicable to important research questions. Because of this, it is highly recommended that, in future NRHP eligibility evaluations or reevaluations, attention be paid to the research potential of individual concentrations or loci within sites. Eligibility determinations must be made at the level of the entire site, but each discrete locus within a site should be evaluated individually in terms of whether it contributes to the eligibility of the site as a whole. More specifically, individual artifact concentrations within sites should be evaluated against the eligibility factors described here, and if one or more concentrations exhibits significant research potential based upon those eligibility factors, then the site as a whole should be considered eligible for the NRHP, and the concentrations that exhibit that research potential should be considered to be components of the site that contribute to its eligibility. Concentrations that do not exhibit significant research potential based on the above eligibility factors should be considered to be non-contributing components, and if no concentrations at a site exhibit such research potential, the site as a whole should be considered not eligible for the NRHP. It may also be advisable for management purposes, in some circumstances, to define site boundaries such that artifact concentrations with and without research potential are grouped together into sites that are, respectively, eligible and not eligible.

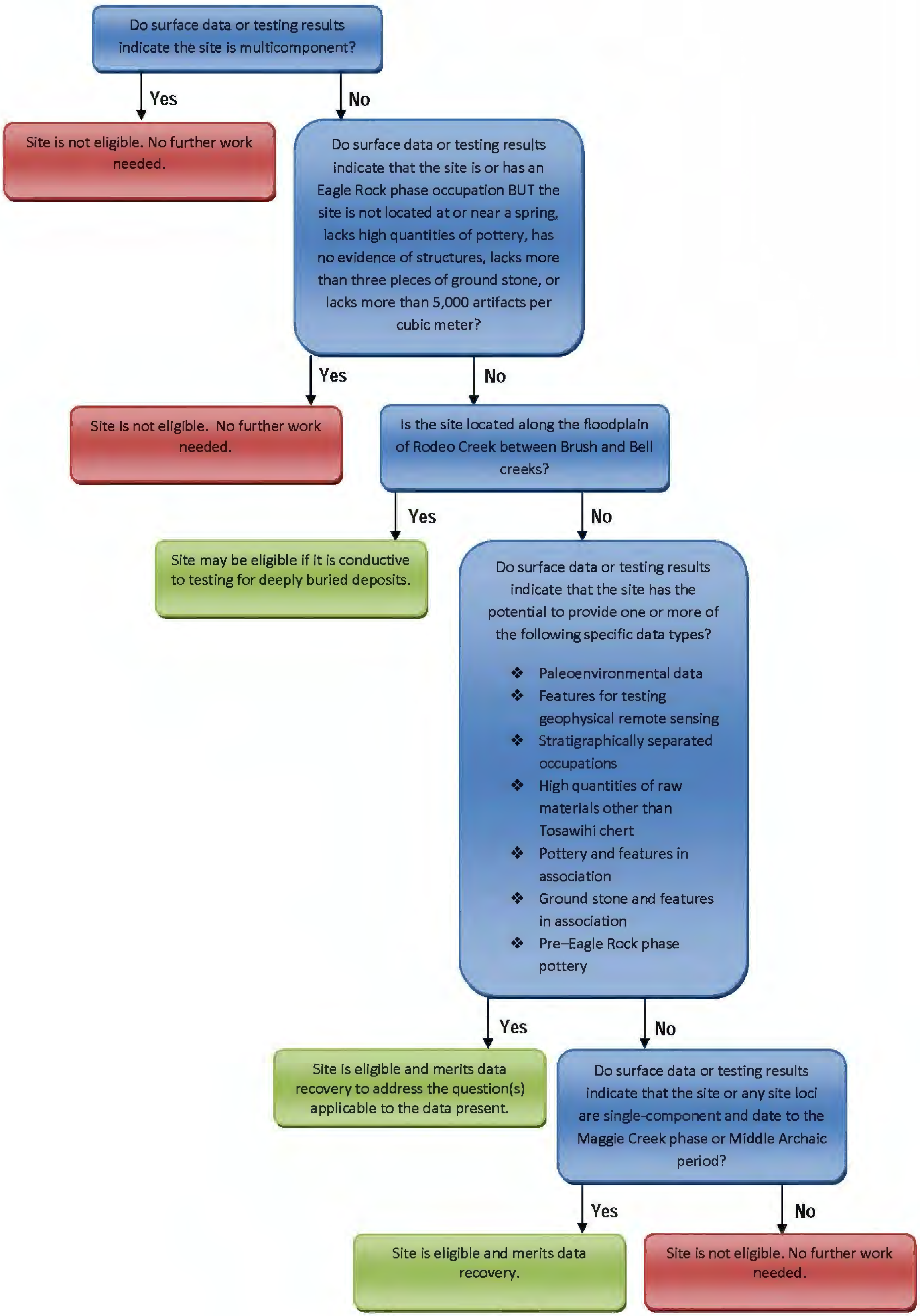

Figure 46. Proposed flow chart for evaluating the NRHP eligibility of prehistoric archaeological sites in the LBB area under Criterion D.

10.4.2. Multicomponent Sites or Site Loci

It has been argued throughout this document, and, indeed, throughout much of the history of archaeological research in the LBB area, that multicomponent sites have little research value because, for example, they do not lend themselves to diachronic analysis or to classification into functional types. There may, however, be certain basic questions that could be addressed using data that already exists from multicomponent sites or site loci, or that could be obtained with a minimal amount of effort. For instance, it may be possible to understand why some points on the landscape were occupied repeatedly and thus became multicomponent sites, whereas others weren't. This issue could likely be addressed by examining the geographic distribution of multicomponent sites with respect to topographic and environmental features, data that is readily available from site location maps in site recording forms. It is not argued here that sites that are clearly multicomponent (or sites at which all artifact concentrations or discrete loci are multicomponent) be considered eligible for the NRHP: because their potential for providing useful data will in most cases be exhausted once the information that is typically collected in site recording forms is captured, they cannot be said to have any remaining information potential that would make them continue to be eligible for the NRHP under Criterion D. However, if the opportunity arises to address research questions based on data already collected from sites or site loci that are clearly multicomponent, that opportunity should certainly be pursued.

10.5. Proposed Mitigation Strategies

It is the goal of BLM-Elko that this revised historic context document be used to reduce the number of archaeological sites that must be managed over the long term for avoidance by disturbing activities. To this end, sites may either have their NRHP eligibility evaluated or reevaluated based on the eligibility factors listed above, in which case sites determined to be not eligible for the NRHP would not require long term avoidance, or adverse effects to eligible sites may be mitigated. Regarding mitigation, all previous work in the LBB area has suggested that single-component archaeological deposits have the greatest research potential. This revised context supports that conclusion and provides greater detail on the specific characteristics that would give single-component deposits of various ages the highest research potential. However, given the uncertainties that will always be associated with identifying single-component deposits based upon surface evidence, any mitigation strategies that may be employed should be adjusted to account for the uncertainties so that the potential for realizing valuable returns is maximized. Specifically, mitigation strategies should be tailored to the degree of confidence that the site will yield data to address the research priorities and questions identified in this document.

10.5.1. Strategies for Sites with High Potential to Yield Data for New Research Questions

If a site unambiguously meets one or more of the criteria and data needs described in Section 10.3, and if adverse effects to that site can be resolved only through mitigation, full data recovery and reporting are recommended, with data recovery methods tailored to the characteristics of a site and the research questions it can address. For many sites, archaeological excavation may be the only way to mitigate the potential loss of data. For others, however, particularly those that appear based on testing or other evidence to have little depth, it may be possible to recover all data necessary to address applicable research questions simply through collection of surface artifacts. For still other sites, geophysical remote sensing might be a useful component of data recovery. Whatever the case, preparation of a treatment plan and research design, specifying research questions and an approach for addressing those questions, will be the first step in mitigating impacts to sites in this category, followed by fieldwork, analysis, and reporting.

As noted above (Section 10.4.1), many LBB area NRHP-eligible sites are likely to be composed of individual artifact concentrations or loci that vary in their research potential, or the degree to which they contribute to the site's eligibility. Obviously, data recovery efforts at such sites should focus on those discrete areas that appear to have the greatest potential to address research questions identified in the site treatment plan, with perhaps some limited testing in others areas perceived to have lower potential (see next section). Once a sufficient number of the concentrations that contribute to a site's eligibility have been thoroughly investigated, the BLM may determine that the site's data potential has been exhausted and that it is no longer eligible for the NRHP under Criterion D.

10.5.2. Strategies for Sites with Moderate to Low Potential to Yield Data for New Research Questions

The research potential of many sites is likely to be somewhat ambiguous when evaluated using surface data only. A site may have few or no projectile points on the surface to suggest a date. A site's surface may have some artifact classes that are associated with archaeological features, such as ground stone, but no other more direct indication that features are present. In such cases, it may be difficult to determine if the site meets one of the criteria in Section 10.3 on the basis of surface data alone. For these sites, it may be reasonable to treat them as being NRHP-eligible, but then, if the BLM determines that mitigation of effects is necessary, directed testing should be employed prior to the initiation of more extensive data recovery efforts in order to resolve uncertainties over the site's data potential. In such cases a treatment plan should be prepared beforehand identifying not only testing methods and locations, but also the research questions that the site might be expected to address. If testing reveals that the site does have potential to answer those research questions, efforts should be expanded to recover the data required to answer the proposed research questions. If testing indicates that it is unlikely that a site will be able to provide the necessary data, then no further work should be required, and a determination that the site is not (or is no longer) eligible for the NRHP should be made.

At some sites, geophysical remote sensing methods may be an appropriate component of a testing program (see discussion in Chapter 6). Such methods are most likely to be useful at sites that have the characteristics listed above in Section 10.4. In addition, it may be particularly valuable at sites where illicit artifact collecting has occurred, such that surface artifact distributions are of limited utility for indicating the locations of significant buried deposits, and at bigger sites, where it might be inordinately expensive to implement a research design of complete test excavation.

10.6. Other Management Considerations

10.6.1. Resolving Adverse Effects through Means Other than Mitigation

The regulations implementing Section 106 of the NHPA (36 CFR 800) describe three options for resolving adverse effects to historic properties: avoidance, minimization, and mitigation. So far, this chapter has considered resolving adverse effects only through mitigation, which, as was noted in Chapter 1, is typically done in the LBB area by conducting archaeological data recovery excavations. However, the focus on mitigation should not be taken to imply that other means of resolving adverse effects are foreclosed. Indeed, the Nevada BLM Cultural Resource Inventory General Guidelines and the Nevada BLM-SHPO Protocol Agreement both state that avoidance is the preferred way to resolve adverse effect situations.

10.6.2. Off-Site Mitigation and Supplemental Identification Methods

As has been noted periodically throughout this document, there are certain types of investigations that would undoubtedly greatly advance our understanding of the prehistory of the LBB area, but that are not typically feasible in compliance-oriented projects where the focus is usually on mitigating direct impacts to one or more specific, previously identified sites. These types of investigations include:

- Paleoenvironmental research, which requires data that are not usually available at LBB area archaeological sites (e.g., data that come from pollen cores, packrat middens, paleontological animal bone assemblages, deep stratigraphic profiles, etc.).

- Evaluation of the likelihood of finding deeply buried early sites, which may not correspond to the locations of sites identifiable from surface evidence.

- Collection of comparative data from areas adjacent to the LBB.

- Evaluation and improvement of geophysical methods for identifying buried archaeological deposits and features in the LBB area, which will require a level of "pure" research not typically incorporated into Section 106 mitigation projects.

There are various ways in which it might be possible to begin to include these types of investigations into cultural resource management efforts. One way would be to use them not as mitigation for direct effects, in which case data recovery excavations are usually conducted, but as mitigation for indirect or cumulative effects. If the BLM determines that it is necessary to mitigate cumulative or indirect effects in some case, any of the above types of investigations might be chosen, through consultation, as a means for doing so. There may also be instances in which the BLM determines that it is necessary to mitigate unanticipated direct effects for which no treatment plan was prepared before the fact (e.g., cases of accidental damage to sites), and any of the above types of investigations might again be chosen, through consultation, as an appropriate mitigation measure in those cases as well.

In addition to these types of "off-site" mitigation measures, which are focused on collecting information about LBB area prehistory, efforts to disseminate information about the area's past may in some cases also be appropriate off-site measures for mitigating cumulative, indirect, or unanticipated effects. Specifically, public outreach efforts could be undertaken involving the production of popular reports or websites that take the information gained from years of research in the LBB area and give it back to the general public. Public outreach could also include collaborative education efforts with local elementary and high schools and/or development of museum exhibits.

Mitigation might also be accomplished in some cases by setting aside specific areas or individual cultural resource sites for preservation. This would allow some sites to be held in trust for the future, when archaeological methods might be greatly advanced such that things could be learned that are out of reach today.

For one of the types of investigations listed above—testing for deeply buried sites—a second way to incorporate it into cultural resource management efforts would be to begin to use it during the identification (inventory) phase of the Section 106 process. For undertakings in locations where there is some potential for the presence of deeply buried sites—in the LBB area, floodplains and especially places where Mazama tephra is exposed in alluvial profiles—the BLM could require that deep testing be required as part of the inventory process. This testing could be accomplished through backhoe trenching, coring, or some other method of efficiently exposing deep stratigraphic profiles. Documenting the profiles revealed in this way could also provide important paleoenvironmental information and/or information on other aspects of site-formation processes. At least a sample of the sediments excavated in such efforts should be screened to look for artifacts or other cultural materials, and all work should be directed by a trained geoarchaeologist.

These off-site mitigation and supplemental identification measures are discussed here because they would certainly produce important data relevant to the prehistoric human occupation of the LBB area, but their inclusion does not imply a commitment on the part of BGMI or any other project proponent to undertake them. Determining whether or not any of these measures are appropriate in any specific case is something that should be done through the BLM's Section 106 consultation on a project-by-project basis. Ideally, the details of when and how such measures will be used will be described in Programmatic Agreements or Memoranda of Agreement that are reached pursuant to future Section 106 consultations.

10.6.3. Opportunities for Academic Research in the LBB Area

Another way in which the types of investigations listed in the previous section could be undertaken would be for archaeologists in the academic sector to take a more active role in working in the area. Many of the topics in that list—and, indeed, most of the research priorities and questions identified throughout this document—would provide excellent opportunities for student or faculty research projects. For example, the LBB area is ripe for the development of groundbreaking advances in the application of geophysical methods to hunter-gatherer sites with ephemeral features in a complex geological environment. The near complete lack of paleoenvironmental data from the area presents a similar opportunity for important contributions to be made. Greater involvement by academic archaeologists in the area would go a long way towards alleviating the fact that compliance-oriented investigations do not easily lend themselves to certain types of research. In addition, archaeological surveys conducted by academics are perhaps the best chance for expanding the current focus of research in the area to places outside of operating mines, thereby increasing the diversity of investigated environments and site types. Researchers in the academic sector who are interested in pursuing opportunities in the LBB area are encouraged to contact BLM-Elko archaeologists to discuss the possibilities.

10.6.4. Data Submission, Curation, and File Search Standards

The analyses conducted for this document have been hindered somewhat by the fact that, for some previous data recovery projects in the LBB area, raw data were not accessible. In light of this, based on consultation with BLM-Elko, the following recommendations are made here regarding data submission and curation standards to be followed in future cultural resource investigations:

- In general, the curation and reporting requirements and guidelines of the BLM Elko District Office, the BLM Nevada State Office, the Nevada SHPO, and the Nevada State Museum (the required repository for collections from BLM-administered lands in Nevada) should be followed. The relevant guidelines include, but are not limited to, BLM-Elko Cultural Resource Stipulations, the Nevada BLM Cultural Resource Inventory Guidelines, the Nevada BLM-SHPO State Protocol Agreement, Nevada SHPO Guidelines for Section 106 Submissions, Nevada State Museum Curation Guidelines, and the stipulations of any Programmatic Agreement or Memorandum of Agreement under which a project may be conducted.

- In addition, BLM-Elko requires that investigators consult with them to discuss data and collections submission requirements, on a project-by-project basis, prior to submittal.

- Copies of project data will generally need to be submitted to both the Nevada State Museum and BLM-Elko. Data should be submitted in both digital and hardcopy format, with details to be worked out during consultation with BLM-Elko. Submission of raw data (analysis and cataloging databases, etc.), in electronic format, is required to facilitate future research and to enable knowledge about LBB area archaeology to be built in a cumulative manner.

BLM-Elko also requests that the following guidelines be followed concerning use of data obtained from their files.

- Prior to initiating any cultural resource investigation (data recovery or inventory), site locations should be confirmed by examining records on file at BLM-Elko. Data obtained from other sources, such as the NVCRIS database maintained by the Nevada SHPO, should not be relied upon without verification against records held by BLM-Elko.

- Any cultural resource data that a BLM-permitted archaeologist obtains from BLM-Elko files must be treated with professionalism and not be distributed to any third party without prior consent from a BLM-Elko archaeologist.

Evaluating Existing Collections from the LBB Area

Because the whereabouts and condition of some data from previous investigations in the LBB area are unknown, future research in the LBB area would likely greatly benefit from a feasibility study into the usability of records from the region that may be housed at the Nevada State Museum or other repositories. It has been noted previously in this chapter that it may be possible to answer some current research questions for the area using data from previously excavated sites, but before this can be known for certain, it must be shown that the required data exist in a usable format and are available at an accessible curation facility. This is merely a statement of fact regarding the need for such work from a research perspective, and it does not imply a commitment on the part of BGMI or any other project proponent to undertake such an investigation. Ideally, such work would be undertaken by academic or student researchers who are located in close proximity to the Nevada State Museum and who are familiar with use of its holdings, as part of larger projects directed at answering research questions for the area using museum collections.

10.6.5. Updating This Research Context

As this document has shown, much has been learned about the prehistory of the LBB area over the last two to three decades of professional archaeological research in the region, and the important research questions for the area—the basis for evaluating the NRHP eligibility of sites under Criterion D—have changed over time accordingly. It can only be expected that, as investigations continue, research questions that are a high priority as of 2010 will be answered and new ones will arise. To ensure that future NRHP eligibility evaluations or re-evaluations can be made based on up-to-date research priorities, this context should periodically be revised by (1) determining which previously identified research needs have been met and (2) by posing new research questions that build upon the results of the latest research. Based on consultation with BLM-Elko, the following recommendations are made here regarding the timing of such revisions:

- *Future Data Recovery Reports:* Once BLM-Elko adopts this research context for use in the LBB area, archaeological data recovery treatment plans should incorporate the priorities and research questions identified within it, and excavation reports should attempt to provide answers to those research questions. Excavation reports should refer to earlier work in the region and should build upon the synthetic analyses presented in this document using data from the sites on which they are reporting. The goal should be to further strengthen our understanding of prehistoric occupation in the LBB area by adding to the existing regional database in a cumulative manner. It should be explicitly stated whether any previously-identified research questions can be adequately answered using data from the sites being investigated, and new research questions that build upon the knowledge gained should be developed for subsequent work. Those new research questions may then be considered in subsequent NRHP eligibility evaluations or re-evaluations, as well as in subsequent data recovery treatment plans.

- *Stand-Alone Contexts:* Once a sufficient number of additional sites in the area have been excavated that the research priorities and questions identified in this document might require a substantial update, the BLM may assess the need for another stand-alone context such as this one to be developed. BLM-Elko currently suggests that this may be appropriate after another 20 to 30 sites have been excavated. It should be noted that future archaeological excavations in the LBB area may occur as the result of developments proposed or initiated by entities other than BGMI, and in no way does this recommendation commit BGMI to being the party responsible for the preparation of any future stand-alone context documents such as this one.

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